INDWELL COMMUNITY HOMES

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SUSTAINABILITY BLOOMS AT BLOSSOM PARK

PREPARED AND PRESENTED BY

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A CASE STUDY ON PASSIVE HOUSE AT INDWELL'S BLOSSOM PARK APARTMENTS

In the spring of 2018, Indwell demolished a group home in Woodstock, Ontario to make room for a new project that aimed at providing affordable, independent housing, while limiting annual building energy consumption and greenhouse gas emissions. In 2019, we opened Blossom Park Apartments project built to Passive House standards.

in 2016, Indwell decided to adopt environmental sustainability strategies for all projects. Blossom Park Apartments was certified to the Passive House institute (PHI) standard for energy efficiency, as a showcase demonstrating how to positively impact energy consumption, sustainability, and utility bills for tenants

This project replaced a single-storey group home with a three-storey, 34-unit (7 barrier free) complex including a community kitchen, support staff offices, and various tenant amenities

"ADEQUATE HOUSING IS ESSENTIAL TO ONE'S SENSE OF DIGNITY, SAFETY, INCLUSION AND ABILITY TO CONTRIBUTE TO THE FABRIC OF OUR NEIGHBOURHOODS AND SOCIETIES."

- ONTARIO HUMAN RIGHTS COMMISSION

Each apartment is equipped with a bedroom, full kitchen, bathroom and living room that became home for tenants seeking safe, comfortable, affordable, and supportive housing. In addition to increasing the supply of affordable housing, these apartments were designed with the desire to influence Ontario's housing development industry towards meeting the goals of fossil fuel reduction, green construction support, and renewable energy production as outlined in the Future Oxford Sustainability Plan. It also exceeds Ontario Building Code Standards and Canada's National Energy Code for Buildings (NECB).

PASSIVE HOUSE FEATURES

There are several key building characteristics that are the foundation of Passive House buildings, which result in a comfortable, energy efficient building. High insulation levels, an airtight envelope, and an energy efficient mechanical system were the focal point in the design of Blossom Park Apartments.

