

# The Passive House

Movement gains popularity in North America

Julia Teeluck



Reducing the global carbon footprint continues to be an important initiative for many individuals, companies and governments. A European standard slowly gaining popularity in North America is the Passive House—a performance standard that considers thermal comfort, indoor air quality and energy consumption. The concept’s beauty lies in the science behind its design. Passive Houses aren’t simply “super-insulated” structures. They are a movement.

## The passive path

According to the Canadian Passive House Institute, the Passive House standard differs from other certifications, such as LEED, because its principal focus is on radically reducing a building’s energy consumption over the long term. And despite the term, Passive House is not just about houses. It’s a building performance standard applicable to multi-residential units, offices, schools, supermarkets, gyms, churches, fire stations, as well as retrofits – almost any building you can think of.

Dr. Wolfgang Feist, a professor of building physics at Innsbruck University in Austria and the founder of the Passivhaus Institut, an independent research facility in Germany, developed a set of specific requirements to define a passive building (see sidebar). The institute’s 1990 pilot project is considered the world’s first official Passive House. The white, box-like structure with south-facing windows is located in Darmstadt-Kranichstein, Germany.

TrekHaus, a new construction four-plex located in Portland, OR, received Passive House certification in May 2012.  
PHOTOS CREDITS: Rob Hawthorne and PHIUS

"From 1991 on, more and more Passive Houses were built," says Dr. Guido Wimmers, Founder and Director of the Canadian Passive House Institute. According to Wimmers, the highest Passive House density can be found in Austria and in the European alpine countries including southern Germany, northern Italy and Switzerland where more extreme climate and weather, a highly developed building culture, and lack of easy access to fossil fuels are factors. "Austria, at least to the best of my knowledge, has the most progressive political system when it comes to energy savings, incentives and renewable energies," says Wimmers. This influences consumers and the industry. Although Austria has eight million people, it is home to one of Europe's largest solar thermal manufacturers, and also the world's largest Passive House window manufacturer.

Windows are a significant component in Passive Houses. "In most residential buildings, windows are typically responsible for 50 per cent or more of the heat losses," says

Wimmers. "Given the small area of the windows it becomes obvious that they are by far the weakest link. Beside the fact that this is neither economical nor environmentally friendly, the big downside is also a lack of thermal comfort and potentially even health issues." The impact of windows on the energy balance of a building is huge. "Good windows with insulated frames and good glazing (overall U value  $0.8\text{W/m}^2\text{K}$  or lower) ensure thermal comfort and acceptable heat losses to achieve Passive House requirements," says Wimmers.

He adds that harvesting energy from the sun is ideal. "A really good window can harvest more solar energy in winter's limited daylight hours than it loses during the night-time and cloudy days," says Wimmers.

Although Feist transformed the concept into the science-based solution it is today, passive structures have existed for centuries. The concept was not invented; it developed organically over time. *Passivepedia*, an online encyclopedia dedicated to the concept, names a late-nineteenth-century ship called *Fram* as the first Passive House. The ship belonged to Norwegian explorers Fridtjof Nansen, Otto Sverdrup, Oscar Wisting, and Roald Amundsen who sailed it to the North Pole. In "Farthest North," Nansen's account of his expedition, he reported that *Fram* maintained a comfortable interior temperature and excellent ventilation. In Canada, energy efficient buildings built in the late 70s and early 80s were also important predecessors of today's Passive House.

In Canada, the Canadian Passive House Institute and Passive Buildings Canada are two organizations that support and promote the standard. The Canadian Passive House Institute is the only licensed partner in Canada of the International Passive House Association to offer Passive House Training. The five-day seminar covers the Passive House concept and the building science behind it. More advanced one- or two-day courses that cover topics such as thermal bridge calculation are available. The Institute also offers a preparatory course for the Certified Passive House Designer exam. About 250 professionals have taken the

course across the country, says Wimmers. Katrin Klingenberg, Founder and Director of Passive House Institute U.S., champions the movement in the United States.

A Passive House does not necessarily need to be certified, and in fact, some clients may choose to invest in materials rather than in certification. "The really important thing is building better buildings rather than getting any kind of title. I think the cultural mindset is a little bit different because those people who are doing Passive Houses are usually truly motivated and want to do something different," says Wimmers.

Canada's first Passive House, named Austria House, debuted at the 2010 Olympic winter games in Vancouver. "It was strategically very important because it brought Passive Houses on the map [in Canada]," says Wimmers, who contributed to the project.

