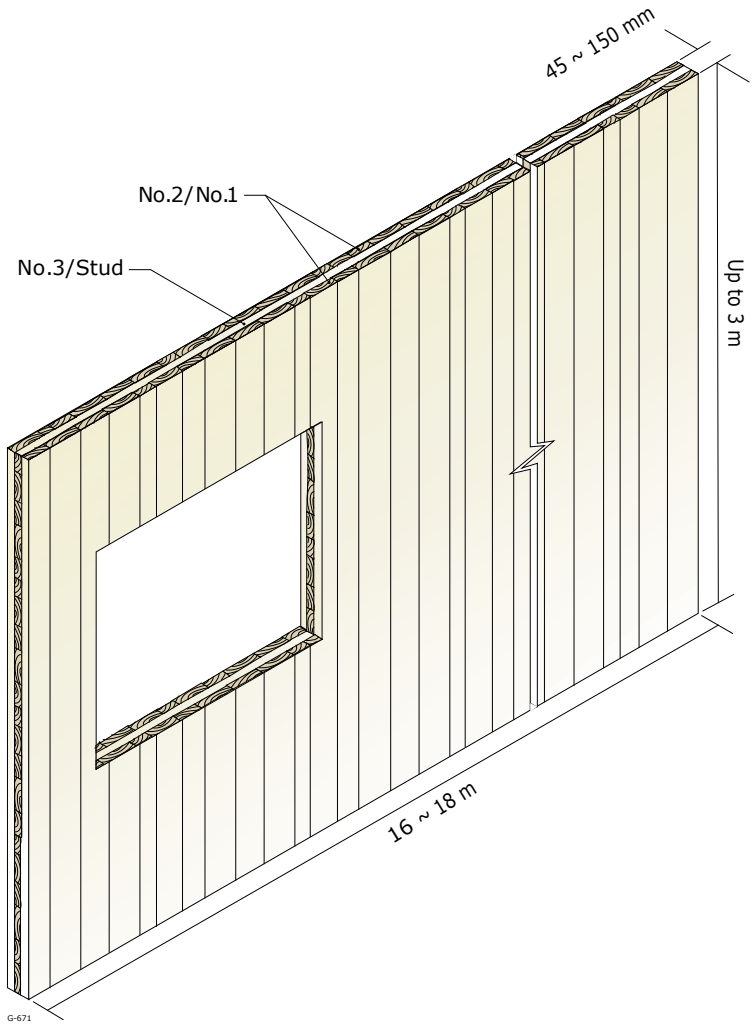
FEATURING THE DOWLING RESIDENCE

CROSS-LAMINATED TIMBER IN BRITISH COLUMBIA







BRITISH COLUMBIA'S WOOD BUILDING TRADITION

BRITISH COLUMBIA IS RENOWNED INTERNATIONALLY for the quality and innovative use of wood in architecture. From the earliest First Nations longhouse to the Richmond Speed Skating Oval, wood-based construction has been a widely used structural approach. The impetus to use wood in a wider variety of building projects has gained momentum in recent years. Now, a European-developed engineered wood product called cross-laminated timber (CLT) has become a viable building material option.

