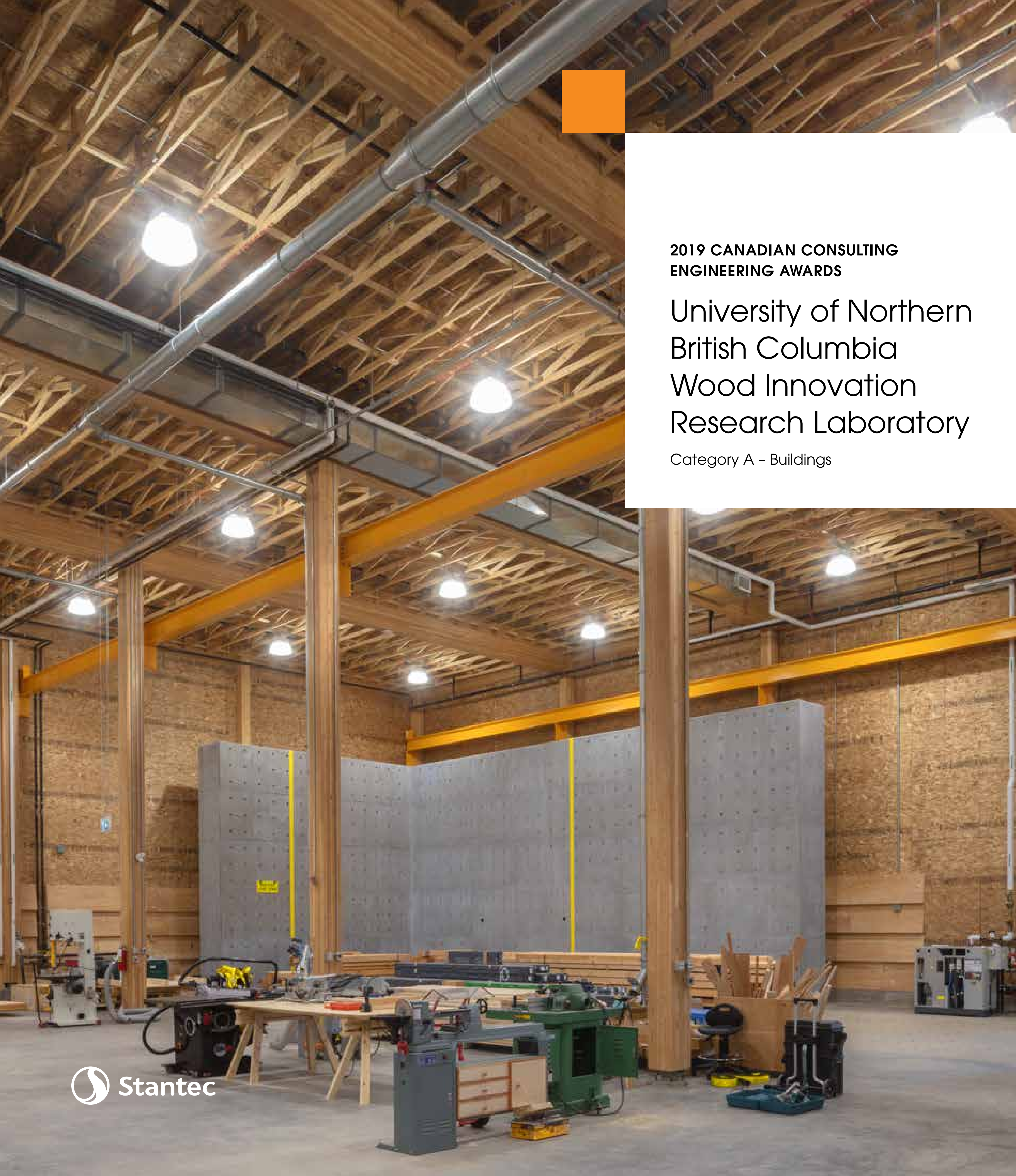


2019 CANADIAN CONSULTING ENGINEERING AWARDS

University of Northern British Columbia Wood Innovation Research Laboratory

Category A – Buildings

Stantec

University of Northern British Columbia Wood Innovation Research Laboratory

UNBC’s Wood Innovation Research Laboratory is the first certified Passive House university educational and industrial facility in North America—a particularly impressive feat due to the cold climate in Prince George. The facility features a simple wood structure and is conceived as a modest building inspired by passive design principles and wood innovation. The laboratory responds to and complements its surrounding building forms, orienting itself in response to the urban landscape.

