TEST LAB for Sustainability

BY ALBERTO CAYUELA, P.ENG., AND ANGELIQUE PILON

The Centre for Interactive Research on Sustainability (CIRS) aims to not only reduce impact on the environment, but improve the lives of its occupants and its community through net positive operation. The research institution at the University of British Columbia (UBC) is designed as a living laboratory to test sustainable building strategies and accelerate their adoption into urban development. As with any experiment, the primary goal is to learn from successes and failures alike, ultimately informing future sustainable designs. While the building has not yet reached its goals of net positive energy and water operation, researchers are sharing insights gained from its operation.

Martin Dee

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Above The main auditorium is one of the largest on campus, with 425 seats. It can provide supplemental natural ventilation through skylight awnings. Conditioned outside air is fed through a raised floor plenum.

Opposite On the exterior of the CIRS building, a vegetated façade on a metal armature shades the western face of the building from low-angle afternoon sunlight in the summer. The solar aquatics biofilter lab, a reclaimed water treatment system, is located in a greenhouse in the most prominent corner of the building.

Conceived in 1999, the project was seen as an opportunity to create a building that would push the envelope of sustainable design by integrating passive design strategies with the most advanced sustainable technologies of the time. The four-story building, which was completed in 2011, is the home of dozens of UBC sustainability researchers, planners and policy makers.

It includes offices and computer labs, an auditorium, meeting rooms, a café and open spaces for social interaction. The total project budget was approximately CAN$36 million (US$30 million), with a construction budget of approximately CAN$24 million (US$20 million). It has received Canada Green Building Council's LEED Platinum certification (equivalent to USGBC's certification), and is seeking Living Building Challenge recognition.

The building systems and infrastructure, as well as the processes of planning, designing, building and operating the facility, are part of the research agenda of the research center. The building is equipped with an extensive network of sensors and controls that are part of a building automation system that has more than 3,000 points. This capability helps ensure that all systems in the building are properly monitored to facilitate performance tracking and reporting, and to enable the implementation of continuous optimization protocols.

Through research projects, systems and components in the building are being studied over the course of the building's economic life, and improved through innovative system design and the application of new technology. CIRS has been defined as a "100-year process" rather than a fixed "product" to be used and decommissioned in 30 to 40 years. The aspiration is that CIRS will not become obsolete because entire systems and components will be replaced with newer, higher-performing technologies supporting relevant research throughout the entire life cycle of the facility.

Flexibility, modularity, adaptability and expandability principles are included in the design of CIRS to ensure that it can adapt to new uses and respond to future space configuration requirements without the need for expensive renovations. The entire building was built as a "Meccano" or "Erector" set with mechanical connections joining structural components that will enable the complete disassembly of

BUILDING AT A GLANCE

Name Centre for Interactive Research on Sustainability (CIRS)

Location University of British Columbia, Vancouver, B.C., Canada

Owner University of British Columbia

Principal Use Research, education, and administrative building
Includes Labs, an auditorium, meeting rooms, a café, open social spaces

Employees/Occupants About 180 permanent occupants and a variable number of students and attendees of the various events held at the building

Expected (Design) Occupancy 200 researchers
Percent Occupied 92%

Gross Square Footage 61,085 ft^2
Conditioned Space 61,085 ft^2

Distinctions/Awards
Excellence in Structural Engineering Award, National Council of Structural Engineers Associations (NCSEA), 2012; Wood Design Award, Canadian Wood Council, Wood Design & Building, 2012; LEED Canada for New Construction and Major Renovations 1.0, Platinum, 2012

Total Cost* CAN$36 million (~US$30 million)

Construction Cost CAN$24 million (~US$20 million)
Cost per Square Foot $598.34/$ft^2$

Substantial Completion August 2011

Building Occupancy September 2011

*Total cost includes indirect costs such as planning and design, project management, insurance, legal, etc.

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The CIRS four-story atrium is the heart of the building. It is flooded with daylight, is naturally ventilated and is heated through in-floor hydronic tubing. It is the circulation backbone of the building, functions as a gathering space for building inhabitants, and hosts a variety of events.

the building and repurposing of its constituent components at the end of building's useful life. This increases its resiliency to change and reduces its total cost of ownership.

