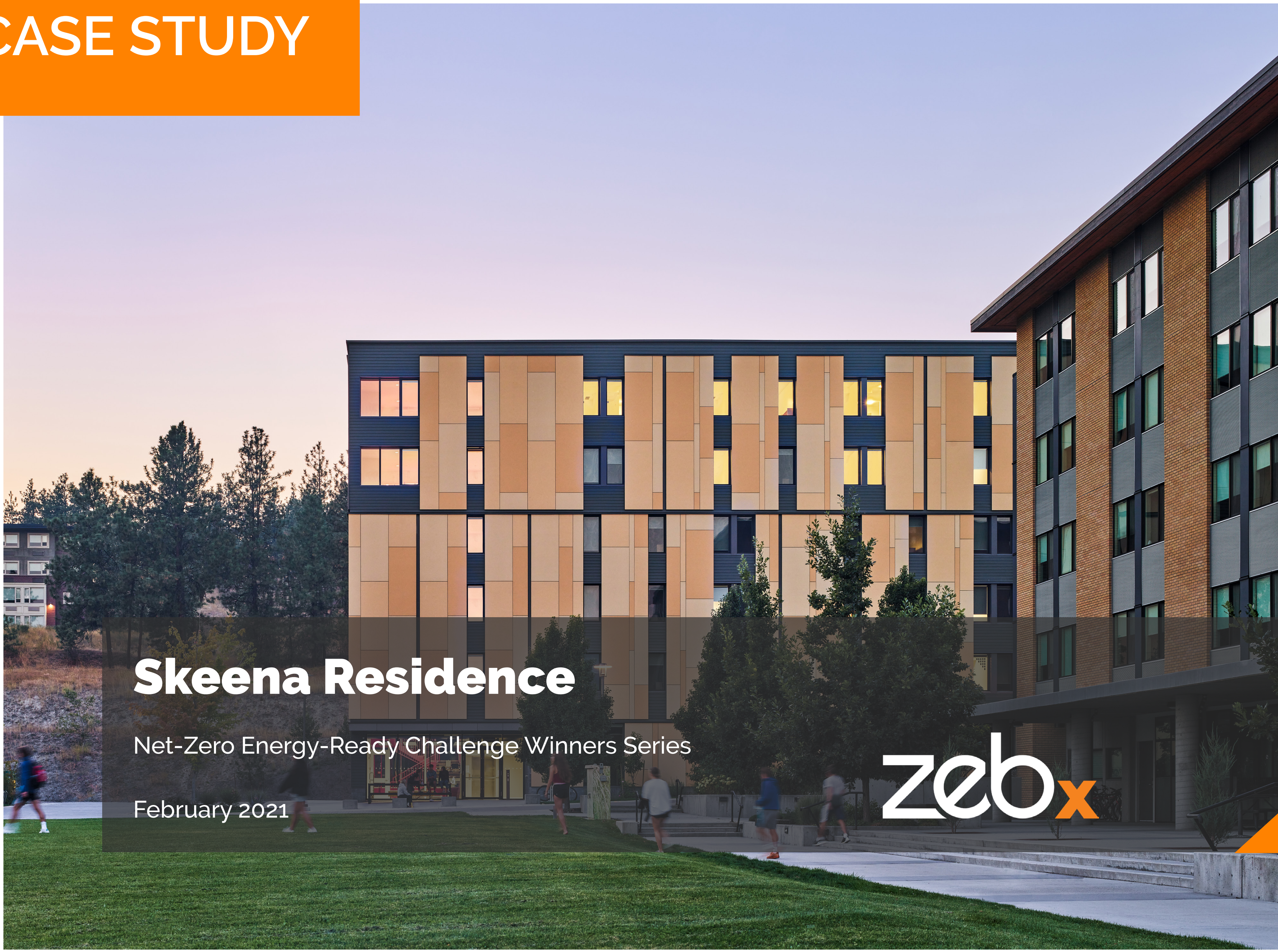
CASE STUDY



Skeena Residence

Net-Zero Energy-Ready Challenge Winners Series

February 2021

The NZER Challenge

The Net-Zero Energy-Ready (NZER) Challenge is a provincial CleanBC incentive program for large buildings (multi-unit residential, office, retail, commercial, institutional, etc.) launched in late 2018. In addition to providing financial support for developments targeting NZER levels of performance, the program aims to celebrate, promote and learn from these innovative and energy-efficient projects.

