UBC CHEMISTRY CENTRE

CASE STUDY: A NEW TAKE ON AN OLD BUILDING

"While we can and do measure many aspects of sustainability to gauge our progress, sustainability is not a destination at which we will one day arrive. Rather, it is about working toward a future that is both desirable and achievable in ecological, social and economic terms. One thing is for certain: the more we know about the impacts of our actions today, the better equipped we will be for the challenges of tomorrow." – UBC Sustainability

BACKGROUND

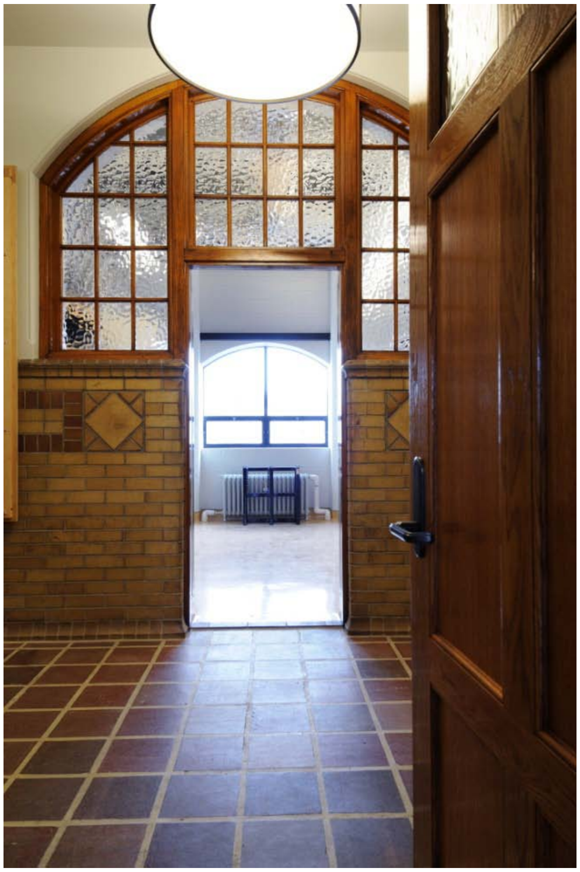
Complete with granite facade, copper scuppers and downspouts, leaded windows, and corridors with detailed brickwork and woodwork, the Chemistry Centre is one of only two Collegiate Gothic style buildings on the University of British Columbia's (UBC) campus. Built in 1923, it was UBC's first permanent building and today the Chemistry Centre remains a major heritage landmark.

Although these historical architectural details remained intact, the building was in desperate need of life safety and seismic upgrades. It could no longer support today's chemistry research, and its original building systems were practically non-functional. With 60% of UBC's buildings over 30 years old and a history of inadequate maintenance funding, the Chemistry Centre situation was far from unique.

Most building systems require substantial renewal after 25 to 30 years, but the cost of maintaining a building increases exponentially as deterioration accelerates and the cost of repair and renovations increase. However, public institutions often defer maintenance when faced with the demand for new space, limited budgets and funding cutbacks.

UBC is the province's oldest and largest university with the first buildings erected in the 1920s. Throughout the building boom of the post-war years through to the 1970s, capital renewal funding did not keep pace. At present, nearly 70 percent of the core academic space at UBC is more than 30 years old and UBC is facing a deferred maintenance bill in excess of $550 million. If facility maintenance is put off too long, buildings may fail to meet fire safety and seismic stability codes and replacing these buildings is usually more expensive than maintaining them. A bold initiative was needed.

UBC RENEW



In a rejection of the “new is better” mentality, UBC and the provincial government entered into a partnership to preserve and upgrade the deteriorating building stock. The $120-million UBC/Provincial partnership is aimed at upgrading UBC’s aging buildings. UBC Renew's premise is that retention of the building is inherently sustainable, diverting waste from the landfill, avoiding the energy, carbon emissions, water and coal consumption in the manufacture and transportation of new building materials, saving millions of dollars, and preserving campus culture. It is a Provincial directive that a UBC Renew building must be renovated for no more than 67% of the cost of a comparable replacement building.

The program will allow the UBC Vancouver campus to extend the life of more than 90,000 square meters of building by 40 years or longer. UBC Renew is a new financing model for public institutions. Among the first Canadian universities to do so, UBC secured financing in the bond market on the strength of its credit rating. This 2002 initiative made it possible for UBC to propose a joint financing plan with the government.

The UBC Renew program is a long-term investment in UBC that will make its buildings safer, more accessible, more cost-efficient and more functional, at the same time as achieving ambitious sustainability goals. Improvements include building code, mechanical, electrical and seismic upgrades; improved disability access, updated research and teaching spaces, and more than 1,000 square meters of additional usable space. UBC Renew will improve learning conditions for thousands of students, support new academic plans and priorities and mitigate millions of dollars in deferred maintenance.

