THE HEIGHTS MULTI-UNIT RESIDENTIAL PASSIVE HOUSE

CASE STUDY

Standing 6 stories tall, the Heights was one of the first certified Passive House multi-unit residential buildings in Vancouver and is among the largest Passive House buildings in Canada.

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PREPARED BY

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CORNERSTONE

THE UNIVERSITY OF BRITISH COLUMBIA

GENERAL OVERVIEW

The basement has concrete structure and is used for parking, ground floor for retail-commercial activities. The upper floors have wood framing and house 85 units.

Project Overview

Building Type	Multi-unit residential
Climate Zone	5
Location	Hasting Sunrise neighborhood, Vancouver BC
Gross/Treated Floor Area	5,917 m^2 / 4,191 m^2
Building Height	19.74 m
Number of Floors	6 stories / 85 Units
Project completion date	2017

Project Team

Project Owner	Hastings Northview Apartments Ltd.
Developer	Eighth Avenue Development Group Ltd.
Architect	Cornerstone Architecture
Structural Engineer	Weiler Smith Bowers Consulting Structural Engineers
Structural Engineer	Peak Construction Group
Mechanical Engineer	Integral Group
Mechanical Engineer	Aqua-Coast Engineering Ltd.
Envelope Consultant	Aqua-Coast Engineering Ltd.

Project Context

In respond to global climate change concerns, the City of Vancouver released the Zero Emissions Building Plan, which sets a roadmap for making all new buildings zero emissions by 2030. In 2017, the Province of British Columbia enacted the Energy Step Code to incrementally move toward net-zero energy ready buildings by 2032.

At the time of construction, The Heights, a six-stories, mixed-use rental was the largets Passive House multi-residential building in Canada.

Planning and Design

The basement and ground floor have a concrete structure and the upper floors are wood stud framing. As an early adopter, the main focus in the project deign process was on the Passive House standard requirements. For instance, special attention was given to connection and exhaust ducts details to ensure they are free of thermal bridges.

The designed building has a simple and compact box-like shape, allowing for a lower form factor - 1.12. Larger, multi-storey buildings typically have lower form factor compared to single-family houses – typical around 3 – and thus can achieve high-energy performance more easily, as they have less surface area that can lose or gain heat.

ENERGY PERFORMANCE

To achieve the performance required by Passive House standard, this building incorporates a highly insulated envelope and high-efficiency heat recovery units for each floor.

Table: Achieved energy performance compared to Passive House criteria.

Parameter	Characteristic	Unit	Passive House		Building Performance
			Criteria	Alternative	
Air tightness		ACH @ 50Pa	≤ 0.6	-	0.3
Space Heating	Annual demand	kWh /m²a	≤ 15	-	7
	Heating load	W/m²		≤ 10	8
Space cooling	Annual demand	kWh /m²a	≤ 15	-	-
	Cooling load	W/m²	-	≤ 10	-
	Frequency of overheating > 25˚ C	%	≤ 10	-	5
Primary energy requirements	Non-renewable (PE)	kWh/m²a	-	≤ 60	95
	Renewable (PER)	kWh/m²a	≤ 120	-	119

Envelope

The majority of the exterior walls are insulated on the inside, allowing the airtightness layer to be completed by one trade in dry conditions, but requiring careful consideration of drying and vapour barriers in the design of the wall. The building was designed with no thermal bridges as very few exterior wood or cement components touch interior wood or cement. A continuous layer of locally sourced polystyrene insulation protects the indoor walls, floor lines and surfaces from the outdoors.

Heating & Cooling

Focusing on building envelope design and construction reduces the need for complex heating and cooling systems. Heating and domestic hot water are provided with heat pumps. The suites are equipped with small 300 watt electric baseboard heaters that are easy to operate and maintain. Using only the third of the energy of a single hairdryer. Building owners benefit from a heating system with minimal maintenance, while tenants have control over their suites comfort.

Cooling is provided by operable windows in the units, allowing for natural ventilation as needed. Sunshades serve to control the influx of light and heat and reduce overheating.