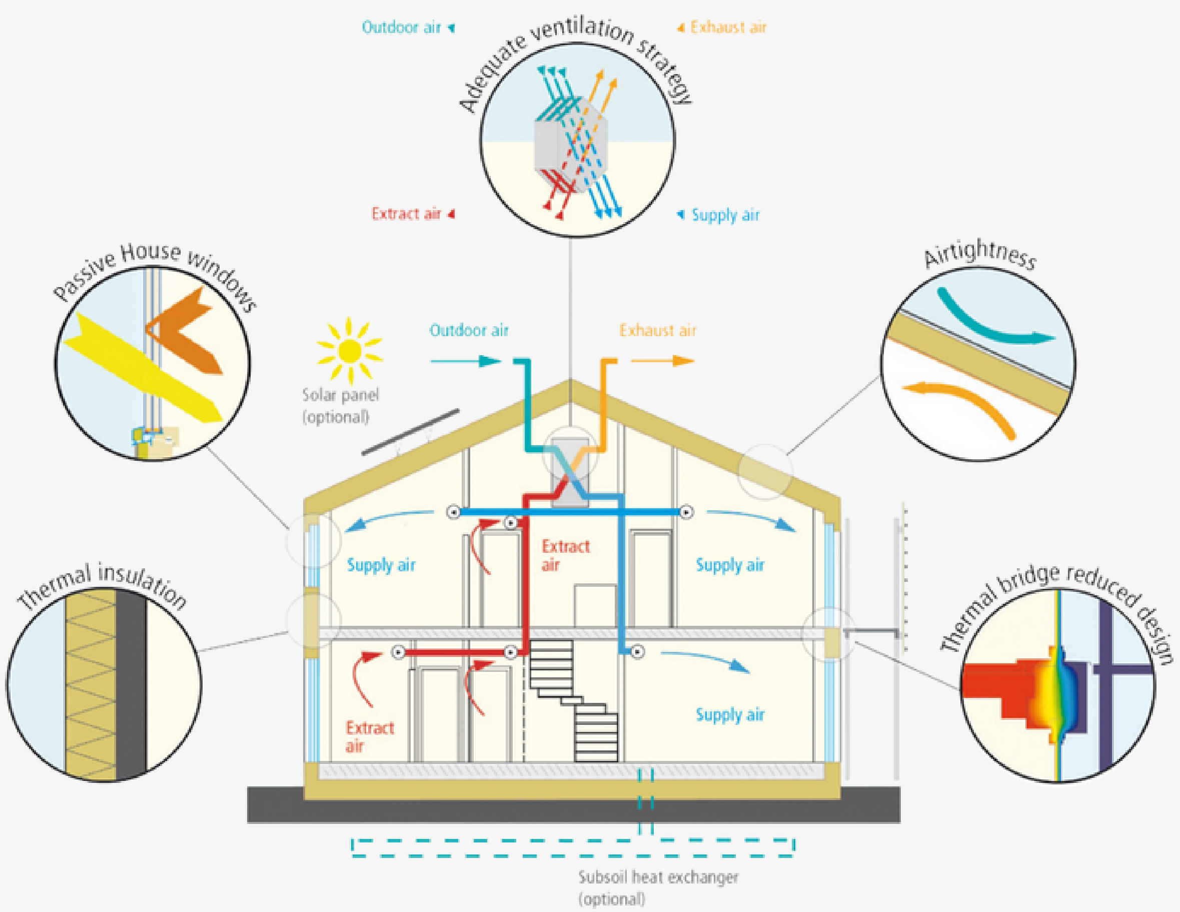


FIG. 1. PASSIVE HOUSE REQUIREMENTS. PASSIVE HOUSE INSTITUTE. 2015. HTTPS://PASSIV.DE/EN/02_INFORMATIONS/02_PASSIVE-HOUSE-REQUIREMENTS/02_PASSIVE-HOUSE-REQUIREMENTS.HTM ACCESSED 20 APRIL. 2022.

INSULATION

A cornerstone to any Passive House project is high insulation levels. Roughly 75% of building heat loss occurs through the walls, roof, and floors in an NECB baseline designed apartment building in Ontario. Heat loss in the winter months directly equates to energy loss, and with that, higher consumption along with poor performance. To combat heat loss, investing in building materials with a high R-value or thermal resistance rating is essential.

The higher the R-value the lower the heat loss rate.

To lower heat loss through the ground and basement floors that were in direct contact with the earth, we constructed floors using eight inches of high-density extruded polystyrene under the concrete slabs, continuing under the foundation wall footings, and wrapping up the outside of the foundation walls. This resulted in an R-value of 41 (compared to an NECB baseline of 20!).

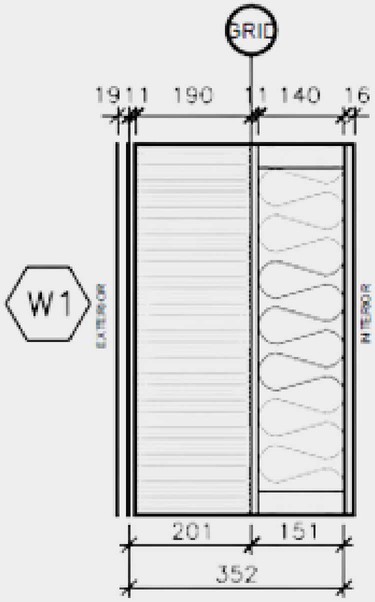


FIGURE 2: EXTERIOR WALL W1

EXTERIOR WALL W1

The exterior walls were constructed using the Build SMART prefabricated wall panel system, giving us an overall effective R-value of 51. The exterior walls consist of:

19 mm - Air space with 19X38 vertical wood strapping
11 mm - ‘Zip’ Sheathing board
190 mm - Foam Control Expanded Polystrene
11 mm - Oriented Strand Board
140 mm - Wood Stud and Mineral Wool Batt between
16 mm - PT type ‘X’ GWB

The roof was designed with a traditional attic wood truss assembly with 16” of blown-in cellulose insulation. This provided an effective R-value of 70 while allowing space for the energy recovery ventilators (ERV) to be mounted above the insulation inside the building to provide sufficient access for equipment maintenance.