Out of over 50 applications received, a juried competition resulted in the selection of 11 winning projects that represent the best examples of NZER buildings. These projects received up to $390,000 in incentives to help cover the estimated cost premiums associated with the design and construction of NZER buildings.

Carrington View Building A (Credit: Skyline Living)

825 Pacific Street (Credit: IBI Group Architects Ltd.)

SFU Parcel 21 (Credit: Local Practice Architecture + Design)

Project Overview

When the University of British Columbia decided to add another student residence to their Okanagan campus in 2017, the UBC Board of Governors (with input from UBC Properties Trust) decided to pursue Passive House certification for the project to affirm UBC's reputation as a leader in sustainability. This was an ambitious goal. Not only was this going to be UBC's first Passive House project, but no other educational institution in Canada had yet attempted Passive House certification for a student residence. To tackle the challenges that come with this goal, the development, design and construction team had to unite early in the design stage to ensure that the goals of the project were met.

Credit: Andrew Latreille

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Project Specs

Address	1320 International Mews, Kelowna, BC
Climate Zone	5
Ownership Type	University Student Residence
Residential Units	220 suites (1 shared bathroom per 2 suites)
Levels	Six storeys above grade
Electrification	Yes (not connected to the gas-powered district energy system)
Minimum Building Code Requirement	BC Building Code 2012 NECB 2015
Canadian Construction Documents Committee (CCDC) Contract	5a (construction management contract)
Gross Floor Area	6,740 m^2 (72,549 ft^2)
Treated Floor Area	4,927 m^2 (53,034 ft^2)
Window to Wall Area	15.7%
Form factor[1]	1.25
Construction Duration	17 months (March 2019 to August 2020)
Primary Energy Renewable[2]	70 kWh/m^2 yr
Primary Energy[2]	153.4 kWh/m^2 yr
Annual Heating Demand[2]	7.1 kWh/m^2 yr
Annaul Cooling Demand[2]	1.7 kWh/m^2 yr
Greenhouse Gas Intensity[2]	0.66 $kgCO_2eq/m^2$ yr
Airtightness at 75 Pa	0.08 $L/s.m^2$ (0.08 ACH_{50})

1 The form factor is calculated using the treated floor area. Using the gross floor area for the calculation would result in a lower form factor.
2 Based on the as-built conditions.

Credit: Andrew Latreille

PROJECT TEAM	
Owner	UBC Student Housing and Hospitality Services
Project Manager	UBC Properties Trust
Construction Manager	Sawchuk Developments Co. Ltd.
Architect	Public Architecture + Communication
Building Envelope & Passive House Consultant	RDH Building Science Inc.
Structural Engineer	Bush, Bohlman & Partners LLP
Mechanical Engineer	AME Consulting Group Ltd.
Electrical Engineer	Jarvis Engineering Consultants Ltd.

Technical Details

Structure

The building structure consists of a concrete structure for the ground floor and conventional wood framing for the floors above. The wood-framed exterior walls were constructed with 50mm x 150mm (2"x 6") wood studs and 19mm (¾") thick plywood sheathing. The floor and roof structures were constructed with 240mm (9.5") deep TJI® joists, 19mm thick plywood sheathing (floors) and 16mm (5/8") thick plywood sheathing (roof).

Airtightness

Soprema Sopraseal Stick VP was selected as the air barrier and installed over the exterior plywood sheathing. Soprema Lastobond 195 was used as the air/vapour barrier in the roofing assembly.

Installation of the air barrier. (Credit: Sawchuk Developments Co. Ltd.)

Construction of the wood-framed structure over the ground floor.
(Credit: Sawchuk Developments Co. Ltd.)

Insulation

Exterior walls were designed to achieve an effective thermal resistance of RSI 7.57 m^2K/W (R-43). 150mm (6") thick semi-rigid stone wool batt insulation was installed in the wall cavities and 200mm (8") thick stone wool insulation board was installed over the exterior air barrier. Cascadia Clip® fiberglass thermal spacers were installed on the plywood sheathing to support the fibre-cement panel cladding and the steel siding. A 200mm (8") deep layer of extruded polystyrene (XPS) insulation was placed below the concrete slab-on-grade to achieve an effective thermal resistance of RSI 7.04 m^2K/W (R-40). The ground-floor concrete walls (including the footings) were covered in 150mm (6") thick XPS insulation. The conventional roofing assembly included a 450mm (18") thick layer of polyisocyanurate foam insulation board covered by a 75mm (3") thick layer of stone wool insulation board. Together with the sloped insulation package, the effective thermal resistance of the roofing assembly totals RSI 19.08 m^2K/W (R-108). Only one plumbing stack vent penetrates the roofing assembly.