FIGURE 1
MONTHLY ENERGY USE, 2012–2013

	Electricity Use (kWh)	PV Electricity (kWh)
Apr 2012	58,645	N/A
May 2012	55,640	N/A
Jun 2012	55,372	N/A
Jul 2012	56,374	N/A
Aug 2012	54,509	N/A
Sep 2012	57,081	341
Oct 2012	65,476	885
Nov 2012	67,333	398
Dec 2012	69,551	155
Jan 2013	84,007	361
Feb 2013	64,986	366
Mar 2013	65,817	1,632
Totals	**754,791**	**4,137**

Notes: PV monitoring began Sept. 24.

Data on heat exchange between the CIRS Building and EOS Building not included due to some inconsistencies identified by the building team. The team is trying to solve these issues for future performance reports of CIRS.

Design Strategies

CIRS showcases the integration of a host of off-the-shelf sustainable systems and technologies, such as water harvesting, a vegetated façade and solar shading components fitted with integrated photovoltaic (PV) panels. The design team engaged in an integrated design process that included a 3-D design model. Sustainable design goals were organized into four categories: design principles; water supply treatment and reuse; daylighting and solar shading; and energy modelling.

The design charrettes included technology partners, who came to the table with ideas and technologies to consider. These charrettes were partially funded by Natural Resources Canada and compiled into comprehensive reports that are available on the CIRS website, www.cirs.ubc.ca, as well as in a detailed integrated design process report.

Before considering energy efficiency measures and the proper sizing of mechanical and electrical systems and components in the building, the design team worked to reduce energy and water demand to the absolute minimum through passive design strategies. The team also maximized harvested energy and water from "free" sources, such as waste thermal energy, renewable energy and rainwater.

Lighting. The building has two narrow wings connected by an atrium and auditorium in the middle. Each of the wings is just 30 ft (10 m) wide, with large windows that open, providing natural light and fresh air for all building inhabitants when conditions allow it. The result is a building that's bright inside even on cloudy days.

In the offices and labs, when the amount of available daylight isn't sufficient, artificial lighting is available through addressable and programmable fluorescent lighting fixtures (using a controller in combination with the building management system [BMS]). Lighting levels are controlled by photocells and through motion sensors mounted directly on the fixtures that turn the lamps off when unneeded.

Additionally, these lamps can be de-energized through individual relays installed in electrical panels. These relays are controlled by the BMS system.

Classrooms and meeting room lamps are controlled by on/off switches. In the lobby/atrium, fixed and pendant lamps are controlled by photocells. Lighting in public spaces is programmed according to the building operation schedule, which also eliminates unnecessary use at night and during unoccupied days.

Using Plants in the Envelope. On the west exposure of the building a metal armature supports deciduous vines that form a vegetated façade. It shades the building in the summer and allows heat and light in the atrium/lobby during the winter.

A living roof of local, well-adapted plants sits on top of the auditorium. The green roof retains a significant amount of the storm water runoff

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generated by the building and provides evapotranspiration cooling during the warmer months of the year.

Flexible Layout. CIRS is designed to allow for changeable floor plans in the building's wings. The modular office/lab partitions can be reconfigured as often as required. All of the power and data for offices and work stations comes from the raised floor, and no wires are run through any of the partition walls.

Solar Energy and Waste Heat. In addition to 25 kW of building integrated PV, CIRS captures solar energy through a 40 kW series of evacuated vacuum tube solar collectors that are used to preheat domestic water.

CIRS captures waste heat from the neighboring Earth and Ocean Sciences (EOS) building and was designed to return 600 MWh of surplus energy back to the campus annually. The process of running all mechanical and electrical systems in the building using hydroelectric power with a very low carbon footprint was estimated to require 585 MWh per year.

The net result of this scenario would be net-positive energy performance. The energy that is returned to campus from CIRS displaces the use of fossil fuels, which was intended to translate into 330,693 lbs (150 tonnes) of CO_2e emission reductions per year.

