WOOD INNOVA

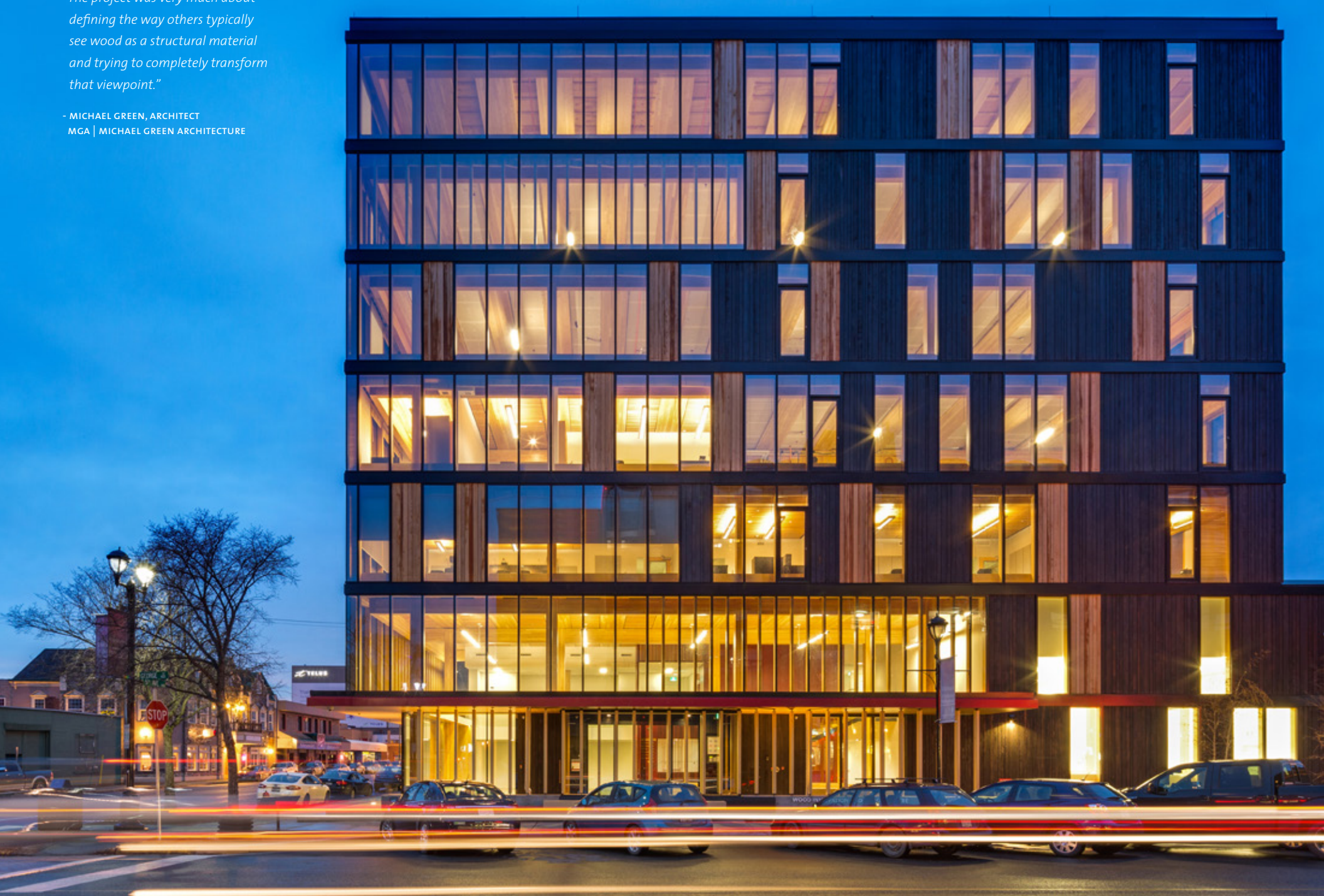
WOOD INNOVATION & DESIGN CENTRE

SHOWCASING BRITISH COLUMBIA'S EXPERTISE IN TALL WOOD BUILDING DESIGN AND CONSTRUCTION

Wood Innovation & Design Centre, Prince George, B.C.

