Vancouver Coastal Health Authority:

Radical Energy Savings through Passive House Design

Photo credit: Metric Modular

When a fire damaged the staff housing complex for R.W. Large Memorial Hospital in Bella Bella, the Vancouver Coastal Health Authority rebuilt the complex to Passive House standard as a way to significantly—and permanently—reduce greenhouse gas (GHG) emissions and energy costs. The project demonstrates that high quality, energy efficient buildings can be achieved in remote communities, reducing energy costs and reliance on GHG-intensive fuels.

Project Summary

Many remote communities in B.C. rely on propane or diesel fuels, both of which result in significant greenhouse gas emissions relative to hydroelectricity. When a fire damaged a block of staff housing in the remote community of Bella Bella, the units needed to be replaced quickly without compromising the Vancouver Coastal Health Authority's (VCH) strategic priority to "innovate for sustainability."

For VCH, a cost-effective, sustainable and time-sensitive solution was found in modular construction built to Passive House standard. Passive House is a leading-edge standard for energy-efficient construction that reduces energy consumption for heating and cooling by 80 to 90 per cent compared to traditional construction. The VCH staff housing was the first completely modular multi-unit Passive House building in Canada.

> *"This is smart design that makes sense from every perspective (financially, socially, and ecologically). It's hard to think of a residential construction scenario where it wouldn't make sense." – Alex Hutton, Energy Manager, Lower Mainland Facilities Management*

A prefabrication approach allowed the project to be completed quickly and economically, in part due to minimizing the cost of getting materials and specialists to the remote location. The building components for the housing units were manufactured in B.C. by Langley-based Britco Building Innovation. The project team assembled the units in Agassiz, B.C., shipped them by barge 700km up the coast to Bella Bella and finished assembly on site. This allowed it to be built within seven months, compared to an estimated two years for traditional construction

The key to Passive House design is an extremely well insulated, thermally efficient, tightly sealed building envelope that traps heat inside, minimizing the need for additional heating sources. This is combined with a high-efficiency heat recovery ventilation system, ensuring a consistently comfortable indoor environment and steady stream of fresh air.

On the coldest day of the year, each unit in this complex will have a peak heating load of about 600 watts—the equivalent of the heat generated from six 100-watt light bulbs. Internal heat gains from people and lighting are enough to keep the units warm most of the year, and operable windows are sufficient to keep the space cool in summer. Each unit has a small heat pump and an electric baseboard in each bedroom to ensure comfort. No fossil fuel combustion is required.

Energy Savings/GHG Reductions:
(compared to standard construction)

- 75% reduction in energy use
- 80% lower GHG emissions

Benefits:

- Improved occupant comfort and reduced risk of mold and mildew
- Greater resilience to extreme temperatures
- Faster construction with modular components
- New opportunities for B.C.-based Passive House construction

Operational Cost Savings:

- 54% reduction in energy costs
- Energy savings of almost $5,000 per year

Total Project Cost:

- $2.6 million
- 20-40 per cent savings through pre-fabrication approach for this remote location

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Making the Case

A critical factor in enabling this unique project was to create the conditions that allowed the organization to move swiftly as soon as the opportunity presented itself. This started by embedding the goal to have at least one Passive House building by 2020 in the strategic framework of the energy and environmental sustainability team. Support was further cultivated through staff education events and conversations with individuals who had the capacity to influence decisions.

The team determined that Passive House would provide many of the benefits they were looking for: modular components that could be pre-built and tested off site, extreme energy efficiency and a short timeframe for completion. The Passive House standard was predicted to reduce energy consumption by 80 percent compared with conventional construction, allowing for a quick payback for any additional building costs.

The Passive House project was completed at a cost of $2.6 million – about 20-40 per cent less than it would have cost to develop the same project on site due to the remote location. The advantages of pre-fabrication were so amplified for this location that designing to the Passive House standard still resulted in a project that was less expensive than on-site standard construction. A pre-fabricated approach allowed the design-build team to test the building envelope for adherence to the Passive House standard. Because of the modular approach, Vancouver Coastal Health was able to start moving in employees within seven months, compared to an estimated two-year completion schedule for traditional construction.

