

WOOD: AN INTEGRATED TOOL TO MEETING  
SUSTAINABILITY GOALS AT UBC

# WOOD IN HIGHER EDUCATION







*Bioenergy Research & Demonstration Facility*





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#### SITUATED ON A FORESTED PENINSULA ON THE WESTERNMOST POINT

of Vancouver, Canada along the Pacific coast, the University of British Columbia campus is a 1,001 acre (450 hectare) community of academic, residential, commercial, agricultural and operational facilities. University policies and guidelines have adopted strong sustainability performance criteria that all building projects and development initiatives must comply with. Under UBC's Campus as a Living Laboratory (CLL) initiative, the university is developing a sustainability lens for new projects, which determines and evaluates the potential environmental, social and economic impacts of construction and building operations, including methods to measure long-term progress.

For UBC, building sustainably is a comprehensive approach that encompasses diverse efforts for effective resource management that supports both human and environmental health and well-being. Additionally, UBC is designing long-lasting buildings that are adaptive to change and can be deconstructed at the end of their useful life.

Wood has emerged as a key element in achieving UBC's sustainable design goals. The University has determined, through studies such as life cycle assessment (LCA), that wood is an optimal building material due to its structural, aesthetic and low environmental impact characteristics.

Wood's key features:

- sequesters carbon
- renewable resource
- durable
- locally sourced
- optimal strength to weight ratio for structural building products/materials
- versatile and can be reused and recycled for new products and applications

These qualities are essential in supporting UBC's ambitious goals to create sustainable buildings that are "regenerative"—designed to achieve net-positive performance in both environmental and human terms.

Wood-frame and mass-timber construction has been utilized in a variety of UBC buildings. Moving forward, these buildings provide a foundation for the expanded scope of wood in sustainable buildings, as well as demonstrate the important role that cultural significance, technical capabilities, and environmental benefits play in wood construction.



## FIRST NATIONS LONGHOUSE

SIZE: 21,528 FT<sup>2</sup> (2,000 M<sup>2</sup>)

COMPLETED: 1992

**Emphasizes the First Nations' long regional history and cultural practice of using wood in community buildings where artists and ceremonies keep traditions alive.**

The design of the First Nations Longhouse combines traditional regional wood construction techniques of the Coast Salish peoples with contemporary architectural forms. It is part of the First Nations House of Learning facility, which houses the Native Indian Teacher Education Program, Faculty of Education and the UBC First Nations Student Association programs. The building serves as a home away from home to the First Nations, Métis and Inuit students, faculty and staff on campus. Community members can meet, engage in activities, and share their knowledge, culture and experiences with each other. In addition to the Longhouse, the House of Learning includes the *X̱wi7x̱wa* (pronounced whei-wha) Library, based on the circular form of Interior Salish pit houses, and the traditional Spirit Renewal Hall.

The Longhouse is a Musqueam-style shed: a single storey, heavy timber structure sited to align with the cardinal compass directions. Within the Longhouse are administration offices, seminar rooms,

resource centre and workshop, elders' hall, and great hall. As the focal point of the Longhouse, the great hall—*Sty-Wet-Tan*—is a showcase for traditional wood building techniques and decoration. The four great houseposts and supporting roof beams are all western red cedar, hand carved in traditional First Nations designs by local artists.

The structural framing, as well as most of the interior finishes and exterior cladding, of the Longhouse is regionally-harvested western red cedar. The timber members were milled to a constant diameter and the detailing for the steel connections cut at the processing factory then assembled onsite. Lateral bracing is provided by light wood-framed shear walls constructed of hem-fir studs and sheathed in Douglas-fir plywood. The exterior cladding is ship-lap planks, naturally weathered to a warm grey. The interior is mostly tongue & groove planks with exposed rafters and purlins, all naturally stained.

The roof of the Longhouse is shaped in a parabolic curve, designed to resemble the wing of a bird in flight. It is covered in copper which was chosen for its ability to accommodate the complex shape and because it was a traditional material of value to the coastal First Nations people.