Above **Photovoltaic cells are mounted on shading devices on the north and south bar windows along the south facing façades.**

Below **The CIRS atrium is a busy space, with traffic from classes and meetings. A video wall displays information on the sustainable features of the building, system performance, research projects and upcoming events and activities.**

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TABLE 1 **SUSTAINABLE TECHNOLOGIES PAYBACK EXAMPLES**

System	Capacity	Cost	Simple Payback
Building-Integrated PV	25 kW	CAN$250,000	62.5 years
Solar Collectors	40 kW	CAN$75,000	Calculations Underway
Geoexchange System	150 kW	CAN$150,000	15 years

WATER AT A GLANCE

Annual Water Use 439,925 gallons

ENERGY AT A GLANCE

Annual Energy Use Intensity (EUI) (Site) 41.4 kBtu/ft^2*
- Electricity (From Grid) 41.2 kBtu/ft^2
- Renewable Energy (PV) 0.2 kBtu/ft^2
- Geothermal Heat Absorption and Heat Rejection 5.4 kBtu/ft^2

Annual On-Site Renewable Energy Exported 0 kBtu/ft^2

Annual Net Energy Use Intensity 41.2 kBtu/ft^2 (excluding geothermal and heat transfer energy)

Annual Source (Primary) Energy 85 kBtu/ft^2

Annual Energy Cost Index (ECI) $0.60/ft^2 (an approximate cost as UBC isn't billed by the utility on a per-building basis)

Savings vs. Canada's Model National Energy Code for Building Design Reference Building 32%

Carbon Footprint 0.369 lb $CO_2e/ft^2 \cdot yr$**

Percentage of Power Represented by Renewable Energy Certificates 12.8 %
- Number of Years Contracted to Purchase RECs Indefinite through BC Hydro

Heating Degree Days (Base 65˚F) 5,353

Cooling Degree Days (Base 65˚F) 176

Annual Hours Occupied 1,976

*Geothermal and waste heat transfer between CIRS and neighboring (EOS) building not included in site or source EUI.

** Carbon footprint calculated using BC Hydro's conversion factor of 14 tonnes of CO_2e per GWh of electricity supplied by the utility.

Note: The CIRS building exchanges waste heat with the neighboring Earth and Ocean Sciences (EOS) building. Approximately 7.2 kBtu/ft^2 per year of heat was transferred from CIRS to EOS during the monitoring period. However, energy data for the "waste heat" transferred from EOS and used by the CIRS building is unavailable due to metering concerns.

HVAC. Space heating is provided through a building-wide radiant system. Convective radiators are located along the perimeter of the two wings and a radiant floor system is installed in the lobby/atrium.

Two air-handling units (AHU) provide conditioned air to the building. One provides conditioned air to each floor's underfloor air distribution (UFAD) metal plenum that supplies each textile duct.

Each plenum has dampers that the BMS can automatically shut off by zone during unoccupied periods or when the building is mostly relying on natural ventilation. CIRS has manual or automatically operated high and low level windows, which occupants or the BMS can open for free cooling and natural ventilation when conditions allow for it.

The second AHU supplies CIRS's 425-seat auditorium. This space uses an underfloor metal air distribution system manufactured specifically for theaters. Unlike the offices and labs, which don't have active cooling, the auditorium uses mechanical cooling through heat pumps that reject heat into the geothermal field when heat is not being extracted from it.

The other areas of the building that are actively cooled through the building heat pumps are data rooms and the electrical vault in the basement. Heat recovery ventilators harvest heat from air discharged through the building exhaust systems.

Envelope and Structure. CIRS's high performance envelope and high R-value design uses building materials that limit solar gains, such as low-e triple-pane sealed curtainwall glass modules and low-e glass double-pane punch-in windows.

The structure of CIRS is a hybrid system. The basement and ground level auditorium are cast-in-place concrete, with a roof of curved glued laminated timber (glulam) beams supporting a solid wood roof over the auditorium.

The upper floors have a frame of engineered wood members supporting a solid wood floor assembly. In addition to the building-wide fire suppression system, the wood members are all sized slightly larger than structurally required to handle external charring in case of fire.

The vertical support is provided by rectangular glulam columns and supporting rectangular glulam beams. Along the wings of the building the beams span 32 ft (10 m) and are spaced 10 ft (3 m) apart.

The floor system spanning between the beams is standard 2 × 4 dimensional lumber, laid on end, gang nailed together and covered in a single layer of plywood. The glulam and lumber underside of the floor is left exposed while the top is covered by a raised floor system with a plenum for power, data and supplementary ventilation.

Lateral resistance is provided through two systems: Conventional

KEY SUSTAINABLE FEATURES

Water Conservation Low-flow fixtures.

Rainwater System Harvests rainwater from the rooftops, purifies it using filtration and disinfection, and stores it for use in the building. Storm water runoff is redirected through bioswales to the local aquifer.