A GREENER UNIVERSITY

UBC is an acknowledged leader in campus sustainability and is increasingly recognized as a hub for discussion and research on many wide aspects of sustainability, including resource conservation, habitat preservation, climate change, social equity and economic resiliency.

UBC prides itself on being a model green university and runs several programs that address sustainability. All of which, address the sustainability of its operations and infrastructure, and generate long-term environmental, social and financial results. UBC also offers innovative programs to educate students, staff and faculty on sustainability issues and empower them to change their behaviors and inspire their peers to follow their lead.

Some of the programs include: a monthly Green Research Newsletter that informs the research community on the latest green research information and initiatives; several self-funding projects aimed at reducing the University's energy consumption, water consumption and greenhouse gas emissions; its Green Research Program that takes progressive and innovative steps to reduce the impact of its research activities—activities typically requiring an intense use of energy, materials and resources; and its Green Building Program that focuses on reducing UBC's environmental footprint through efficient building operations and transforming buildings to become visible and enduring elements of their commitment to sustainability… just to name a few.

GREEN BUILDINGS

UBC Infrastructure Development is responsible for delivering cost effective, durable and sustainable buildings to support learning and research at the University. While UBC has been integrating sustainable building practices directly into its Technical Guidelines for years, the University continues evolving its approach to green building. For example, UBC is developing its own procedures to ensure that the campus's environmental priorities are optimally addressed, while meeting the Province of BC's requirement for LEED Gold certification.

UBC made early contributions to the green building industry with the C.K. Choi Building in 1996, and the Liu Institute for Global Issues in 2000. Since then, UBC has built many more buildings with high-performance features and has earned LEED Gold certification with the Life Sciences Centre (2005), the largest LEED Gold certified building in North America, and the Aquatic Ecosystems Research Lab (2008). Both of these projects were certified under the LEED Canada rating system.

The University is creating a 'living laboratory' on its campuses, showcasing innovative approaches to conserving energy, water and materials, while striving to make positive impacts on the environment. This living laboratory provides the UBC community with a diverse range of opportunities for research and innovations in practice across campus, spanning everything from new construction to major renovations, and existing building operations.

The Centre for Interactive Research on Sustainability (CIRS) on the UBC Vancouver campus was approved for construction in 2009. This visionary, low-impact building will embody green building design best practices and foster research and collaboration on sustainability solutions. CIRS will be the most innovative and high-performance building in North America, demonstrating leading-edge research and sustainable design, products, systems and decision-making. A state-of-the-art living green building, it will include environmentally progressive storm water management, wastewater treatment, and ground-source heating. The CIRS building will be a true living lab—a home to inter-disciplinary researchers working in collaboration with industry and community partners to accelerate sustainability solutions. Construction has begun and building occupancy is expected in spring 2011.

LEED

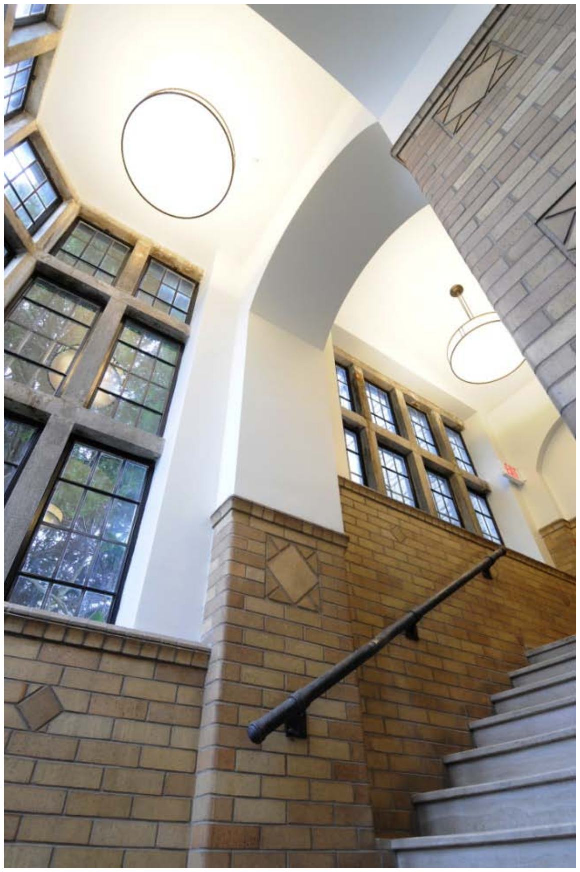
The LEED Green Building Rating System is a voluntary, consensus based, market driven program based on existing, proven technology. It evaluates performance from a whole building perspective over a building's life cycle, providing a definitive benchmark for what constitutes a "green building".