Project Highlights

Q.1 INNOVATION

The University of Northern British Columbia (UNBC) Wood Innovation Research Laboratory (WIRL) is Canada's first Passive House certified university educational building.

In order to achieve explicit performance goals as specified by the Passive House standard – thermal energy demand intensity, source energy use intensity, airtightness, comfort – engineers need to take a leadership role to guide all disciplines so that the overall goal can be achieved. UNBC had requested a project team with both, a lead architect as well as a lead Passive House designer to lead the project. This is different from the traditional role of an energy engineer or sustainability consultant which is much more removed from the main project team.

This is the first Passive House certified university educational and industrial facility in North America, and so represents a new and advanced application of a long established standard. This building is one of the pioneering buildings in North America achieving very high airtightness and thermal insulation.

The performance criteria in the Passive House standard are the same for all buildings, sizes and geographies. For conventional residential buildings the strategies to achieve Passive House certification are generally proven and well understood.

The requirements and constraints set out for the WIRL project fall well outside typical practice and the following building characteristics made meeting Passive House criteria particularly challenging:

- Climate – Prince George has extremely cold winters with a design temperature of -38°C
- Building height – Passive House criteria are defined by floor area. The WIRL had a minimum clear height of 9m resulting in a very large wall areas relative to floor area and so disproportionately high heat losses.
- Specialized equipment – as a wood research facility, the WIRL contains energy intensive equipment including a Hundegger automated joinery machine and hydraulic power pack for stress testing wooden assemblies. The energy used by this equipment must be included in the total building energy use allowance.
- Dust removal – working with wood requires a dust collection system to be provided which must meet strict NFPA standards. These systems typically remove large amounts of air from the building together with the dust. Applied in a conventional manner, this system alone would have used up more than the total building heating load allowance.
- Mixed-use – the building accommodates office spaces, a seminar room and a wood workshop/ laboratory

The collaborative response of the design and construction team to these unique challenges is the outstanding engineering achievement of this project.

Laboratory space

Q.2 COMPLEXITY

The complexity of this project is reflected in the competing goals and the unique challenges of its purpose and location – including limited budget, energy efficiency, cold climate, wood structure and mix of usage: office, seminar space and. When working within a Passive House energy budget, even small changes in design approach or building use have significant impacts on compliance. Understanding, managing and balancing these interdependencies was the most complex challenge for the project.

The resulting building design is elegant and relatively simple, utilizing a basic architectural palette, simple structural elements such as residential roof trusses, and simple mechanical and electrical systems.

Most construction projects involve challenges which must be overcome by the team. Achieving Passive House certification created some additional issues which had to be addressed. The key building components had to meet and support Passive House targets which limited the available suppliers. The large garage door, for example, was imported from Germany and so orders had to be placed much earlier in the construction schedule than they usually would. The thickness of the insulation in the walls meant that there was an increased risk of moisture being trapped in the middle. Based on our engineering analysis, a 'smart' vapor control and air barrier membrane was specified to prevent this happening. A new process also had to be developed with the installer for the insulation to be blown the wall cavity on site.

Aerial view showing the building in its context

Q.3 SOCIAL AND/OR ECONOMIC BENEFITS

The WIRL is located in downtown Prince George, adjacent to and complementing the Wood Innovation Design Centre. Together, these buildings house the UNBC Master of Engineering in Integrated Wood Design program. The use of a wood structure and the implementation of the Passive House standard is representative of the university's commitment to the advancement of sustainable design using wood as a primary construction material.