Fenestration

The fenestration consists of vinyl-framed, triple-glazed, tilt-and-turn windows from Westeck Windows and Doors. These are Passive House-certified windows with argon-filled insulating glass units and a low emissivity coating. The effective U-value of the windows is 0.8 W/m²K, but taking into account the linear thermal transmittance of the wall-to-window interface, the installed effective U-value of the windows is 0.91 W/m²K. The windows include sensors in the frame that are connected to a relay switch controlling the in-suite fan coils. When the windows are opened, the fan coils turn off to avoid wasting heating and cooling energy.

Ventilation

The building's semi-centralized ventilation system includes three Swegon Gold RX energy recovery ventilators (ERV). Depending on the model, the ERVs have a sensible heat recovery temperature efficiency ranging from 84% to 86% based on -10°C (14°F) supply air. One ERV serves the ground floor and two larger ERVs serve the floors above. The two units serving the floors above are interconnected in parallel to work as one larger ERV. The ERVs run continuously and are equipped with a bypass mode for when the outdoor temperature can be used for free cooling. The ERVs are equipped with a heating coil which provides top-up heating in the event that the rotary heat exchanger slows down to avoid freezing in cold weather conditions.

Passive House-certified window (Credit: Andrew Latreille.)

Swegon ERV (Credit: Sawchuk Developments Co. Ltd.)

Mechanical room on the ground floor. (Credit: Andrew Latreille.)

Heating and Cooling

One Airmec air-to-water heat recovery heat pump (R-410a refrigerant) with five scroll compressors provides hydronic heating and cooling for the building. The heat pumps have a coefficient of performance (COP) of 3.12 for heating and a seasonal energy efficiency ratio (SEER) of 9.66 for cooling. It is connected to a four-pipe hydronic system with two-pipe changeover Jaga fan coil units (FCU) in all suites. The FCUs are equipped with demand-controlled, variable-speed motors. A 120 kW Bryan BE Series electric hot water boiler provides backup water heating when outdoor temperatures fall below -15°C (5°F). Four ceiling-mounted hydronic unit heaters are installed in the laundry room. Corridor air is tempered by the supply air from the ERVs.

Domestic Hot Water

Two Colmac air-to-water heat pumps (R-134a refrigerant) are used to generate domestic hot water (DHW) for the occupants of the building. The COP of the heat pumps is 4.2 based on a dry bulb outdoor temperature of 24°C (75°F). The actual average COP is estimated to be between 3 and 4 based on the lower average annual temperature of the specific climate zone. Two AO Smith® electric water heaters provide backup water heating. The two Niles Steel® storage tanks are insulated with 100mm (4") thick insulation and the DHW piping is insulated with 35mm (1.5") thick insulation. The length of the recirculation loop is minimized by installing DHW supply risers in vertical shafts passing through the washrooms and a single centralized return line to the ground-floor mechanical room. When the building requires cooling, the cool air shed from the heat pumps is diverted into the intake plenum of the ERVs for free cooling.

Appliances

The suites do not include appliances. The lounges on each of the five residential floors include an ENERGYSTAR®-certified range and refrigerator from Whirlpool and an Elica Volterra recirculating range hood. The laundry room is equipped with conventional direct exhaust dryers as no coin-operated condensing dryers were available on the market at the time the building was designed.