The rating system is organized into five categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources and Indoor Environmental Quality. An additional category, Innovation & Design Process, addresses sustainable building expertise as well as design measures not covered under the five categories.

LEED is a measurement system designed for rating new and existing commercial, institutional, and residential buildings. It is based on accepted energy and environmental principles and strikes a balance between established practices and emerging concepts. It is a performance-oriented system where credits are earned for satisfying criterion designed to address specific environmental impacts inherent in the design, construction, occupancy, and Operation & Maintenance of buildings. Different levels of green building certification are awarded based on the credit requirements achieved and total points earned. The system is designed to be comprehensive in scope, yet simple in operation.

The LEED rating system awards points earned by meeting specific performance criteria that outperform typical standard building practice defined in Prerequisites and Credits. Improved building performance is certified with ratings – Certified, Silver, Gold or Platinum – based on the total number of points earned by a project.

THE CHEMISTRY BUILDING CHALLENGE



Chemistry Centre is by far the most significant building to be renewed under the UBC RENEW program so far, and the design team had numerous challenges when faced with this renovation. They were challenged to: reduce the impact of demolition by retaining as much of the building as practically possible, while still reconfiguring the space to create open concept chemistry labs, lecture theatres, and student, faculty, and administrative spaces; preserve the building's distinctive architectural features; intensify the use of space and build in flexibility for future reconfiguration; harness the building's potential to maximize sustainability benefits, *and* achieve LEED Silver certification.

Henriquez Partners Architects collaborated with Stantec Consulting Ltd. for mechanical engineering, LEED consulting and building energy simulation expertise. The design team responded to the project goals with a scheme that preserved the heritage character of the exterior, the entrances and circulation spaces, while creating state of the art laboratory spaces which range from fume hood intense synthetic chemistry labs to analytical chemistry labs with computer workstations. Open concept labs allow maximum adaptability to changing research and team sizes, and the top floor labs actually incorporate the heritage corridor. All exterior facade elements were repaired and cleaned, including – after much deliberation -- the existing single-paned windows which, although not energy-efficient, are a significant identifying element.

DESIGN

MATERIALS AND RESOURCES

A large focus of the UBC Chemistry Building renovation was maintaining the existing building. 100% of the building shell including the foundation, columns, beams, and roofing all remained intact and were seismically upgraded. Interior building elements were also preserved, such as ceilings, floors and walls, effectively amounting to a retention of 60% of all interior elements. Throughout the construction process the construction team was careful to properly sort and recycle waste where possible. An impressive 80% of all the construction waste was sent to recycling or refurbishing facilities and diverted from landfill, an extremely large quantity in comparison to many standard building practices where virtually all construction waste ends up in landfill.

Finishing materials for the building were specified to contain recycled content and/or were sourced regionally. Materials such as new gypsum wallboard, steel studs and toilet partitions contribute to the 18.9% of materials with recycled content, while 22.4% of all the building and finishing materials came from local sources. Interior wood doors were refurbished and reused where possible.

ENERGY AND ATMOSPHERE

Reducing the energy consumption in any retro-fit has its challenges, particularly in a heritage building. A theoretically simple energy-savings initiative such as adequate building insulation, for example, suddenly becomes problematic in a renovation as the cost to open the structure, install the insulation, repair, patch and refinish the walls can creep up to similar price points as new construction. Managing these costs is the most prevalent challenge with retro-fits. The same goes for lighting. Depending on the age of the building, the type of existing lighting, and the installed ceiling system, installing energy-efficient lighting might require significantly more effort than simply changing out a few light bulbs. Heritage structures pose a particular challenge because preserving the historical features are as much a priority as implementing energy efficient strategies, and implementing these upgrades can cause these two goals to conflict.

Because achieving both was ultimately the goal for the Chemistry building, the roofline, exterior granite cladding, and leaded glass windows were not altered during the renovation. To impact the energy savings, energy conservation measures include high-efficiency lighting, heat recovery from building exhaust, high-efficiency pumps, and hot water heating savings from low-flow fixtures and reduced water consumption. With the view that district energy sources are a more efficient strategy on campus settings, district steam heating was also incorporated into the building system to heat the hot water. These measures impact the building's annual energy consumption which is calculated to be 700.3 MJ/m2 — an energy cost saving of 21% compared to the baseline case.*

In addition, as a committed supporter of local and green energy, UBC engaged in a 2-year contract with Bullfrog Power, purchasing all of the required power for the Chemistry Building through renewable and Ecologo certified sources.