- Lower left hand post: Wolf and Wolf pup by Gitksan artists Chief Walter Harris and Roger Harris
- Upper left hand post: Man and Raven by Tahltan-Tlingit-Tsimshian artist Stan Bevan and Tahltan-Tlingit Nisga'a artist Ken McNeil
- Upper right hand post: two-sided Beaver and Eagle clan crest by Haisla artist Lyle Wilson
- Lower right hand post: Raven with Spindle Whorl by South Coast Salish artist Susan Point





## C.K. CHOI BUILDING

SIZE: 301,573 FT<sup>2</sup> (28,017 M<sup>2</sup>)  
COMPLETED: 1996

**A demonstration of sustainable building strategies including the use of salvaged and re-used materials.**

The C.K. Choi Building for the Institute of Asian Research is a distinctive long narrow building with a series of angled arc roofs invoking waves. This three-storey, red-brick building, built with re-used and salvaged materials, is home to the Institute of Asian Studies, composed of five research centres focussing on China, Japan, Korea, Southeast Asia, and India and South Asia. Each research centre is clustered around one of the five atria, surrounded by offices, meeting areas and study rooms. The unusual shape is the result of the size of the salvaged structural framing members and site constraints, specifically, efforts to preserve an existing grove of trees on the majority of the site.

Seventy per cent of the structural framing in C.K. Choi is made from wood roof trusses salvaged from the 1940s Armoury building that was demolished in the early 1990s. The exposed heavy timber framing is distinctive and immediately apparent at the building's entrance. Each timber piece was inventoried by size, length, species, and an initial visual grading as the armoury was deconstructed and assigned to locations in the new structural system.

For the columns, pieces were spliced together with steel connections to achieve the required three-storey height. To achieve the necessary strength requirements, timber pieces were bolted together to form thicker cross-sections. Metal fasteners were recessed and covered with wooden plugs, as an alternative solution to achieving the required fire rating. Used strategically throughout the project,





*Interior of Armoury, heavy timber framing in the original location*

*Nearly 95 per cent of the construction waste was diverted from the landfill, an extraordinary achievement.*

glued-laminated (glulam) beams and columns supplement the timber framing members; most notably as the structural support to the custom-shaped curved atrium roofs.

The design and construction of C.K. Choi predated the widespread use of green building rating systems; however environmental considerations were a key priority for the design. Along with the salvaged Douglas-fir timber, 100 per cent of the distinctive red brick cladding was sourced from a demolished building in downtown Vancouver. Other salvaged components include office doors and frames, washroom sinks and electrical conduits. Nearly 95 per cent of the construction waste was diverted from the landfill, an extraordinary achievement. Additionally, C.K. Choi was designed and detailed for a 200-year expected building life, with a flexible interior design to accommodate change over time.







SIZE: 231,424 FT<sup>2</sup> (21,500 M<sup>2</sup>)

COMPLETED: 1998

## FOREST SCIENCES CENTRE

A showcase for the technical capabilities of wood construction and the large-scale use of wood applications and products.

With an internationally-recognized forestry program, it was important for UBC to provide a modern research and teaching space to match its standard of excellence. Completed in 1998, the Forest Sciences Centre is the hub of the Forestry programs at UBC and home to the departments of Forest Science, Wood Science and Forest Resource Management, as well as the Centre for Advanced Wood Processing. It is an academic building that includes classrooms, lecture theatres and a café on the ground level, with offices and study areas on the upper floors, and various types of teaching and research laboratories. The design mandate for the project was to integrate wood construction throughout the facility and to visually demonstrate and highlight wood use, both structurally and aesthetically, and to, in part, expand the market for wood-based building products, as one of British Columbia's most important resources.

The Forest Sciences Centre was designed as three distinct blocks to meet the B.C. Building Code regulations at the time of construction. These consist of a five-storey laboratory block, a four-storey office block, and a one-storey wood processing centre, surrounding a large central sky-lit atrium. Each of the three blocks is separated by seismic joints and fire barriers, and has a distinct structure and design, driven by functional needs. The office block consists of parallel strand lumber (PSL) beams and columns supporting a floor assembly of engineered wood joists and plywood sheathing topped with concrete. Walls are framed conventionally with SPF (spruce-pine-fir) dimensional lumber and oriented strand board (OSB) for shear resistance. The processing centre is Douglas-fir glulam beams and columns supporting the exposed wood trusses and I-beams roof. Code limitations and concerns about the transfer of vibrations to and from sensitive laboratory equipment dictated that the laboratory block is a reinforced concrete structure.