"The project was very much about defining the way others typically see wood as a structural material and trying to completely transform that viewpoint."

- MICHAEL GREEN, ARCHITECT
MGA | MICHAEL GREEN ARCHITECTURE



THE WOOD INNOVATION & DESIGN CENTRE, located prominently in downtown Prince George in north-central British Columbia, and completed in October 2014, is a precedent-setting building. At 51,882 ft^2 (4,820 m^2), the Centre is six floors, 97-ft-high (29.5 meters). Representing a milestone in mass timber construction, the Wood Innovation & Design Centre is one of the tallest modern wood buildings, and the first of its kind, in North America.

The shape of the building—a clean, modern box—is intentionally restrained, with simplicity being a canvas for the beauty of the various woods and all their details. The simplicity lends itself to a practical and essential goal: that the design be a repeatable and expandable template for constructing future tall wood buildings of different sizes and functions.

FACTS

- The Wood Innovation & Design Centre is a showcase of innovative uses of wood that will nurture community sustainability and resiliency in a region with a long and historical connection to the forest and the forest industry.
- The Centre's straightforward design, in tandem with a practical structural system, eliminates the use of concrete above the foundation, and offers the advantage of being repeatable in future wood buildings.
- All the dimensional and engineered wood products were manufactured in British Columbia.
- The Province of British Columbia (building owner) invested $25.1 million in the Centre, creating 250 new jobs during the life of the project.
- At 97 ft (29.5 m) in height, the Wood Innovation & Design Centre is among the world's tallest modern wood buildings, and is one of the tallest wood buildings in North America.

The building envelope design is a metaphor for the natural outer layer of a northern tree. Thick bark and moss on the north side provides needed protection from the cold and elements, but the bark thins on the opposite side, allowing for greater exposure to the sun. Thus as the exterior gracefully transforms from the opaqueness of the north side's charred cladding and fewer windows to the south side's glassy transparency, the design optimizes sun exposure and insulation, tuning the building's energy performance to its orientation and the northern climate. The south side's maximum transparency provides passive solar heat gain in cooler months, which in summer is moderated with interior wood blinds. On the east and west façades, the laminated veneer lumber mullions support the glazing of the curtain wall and buffer the low angle of the rising and setting sun.

The structural concept is that of "dry construction" —using custom prefabricated structural wood components—which virtually eliminates the use of concrete above the foundation, with the exception of the floor in the mechanical penthouse. This concept also allows for the wood to be elegantly and purposefully exposed as the finish throughout the building. Dry construction is key to the building's sustainability story because the prefabricated components can be easily disassembled at the end of the building's functional life, thus re-purposing the wood is straightforward and practicable compared to conventional construction.

The Wood Innovation & Design Centre is constructed of wood products sourced and engineered within British Columbia, making the building a showcase for the province's leading expertise in designing and constructing large-scale wood buildings.

South east facade of the Centre during construction.

Structurlam Products facility, Penticton, B.C.

" On the project management side, this building is very unique because many things had not been done before. There wasn't a playbook or past experiences that we could refer to. We were really forced to think outside the box and come up with creative new solutions, instead of going back to see what was done in the past."

– CHAD KALDAL, PROJECT MANAGER PCL CONSTRUCTERS WESTCOAST INC.

Feature staircase made with LVL in the foyer.

Connecting hallway with LVL window mullions and charred western red cedar roof.

Design-Build team collaborating during construction.

Glulam columns and beams in the main foyer.

STRUCTURE AND INNOVATION

SEVERAL WOOD SPECIES THAT WERE USED IN THE CONSTRUCTION—including Douglas-fir, western red cedar, hemlock, pine, and spruce—were all sourced from British Columbia's sustainable forests. While traditional wood products like dimensional lumber and plywood panels were employed in various ways, the structural design and building envelope focussed on engineered wood products—glulam, cross laminated timber (CLT), parallel strand lumber (PSL), and laminated veneer lumber (LVL), all of which were produced in British Columbia.