Heat Recovery Ventilation

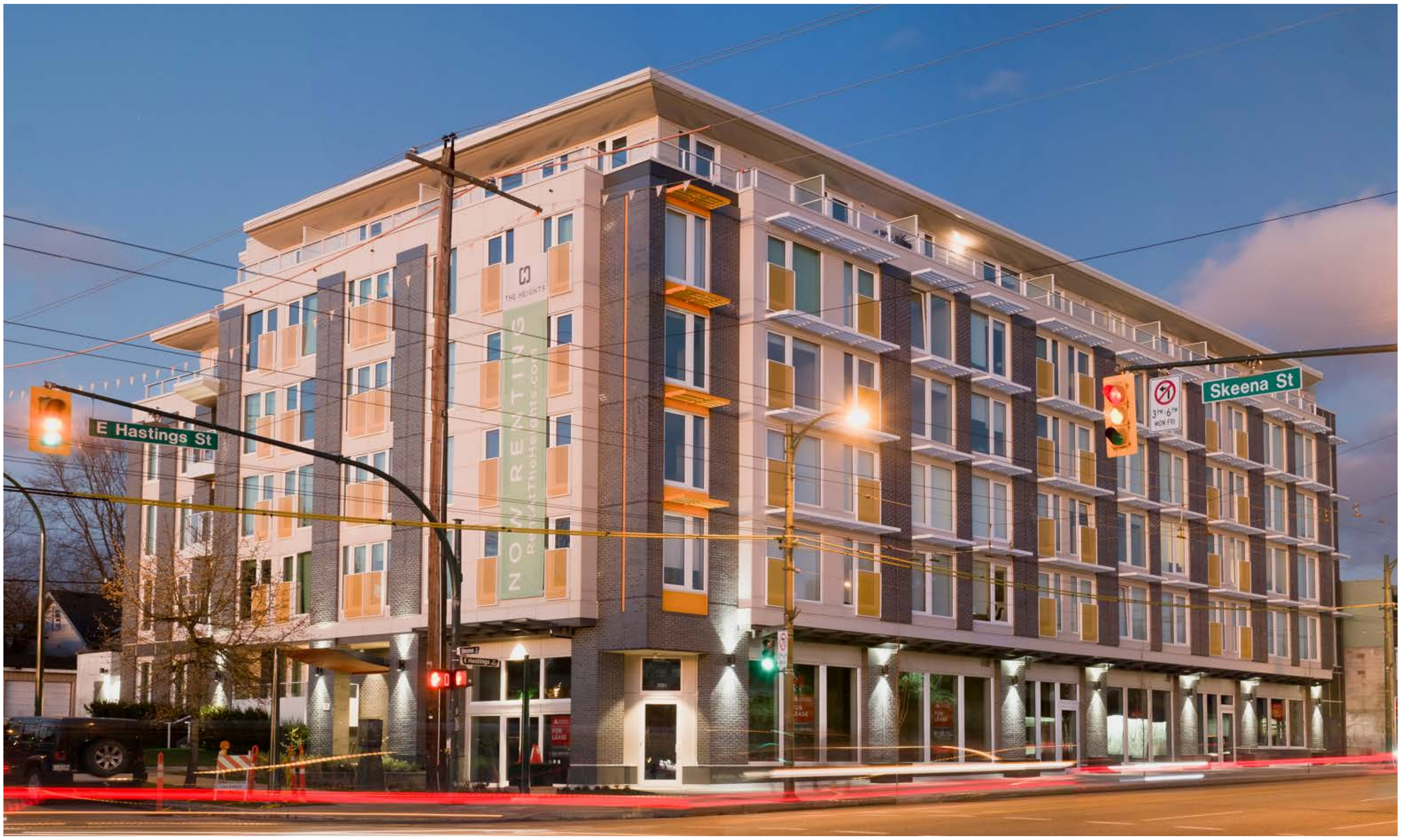
The building uses extremely efficient (90%) heat recovery ventilation (HRV) units in a semi-central ventilation system, in which 5 units are served by a single HRV. This ensures that as much of the previously generated heat energy is transferred into the constantly circulating fresh air entering the suites, as well as minimizing maintenance tasks and responsibilities.