The atrium is a showcase of innovative wood use in the Forest Science Centre, with large PSL “trees” supporting the skylight roof to recreate the feel of a forest canopy. The “trees” are composed of 42.7 ft (13 m) tall column “trunks” clustered in groups of four and supporting three dimensional truss “branches”. The trusses are anchored against the office block and cantilevered towards the lab block. The skylight roof is framed in 11.2 ft (3.4 m) long wood purlins that span between the transverse PSL roof frames and is sloped to accommodate the different heights of the lab and office blocks. In addition to the structural columns, the walls of the atrium are lined with Douglas-fir boards and bigleaf maple wood veneer and solid panelling, and the open stairs and raised study area are tongue & groove Douglas-fir boards.

*To provide the necessary connections for the complex three-dimensional trusses, a special steel shear plate connection utilizing the Timber Rivet (also known as the Glulam Rivet) was used. Developed for use in glulam construction at UBC in the 1960's; the Timber Rivet was still the most suitable solution 35 years later, as it allowed for a more efficient transfer of loads and easier access for on-site assembly.*

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## CENTRE FOR INTERACTIVE RESEARCH ON SUSTAINABILITY

SIZE: 61,085 FT<sup>2</sup> (5,675 M<sup>2</sup>)

COMPLETED: 2011

**Wood has a significant role in demonstrating that buildings can provide net environmental and human well-being benefits.**

An interdisciplinary academic centre that is a focal point for sustainability research and operations at UBC, the Centre for Interactive Research on Sustainability (CIRS) is home to a range of UBC units, research groups, and industry partners. The design mandate for CIRS was to create a “regenerative” building — one that would go beyond conventional sustainable design principles and to have a “net-positive” impact on its environment and the lives of its human inhabitants. In the building, passive design strategies are integrated with high-performance systems, using renewable resources and unique site opportunities. CIRS is on target to achieve LEED® Platinum and Living Building Challenge recognition.

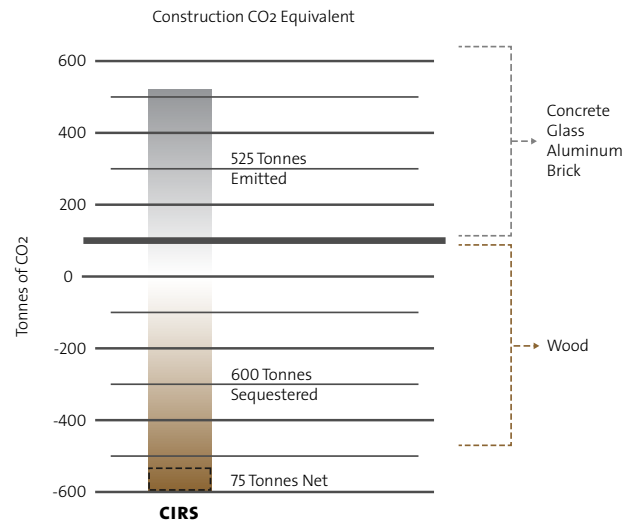
CIRS is a four-storey U-shape building that wraps around a large auditorium, with a living roof courtyard on the second level. The two main wings of the “U” contain offices, labs and work spaces, a café, and

service spaces such as an ecologically based reclaimed water treatment plant, and are connected by a four-storey day-lit, naturally-ventilated atrium. CIRS is the source of multiple research projects, as well as the subject of ongoing studies on the long-term effects of sustainable design, construction, and operation, including the performance of wood structures over time. It is intended as a new baseline in sustainable buildings at UBC, for other projects to strive to surpass.

