CASE STUDY

825 Pacific Street

Net-Zero Energy-Ready Challenge Winners Series

Revised September 2021

zebx

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.

OSO (Credit: Vidorra Developments)

UVic Student Housing and Dining (Credit: Perkins & Will)

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

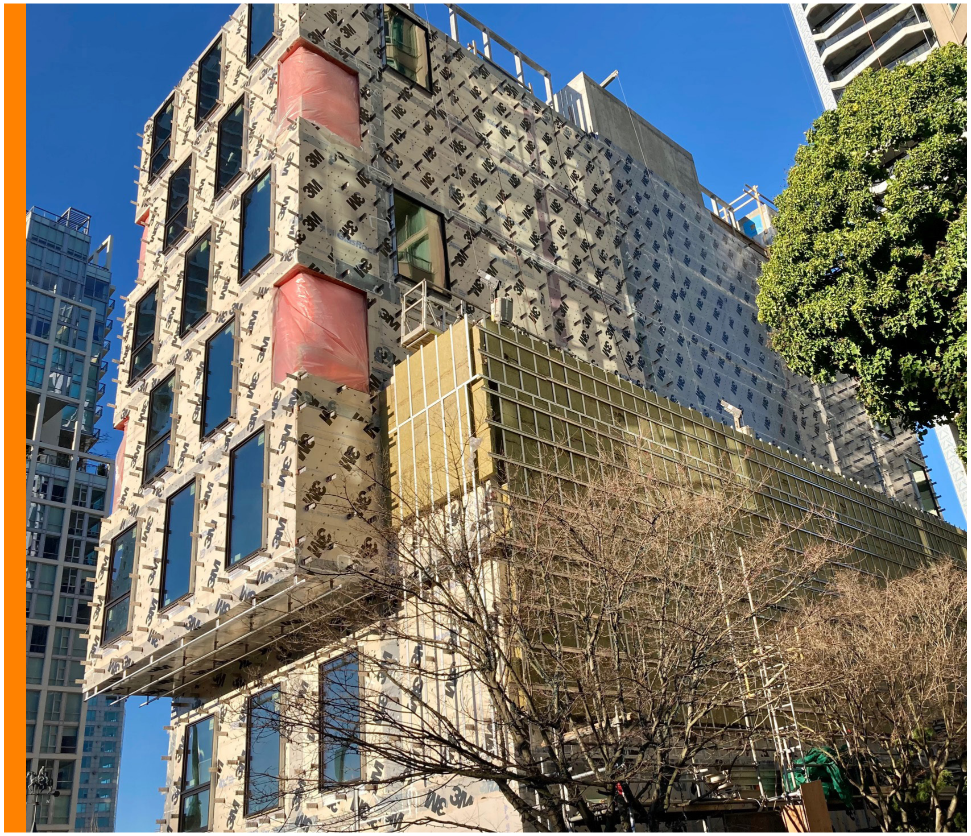
Project Overview

In order to obtain a rezoning application to construct *The Pacific* at 889 Pacific Street, Grosvenor Americas offered to build the City of Vancouver a cultural amenity building adjacent to the development as part of its Community Amenity Contribution (CAC). Because the City is going to assume ownership of the building, the development was required to meet the Passive House standard. This multi-purpose arts and culture hub, located at 825 Pacific Street, is a seven-storey core-and-shell development which will be operated by a not-for-profit arts organization. The ground floor will serve as a gallery and event space while the floors above are intended for studio production and office space. There are no demising walls or corridors on any of the floors, apart from the basement. Currently, this building is the tallest, completed Passive House project in British Columbia and the first Passive House certified arts and culture hub in Canada.