Wastewater Treatment System Treats campus waste water using solar aquatics and constructed wetland technologies. The reclaimed water can be used to flush toilets and for irrigation.

Recycled Materials Recycled nylon fiber carpets throughout; recycled rubber flooring in the lobby/atrium and café; fly ash in hydraulic concrete admixtures; recycled concrete pavers and recycled plastic planters, among other materials.

Daylighting Available in 100% of occupied spaces; solar shades and spandrel panels in the glazing system and the living wall are designed to control glare and heat gain.

Individual Controls Manually operable windows in office blocks. Manual diffusers at each vent in underfloor air system allow inhabitants to control airflow in personal spaces.

Carbon Reduction Strategies The wood structure demonstrates the use of both pine beetle-damaged and certified wood products as viable materials for institutional applications that store carbon and reduce the building's greenhouse gas (GHG) emissions from construction.

Transportation Mitigation Strategies Following one of the imperatives defined by the Living Building Challenge, the building must use materials from within prescribed radii. The material radii correlate with product density and function. Heavier and dense materials have the tightest radius.

Living Roof Recreates a meadow environment for birds, insects and native plants, and contributes to reducing heat island effects by providing evapotranspiration cooling.

Living Façade Provides shading during the summer and allows warmth from the sun to be absorbed by the building in winter. The vegetated wall of vines uses rain or reclaimed water for irrigation.

Solar Energy Harvested through collectors that provide hot water for the building and through photovoltaic panels.

Geoexchange System Transfers thermal energy between the building and the ground, providing heating in the winter and cooling in the summer.

Heat Exchange System Collects waste heat from within CIRS building systems and from the adjacent Earth & Ocean Sciences (EOS) building. Surplus heat is returned to EOS.

Don Erhardt

Don Erhardt

Above The solar aquatic biofilter lab was designed with two parallel treatment trains, with a monitoring and control system that allows for research and experimentation while maintaining functionality.

Left The solar aquatic biofilter lab is a wastewater reclamation system that uses bacteria to treat all of the liquid waste from the building on site. Reclaimed water is intended to be used in the building for irrigation of the living roof and vegetated façade, and for flushing toilets.

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.

This strategy maximizes opportunities for interior daylighting and allows for occupant control of natural ventilation via operable windows. Natural ventilation in turn reduces the energy demand of the building and creates an interior environment that is comfortable and healthy.

The sizing of the structural members is consistent throughout the building except in specific instances where large loads require more support. The beams and columns in the auditorium, for example, are sized to handle a long span and the load of the green roof.

In typical areas the structure is sized to support a live load of 100 lbs/ft^2 (4.7 kN/m^2), double what is required by the British Columbia Building Code. This increased capacity supports the flexibility of the design, allowing for additional equipment and changes of use in the future.

The solid wood members of the CIRS structure store the equivalent of 1.3 million lbs (600 tonnes) of CO_2e in atmospheric carbon absorbed by the originating trees as they grew. This is more than the 1.2 million lbs (525 tonnes) emitted during the manufacturing, transportation and installation of other building materials used in the building. This makes CIRS net positive in structural carbon.

Water. From the outset the design intent of CIRS was to achieve water self-sufficiency. The design team also aimed for the building to supply other campus buildings with reclaimed water, further reducing campus water demand.

The CIRS water system consists of three separate components. First, a rainwater harvesting, storage,

BUILDING ENVELOPE

Roof (Laminated Wood, Sloped Insulation) Thermoplastic polyolefin (TPO) membrane, 0.5 in. protection board, 4 in. rigid insulation (R-value: R-20 min), vapor retarder, plywood and laminated wood
Overall R-value 40
Reflectivity 0.79, minimum (white, thermoplastic membrane roofing)

Roof (Laminated Wood, Green Roof on Auditorium) Plant layer, growing medium, filter fabric, 2 in. drainage board, root barrier, TPO membrane, 0.5 in. protection board, 4 in. rigid insulation (R-value: 20 min), vapor retarder, plywood and laminated wood
Overall R-value Not known
Reflectivity N/A

Walls
Glazing Percentage ~35%

Walls (White Brick Staircase Enclosures)
R-value R-20 (brick only)