In addition to the insulation improvements to the walls, roof, and floors, the windows account for the final 25% of heat loss in a typical building envelope. Windows play a significant role in a building’s Passive House rating, balancing desired solar gains while limiting thermal losses through glass and frames

The U-value is a metric standard for efficiency to determine the rate of heat gain or loss from a warm area to a cool area, so choosing windows with a lower U-value is also critical. This building used a combination of fixed and tilt-and-turn windows, The PassiV Future Proof uPVC frames have excellent thermal performance characteristics, with U-Values of 0.72 W/(m2·K) for fixed windows and 0.75 W/(m2·K) for tilt/turn windows and a solar heat gain coefficient of 0.39. These are a significant upgrade from the NECB standard windows with a U–value of 2.2 W/(m2·K). For more specifics and a comparison of how our insulation compares to the average NECB building, see the table below.

TABLE 1: EXTRIOR COMPONENTS R-VALUES

COMPONENT	NECB BASELINE	DESIGN
EXTERIOR	R 20.44	WALL W1: R-51 (U-VALUE: 0.111 W/M²·K) WALL W2: FOUNDATION WALL R-41 (U-VALUE: 0.140 W/M²·K)
ROOF	R 31.05	R-70 (U-VALUE: 0.08 W/M²·K)
WINDOW	U VALUE 2.2 W/(M2·K) SHGC 0.4	FIXED WINDOWS: U – 0.72 W/(M2·K) TILT/TURN WINDOWS: U – 0.75 W/(M2·K) SHGC 0.39
SLAB ON GROUND	R 31.05	R-41 (U-VALUE: 0.140 W/M²·K)

BUILDING ENVELOPE

The second pillar of passive house design that the Blossom Park Apartments project focused heavily on was building envelope. All of the building components that separate the inside from the outside. It is crucial to eliminate thermal bridging and invest in the building's airtightness. These concepts identify and limit heat loss and heat gain points that cannot be addressed with insulation alone.