EXPANDING THE MATERIAL PALETTE

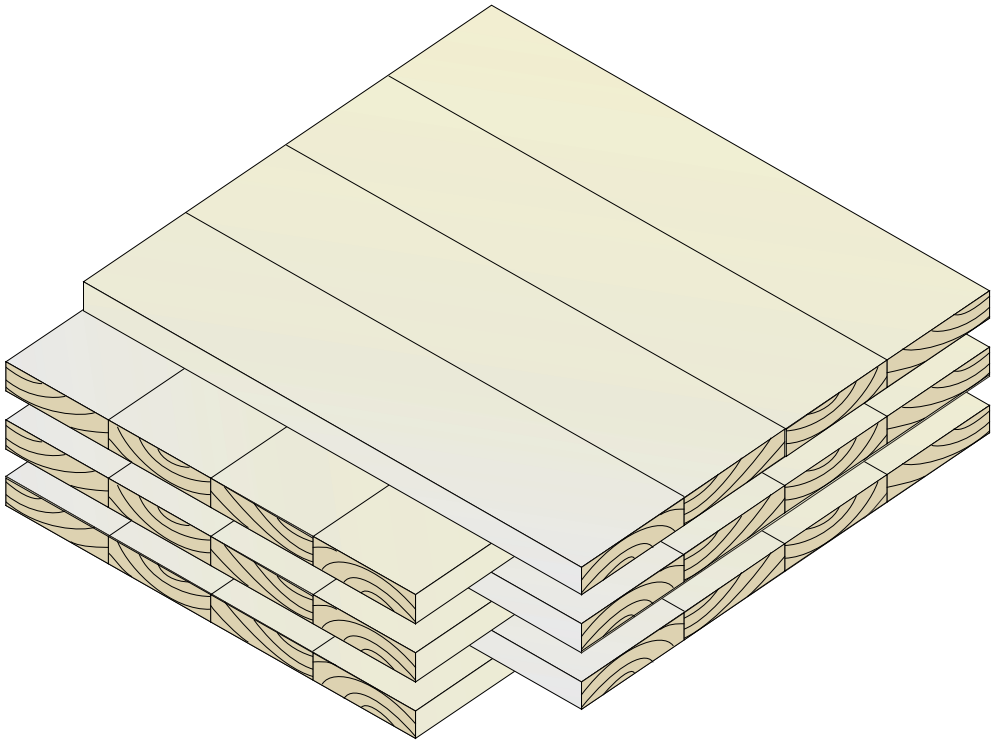
FOR MORE THAN A HUNDRED YEARS, solid sawn spruce-pine-fir (SPF), hemlock-fir, Douglas-fir and western red cedar have served as key building materials. During the 1980s and '90s, engineered woods such as glulam and structural composite lumber (SCL) became more common building materials. Now, leaders in the forest industry are positioning cross-laminated timber to become an exciting new product for many applications. By the nature of its design, CLT has inherent load-bearing strength and can serve as material for both vertical and horizontal assembly applications. Wall, floor and roof sections made of CLT are formed off-site in a factory, which allows a much shorter on-site construction time. Its introduction into the

North American marketplace brings new options for designers and builders, as well as a potential boost to the regional economy. CLT can theoretically be used as a structural system in buildings as high as 10 storeys, and can be used as an alternative to concrete or steel.

CLT FABRICATION

CROSS-LAMINATED TIMBER panels are created with similar steps as other engineered wood products. The panels are formed by stacking together successive perpendicular adhesive-backed layers of wood. The layered stacks are then pressed in large hydraulic or vacuum presses to form an interlocked panel. The panel is then sized and shaped in some cases with a Computer Numerically Control (CNC) machine into a fully articulated construction-ready component.

CLT panels vary among manufacturers depending on the species, grade and size of the wood lamina, type of glue, and connection details. The numbers of layers in a panel can range from three to seven or more, and panel thickness can vary from 4 to 16 inches (10 to 40.5 cm). Panel lengths are limited only by the length of a press; the largest European press are now up to 52 feet (16 m). Panels can have door and window openings, plus routings for electrical and mechanical systems, before shipment to the building site.



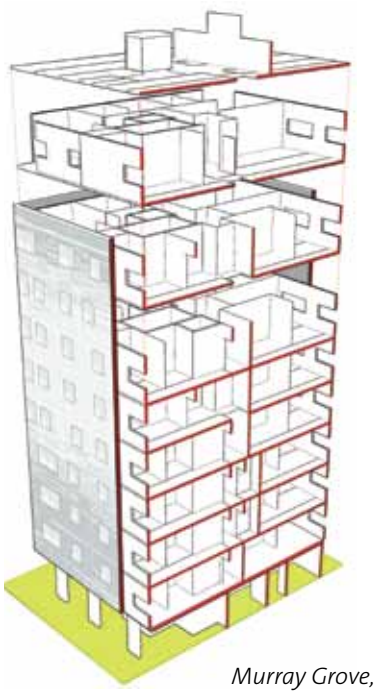
University of British Columbia
Bioenergy Research + Demonstration Project