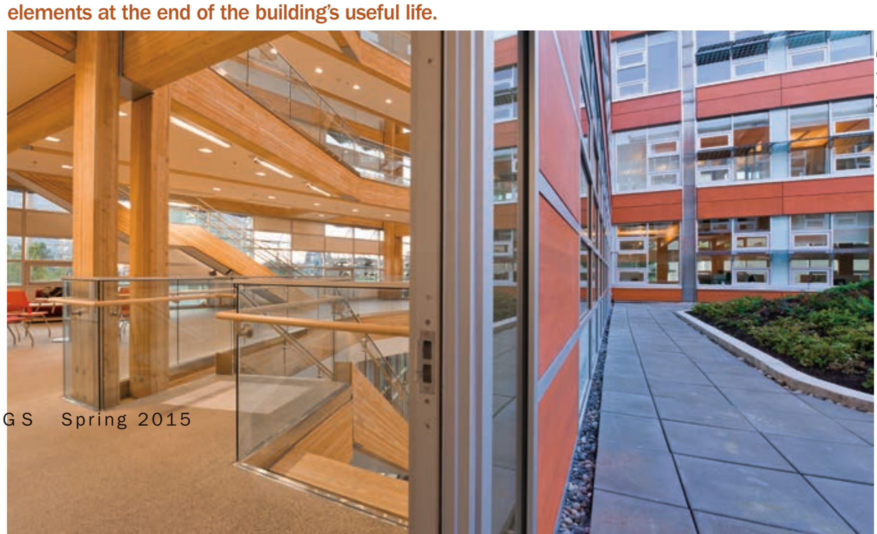
Walls (Spandrel Unit)
R-value Not known

Windows*
Effective U-factor for Assembly
No more than 0.16
Solar Heat Gain Coefficient (SHGC)
No more than 0.35
Visual Transmittance No less than 0.45

Location
Latitude 49.2611°N
Orientation 28° Southeast

*Windows values are design targets.

A living roof (right) is vegetated with local and well-adapted plants. In addition to retaining storm water runoff, it provides a habitat for insects and birds, evapotranspiration cooling, and a visually appealing background for labs and offices. Within the atrium (left), the glulam beams and columns have mechanical connections to facilitate deconstruction and reuse of elements at the end of the building's useful life.



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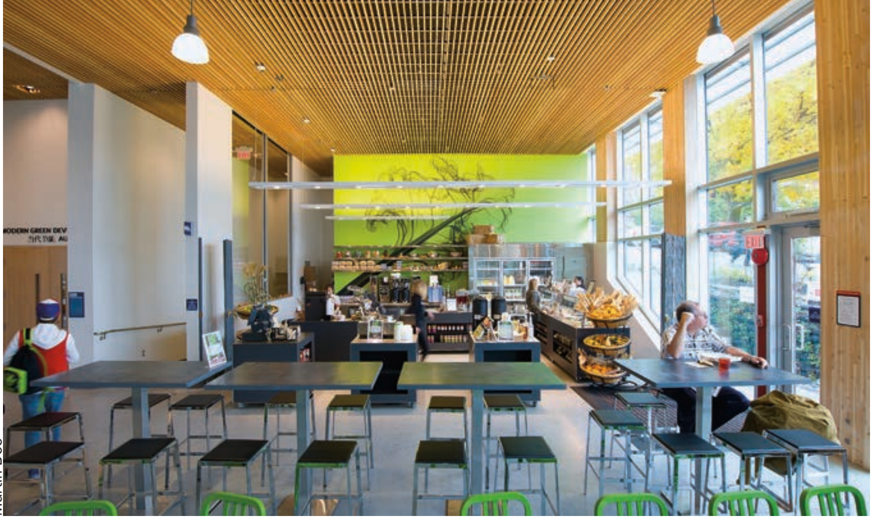

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Jen Crothers

Above Loop Café serves local and sustainable food selections, including produce from the University of British Columbia Farm. Products sold have minimal packaging that is compostable or recyclable, with no bottled water or soft drink cans available at the facility.

Right Meeting rooms and multi-use venues within the building accommodate a variety of activities, including research projects, educational and engagement events, award ceremonies and recognition dinners.

Below The structure of the CIRS building is a hybrid of concrete and wood. In the main auditorium the glulam beams arch the full span of the space and are sized to handle the weight of the green roof above. The lumber is harvested from local forests affected by pine beetle infestations.

treatment and distribution system provides potable water to the building for bathing, hand washing, dish washing, water fountains and taps, and food preparation.