FIGURE 3: OUTER WALL MID-CONSTRUCTION

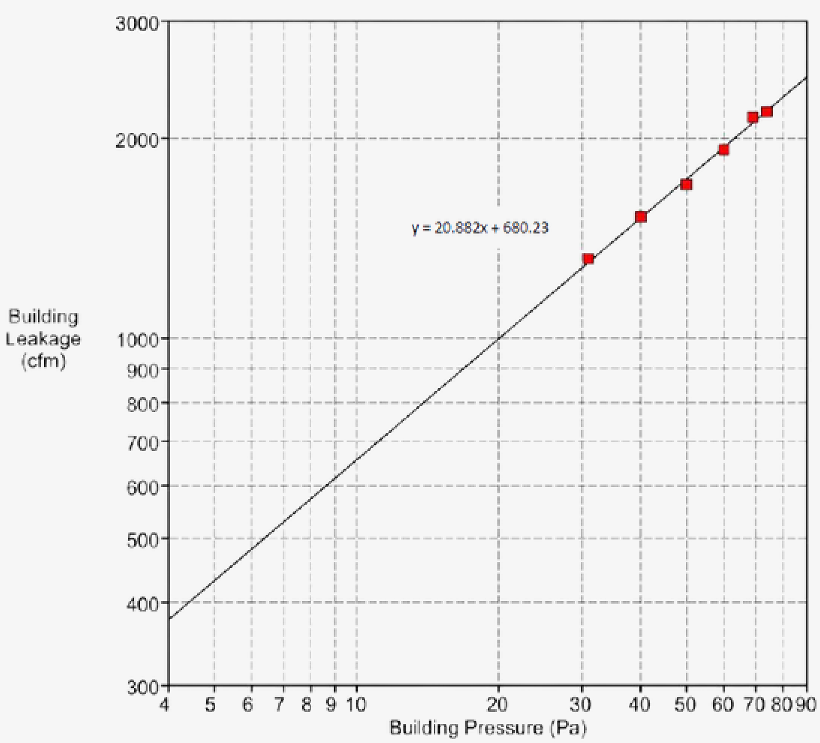
THERMAL BRIDGING

Thermal bridging is a term that describes a point where heat can transfer through a structure resulting in heat loss or gain. A common example of this is wall studding backed up against an exterior wall with siding; the studding creates a direct line of highly conductive material (a "bridge"), allowing heat to escape. If there is too much thermal bridging, energy savings expected from upgraded insulation can be quickly reduced. To combat thermal bridging, the exterior walls outlined in figure 2 installed 190mm of rigid XPS insulation outside of the 140mm wood structured frame creating a continuous thermal break. the rest of the insulation was between the studs

AIR TIGHNESS

Constructing an airtight building enclosure significantly reduces energy use, but also helps to maintain comfort (for example, no cold drafts), improves indoor air quality (controlling pollutants and unpleasant odours), and helps to preserve the durability of the building structure and components over time by elimination uncontrolled moisture infiltration. To be successful, the air control layer must be continuous around the entire enclosure, and it must remain durable over the life of the building.

Structural, mechanical, and electrical penetrations were air sealed using a variety of products and methods, including EDPM gaskets, tape (Pro Clima Contega and Tescon Vana), and putty conduits. . The building then underwent an air tightness test to determine if it achieved the 0.6 air changes per hour at 50 Pascals of pressure required for PHI certification. The air tightness test conducted by RDH concluded that the project exceeded the performance requirements with the results showing 0.58 air changes per hour.



Test Results

1.	Airflow at 50 Pascals: (50 Pa = 0.2 w.c.)	1738 CFM50 (+/-0.7%) 0.5797 ACH50
2.	Leakage Area:	107.1 in2 LBL ELA @ 4 Pa
3.	Building Leakage Curve:	Flow Coefficient (C) = 163.1 (+/- 9.8 %) Exponent (n) = 0.605 (+/- 0.024) Correlation Coefficient = 0.99682
4.	Test Settings:	Test Standard: RESNET Multi-Point Test Test Mode: Pressurization
5.	Accuracy Level	Standard Level of Accuracy Test

FIGURE 4: AIRTIGHTNESS TEST PRESSUIZATION DATA

MECHANICAL SYSTEM

A building constructed to Passive House energy standards must include energy-efficient ventilation systems that provide fresh, filtered, tempered air to all occupied spaces in the building. At Blossom Park, four (PHI) certified Swegon GOLD RX series energy recovery ventilators (ERVs), were mounted outside of the building's thermal envelope in the attic. These deliver continous fresh air to all apartments and common areas, and exhaust used air in equal rates from kitchens and washrooms A Mitsubishi City-Multi variable refrigerant flow (VRF) air source heat pump system provides the heating and cooling capacity for all the apartments living areas, as we;; as tempering the makeup air supply.

This provides all tenants with control of their apartments temperatures. Exchanging energy from the exhausted air to the supply air reduces the heating energy use in the building in cooler months. This process also works in reverse to extract the heat from fresh air in the warmer months.

Gas-fired boilers supply the domestic hot water (DHW) and circulate it with a smart controlled circulation pump. This tracks the usage pattern of the building over time scheduling the pumps operations to save energy and to reduce DHW wait times in suites and common washrooms. As with most components in the building, the recirculation pipes are insulated with 2” of insulation along their entire length.

TABLE 2: ERV EFFICIENCY COMPARISON

CATEGORY	NECB BASELINE	DESIGN
ENERGY RECOVERY VENTILATION	HEAT RECOVERY EFFICIENCY: 50% ELECTRIC EFFICIENCY: 1.6 WH/M3	HEAT RECOVERY EFFICIENCY: 85% ELECTRIC EFFICIENCY: 0.45 WH/M3