The overall design emphasizes simple forms and materials, exemplified by the exposed wood and visible connections. The structure consists of a frame of rectangular Douglas-fir glulam columns and beams, supporting a floor system of standard 2x4 dimensional lumber, laid on end and gang nailed together, and covered in a single layer of plywood. Lateral resistance is provided through two systems: conventional plywood shear walls in the direction of the short spans of the building and a moment frame system combined with spandrel panels in the direction of the long spans. The spandrel panels are



## NET-POSITIVE CARBON CONSTRUCTION (DESIGN ESTIMATE)



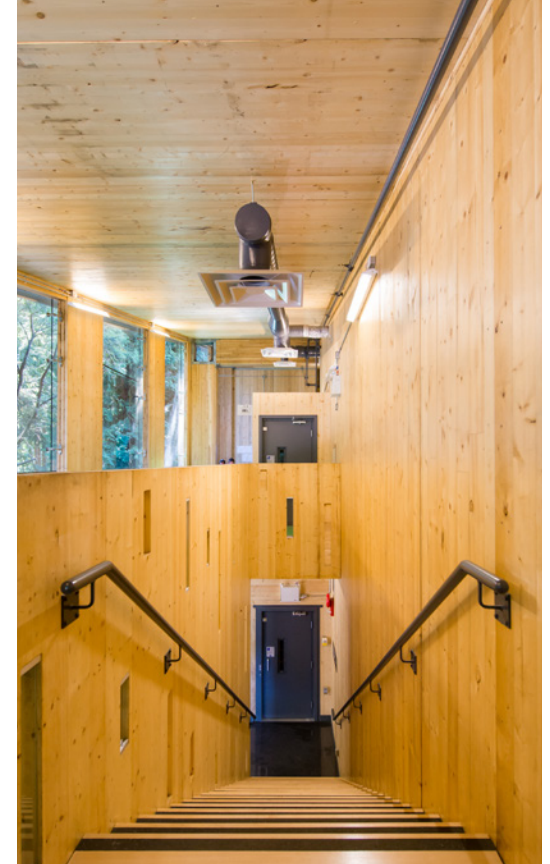
*More carbon dioxide is stored in the wood structure than was emitted during the extraction, manufacturing, transportation and installation of all the other building materials used in CIRS.*

constructed as box beams made of dimensional lumber and plywood and are placed between the structural members along the exterior walls, just above the floor deck. This strategy optimizes the size and placement of windows in the exterior wall, creating opportunities for day-lighting and direct control of natural ventilation, which in turn reduces the energy demand of the building. The structural connections are steel bolts and shear plates designed to allow for easy deconstruction at the end of the building's estimated 100-year life.

Using wood as a building material was integral to the regenerative principles of the project. It is a renewable resource which provides multiple ecological services, creates comfortable interior environments and stores carbon.







## BIOENERGY RESEARCH & DEMONSTRATION FACILITY

SIZE: 24,510 FT<sup>2</sup> (2,277 M<sup>2</sup>)

COMPLETED: 2012

**Reflects wood in multiple states: sited within a dense area of trees, built from wood products, and generating energy from wood waste.**

The Bioenergy Research & Demonstration Facility (BRDF) was built in response to UBC's need to generate sufficient heat and power to meet the campus' growing energy demand through an affordable alternative fuel source that would also reduce campus greenhouse gas emissions (GHGs). The plant is a combined heat and power (CHP) system, which converts wood chips into a synthesis gas that is a natural gas replicant for heating, and electricity generation through an internal combustion engine that powers a generator. The facility is part of the Campus as a Living Lab initiative that combines operational infrastructure, research and educational opportunities related to sustainability, in this case, bioenergy.

The building enclosing the plant is a simple rectangular industrial-style shed, clad in glass and corrugated metal. A clear span, high height section houses the CHP system and a mezzanine area includes offices, labs and a public viewing space. BRDF is targeted to achieve LEED® Gold rating, which is a UBC requirement for all new buildings on the academic campus.

The industrial purpose of the BRDF drove the selection and design of the structural system, materials, and connections. The exposed structure of engineered wood is a combination of Douglas-fir glulam columns and beams that function as composite assemblies with SPF cross-laminated timber (CLT) walls, floors, and roof decking all supported on a concrete foundation.