**LEED requires that major renovations to existing building reduce the design energy consumption by 10% relative to reference design building prescribed by the Model National Energy Code for Buildings (MNECB) 1997. The MNECB is intended to help design energy-efficient buildings by establishing minimum requirements for features of buildings that determine their energy efficiency, taking into account regional construction costs, regional heating fuel types and costs and regional climatic differences. The MNECB has, in addition to sections on the building envelope and water heating, detailed information on lighting, HVAC systems and electrical power, which can offer major energy savings.The MNECB applies to all buildings, other than houses of three storeys or less, and to additions of more than 10 m^2 to such buildings.*

INDOOR ENVIRONMENTAL QUALITY

The design team took advantage of the building's location, large operable windows, and relatively narrow floor plate to maximize passive ventilation and daylighting to drastically reduce the building's energy consumption. All occupied rooms have operable windows; the non-loadbearing concrete masonry walls were removed to create bright, open spaces, and existing skylights were uncovered to flood the third floor labs with daylight. Drop ceilings were removed to take full advantage of the soaring ceiling height and to make rooms feel more spacious. Careful consideration was paid to occupant health and well-being and the new design plan called for daylight and view access for 90% of the occupied spaces.

Cross-ventilation delivers fresh air and free cooling without fans, and the building's highmass stone and concrete elements maintain relatively stable indoor comfort conditions, absorbing “cool” from the prevalent summer breezes, and solar radiation from the low winter sun.

The ventilation system was upgraded to meet ASHRAE*, and new control systems improve building operation and maximize efficiency. New piping to the existing radiators controls the zones and optimizes perimeter radiation, and fume hood controls decrease energy consumption when not in use.

Adhesives, sealants, paints, coatings, and carpets all emit volatile organic compounds (VOC’s) that off-gas and contribute to smog generation, air pollution outdoors, as well as have an adverse affect on human health indoors. As such all finishing materials were specified to be low-emitting in order to maintain high quality and healthy indoor air. The building was also flushed with fresh air after construction and before occupancy to remove any remaining construction odors or particulate in the ventilation system.

**ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Standard 62-2001 has become the standard ventilation design practice and typically does not require additional design effort or cost. This standard specifies minimum ventilation rates and indoor air quality levels to reduce the potential for adverse health effects. The standard specifies that mechanical or natural ventilation systems be designed to prevent uptake of contaminant, minimize the opportunity for growth and dissemination of microorganisms, and filter particulates.*

SUSTAINABLE SITES

The Chemistry Building is located in a densely populated area with existing infrastructure, thus promoting walkablility and lessening demand for single occupant vehicle use. This is further strengthened by the project's close proximity to public transit and the numerous bike racks available for use on site.

"Heat Island Effect," the term given to the condition that occurs when warmer temperatures occur in urban landscapes compared to adjacent rural areas as a result of solar energy retention on constructed surfaces (which also significantly and negatively impacts microclimate and wildlife habitat) was minimized by shading over 50% of the impervious surfaces with maple and cherry trees. In addition, 1242 square meters of the 1428 square metered roof (87%) was built with reflective roofing materials to reduce this effect.

WATER EFFICIENCY

Low flow and flush water consuming fixtures were installed throughout the building to achieve a water savings of 20% better than conventional a conventional building as compared to the baseline.*

Toilet flushing uses the most water in residential and commercial buildings. Older toilets use up to 15 to 30 litres of water per flush, while new standard toilets use a maximum of 6 litres per flush. Low flow toilets can use as little as half this amount.

**The baseline case is calculated in the same manner as the design case, except that all the fixtures are assumed to be standard fixtures. The overall water savings is calculated by taking building specific usage patterns into account and comparing the actual installed fixtures to the standard fixtures. Fixtures include toilets, urinals, bathroom and kitchen faucets, and showers.*

This $31.8 million project has set a new benchmark for sustainable renewal of the University's buildings.

The rich detail and traditional materials of the heritage corridors, entrances and staircases complement and contrast with the clean lines and functional appearance of the high-tech research labs. Past and present now comfortably co-exist, and contribute significantly to sustainable development at UBC.

PROJECT TEAM

Owner:	University of British Columbia
Architect:	Henriquez Partners Architects
LEED Consultant:	Stantec Consulting Ltd.
Mechanical:	Stantec Consulting Ltd.
Electrical:	RADA
Energy Engineer:	Stantec Consulting Ltd.
Structural:	Loh CY & Associates
Landscape Architect:	Phillips Farvaag Smallenberg
General Contractor:	Ledcor Special Projects
Commissioning Agent:	KD Engineering Co.

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