Project Specs

Address	825 Pacific Street, Vancouver BC
Climate Zone	4
Ownership Type	Municipal building
Levels	Seven storeys over a basement
All-Electric	Yes
Minimum Building Code Requirement	2014 Vancouver Building By-Law (VBBL)
Canadian Construction Documents Committee (CCDC) Contract	2 (Stipulated Price)
Gross Floor Area	2,220 m^2 (23,896 ft^2)
Treated Floor Area	1,537 m^2 (16,544 ft^2)
Window to Wall Area	18.1%
Form factor[1]	1.97
Construction Duration	17 months (January 2020 to June 2021)
Primary Energy Renewable[2]	51.6 kWh/m^2 yr
Primary Energy[2]	115.8 kWh/m^2 yr
Annual Heating Demand[2]	12 kWh/m^2 yr
Annaul Cooling Demand[2]	0.4 kWh/m^2 yr
Greenhouse Gas Intensity[3]	0.34 $kgCO_2eq/m^2$ yr
Airtightness at 75 Pa	0.098 L/s.m^2 (0.19 ACH_{50})

1 The form factor is the ratio of the building envelope area (all areas where heat loss can occur) divided by the treated floor area. Using the gross floor area for the calculation would result in a lower form factor.
2 Based on the final airtightness test results.
3 Calculated using an emissions factor of 10.67 $kgCO_2e/kWh$



PROJECT TEAM	
Developer	Grosvenor Group
Owner	City of Vancouver
General Contractor	Ledcor Group
Architect	IBI Group
Building Envelope Consultant and Energy Modeler	Morrison Hershfield
Structural Engineer	Dialog
Mechanical and Electrical Engineer	Integral Group

Technical Details

Placement of rigid insulation below the slab-on-grade

Exterior insulation and cladding attachment system

Structure

Constructed over a raft slab foundation, the structure consists of conventionally reinforced concrete walls, columns, floor slabs and roof slab. The slab-on-grade is installed over structural aggregate placed over the raft slab. High supplementary cementitious material and fly ash content was specified for the raft foundation, which resulted in a decreased embodied carbon content relative to a standard concrete mix. The stair core provides the lateral resisting system.

Insulation

The below-grade perimeter walls and slab-on-grade are insulated with 127mm (5") thick extruded polystyrene (XPS) insulation which provides an effective thermal resistance of RSI-4.8 ($m^2 \cdot K$)/W (R-27 $ft^2 \cdot °F \cdot h$/BTU). A 203mm (8") thick layer of XPS was placed over the roof slab to provide a thermal resistance of RSI-7.5 (R-43) for the green roof. The exterior concrete walls on the ground level are insulated with 203mm thick rock wool insulation which provides an effective thermal resistance of RSI-5.6 (R-32). The steel stud-framed exterior walls above the ground floor are insulated with 152mm (6") thick mineral wool batt insulation between the steel studs. An additional layer of 203mm thick exterior mineral wool semi-rigid insulation is supported by a thermally broken cladding attachment system using EJOT® CROSSFIX® stainless steel brackets secured to the sheathing. These steel-stud framed walls were designed to achieve an effective thermal resistance of RSI-7.7 (R-44). The gauge of the steel studs was increased to allow the brackets to be spaced further apart, reducing the number of brackets needed and reducing overall thermal bridging. Additional thermal bridging along the walls was also mitigated by using non-metallic through-wall flashing for water shedding.