*“What was truly unique about this project was the presence of wood in three-fold: from the construction of the building, to the project’s location on the campus in a relatively dense area of trees, to the utilization of wood as fuel for the gasification unit – wood remains omnipresent.”*

LARRY MCFARLAND, PRINCIPAL, MCFARLAND MARCEAU ARCHITECTS

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This mass timber system provided an acceptable alternative solution to the B.C. Building Code requirement for non-combustible construction, in a facility housing equipment of this type. Along with enabling faster, efficient erection through simplicity of design and limited components, CLT panels have excellent acoustic dampening properties due to their thickness and therefore reduce the sound transfer from the equipment. The panels also create a beautiful natural wood interior surface that required no additional finishes.







SIZE: 161,060 FT<sup>2</sup> (14,963 M<sup>2</sup>)

COMPLETED: 2012

## EARTH SCIENCES BUILDING

Specially-designed composite wood assemblies and connections in a high-performance structural system feature prominently.

Adjoined to the existing Earth and Ocean Sciences (EOS) facility, the Earth Sciences Building (ESB) is a five-storey L-shape structure with classrooms, lecture halls, seminar rooms, study areas, and research labs. It houses the departments of Statistics, and Earth, Ocean and Atmospheric Sciences, the Pacific Institute for Mathematical Sciences, the office of the Dean of Science, and the Pacific Museum of the Earth. The innovative use of wood throughout the building complements the relationship between environment and science inherent in the academic agenda of ESB — the advancement of knowledge and understanding about earth, ocean and atmospheric systems. Although the material palettes differ, the new north tower is designed to form a cohesive



whole with the existing concrete south tower. As an academic building on the main campus of UBC, ESB is targeted to meet the required LEED® Gold certification.

Built on a concrete foundation, the structure consists of Douglas-fir glulam beams and columns, spanned by a composite flooring system consisting of laminated strand lumber (LSL), foam board insulation and a reinforced concrete topping, and SPF CLT for the structural roof decking between the beams. Composite action within the panels is achieved through the use of steel shear connections embedded in the wood panels and extending into the concrete to support the reinforcement. The characteristics of the floor panels were adjusted to meet the design requirements, such as structural loading, fire-resistance, vibration isolation, and acoustic absorption.





The connection system for the framing consists of two steel pieces embedded in the beams during manufacture that lock together and are fastened on site during assembly. Diagonal glulam trusses are located at the end of the building on each floor to provide resistance to shear loads with special cast steel connectors at the truss points. The first storey of ESB includes a building-wide column-free gathering space and the second floor effectively supports the rest of the building above. To handle these loads, large steel transfer trusses span across the building. These trusses are a full-storey in height and act like roof trusses over the first storey, transferring the loads from above to the perimeter structure.

The Earth Sciences Building and Earth and Ocean Science building are connected by an atrium that houses one of the most striking elements of the project — a five-storey free-floating cantilevered staircase constructed of a rigid wood-steel composite of solid glulam timber slabs with glued-in steel connections.







SIZE: 133,429 Ft<sup>2</sup> (12,396 m<sup>2</sup>)

COMPLETED: 2013

### **YU MODERN GREEN LIVING**

**Extends the long tradition of wood construction in mid-rise residential buildings into new sustainably-designed projects.**

Yu Modern Green Living is the most sustainable residential mid-rise building at UBC. It is a six-storey (four-stories of wood construction on a concrete base), 106-unit, mixed-use project located in Wesbrook Place to the south of the academic campus. Wesbrook is one of eight University Towns, or “U-Towns” which provide a mix of housing options, services, and social amenities for the families of faculty, staff, students, and other residents. All residential projects in these neighborhoods are required to comply with the Residential Environmental Assessment Program (REAP), a sustainable building rating system developed by UBC that is tailored specifically for the Vancouver campus context. The Yu project targets REAP Platinum, which surpasses the new standard for all new residential developments on campus, which is REAP Gold.

