

HOUSING OBSERVER 2017

Passive Approaches to Low-Energy Affordable Housing



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1. Passive approaches to low-energy affordable housing

An introduction to the benefits, technologies, costs and best practices

Affordable housing providers are increasingly interested in energy-efficient housing models that can achieve improved levels of building performance in support of lower-cost housing and better quality living environments. For many, the rising cost of utilities can make even the lowest-cost housing unaffordable, or force them to make hard choices between utilities, groceries and other basic needs. For housing providers, high energy bills or operating and maintenance costs can significantly reduce the money they have available for other much-needed expenses, like repairs or client services. Fortunately, in recent years, innovations and experience in more sustainable, affordable housing development have made it more accessible and financially viable.

One of the most promising ways to meet both affordability and environmental goals is through a **better building** strategy that uses “passive” approaches to design and construction to significantly reduce energy consumption while creating a comfortable, attractive and healthy living environment. To help affordable housing providers explore this new approach in affordable multi-residential buildings, CMHC carried out a comprehensive literature review of existing research and projects in the field. The goal of the review was to:

- **identify promising passive design strategies and technologies** for low-energy and affordable multi-residential buildings;
- **identify real-world projects** that have successfully implemented passive low-energy approaches in their design and construction; and
- **identify some of the challenges, costs and benefits** associated with passive low-energy affordable homes.

2. What is “passive design?”

“Passive design” refers to any technologies, construction methods or other strategies that increase energy efficiency, reduce operating costs and improve indoor environmental quality, without the need for expensive and overly complex mechanical or energy systems.

This includes relatively simple and inexpensive improvements like increasing the amount or performance of a building’s **insulation**, reducing **thermal bridges**, creating **airtight building envelopes**, using high-efficiency **space conditioning (heating and cooling) systems** and incorporating **heat recovery ventilators (HRVs)** to maintain comfort, provide good indoor air quality and control moisture.



3. Existing high-performance labels, programs and standards

There are a number of high-performance and energy efficiency labels, programs and standards in use today, which incorporate passive low-energy design features and technologies. These include such industry-leading initiatives as:

- **Leadership in Energy and Environmental Design (LEED®)** certification programs developed and delivered by the United States Green Building Council (USGBC) and Canada Green Building Council (CaGBC);
- **Passive House Standard** by the international Passive House Institute;
- **Net-Zero Energy Home initiatives** like the Canadian Home Builders' Association's Net Zero Energy Housing Labelling Program, the U.S. Department of Energy's Zero Energy Ready Home program and CMHC's EQuilibrium™ Housing Demonstration Initiative; and
- **Living Building Challenge** by the International Living Future Institute (ILFI).



Figure 1 The Heights – Vancouver, B.C.

Credit: Image courtesy of Cornerstone Architecture



Numerous affordable housing projects across Canada and the U.S. are using these programs to achieve extremely high levels of energy performance at a minimal additional cost. Some of the examples outlined in the report included the following:

Figure 2 Canadian and U.S. construction and retrofit projects outlined in CMHC report: Passive Approaches to Low-Energy Affordable Housing

Project Name	Location	Building Type	Performance Target	Completed	Affordable Housing
Southeast False Creek Net Zero Building	Vancouver, BC	8-storey	Net-zero	2010	Yes
Chapelview Apartments	Brampton, ON	16-storey	LEED platinum	2010	Yes
Bedford Roadhouse	Nelson, BC	Triplex	Passive House	2013	No
North Park Passive House	Victoria, BC	6-unit multi	Passive House	2014	No
HNS Passive House Pilot Project	Truro, NS	Duplex	Passive House	2015	Yes
Vancouver Coastal Health Staff Housing	Bella Bella, BC	6-unit townhouse	Passive House	2015	No
Social Housing Duplex	Quaqtaq, Nunavik	Duplex	Passive House inspired	2015	Yes
Salus Clementine	Ottawa, ON	4-storey	Passive House	2016	Yes
Marken Design+Consulting	Vancouver, ON	10-storey	Passive House	Design	n/a
Intermet Housing Society	Edmonton, AB	16-unit townhouse	Passive House	Planned	Yes
Cordage Green	Welland, ON	44-unit townhouse	Passive House	Planned	Partial
Station Point Greens	Edmonton, AB	16-storey	Passive House	Planned	No
Cornerstone Architecture	Vancouver, BC	6-storey	Passive House	Planned	No