Social

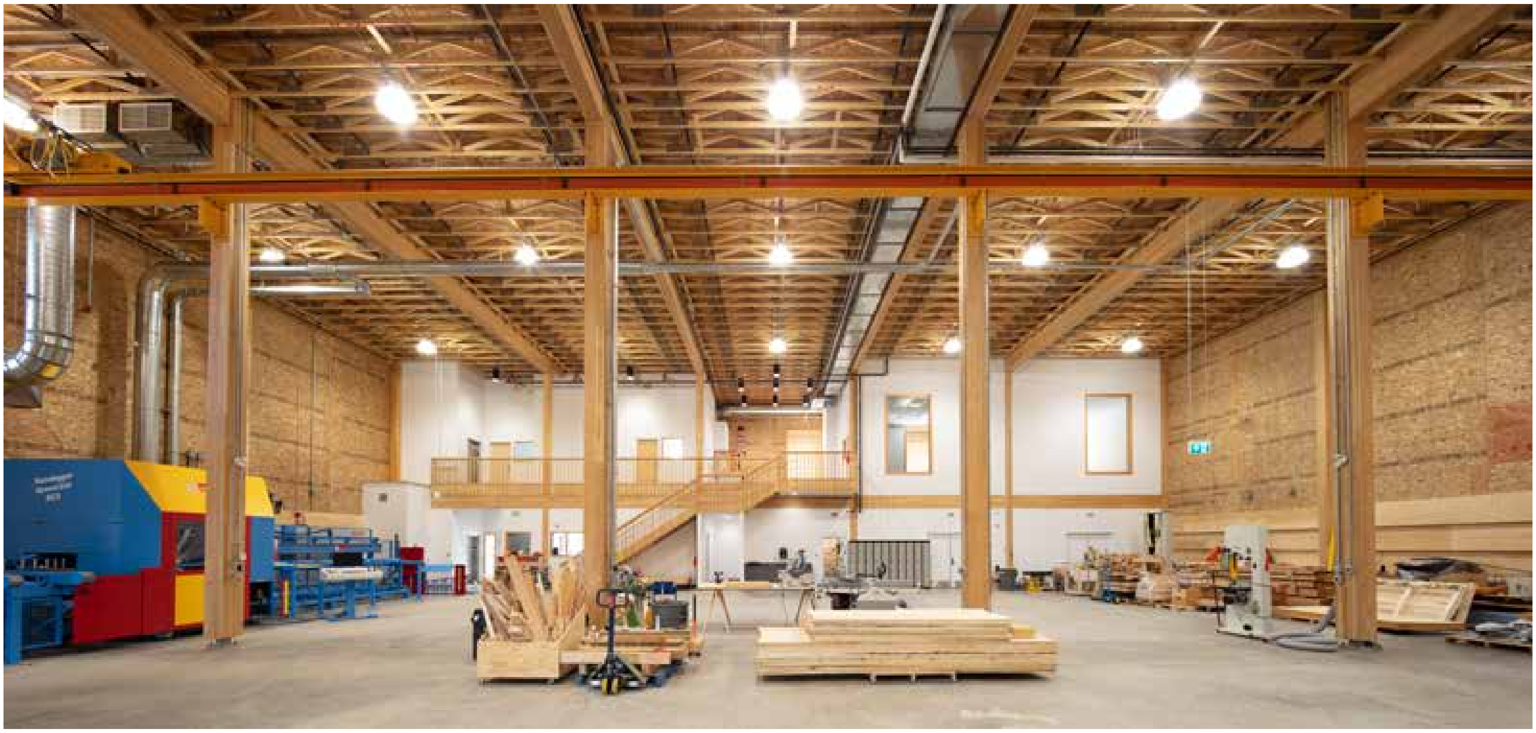
- Prince George is traditional a logging and wood-resource oriented city. UNBC's program teaches advanced wood working and wood engineering skills, supporting a high-tech industry building on the traditional wood resource extraction.
- The WIRL adds to the revitalization of downtown Prince George.

Economic

Employment opportunities and industry growth have been challenged in resource oriented Northern BC. High-tech wood products keep more of the wood product value chain in the region and thus provide more and higher quality employment opportunities. In general, this contributes to increased prosperity in a challenged region. The WIRL is located in downtown Prince George, adjacent to the Wood Innovation Design Centre. Together, these buildings house the UNBC Master of Engineering in Integrated Wood Design program. The use of a wood structure and the implementation of the Passive House standard is representative of the university's commitment to the advancement of sustainable design using wood as a primary construction material.

Students now have a beautiful, sustainable, and modern facility to conduct research on new uses for wood, creating new jobs and markets in the forestry industry—helping British Columbia secure a sustainable future.

Q.4 ENVIRONMENTAL BENEFITS



Internal view of the laboratory space. The Hundegger can be seen on the left.

This is the first Passive House certified university educational and industrial facility in North America, and so represents a new and advanced application of a long-established standard. This building is one of the pioneering buildings in North America achieving very high airtightness and thermal insulation.

To limit the impact of the energy used by the activities in the building, the mechanical system captures useful heat from the occupants and equipment. A heat pump is used to transfer heat from fan coil units cooling the offices and seminar room on the south elevation to the large north facing laboratory space. The hydraulic power pack rejects heat directly to the heating loop which uses a radiant floor system to store this useful energy in the concrete floor slab.