## Energy revolution

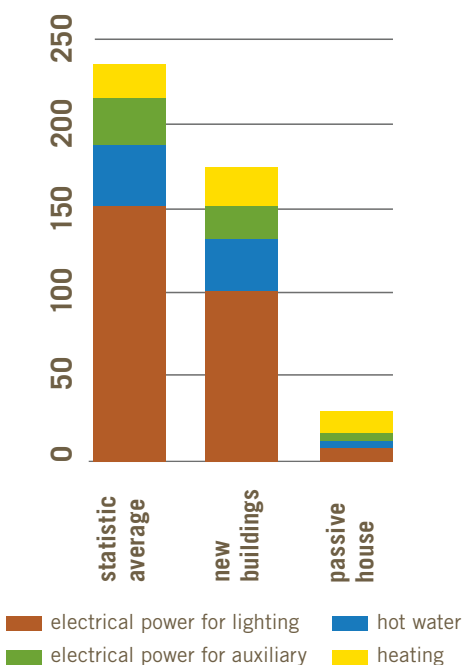
"[The] Passive House is gaining popularity because it is a simple, science-based solution to reducing energy use in buildings," says Terrell Wong, President of Passive Buildings Canada and owner and principal architect at Stone's Throw Design in Toronto. "The advantages are obvious," says Wong. A Passive House is a more durable, healthy building that costs 90 per cent less to run. However, she cautions that if you want a 90 per cent glazed building with lots of corners and cantilevers, and expect to meet the standard for a Passive House, you will be disappointed. "That is certainly not to say that all Passive Houses are simple boxes that face south, that's just the easiest place to start."

## Building a passive house

"Any penetrations in the envelope have to be well considered," says Wong. She recommends having someone on-site in charge of air sealing and advises that builder training is key to creating a Passive House. "In anything that has multiple players, it only takes one who either doesn't care, or doesn't know to lessen the chances of success."

Tom Gyimesi, Building Engineer and Designer & Distributer for Passive House/

Energy consumption for residential buildings in kWh/m<sup>2</sup> per year



Courtesy of: Canadian Passive House Institute

Green Building Association at 5th C Building Solutions in British Columbia, reinforces the importance of skilled and knowledgeable workers. Wrong data can lead to thermal bridges, and improper material selection can cause damage to the envelope. Incorrect assembly or construction by the craftsmen on-site can ruin the project. However, a well-built Passive House provides a return on investment in the long term. "When the design and the craftsmanship on-site is carried out with the highest level of performance and knowledge, a Passive House is the most perfect living environment you can attain because you have a very low energy demand in a consistent and healthy climatic situation," says Gyimesi.

He adds, building costs vary according to location and climate. "Passive Houses are highly complex structures designed and built to meet building code standards and can be more expensive." According to Gyimesi, they cost approximately 15 per cent more than the average custom home.

Because not all of the necessary building materials are available in Canada, 5th C imports some building materials and components from Germany. However, there are no prescribed limits to the types of materials used; it is the quality, durability and performance of the material that is important. "You can build a Passive House with bricks, concrete and certainly also with wood," says Wimmers. Because many who build Passive Houses have a "green conscience," they tend to use wood. 🌱



Lost Lake Passivhaus (formerly Austria House), was the first registered Passive House in Canada and is a legacy of the 2010 Olympic Winter Games.



## Certification

If a building meets all Passive House criteria, it can be designated as a Certified Passive House. In 2012, the Canadian Passive House Institute will offer this service in collaboration with its international partners, including the Passivhaus Institut, based in Darmstadt, Germany.

The certification process is rigorous and involves extensive work both by the Passive House consultant and the certifier. The process starts with a thorough check of the design drawings, specifications and details, Passive House Planning Package analysis and site photos.

A certification can only be issued post-construction, when an independent test for air tightness has confirmed the performance of the building envelope.

### Here are four requirements:

1. The building must not use more than 15 kWh/m<sup>2</sup> per year in heating energy.
2. The building must not leak air at more than 0.6 house volume per hour ( $n_{50} \leq 0.6/\text{hour}$ ), when depressurized to 50 Pa (N/m<sup>2</sup>) below atmospheric pressure by a blower door apparatus.
3. The total energy consumption shall not exceed 33 kWh/m<sup>2</sup> per year.
4. The total primary energy consumption (primary energy factors in all energy which was needed to deliver the energy to the end user – from the raw material to the generation to the electrical lines) must not exceed 120 kWh/m<sup>2</sup> per year.

For more details on certification, see [www.passivehouse.ca](http://www.passivehouse.ca)