SOLAR PV SYSTEM

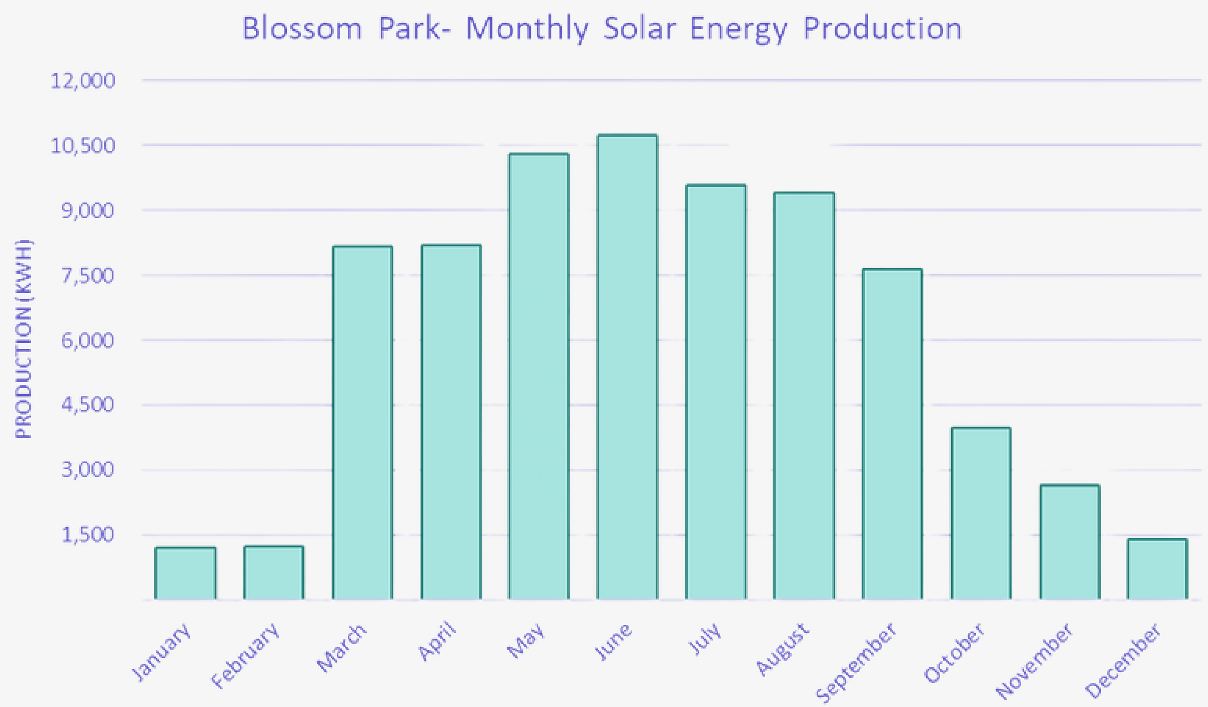
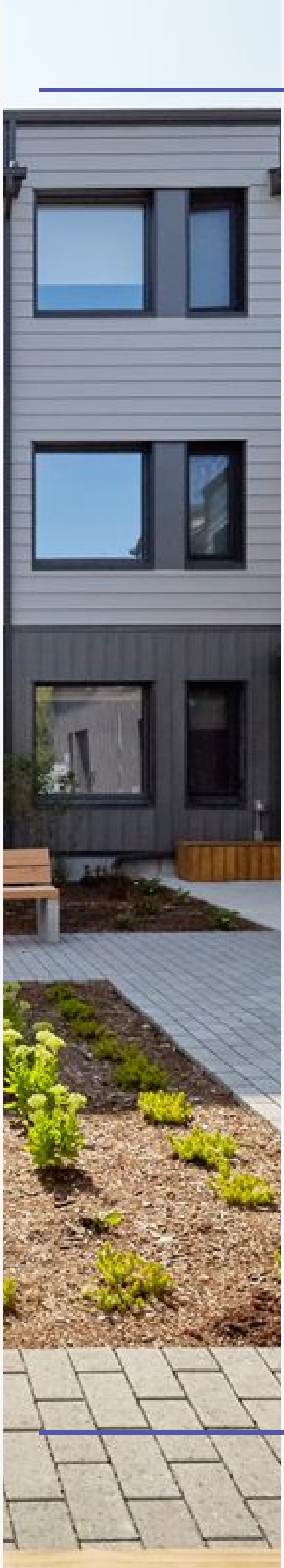