Results

Over the long term, this building will use 75 per cent less energy and produce 80 per cent fewer GHG emissions than a similar building built to code, saving an estimated $9.5/m^2 in operational costs compared to the previous staff housing building—for a savings of $4,750/ year.

Building/Design Specs	
Building area	5,376 sqft = almost 500 m^2 (499.5 m^2)
Construction cost per unit floor area	$484/sqft = $5210/m^2
Energy consumption per unit floor area	66 kWh/m^2/year

Annual Energy Use	Previous Building	New Building	Saving
Electricity Consumption	106 kWh/m^2/year	66 kWh/m^2/year	40 kWh/m^2/year
Propane*	38 ekWh/m^2/year	0	38 ekWh/m^2/year
Total Energy Consumption	144 ekWh/m^2/year	66 kWh/m^2/year	78 ekWh/m^2/year (54%)
Electricity Cost	12.9 $/m^2/year	8.1 $/m^2/year	4.8 $/m^2/year
Propane Cost	4.7 $/m^2/year	0	4.7 $/m^2/year
Total Energy Cost	18.0 $/m^2/year	8.1 $/m^2/year	9.5 $/m^2/year (54%)
GHG Emissions**	9.6 kgCO_2e/m^2/year	0.7 kgCO_2e/m^2/year	8.9 kgCO_2e/m^2/year (93%)

**Propane consumption associated with the previous building has been estimated based on statistical data for similar facilities, as propane was purchased for the hospital and staff housing combined, making it difficult to separate the portion for the staff housing only.*
***GHG Emissions updated February 2018.*

Lessons Learned

Make Foundational Decisions Early

Efforts were made to pursue Passive House standard on a previous project. Although these efforts were not successful, analysis and discussions led to a crucial learning: committing to a development approach at the business case stage is essential.

Leadership is Essential

Decisive leadership was essential to the realization of this project. Previous analysis of the potential for a Passive House standard helped the director have the confidence to champion Passive House, knowing the sustainability team staff had evidence to support the benefits of this approach.

Assemble the Right Team

Rather than managing the project through individual teams of architects, consultants, designers, pre-fab builders and on-site construction personnel, VCH had the teams assemble themselves through one comprehensive Request for Proposals (RFP). VCH also ensured that the RFP favoured proponents with expertise specific to building in remote communities, Passive House design/certification and pre-fabrication.

Tight Timelines Can Work in Your Favour

Although perhaps counterintuitive, the tight project timeline worked in the project's favour. There was no time for extensive deliberation over the design; the design-build team moved forward with approaches that were familiar, proven and time-efficient.

Modular Approach Allows for Efficiencies

The modular construction approach allowed the builders to pre-test each unit for airtightness and other factors critical for Passive House certification before it left the construction facility. During site preparation, the off-site team could simultaneously proceed with exterior envelope work and interior finishing. On-site worker training preceded the delivery of the modules, which also added scheduling efficiencies.

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Related Resources & Links

Resources

- Canadian Passive House Institute (CanPHI)
  http://www.passivehouse.ca/
- Passive House Canada | Maison Passive Canada
  http://www.passivehousecanada.com/
- Passive Design Toolkit (City of Vancouver)
  http://vancouver.ca/files/cov/passive-design-large-buildings.pdf
- PassivScience
  http://passivscience.com/

Articles/Documents

- 10 Misconceptions About the Passive House Standard – Green Building Advisor
  http://www.greenbuildingadvisor.com/blogs/dept/guest-blogs/ten-misconceptions-about-passive-house-standard
- Passive House Commercial Buildings Find Economic Sweet Spot – Real Estate News Exchange
  https://renx.ca/passive-house-commercial-buildings-find-economic-sweet-sp
- Concept of Passive House as a Commercial Building – Night Hawks
  http://www.night-hawks.eu/?case-study=concept-of-passive-house-as-a-commercial-building
- Affordable Passive House Commercial Buildings – Secrets Revealed – U.S. Green Building Council (USGBC)
  http://www.usgbc.org/education/sessions/building-energy-15/affordable-passive-house-commercial-buildings-secrets-revealed

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