Second, a wastewater reclamation system incorporating wastewater treatment and disinfection via a solar aquatics biofilter, storage, and distribution infrastructure components supplies recycled water to meet non-potable water demands associated with toilet and urinal flushing, and garden, green roof and vegetated façade irrigation. Third, a storm water runoff system redirects excess harvested rainwater in addition to rainwater collected on surfaces deemed unsuitable for treatment (such as the green roof and building hardscapes) into the local aquifer.

To provide reclaimed water beyond the building, the design team sized the CIRS wastewater treatment system to exceed the building's requirements. In addition, the reclaimed water system can mine the campus sewer system as a water resource, treating the raw sewage to meet irrigation demand during the summer when the building's net occupancy is low. While the objective of providing potable water to other campus buildings has not yet been met, plans call for CIRS to provide reclaimed water to the Horticulture building.

CIRS Systems Performance

While the CIRS building was commissioned during the summer and fall of 2011, due to its mandate of being a living laboratory for sustainability, the process of monitoring the performance of the CIRS building systems is an ongoing process. The best accurate reliable data the CIRS team has available covers the period from April 2012 through March 2013.

Energy. The measured heat extracted from the neighboring building (EOS) fume hood exhaust system was 147 MWh as opposed to the modeled 900 MWh. Conversely, the measured annual heat transfer from CIRS to

BUILDING TEAM

Building Owner/Representative UBC Properties Trust

Architect Busby, Perkins+Will

General Contractor Heartherbrae Construction (construction manager)

Mechanical, Electrical Engineer; Energy Modeler Stantec Consulting

Structural Engineer Fast + Epp

Civil Engineer Core Group Consultants

Solar Aquatics System Eco-Tek Ecological Technologies Inc.

Water Systems Experts Nova Tec Consultants

Landscape Architect PWL Partnership

Lighting Design Stantec and Better Bricks Lighting Lab (daylighting)

LEED Consultant Perkins+Will Architects

Commissioning Agent Western Mechanical Services

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The atrium facilitates natural ventilation throughout the building by creating a stack effect that draws air from the offices and labs up and out through vents in the roof. PV panels above the skylight harvest sunlight for electricity and provide shading.

EOS was 128 MWh, compared with the modeled 600 MWh. A subsequent analysis of this data uncovered measurement inaccuracies, which will be corrected in future building performance reports.

The measured electricity use for CIRS was 755 MWh, while the predicted electricity use based on the submitted LEED compliance model was 585 MWh. During this period 36 MWh of renewable energy was produced through BIPV. The net result of the use of grid electricity by CIRS minus renewable PV energy produced and consumed on site results in a net EUI of approximately 41 kBtu/ft$^2 \cdot$yr (129 kWh/m$^2 \cdot$yr).

These discrepancies have resulted in ongoing system performance investigations that are uncovering technical pitfalls in design. First, the design team failed to account for a water scrubber in the duct manifold of the EOS fume hood exhaust system where the CIRS heat exchanger is located, which reduced the air temperature from 68°F (20°C) to 60°F (16°F), which in turn reduces the amount of heat CIRS can extract from EOS.

Secondly, heat from CIRS is being delivered through a new package AHU on the roof of EOS. The AHU is fed with CIRS-generated hot water, which feeds an air-mixing chamber of an old hot-deck/cool-deck air-handling system. The result is that during the times of the year when the air is being cooled and dehumidified before being heated again and distributed through EOS, CIRS is not able to contribute useful heat to EOS.

This scenario has limited the ability for CIRS to provide useful heat to EOS to those days of the year when the air temperature is lower than 50°F (10°C). This problem has been rectified now that EOS has installed new rooftop units, which are being commissioned.

Now CIRS is delivering heat directly to the heating coils of the main AHUs of EOS. Final numbers are not yet available to evaluate the effectiveness of this new strategy.

During this monitoring period, the measured total heating energy extracted from the geothermal field through the geoexchange system was 46.5 MWh. The total amount of

LESSONS LEARNED

Specialist Monitors Building Operation. Due to the complexity of the building systems, including its 3,000 point automation system, the CIRS building is run by a dedicated part-time building automation specialist. This position is critical not only to the ongoing operations of the center and its continued optimization, but to the process of gathering and organizing building performance data for research purposes.