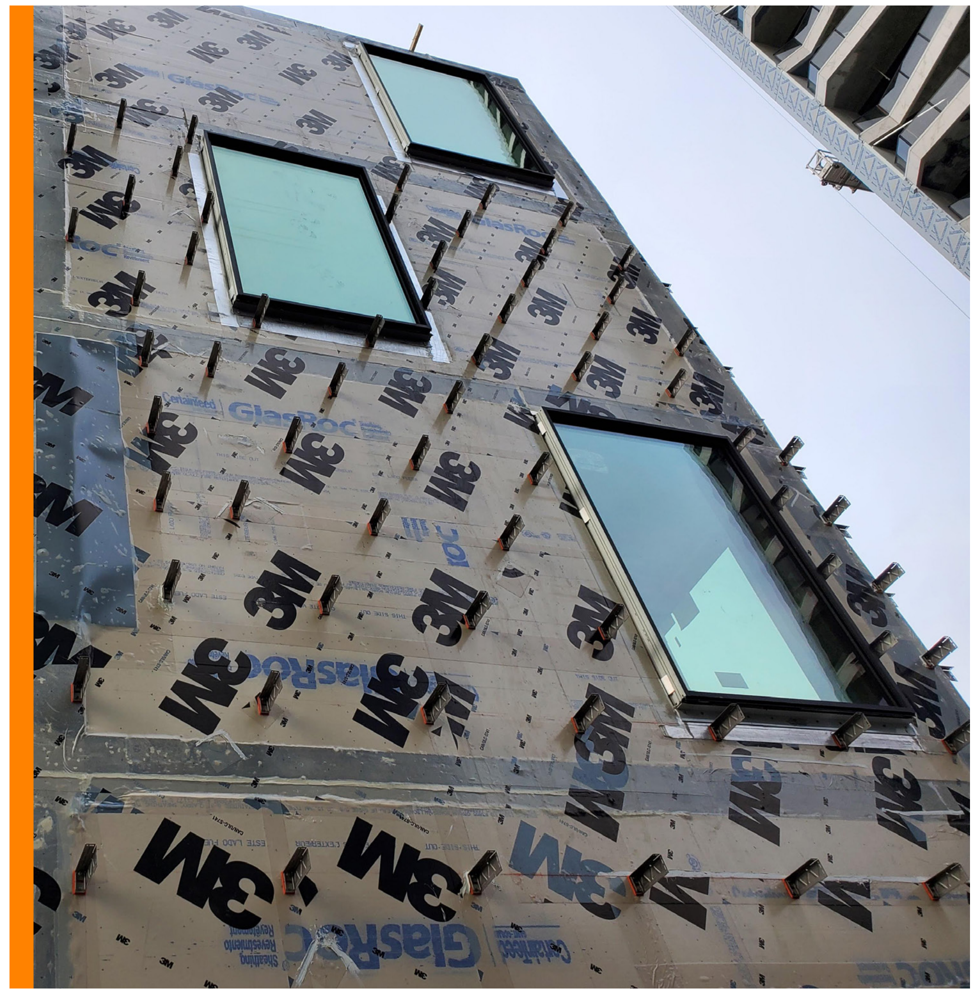
Fenestration

The fixed and operable windows were manufactured by Cascadia Windows and Doors and are Passive House-certified, triple-glazed, fibreglass-framed windows from their Universal™ Series. The overall effective U-value of the windows is 0.80 W/(m^2K), but taking into account the thermal bridging between the windows and surrounding wall, the effective U-value increases to 0.89 W/(m^2K). The insulating glass units have two low emissivity coatings and a low solar heat gain coefficient of 0.27 to reduce the cooling load in the summer months. To dramatically reduce thermal bridging, the windows were installed proud of the steel studs, almost entirely within the exterior insulation layer. The windows were supported by an intermittent metal angle at the corners and the angles were covered with insulation.

Passive House-certified, triple-glazed, fibreglass-framed windows

Airtightness

The air barrier consists of a transparent 3M™ Air and Vapour Barrier 3015 self-adhesive membrane installed over the outside face of the CertainTeed GlasRoc® sheathing and concrete walls. The air barrier also serves as the vapour barrier. Wall penetrations and detailing were completed using Dowsil™ 758 Silicone and Weather Barrier Sealant. The air barrier in the inverted roofing assembly consists of a Soprema® Sopralene Flam 180 membrane torch-applied to the concrete slab.