Because the Centre's mass timber construction type is unique to North America in a commercial building, proving out innovative concepts and approaches consumed much of the design process. In addition to the desire to expose the wood, the aspects of acoustics, integration of services, and fire resistance required considerable design adaptation. Many of the concepts were extrapolated from British Columbia's numerous years of accumulated wood engineering and design knowledge, but extensive research and testing also took place. As most of the components were prefabricated with very low dimensional tolerances, close collaboration between the suppliers, installers and consultants became an important aspect of the pre-construction process. Detailed shop drawing reviews of 3D structural models involving all parties ensured high accuracy in construction and minimized on-site modification.

The primary structure consists of an innovative combination of post-and-beam construction and built-up CLT floor panels. Glulam beams frame into glulam columns, both of which were chosen for their known structural performance. Proprietary aluminum, dovetail connectors allow the columns to run continuously from the concrete foundation to the roof, eliminating cross-grain bearing and shrinkage.

In another atypical architectural application of wood LVL due to its dryness, forms the mullions in the envelope's curtain wall system, instead of conventionally used aluminum. The unique properties of LVL also lend themselves beautifully to form the structure of the entrance canopy and the ground-floor feature staircase.

Much of the building's exterior features a rather unusual and striking type of cladding—a combination of naturally weathered and charred western red cedar siding. Although relatively new to North America, the intentional charring of wood is a traditional and practical construction technique that has been utilized for centuries in Finland, Japan, and Switzerland. Charring changes the molecular structure of the wood through thermal conditioning of its surface, thus making it more resistant to flame and pests. The somewhat shiny finish is durable and low maintenance, and its boldness showcases an alternative, contemporary aesthetic for the cladding of buildings.

Natural and charred western red cedar cladding.

The floor design comprises a completely innovative panel system. 3-ply upper CLT panels are overlapped with 5-ply or 7-ply lower CLT panels, creating a corrugated structural section. The panels are then topped with concrete to form a composite wood-concrete system with the use of HBV (metal mesh) connectors. The cavities created within the structural section between the staggered timber slabs effectively accommodate the running of services both below the floor and above the ceiling.

The practical acoustic-insulated subfloor system is loose-laid over the chases with cut-out panels to provide access to these floor trenches. Lighting and fire-suppression systems are run in the ceiling recesses, simply but cleverly concealed with a removable wood-slat finish. The high-quality acoustic performance of the floor assembly is further enhanced by a noise-barrier system lining the underside of the top CLT panel within the ceiling chase. The service chases inherent in the structural system offer flexibility for reconfiguring the space for current and future tenants.

The wood structure is exposed at the ceiling, providing a beautiful finish that speaks to the purpose and mission of the facility, which is to be a centre of excellence for the research and design of engineered wood. This wood-only solution for the Wood Innovation & Design Centre's floors eliminates the use of concrete in this part of the assembly, and thus minimizes the weight of the floor system and the building overall. The all-wood elevator core, being significantly lighter than a concrete core, also contributed to reduced building weight.

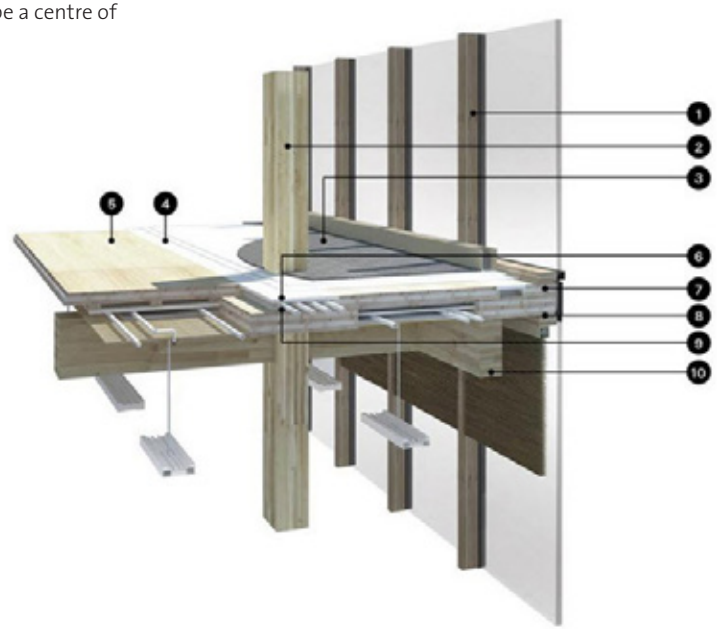
Lateral-load resistance is provided primarily by the elevator and stair core walls, which consist of CLT panels connected together vertically with self-tapping screws. The shear walls are anchored to the foundations using shear brackets and hold-down anchors fastened to the timber panels using a combination self-tapping screws and the proprietary HSK connection system from Germany.