70%

Heating energy reduction from highly insulated envelope and by capturing useful heat gains from equipment, occupants and the sun.

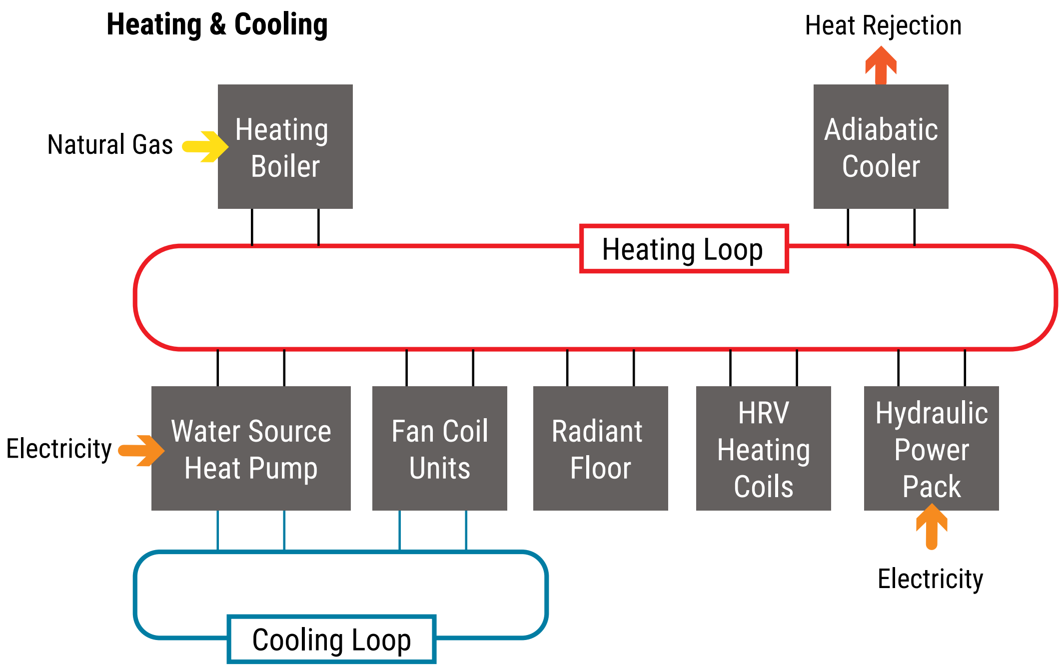
0.07

Air changes per hour building air leakage rate at 50Pa test pressure, a whole order of magnitude less than required for PH and understood to be the most airtight building tested to the PH protocol in North America.

The mechanical ventilation system has been designed to work with the different types of spaces in the building to minimize the overall ventilation rate reducing the amount of heating needed. The air handling unit supplies 100% outdoor air to the offices and seminar rooms where it dilutes CO_2 levels but remains otherwise clean. It is then transferred through the laboratory space which has only a low occupancy but needs high levels of air movement to remove potential pollutants such as VOCs before being exhausted through the high efficiency energy recovery wheel, where over 85% of the useful heat is recovered.

The EUI for the WIRL is 35 kWh/m^2 site energy, and 114 kWh/m^2 source energy, using Passive House primary energy factors. The heating demand as per Passive House Planning Package calculations is 11 kWh/m^2.

Heating & Cooling



Q.5 MEETING CLIENT'S NEEDS

UNBC set out on an ambitious path by making the main innovative targets of this building contractual obligations in a design-build contract.

These two main aspects of the building are 1) a wood structure and 2) international Passive House certification. It was the Building Performance Engineer's role to develop a process and work with the whole design team at every step to assure the Passive House certification goal would be achieved, which meant both to provide design calculations, but also to work with each discipline to assure they know what their responsibilities are. The engineers acted as an owner's representative, using expertise to align the design team and enable the team to achieve the stringent targets.

The team's success is the result of a collaborative process in which every decision was guided and informed by building performance engineering. This has resulted in a design where architecture and mechanical building systems work in harmony to reduce heat loss through the envelope, capture and distribute useful heat from occupants, equipment and the sun, and promote high air quality.

The Honourable Melanie Mark, Minister of Advanced Education, Skills and Training, operating the crane in the workshop at the official opening of the building.