Yu Modern Green Living features a central courtyard and tiered gardens that provide a place for community interaction. It supports a number of passive sustainable design strategies, including optimizing natural daylighting and cross ventilation in all of the units. A key component of this project is a research and development centre jointly operated by the developer, Modern Green Development, and UBC’s Centre for Interactive Research on Sustainability. The centre showcases research on sustainable building practices and products, and provides an important link between the residential and academic communities at UBC.





The Yu building is a hybrid building with poured-in-place concrete on the foundation, ground and second levels, and light wood framing on levels three through six. The wood framing consisted of mostly SPF dimensional lumber and plywood (over half of which was third-party certified), with engineered wood beams in the floor assemblies, made of either PSL or LSL. The wood wall panels were prefabricated on-site then installed in the building, with the floors and roofs built in place. This process allowed for a very fast assembly, approximately two days per unit, significantly decreasing overall building construction time and cost.

In addition to the structure, wood is used as a cladding and finish material throughout the building. The recessed balconies are lined with stained western red cedar panelling, which provides a warm contrast to the dark brick cladding.

The design team proposed alternative solutions to increase the use of wood in the building that both met the B.C. Building Code and integrated with the overall design of the project. These included increasing the depth of floor partitions to provide fire-separation, using non-combustible cladding and overhangs to reduce the risk of exterior fire spread, increasing the fire-rating of suite demising wall assemblies, and providing additional sprinklers at exiting paths of higher risk areas.