Transparent air barrier installed over sheathing

Ventilation

The building's centralized ventilation system uses one Passive House-certified Swegon Gold RX 35 energy recovery ventilator (ERV) installed on the roof. The sensible heat recovery efficiency varies between 86.4% (at 25°C) and 86.5% (at -7°C). The latent heat recovery efficiency varies between 71.5% (at 25°C) and 84% (at -7°C). The ventilation air is delivered to the back of each variable refrigerant flow (VRF) fan coil unit (FCU) on each floor.

Swegon Gold RX energy recovery ventilator

Heating and Cooling

Heating and cooling are provided by a variable refrigerant flow (VRF) system which allows for simultaneous heating and cooling of different zones. The system uses R-410a refrigerant and consists of two Daikin condensing units (CU) on the roof and multiple Daikin FCUs on each floor. For improved energy efficiency, the FCUs can automatically adjust to one of three different speeds depending on the heating/cooling demand. One of the CUs serves the upper half of the building and the other serves the lower half. By dividing the VRF system in two, each with a dedicated CU, the environmental and operational impact of a refrigerant leak (should it occur) are reduced. For heating, the coefficient of performance (CoP) of the CUs ranges from 2.2 to 2.5 (at -8°C outdoor air). For cooling, the integrated energy efficiency ratio (IEER) ranges from 22.6 to 23.5. The elevator machine room and electrical room are cooled using a third CU on the roof, but this CU is not part of the VRF system. The rest of the basement is heated with electric baseboard heaters, but not cooled.

Left: Daikin condensing units; Right: Typical fan coil unit

Colmac heat pump water heaters

Domestic Hot Water

Two Colmac CxV low-ambient temperature heat pump water heaters are installed on the roof to generate hot water for the washrooms and utility sinks on each floor. They can generate 60°C (140 °F) water at an ambient temperature as low as -12°C. The coefficient of performance (CoP) of the heat pumps varies from 1.9 at -9°C ambient air to 4.2 at 24°C. The hot water is stored in a 119 US gallon Bradford White storage tank inside the building. An electric water heater was installed downstream of the storage tank to deal with heat loss in the recirculation loop and provide back-up heating should one or both heat pumps fail. The tank is insulated with 2" thick non-CFC foam insulation and the distribution piping is insulated with 2" thick insulation.

Electrical room with metering cabinets (Credit: Integral Group)

Submetering

Electrical submeters are installed to measure energy consumption on a floor-by-floor basis. In addition, the energy consumed by the condensing units, energy recovery ventilator, heat pump water heaters, electric water heater, elevator, life safety loads and house loads are all separately metered.

Project Highlights

Although construction was tendered to Ledcor with a traditional CCDC 2 contract, Ledcor was involved in pre-construction design under a separate contract. This is consistent with many other high-performance buildings being constructed throughout British Columbia which involve the general contractor in the design stage of the development.

To assist the design and construction team in achieving the Passive House performance targets, Ledcor arranged to have the team, including some trades, take the British Columbia Institute of Technology's (BCIT) Passive House Tradesperson Course before construction began. This was the start of a highly collaborative relationship between the design group and Ledcor which continued into the construction phase of the project. This relationship was key in developing some novel solutions to reduce the amount of exterior insulation by 2", as well as the number of steel studs and cladding attachment brackets, while still meeting both Passive House and structural requirements. As a result of these solutions, the construction cost of the project was decreased.

To further reinforce the BCIT training, a pre-construction mock-up of the typical wall assembly (which included a window, insulation, cladding attachment brackets, etc.) was built by some of Ledcor's trade contractors. The mock-up was reviewed by the team, tested for airtightness using a smoke test and used to evolve the construction sequence for the wall assembly. This, in combination with the mid-construction airtightness test, were important contributing factors in achieving a very low final air leakage rate of 0.19 air changes/hour (ACH_{50}). This high level of airtightness, combined with a meticulous attention to thermal bridging details, has made this building one of the most energy efficient buildings owned by the City.

Exterior walls prior to placement of batt insulation

Pre-construction mock-up

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This case study was supported by:

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