FIGURE 5: MONTHLY SOLAR PRODUCITON 2021

In addition to Passive House features, we wanted to use energy-efficient solar power to reduce energy costs and offset grid-energy use for Blossom Park. A PV solar array was installed on the building roof to reduce greenhouse gases (GHGs) in the energy production process. The system consists of 201 345-Watt modules set at a 25-degree angle to produce maximum energy production. The figure above displays the monthly production over the year 2021

Not only does the building's solar production provide financial ease to the operating cost, but it also lowers grid-energy demand during peak hours, The system's production over 2021 resulted in a GHG reduction to just under 3,000 kg of CO_2, based on the emissions rate of energy produced in Ontario of 40 kg CO_2/kWh.



THAT SEEMS INTENSE. WHY BUILD THIS WAY?

There are several reasons why Indwell is committed to shifting our building design toward a Passive House standard. The reduction of energy consumption through the building structure has a direct impact on the tenant's utility use and monthly bills. According to the Ontario Energy Board, the average monthly electrical utility cost for a one-bedroom apartment of a comparable size is $50 – $70. This is significantly more than tenants at Blossom Park Apartments are seeing, with their bills at roughly $15 (even before the OESP credit for consumers with low income.)

The key features of airtightness, insulation, and mechanical efficiency have benefits beyond the financial savings, though. As outlined in the tables below, the operational energy consumption reduction vs. a code-standard bulding significant. Note the operational reduction of electricity use of Blossom Park Apartments compared to the NECB baseline. In 2021, the power consumption was roughly 201,000 kWh—equating to 72,300 kWh less than the annual NECB baseline. At Ontario grid rate of 40 g CO2/kWh, this reduction equates to 2,920 kg/CO2.

This GHG reduction is only for the energy savings for the building's electrical operations. If you add in the natural gas savings of 121,500 kWh at a rate of 1,888 g CO_2/m^3 there is a GHG reduction of 22,168 kg/CO_2. Add the grid's shift towards greener electrical production to the move away from natural gas space heating and toward electric heat pumps at Blossom Park, and the GHG reductions will only improve over the operating years of the building.

TABLE 3: BUILDING ENERGY CONSUMPTION

CATEGORY	NECB BASELINE (MWH)	BUILDING PERFORMANCE RESULTS (MWH)
SPACE COOLING	12.09	61.01
SPACE HEATING	112.06	91.95
HOT WATER	54.14	2.66
VENTILATION	22.70	15.98
PUMP AND AUX	4.89	4.81
AREA LIGHTS	39.33	17.79
MISC. EQUIPMENT	29.05	7.76
TOTAL	274.26	201.96
PERCENTAGE OF NECB	100%	73.5%

TABLE 4: BUILDING NATURAL GAS CONSUMPTION

CATEGORY	NECB BASELINE (MWH)	BUILDING PERFORMANCE RESULTS (MWH)
SPACE HEATING	65.19	0.9
HOT WATER	146.48	84.35
DRYERS	0.00	5.70
TOTAL	211.67	90.14
PERCENTAGE OF NECB	100%	42.6%

WHAT DOES ALL THIS MEAN?

We all understand that the reduction of greenhouse gases is important to the health of our planet. But what exactly does 22,168 kg/CO2 mean? To put it into context, the reduction of annual CO2 emissions at Blossom Park is equivalent to flying a commercial airliner from Toronto to Vancouver 18 times, or driving a car 107,000 km.

The operational power reduction from the NECB baseline outlined above is the equivalent of powering eight households a year based on the monthly consumption of 750 kWh per month set by the Ontario Energy Board. These yearly reductions will have a significant impact on Indwell's efforts to fight climate change and save tenants money on their utility bills especially when projected over the lifetime of the building.

SPECIAL THANKS TO

THE AWESOME PEOPLE BEHIND THIS PROJECT

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