Project Name	Location	Building Type	Performance Target	Completed	Affordable Housing
Place of Hidden Waters	Tacoma, Washington	20-unit townhouse	LEED Platinum	2012	First Nations
zHome	Issaquah, Washington	10-unit townhouse	Net-zero	2012	Partial
Bellfield Townhomes	Philadelphia, Pennsylvania	3-unit townhouse	Passive House	2013	Yes
The Mennonite	Brooklyn, New York	24-unit, 4-storey	Passive House	2014	Yes
Knickerbocker Commons	Brooklyn, New York	24-unit, 4-storey	Passive House	2014	Yes
Stellar Apartments	Eugene, Oregon	6-unit, 3-storey	Passive House	2014	Yes
Uptown Lofts	Pittsburgh, Pennsylvania	3-storey	Passive House	2015	Yes
Orchards at Orenco	Hillsboro, Oregon	57-unit, 3-storey	Passive House	2015	Yes
Ankeny Row	Portland, Oregon	5-unit townhouse	Passive House	2015	Partial
River Market	Kansas City, Missouri	276-unit, 6-storey	Passive House	Under construction	Yes
Cornell Student Housing	New York, New York	352-unit, 26-storey	Passive House	Under construction	Student housing

4. Passive design technologies and design practices

As the project examples show, passive low-energy design principles can be used with a wide range of construction practices, methods and materials. The “best” choices often depend on where a project is located, the building type and design, current material prices as well as the experience and preferences of the builder or developer.

In general, however, many of the passive, low-energy affordable housing projects tended to feature common design elements and attributes, such as:

- **high-performance wall-systems** with high levels of blown or sprayed insulation; **38x89-mm (2x4-inch) or 38x140-mm (2x6-inch) wood-frame construction** with significant exterior rigid foam insulation; or **structural insulated panels (SIPs)**;
- **a focus on eliminating thermal bridges through the building envelope** to minimize heat loss;
- **strategically placed, high-performance triple-glazed windows** with inert gas fill, thermally broken and insulated frames, warm edge spacers, low-emissivity coatings, multiple airtight seals and external shading;
- **an airtight building envelope** with a minimum airtightness of 0.6 ACH₅₀; and
- **heat recovery or energy recovery ventilators (HRVs or ERVs)** to improve indoor air quality while saving energy and lowering costs.



Figure 3 The Heights – Vancouver, B.C.

Credit: Images courtesy of Cornerstone Architecture



5. Costs and benefits of passive design

The incremental cost of integrating passive low-energy design practices can vary considerably from one project to the next. For the projects reviewed in the study, the additional cost was found to be **between 5 to 10% of the total cost of construction**.

Affordable housing projects tend to have a slightly higher incremental cost, since they often have a lower base cost to begin with. Instead of focusing solely on incremental costs, however, the projects identified tended to look at how the costs and benefits of the affordable passive low-energy design projects compared to the cost of similar projects that don't have these features.

To offset the upfront investment, it's important to remember that passive low-energy design features can achieve **significant long-term energy and operating savings** throughout the entire life cycle of a building. This includes both reduced energy consumption and lower utility bills, as well as a variety of non-energy-related benefits to affordable housing providers, such as:

- the avoidance of rate subsidies;
- lower bad-debt write-offs;
- reduced carrying costs for arrears;
- fewer notices and customer calls;
- fewer shut-offs and reconnections due to delinquencies; and
- an increase in overall property values.