"You need to have a fully collaborated design where all the people involved have looked at the potential conflict areas and have made sure that everything is going to go together smoothly. If you do that, the benefits are huge, both in the quality of the building and the cost."

- JOHN BOYS, OWNER NICOLA LOGWORKS LTD.

FLOOR SYSTEM

1. Laminated veneer lumber mullion
2. Glulam column, 12"x11.5"
3. Carpet
4. .25" acoustical underlayment
5. 99mm three-layer CLT panel
6. 13mm plywood (two-ply)
7. 99mm three-layer CLT panel
8. 169mm five-layer CLT panel
9. 25mm semi-rigid glass-fiber insulation board (two-ply)
10. Glulam beam, dimensions vary



RENDERING COURTESY OF MICHAEL GREEN ARCHITECTURE

LEFT Installation of CLT panels during construction.

Fire testing of the CLT floor assembly

The Centre's second floor incurs significant transfers of load due to the ground floor housing a large laboratory, a theatre/lecture hall, and public spaces. Tall wood buildings do not incur much differential shrinkage or creep, therefore was a preferred choice for the transfer beams because it is very dry and stiff, and has good shear capacity.

Fire resistance is provided through a fully engineered approach, rather than the more common encapsulation method. The very thick columns and beams and the large cross-sections allow for a degree of inherent fire resistance, because large-timber elements char at a slow and predictable rate. The char layer that would occur on a large member would serve to insulate its relatively cool core, so that it can continue to carry the structural load required to achieve a 1-hour fire-resistance rating. For the Wood Innovation & Design Centre, the fire-stopping performance at the service penetrations and construction joints was tested in a laboratory to the CAN/ULC-S115 test standard.

"This building represents an important milestone in the evolution of wood buildings in North America and, to some extent, the world. The project introduces new methods of working with mass timber panels and specifically cross laminated timber. We designed the project as a repeatable solution and a tool to educate designers, building owners, code authorities, contractors and industry in the opportunities of advanced wood products. We are proud of the leadership B.C. has shown in envisioning the project and in helping us all truly deliver such a significant step in the future of tall wood buildings."

– MICHAEL GREEN, ARCHITECT
MGA | MICHAEL GREEN ARCHITECTURE

LEFT Main foyer and mezzanine.

SilvaGro Nursery , Quesnel, B.C.

SUSTAINABILITY

WITH GROWING PRESSURE TO REDUCE THE CARBON FOOTPRINT of the built environment, building designers are increasingly being called upon to balance functionality and cost objectives with reduced environmental impact. Wood—a renewable resource—goes a long way to achieve that balance.

Trees are among the best carbon storage agents on earth. This means that using wood to build, renovate, and operate structures is a good environmental choice, because most of a tree's stored carbon continues to be sequestered within the wood products. Even after the Wood Innovation & Design Centre reaches the end of its function as a building, the carbon can remain sequestered; the Centre's restrained and practical architecture and the use of prefabricated components allow for easy dismantling, ensuring the wood can be effectively re-purposed or recycled.

Research has shown that the embodied energy of a wood building is less than of concrete or steel buildings. A recent life cycle Assessment (LCA) study showed that the environmental performance of the Wood Innovation & Design Centre, compared to a similar baseline concrete building, was reduced by 10% or more in six of seven reported categories, see Figure 01. This LCA also indicated that a multi-storey office building constructed with mass timber systems and LVL curtain walls have an overall lower environmental impact than similar buildings constructed of reinforced concrete structural systems with aluminum curtain wall structures.