As the building is also fitted with hundreds of mechanized controls such as ventilation dampers and window actuators, having a dedicated resource continuously monitoring building systems helps the CIRS team detect component failures. After three years of continuous operations, none of the mechanized components in the building has failed. Several components have been replaced such as wireless temperature sensors and reclaimed water aerator pumps and injectors

Resolving Water System Issues. While the problems with CIRS's water collection and reuse systems have been frustrating and have stalled the completion of the Living Building Challenge recognition process, the technical and operational review of these systems has resulted in a series of recommendations for improvement. The replacement of defective components and the addition of sensors and controls will allow uninterrupted operations of these systems when completed by spring 2015.

Commissioning a Two-Building System. CIRS was designed as a living laboratory and a platform for learning, diffusion and dissemination. The CIRS systems represents an energy design solution that takes into account the local context of the building and puts to the test the concept of system optimization at a level beyond a single building.

In hindsight, the design and commissioning of CIRS should have included both Earth and Ocean Sciences and CIRS as a two-building system. In addition, metering should have been installed on the Earth and Ocean Sciences building to accurately represent the impact CIRS has on the Earth and Sciences building systems. No such analysis and testing was done, or meter or monitoring system installed.

Low-e Glass not Ideal for Plants. Another lesson that illustrates the uncertainties associated with complex interactions between systems in high performance buildings is the enclosure of the biofilter (part of the water treatment/reuse system). The glazing used for the biofilter enclosure was made the same as for the rest of the building—aesthetically appealing in terms of uniformity, but the low-e glass, which reduces the transmission of ultraviolet light, prevented adequate sunlight from reaching the plants. As a consequence, grow lights had to be installed for the plants.

This lesson will make subsequent water reuse installations smoother, informing architects and building engineers who may be unfamiliar with the concept of incorporating water treatment systems into the building envelope. The point of the CIRS building project was to learn, possibly make mistakes, but improve future designs.

Above The multiple levels of the atrium function as a social interaction space for building inhabitants, as well as a popular study location for students. The flooring is made of recycled rubber tires, which helps dampen noise. The sunlight is dappled by the vegetated façade facing west.

Right The raised floor system and movable partition walls allow for interior spaces within the lab/office wings to be easily reconfigured, increasing the building's adaptability to futures uses. The glass partitions enable daylight to penetrate deep into the occupied spaces during day hours.

heat rejected to the geothermal field by CIRS was 50.7 MWh.

Water. The rainwater and wastewater systems of CIRS have not operated continuously since the building opening in November 2011, forcing the building to rely on the university's potable water and wastewater systems. Problems included some lingering construction and commissioning deficiencies such as failing aeration pumps and inadequately sized chlorine pumps, in addition to delays in training and certification of the UBC personnel in charge of operating this infrastructure.

Despite these shortcomings, the total amount of water consumed by the CIRS building during the reporting period was 439,925 gallons (1.7 million liters), which is 30% below the LEED design reference.

Since its opening in late 2011, CIRS has been redirecting storm water runoff (composed of either runoff from the green roof and other landscaped areas of the building or rainwater cistern overflow) into the local aquifer through a 300 ft deep well adjacent to CIRS. The amount of rainwater that CIRS has deposited into the local aquifer as measured by a tipping bucket mechanism and data logger amounts to about 500,000 gallons (1.9 million liters).

Occupant Response. As part of the CIRS research program, graduate students conducted extensive pre- and post-occupancy evaluation through surveys. The majority of the CIRS inhabitants are happy with the performance of the building and the quality of the indoor environment. They particularly like the sense of community of the building as well as the opportunities it creates for social interaction (facilitated by open spaces designed for that purpose).

Some building inhabitants are unhappy about the lack of acoustic privacy of the partition design. Others are unhappy about the fact that lights can only be controlled through a building inhabitant interface that was not in place when they moved to the building. A building inhabitant interface website connected to the CIRS BMS system is being beta tested and will allow building inhabitants to override the automatic lighting system as required, and enable them to request higher or lower temperatures in their work areas.

Impact of CIRS

Buildings like CIRS — those that attempt to operationalize the principles of regenerative sustainability in the built environment, and that seek to achieve net positive performance by contributing net benefits to their communities — are deeply transformative and have a catalytic effect in their constituent organizations. In the case of CIRS, it has inspired the University of British Columbia to institutionalize the notion of a sustainability gradient, meaning that new projects on campus should strive to achieve progressively more stringent sustainability goals than their predecessors, and become a learning platform for continued improvements over time. ●

ABOUT THE AUTHORS

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