Within units, dryers are heat-pump type, rather than vented, allowing for additional energy conservation.

The Heat Recovery Ventilation box

LESSONS LEARNED

The project is estimated to save 80% of the heating cost and about 205,000 KWh electricity per year compared to a conventional Multi-Unit Residential Building in Vancouver. This conservation was achieved through thicker insulation, reduction of heat loss, triple-glazed fenestrations, the orientation of windows to maximize sunlight exposure high levels of insulation, and the use of heat recovery ventilation.



Lessons Learned

- In operation, there were some negative responses regarding overheating. This is likely due to exceeding the space-heating demand target with an improved building envelope. It may require the implementation of active cooling strategies in the future. For future projects, increased cooling strategies including lower solar heat gain on the windows and more shading could be implemented, even of it would result in some reductions in winter solar gain.

- The highly insulative building envelope also requires an increased use of insulation materials, potentially causing issues related to code-defined wall thicknesses, detailing, and constructability. In this case, insulation design was limited by transit infrastructure and adjacent buildings obstructing exterior access. In practice, the installation of insulation proved to be somewhat difficult when it came to the additional insulation of vents and pipes. Builders found that it was difficult to direct insulation around corners and tight spaces during construction, suggesting the consideration of insulating plumbing stacks prior to installation, or the use of air emittance vales as an alternative to plumbing vent stacks, an option currently restricted by regulations.

- Additional local regulations require the mid-construction testing of air-leakage, which is not possible for MURBs due to construction sequencing. The varying stages of construction on each floor contribute to an inaccurate lower project grades. To mitigate this issue, it was suggested, however, that duct-air leakage testing could be completed mid-construction or early in the installation of heat recovery ventilators and ducting to ensure more accurate airtightness testing.
- Finally, some Passive House certified construction methods and materials required additional training, as they were uncommon in non-Passive House projects. Trades teams completed this through courses from BCIT's High Performance Building Lab, prior to completing work on the project.

GLOSSARY

Key terms, definitions, and abbreviations used in this case study.

BC Energy Step Code A voluntary provincial standard that provides an incremental and consistent approach to achieving more energy-efficient buildings that go beyond the requirements of the base BC Building Code.

Heat Recovery Ventilator (HRV) A mechanical energy recovery system which works between two streams of different temperatures. Residual heat from exhaust gas is recovered and effectively transferred to a fresh air stream. Building exhaust air is used as a heat source or heat sink depending on climate conditions, time of year and requirements of the building.

Plenum duct An air-distribution box attached directly to the supply outlet of the HVAC equipment. The ductwork that distributes the heated or cooled air to individual rooms of the house connects to the plenum.

Heat Pump a mechanical device that transfers thermal energy in the opposite direction of spontaneous heat transfer by absorbing heat from a cold space and releasing it to a warmer reservoir.

Passive House an internationally recognized certification program, developed by an independent research institute based in Germany. The program is intended to result in buildings with extremely low space heating and cooling needs and consequently lower environmental impacts, as well as a comfortable indoor temperature and air quality.

Passive House Planning Package (PHPP) PHPP is specifically developed to design Passive House buildings and is based on a combination of several existing, proven and verified calculation methods that are compliant to the European standard for the thermal performance of buildings (EN 832).

Non-renewable Primary Energy (PE) Demand The total energy demand for operation of a building, including heating, cooling, hot water, lighting, and plug loads. To account for energy losses along the generation and supply chain, Passive House Institute (PHI) multiplies the building energy requirement by a PE factor.

Primary Energy Renewable (PER) Demand To account for renewability of different energy sources, PHI developed new factors (PER) to replace PE factors.

Form Factor The form factor is the ratio of external surface area by internal treated floor area.

U-value A measure of thermal performance or heat transfer through a surface due to conduction and radiation. The lower the U-Value, the more energy efficient the surface is.

Thermal Bridge: An area or component of the envelope which has higher thermal conductivity than the surrounding materials, creating a path of least resistance for heat transfer