ENVIRONMENTAL IMPACT OF WOOD USE (POST-CONSTRUCTION CALCULATION)

- Volume of wood products used: 1519 cubic meters (53,629 cubic ft) of lumber and sheathing
- U.S. and Canadian forests grow this much wood in: 4 minutes
- Carbon stored in the wood: 1099 metric tons of carbon dioxide
- Avoided greenhouse gas emissions: 420 metric tons of carbon dioxide
- Total potential carbon benefit: 1519 metric tons of carbon dioxide

THE ABOVE GHG EMISSIONS ARE EQUIVALENT TO:

- 290 cars off the road for a year
- Energy to operate a home for 129 years

*Estimated by the Wood Carbon Calculator for Buildings, based on research by Sathre, R. and J. O'Connor, 2010, A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPInnovations (this relates to carbon stored and avoided GHG).
*CO2 in this case study refers to CO2 equivalent
*Data to inform material quantities installed was taken directly from drawings "Issued for Record" and included architectural drawings dated July 2014

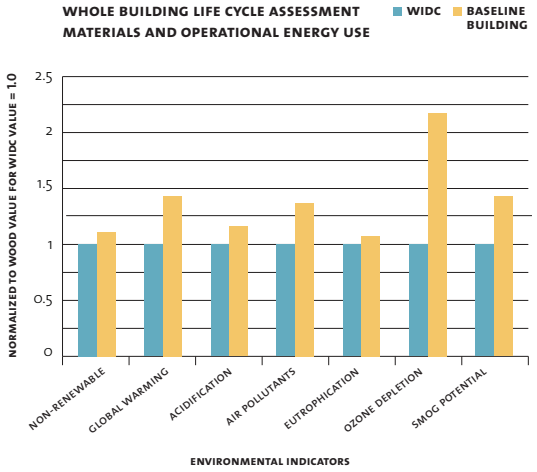


FIGURE 01

Grann, Blane. Wood Innovation and Design Centre Whole Building Life Cycle Assessment, FPInnovations, 2014

EDUCATION

THE FIRST FLOOR OF THE BUILDING HOLDS A 75-SEAT LECTURE THEATRE, classrooms that allow for worldwide collaboration via videoconferencing, and a research/teaching lab that supports the design, fabrication, and testing of wood products.

The University of Northern British Columbia (UNBC), one of the building's main tenants, is offering two new graduate degrees that will provide students with focussed opportunities to study wood products engineering and conduct research: a course-based Master of Engineering in Integrated Wood Design, and a thesis-based Master of Applied Science in Engineering that involves research on wood and other forest products related to future wood structures.

The Centre will also be home to the Emily Carr Centre for Design Innovation and Entrepreneurship which will focus on art and design-based educational programs, applied research activities, as well as partnerships focussed on design innovation and secondary manufacturing with wood and wood-based products.

"Considering that timber is such an important resource for B.C. and Canada, I think it is important that we have facilities teaching timber engineering in a very focussed way."
– ERIC KARSH, PRINCIPAL, EQUILIBRIUM CONSULTING INC.

RIGHT Lecture theatre on the main floor.

ATION

PROJECT CREDITS

CLIENT
Province of British Columbia,
Ministry of Jobs, Tourism and Skills
Training and Responsible for Labour

ARCHITECT
MGA | Michael Green Architecture

CODE CONSULTANT
B.R. Thorson Consulting Ltd.

CONTRACTOR
PCL Constructors Westcoast Inc.

FIRE SAFETY CONSULTANT
CHM Fire Consultants Ltd.

ACOUSTIC CONSULTANT
Acoustics Engineering Ltd.

BUILDING ENVELOPE
RDH Building Engineering Ltd.

STRUCTURAL ENGINEER
Equilibrium Consulting Inc.

MECHANICAL ENGINEER
MMM Group Limited

ELECTRICAL ENGINEER
MMM Group Limited

LANDSCAPE ARCHITECT
Jay Lazzarin Landscape Architect

GLULAM AND CROSS LAMINATED TIMBER SUPPLIER
Structurlam Products Ltd.

LAMINATED VENEER LUMBER SUPPLIER
Brisco Manufacturing Ltd.

WOOD STRUCTURE INSTALLER
Nicola Logworks Ltd.

PHOTOGRAPHY
Ema Peter Photography
Paul Alberts

FOR TECHNICAL INQUIRIES
www.wood-works.ca
1-877-929-9663

Published June 2015