Energy Metering

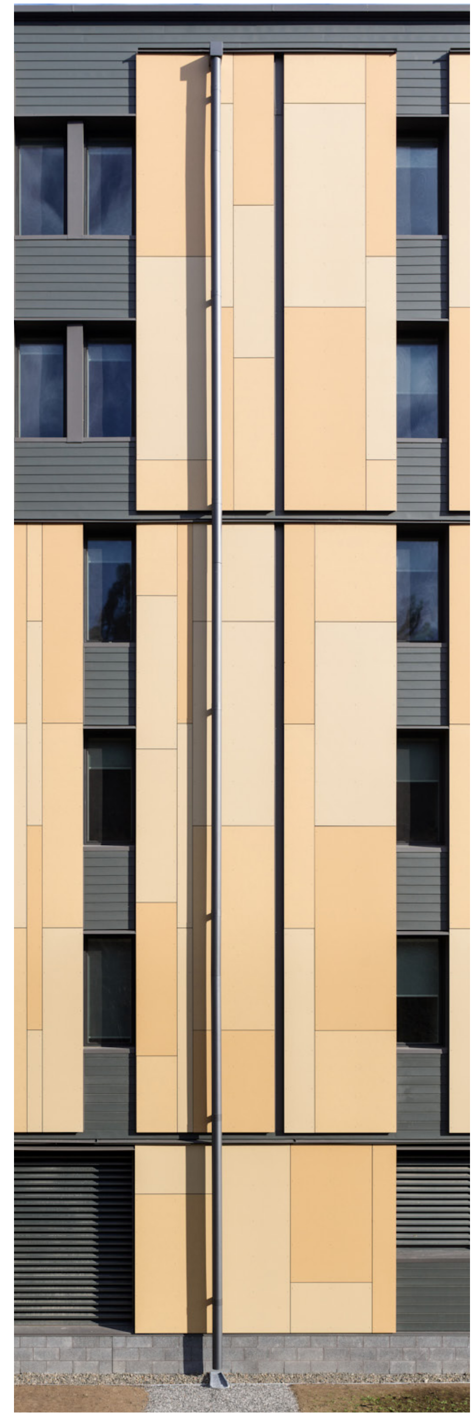
Many electrical submeters are used to measure energy consumed by lighting, plug loads, heat pumps for domestic hot water production, heat pumps for heating and cooling, ERVs, fans, pumps and elevators.

Lounge (Credit: Sawchuk Developments Co. Ltd.)

Entrance Lobby (Credit: Andrew Latreille)

Corridor (Credit: Andrew Latreille)

Project Highlights


Credit: Andrew Latreille

> "Establishing a Passive House performance target early in the development stages and employing the Integrated Project Delivery procurement model was a big contributor to the project's success. The IPD model created a collaborative environment which benefited both the design and construction stages."
>
> — CRAIG SHIRRA, SENIOR DEVELOPMENT MANAGER, UBC PROPERTIES TRUST.

UBC Properties Trust undertakes capital projects through a construction management contract arrangement and uses an **integrated project delivery (IPD)** process to design and build its facilities. UBC typically selects the architect first, then the construction manager, followed by the balance of the design team. This unique approach is not only conducive to achieving an ambitious building performance goal, but also ensures that constructability and budget management is a consistent consideration throughout the design phase.

A variety of best practices were used to achieve the desired **airtightness**. One trade contractor was made responsible for the building envelope. RDH, the building envelope consultant, provided a customized training session to the construction management team and the trade contractor before the trade contractor began their work. An on-site mock-up of the wall assembly was built by the construction team and reviewed by Passive House-certified members of the design team. A mid-construction airtightness test was performed to ensure the project was on track to achieve the airtightness targets. The test allowed the project team to address deficiencies in the detailing of the air barrier. With both the design and construction team committed to a clearly defined common goal, the building achieved a remarkably low 0.08 air changes/hour (ACH@50Pa) which is equivalent to 0.08 L/s/m² @75Pa for this building. The Passive House standard requires 0.6 ACH_{50}.

One of the major challenges that the project team faced was achieving the Passive House targets with several conventional, **direct-vent dryers** in the common laundry room. The dryers vent directly to the exterior and in a student residence of this size, they are constantly in use. This requires a large volume of make-up air for the laundry room. The unconditioned make-up air enters the laundry room through air dampers that are interlocked with the dryers. When a dryer is in use, the damper automatically opens to allow make-up air to enter the laundry room. If required, the laundry room is heated with four hydronic unit heaters. The impact of the dryers was projected to increase the heating demand of the building by 1 - 2 kWh/m^2 yr. This was significant because the heating demand for Passive House projects cannot exceed 15 kWh/m^2 yr. This increase in heating demand was compensated by a number of factors including:

- a well-insulated building envelope
- high-performance windows
- an efficient HVAC equipment
- an efficient building form with no balconies
- minimal thermal bridging (especially around the concrete slab-on-grade)
- an optimized window-to-wall ratio
- optimized ventilation rates
- the capacity of the ERV (serving the ground floor) to allow for setback when the ground floor common areas are not in use.

Based on the actual airtightness achieved on this project, the annual heating demand is projected to be an impressive 7.1 kWh/m^2 yr.

Conventional dryers and make-up air damper (Credit: Sawchuk Developments Co. Ltd.)

Building elevation (Credit: Andrew Latreille)

Net-Zero Energy-Ready Challenge Winners Series

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This case study was supported by:

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