EARLY PROJECTS USING CLT

THE FIRST CLT STRUCTURES WERE ERECTED in Austria and Germany, where CLT was developed in the 1990s. The efficiency of the European design, manufacturing, marketing and distribution increased steadily so that by 2010, the product had become a viable building-material option. In England, the nine-storey Murray Grove residential tower was erected in just nine weeks using CLT panels—overall construction time taking about four months less than conventional on-site concrete construction would have taken.

In North America, the concept of CLT is evolving quickly. At the 2010 Winter Olympics in Whistler, British Columbia Austria House showcased CLT's role in ecological sustainable architecture. The first Passive House in Canada, Austria House used CLT to devise a house with airtight seams to help reduce its overall energy consumption to internationally recognized Passive House standards.

And at the University of British Columbia in Vancouver, the Bioenergy Research + Demonstration Project is under way with CLT walls and roof construction off a concrete foundation. When completed, the 20,300-ft² (1,886-m²) building will house biomass gasification equipment to produce electricity and steam for the UBC campus.



Murray Grove, England

FACTS

- The nine-storey Murray Grove tower in London, England is the tallest modern wood residential structure in the world.
- The 2010 Olympics' Austria House in Whistler is the first Passive House in Canada.
- The UBC Bioenergy Research + Demonstration project will be the first industrial CLT building in North America.

Austria House, Whistler

Dowling residence interior

Cantilevered balcony

Plumbing stack

Electrical system recess

FEATURE PROJECT USING CLT: THE DOWLING RESIDENCE

GREG DOWLING, a partner in the Vancouver firm of DGBK Architects, assumed the triple role of architect, contractor and client for the construction of his own family home in West Vancouver, British Columbia. Dowling conceived his residence as a series of slender, interlocking horizontal planes projected gracefully out of the irregular sloping site. The three-storey house embodies three main construction materials: concrete, steel and CLT. The CLT panels serve as the primary components of the wall, floor and roof assemblies.

Dowling configured the plan to offer sweeping ocean vistas from the southward-facing living area on the upper floor, and a more intimate view of greenery on the mountain side of the house. The structural integrity of this particular CLT floor and roof system offers a long span, which allows a column-free expanse in the main interior spaces. The dominant architecture gesture of the Dowling Residence is a dramatically cantilevered balcony off the second-floor living room. This triangular balcony is constructed with CLT panels. Using reinforced concrete for this balcony would have generated extra thickness and weight, and required additional support — which would have undermined Dowling's aesthetic vision of the project.

Given the precision of CLT fabrication, panels are cut to the millimetre. As Dowling and his team took care in the preparation of foundations and other structural elements, extremely tight tolerances were able to be achieved, ensuring a smooth erection

Interior hallway

South-east elevation

Rear elevation

process and a tightly fitting structure. Dowling notes that the basic CLT framework of the home was completed in just six days, whereas conventional reinforced concrete solutions would have taken several months.