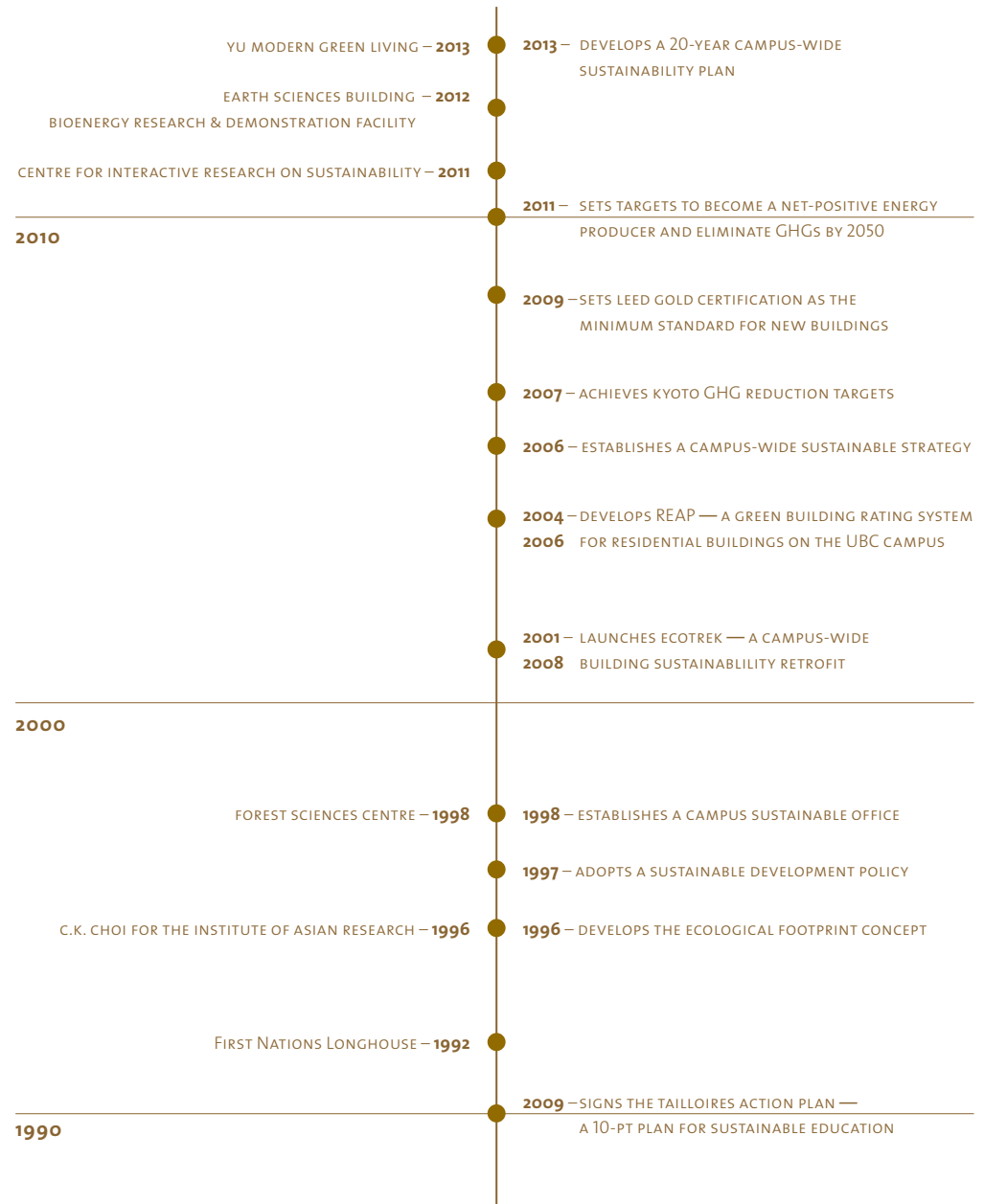


*Centre for Interactive Research on Sustainability*

## WOOD AND SUSTAINABLE DESIGN AT UBC

The use of wood in the construction of buildings at UBC has historically been in conventional methods, due to its availability and ease of workmanship. As one of the oldest building materials, wood provides a connection to the past and to the traditions and practices of many cultures. Engineered wood products, such as CLT, composite assemblies, and hybrid solutions, expand the range of uses and capability of wood construction. The myriad environmental benefits of wood, and the forests that supply it, make it an important component of sustainable design and development. The amount and variety of wood in building construction is increasing at UBC, and wood is becoming integral to the character and identity of UBC's Vancouver campus.

Sustainability at UBC has evolved and grown to become an integral part of the University's identity. At the same time building sustainably has mirrored this evolution, with each project influencing and inspiring the next.







*Earth Sciences Building*

#### PROJECT CREDITS

##### FIRST NATIONS LONGHOUSE

###### ARCHITECT

Larry MacFarland  
(now MacFarland Marceau Architects Ltd.)

###### STRUCTURAL ENGINEER

CWMM Consulting Engineers Ltd.

###### PHOTOGRAPHER

Don Erhardt

##### C.K. CHOI

###### ARCHITECT

Matsuzaki Wright Architects

###### STRUCTURAL ENGINEER

Read Jones Christoffersen Consulting Engineers

###### GENERAL CONTRACTOR

Country West Construction Ltd.

###### PHOTOGRAPHERS

Don Erhardt  
University of British Columbia Archives  
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##### FOREST SCIENCE CENTRE

###### ARCHITECT

Dall-Lana Griffin Dowling Knapp Architects  
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###### STRUCTURAL ENGINEER

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###### PHOTOGRAPHER

Don Erhardt

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###### ARCHITECT

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###### STRUCTURAL ENGINEER

Fast & Epp Structural Engineers

###### CONSTRUCTION MANAGER

Heatherbrae Builders

###### PHOTOGRAPHERS

Don Erhardt  
Michael Robinson

##### BIOENERGY RESEARCH & DEMONSTRATION FACILITY

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###### STRUCTURAL ENGINEER

Equilibrium Consultants

###### CONSTRUCTION MANAGER

Ledcor Group Ltd.

###### PHOTOGRAPHER

Don Erhardt

##### EARTH SCIENCES BUILDING

###### ARCHITECT

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###### STRUCTURAL ENGINEER

Equilibrium Consultants

###### CONSTRUCTION MANAGER

Bird Construction Co.

###### PHOTOGRAPHERS

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##### YU MODERN GREEN LIVING

###### DEVELOPER

Modern Green Development Co. Ltd.

###### ARCHITECT

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###### STRUCTURAL ENGINEER

John Bryson & Partners

###### CONSTRUCTION MANAGER

ITC Construction Ltd.

###### FORMING AND FRAMING

Seagate Structures

###### RENDERINGS

Perkins+Will Architects Canada Co.





Forest Science Centre

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