Figure 4 Cote Bungalow – East River, Nova Scotia

Credit: Photographs by Elemental Photography. All images courtesy of Passive Design Solutions



6. Interviews with key experts

As part of the study, a series of **interviews about passive low-energy design approaches** was conducted with leading affordable housing providers, experts and stakeholders from across Canada and in the U.S.

Figure 5 Stakeholders interviewed by CMHC about passive low-energy housing

Organization	Project	Project Details
BC Housing	Numerous projects, British Columbia	LEED Gold requirement
Housing Nova Scotia	HNS Passive House pilot, Truro, NS	Passive House duplex built in 2015
City of Vancouver	SEFC Net Zero, Vancouver, BC	67-units, 8-storey, built in 2010, 68% energy savings
Centretown Citizens Ottawa Corporation	Beaver Barracks, Ottawa, ON	250-unit mid-rise, 2012, GSHP + energy efficiency
County of Dufferin	40 Lawrence Avenue, Orangeville, ON	30-unit, 3-storey, GSHP + ICF construction
Wood Buffalo Housing and Development Corporation	Stony Mountain Plaza, Fort McMurray, AB	125-unit, 4-storey, prefab, GSHP + energy efficiency
Ottawa Community Immigrant Services Organization	140 Den Haag, Ottawa, ON	64-unit, 8-storey, LEED Silver, R-38 walls
Stellar Apartments, St. Vincent de Paul Society	Stellar Apartments, Eugene, Oregon	6-unit, 3-storey, Passive House
Onion Flats Architecture	Belfield Townhomes, Philadelphia, PA	3-unit, Passive House townhouse
Habitat for Humanity Canada	Various projects in Canada	Requirements vary by project

As a result of those interviews, the study was able to identify some of the main needs, challenges, benefits and trends of passive low-energy housing approaches from some of the foremost experts in the field. Their responses were then grouped into five key categories:

1. Reasons to pursue low-energy affordable housing

- **Meet the requirements** imposed on affordable housing providers.
- **Achieve higher levels of performance** to meet future code requirements.
- **Lower utility bills** for tenants and/or affordable housing providers.
- **Reduce maintenance and replacement costs.**

2. Requirements to implement successful passive design measures

- **Have few or no occupant controls.**
- **Address the lack of trained building operators** and high turnover.
- **Accommodate occupants** who open windows in winter.
- **Ensure measures are simple to design, commission and operate.**

3. Tenant education initiatives introduced after project completion

- **How to reduce overall energy consumption.**
- **How to operate an HRV/ERV.**
- **How and when to open windows** for passive cooling.
- **How to adjust to the slower response time** of ground source heat pumps.

4. Benefits of low-energy passive design

- **Lower utility costs.**
- **Better indoor air quality.**
- **More comfortable and quieter** living environments.
- **Lower tenant turnover.**

5. Barriers to adoption of passive low-energy design principles:

- **Lack of examples of larger passive low-energy multi-residential buildings** to demonstrate lower construction costs, lower utility and operations and maintenance costs, and tenant feedback.
- **Management commitment to other rating systems** that may make it difficult to adopt different approaches.
- **Lack of awareness** of innovative technologies and practices by **authorities having jurisdiction over building design approvals.**
- **Short turnaround time from when projects are awarded funding** to when finished designs are required (approx. three months on average), which doesn't leave enough time to support new design approaches, conduct performance modelling, or try new things.
- **Frequent reluctance of developers to build passive low-energy housing** if they have limited availability of key components and need to sole-source products such as high-performance windows or HRVs.



Find out more

For more information about the benefits, features, costs and best practices related to incorporating passive low-energy design principles into your next affordable housing project, including an in-depth look at the leading **techniques and technologies**, **interviews** with affordable housing providers and other stakeholders, as well as dozens of real-world **case studies** from across North America, download your free copy of the **CMHC research report** entitled *Passive Approaches to Low-energy Affordable Housing Projects – Literature Review and Annotated Bibliography* at www.cmhc.ca or call 1-800-668-2642.

Further reading

Visit www.cmhc.ca/Observer to get the latest information.

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