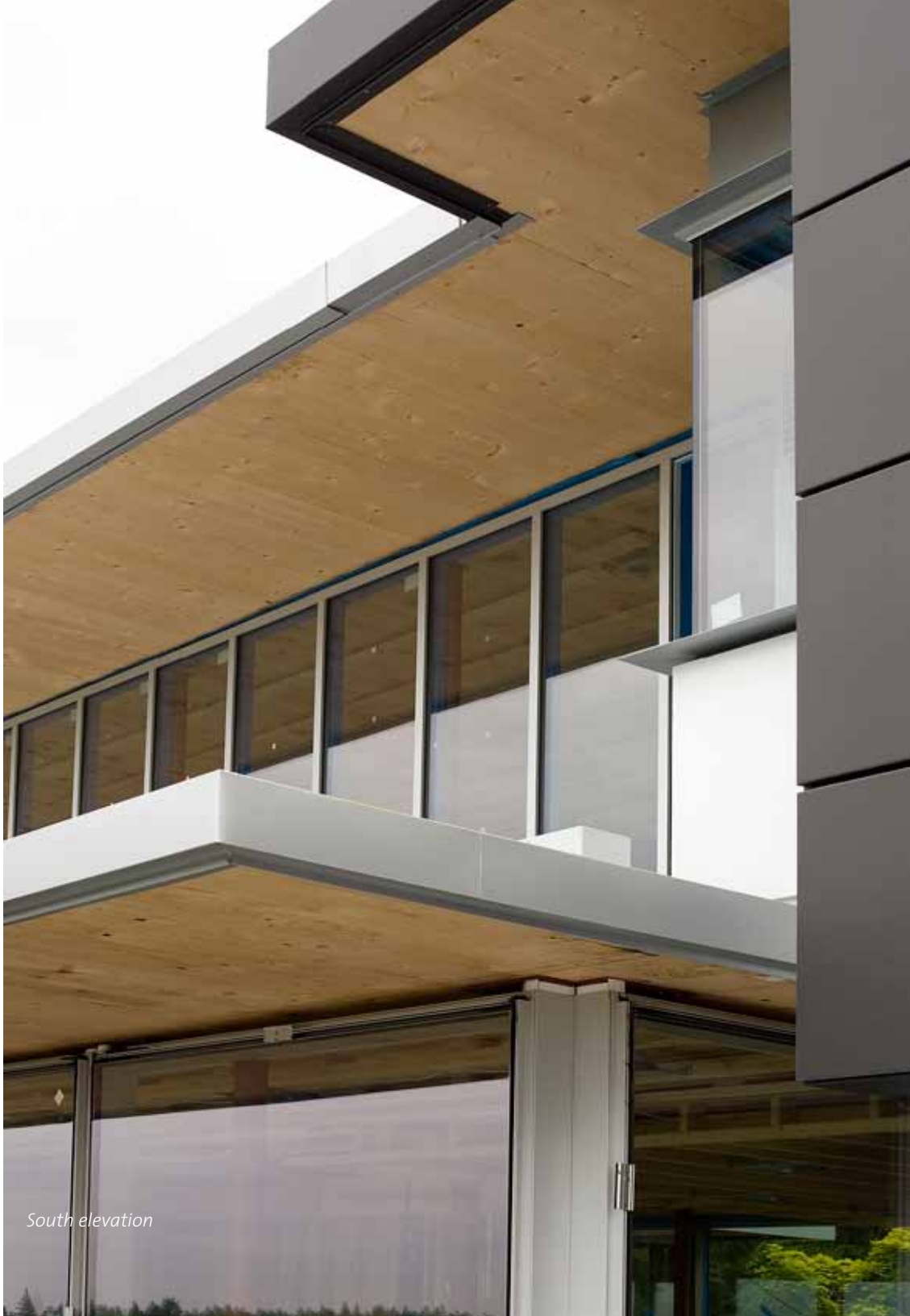
CLT construction allowed Dowling extra flexibility in how the interdependent load-bearing systems worked within the architectural concept. Along the mezzanine corridor on the second floor, a step in elevation is generated by one CLT floor panel overlapping and supporting the other. Such a detail would require a far more complicated fastening and support system with traditional construction methods.

Some recesses for light fixtures and electrical outlets were pre-cut into the CLT panels at the factory, but these elements were possible to modify onsite. Additionally, wood furring has been applied where necessary to accommodate cables; drywall was specified to cover ceiling and wall surfaces and conceals most on-site modifications. But the surface of CLT can also be left permanently exposed, in which case a higher aesthetic grade of CLT would be sourced.

Joining of CLT panels requires different connection hardware from conventional framework. Instead of nails, the panels' size, weight and laminated composition require self-tapping screws, with lengths of 8 , 12 or up to 16 in (20, 30 or up to 40.5 cm), depending on the panel thickness.

FACTS

- The 4,700-ft² (436 m²) Dowling Residence is the first permanent residential project in British Columbia to use CLT as its principle building material.
- Using CLT for the cantilevered balcony created a much thinner and lighter plane than conventional concrete construction.
- The Dowling Residence is a hybrid construction of CLT, concrete and steel.



South elevation

SOFIE Project - sponsored by IVALSA Tree and Timber Institute

Cross-section taken from 3 ply CLT panel protected by two layers of ½" gypsum board and exposed to the standard fire exposure (CAN/ULC S101) for 1 hour and 15 minutes.

DESIGNING WITH CLT

CLT HAS EXCELLENT INHERENT FIRE RESISTANCE PROPERTIES that are similar to that of heavy timber: during a fire, it slowly chars at a predictable rate and can maintain significant capacity for extended periods of time. This charring effect also helps to further protect the panel's core.

In an earthquake-prone region, adequate seismic resistance of the structural system is a key consideration for providing safe design. CLT as a product, along with the connection details and fastenings used in construction, makes CLT structures resistant to earthquakes. In Japan, a seven-storey CLT structure at the E-Defence Laboratory in Miki withstood a series of rigorous earthquake-simulation tests without sustaining significant structural damage.

For indoor air quality, CLT has been tested to determine the level and safety of the off gassing it produces. CLT glue lines were tested for volatile organic compounds (VOCs), including formaldehyde emissions. The VOCs as measured in a series of tests were found to be roughly one parts per billion (ppb), well under the standard of 50 ppb deemed to be a health hazard.

CLT is being used under the "Alternative Solutions" provision in the building codes. This path requires the design teams to use credible, peer-reviewed technical information. The CLT Handbook, published by FPInnovations, provides design teams with the necessary technical information related to all performance attributes such as fire safety, sesmic design, and indoor air quality.

FACTS

- CLT products exhibit a level of fire-resistance similar to that of heavy timber.
- Multi-storey CLT structures subjected to earthquake-simulation tests showed a high level of seismic resistance.
- The VOC emission levels of CLT products have been found to be well within the deemed safety level.

CROSS-L

North elevation

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CLT FABRICATION

GRAPHICS
FPInnovations

AUSTRIA HOUSE

CLIENT
Resort Municipality of Whistler, Austrian Passive House Group, Whistler Blackcomb Foundation, Sea to Sky Consulting

ARCHITECT
Treberspurg & Partner Architekten

STRUCTURAL ENGINEER
Equilibrium Consulting Inc.

PHOTOGRAPHER
Ira Nicolai

UBC BIOENERGY RESEARCH + DEMONSTRATION PROJECT

CLIENT
University of British Columbia

ARCHITECT
McFarland Marceau Architects Ltd.

STRUCTURAL ENGINEER
Equilibrium Consulting Inc.

FABRICATOR
CST Innovations Ltd.

RENDERING
McFarland Marceau Architects Ltd.

MURRAY GROVE TOWER

CLIENT
Telford Homes PLC, Metropolitan Housing Trust

ARCHITECT
Waugh Thistleton Architects Ltd.

STRUCTURAL ENGINEER
Techniker Ltd Consulting Structural Engineers, Jenkins & Potter Consulting Engineers

MECHANICAL ENGINEER
Michael Popper Associates, AJD Design Partnership Ltd.

ISOMETRIC RENDERING
Waugh Thistleton Architects Ltd.

DOWLING RESIDENCE

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STRUCTURAL ENGINEER
Equilibrium Consulting Inc.

PHOTOGRAPHERS
As You Like It, Wade Comer

DESIGNING WITH CLT

PHOTOGRAPHER
FPInnovations

TECHNICAL INFORMATION CAN BE FOUND
IN THE CLT HANDBOOK -
AVAILABLE FOR PURCHASE AT
www.fpinnovations.ca/pdfs/clt.pdf


Dowling residence

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