http://harrisonarchitects.com/passive_house

What Is Passive House?

by Rob Harrison, Principal Architect with Harrison Architects

Passivhaus is a performance standard for energy use in buildings codified by Dr. Wolfgang Feist and Bo Adamson, originally spurred by conversations with Amory Lovins. It can be applied to both new construction and renovation. Known as Passivhaus in Europe and the UK, it was translated (somewhat unfortunately I think) as Passive House in the United States. "Haus" in German means "building" and so the original German spelling more accurately portrays Passivhaus as a standard that can be applied to any type of building, not just single-family houses. In the US, "Passive House" and "Passivhaus" are used somewhat interchangeably. From the Passive House Institute US website, a definition:

A Passive House is a very well-insulated, virtually air-tight building that is primarily heated by passive solar gain and by internal gains from people, electrical equipment, etc. Energy losses are minimized. Any remaining heat demand is provided by an extremely small source. Avoidance of heat gain through shading and window orientation also helps to limit any cooling load, which is similarly minimized. An energy recovery ventilator provides a constant, balanced fresh air supply. The result is an impressive system that not only saves up to 90% of space heating costs, but also provides a uniquely terrific indoor air quality.

Three requirements make up the Passivhaus standard:

- Space heating or cooling demand must be less than 4.75 kBtu/square foot/year.
- Primary (source) energy demand must be less than 38 kBtu/square foot/year. (This includes energy used for space heating and cooling, domestic hot water, auxillary loads such as pumps, lighting and plug loads (everything plugged into electrical outlets)--in other words, all of the energy used in the building.
- The shell of the building must be incredibly well sealed, meeting a standard of less than 0.6 air changes per hour when pressurized to 50 Pascal during a blower door test. (Typical new houses have results of 5.0 to 7.0 air changes per hour measured in the same way.) Note that this is a measure of the air tightness of the building's shell, not an indication of how much fresh air moves through the building.

These requirements must be met, through careful design, by the building envelope itself (everything that touches outside air), without the assistance of elaborate or expensive "active" on-site generation of power like photovoltaic panels, wind generation or micro-hydro. The building, once brought up to temperature after the completion of contruction, is, with the addition of very small amounts of heat, self-regulating and self-sustaining. (Hence "passive.") Compliance to the energy requirements must be demonstrated with the Passive House Planning Package (PHPP) software. The PHPP is a comprehensive Excel-based spreadsheet (with 39 sheets!) into which every aspect that affects energy use of the building is entered, and which allows us to tweak the amount of insulation, the quality of the windows, the orientation of the building, methods of heating and cooling and so on. The blower door test must be conducted by a third party, according to a standard protocol. Square footage is measured according to the German standard of measuring building size, which omits storage areas altogether, and counts some areas as less than 100%.

In addition, there are several recommendations that essentially assist in meeting the above requirements, and that vary by climate:

- Window glass should have a U-value of better than U-0.18 (for Seattle), and a solar heat gain coefficient of greater than 0.50.
- An energy or heat recovery ventilator is typically used, and must have an efficiency of greater than 75%, and its fan(s) must move air at an efficiency of better than 0.75 watts per cubic foot per minute.
- Construction should be virtually thermal bridge free. (Less than 0.003 Btu/square foot/hour.)

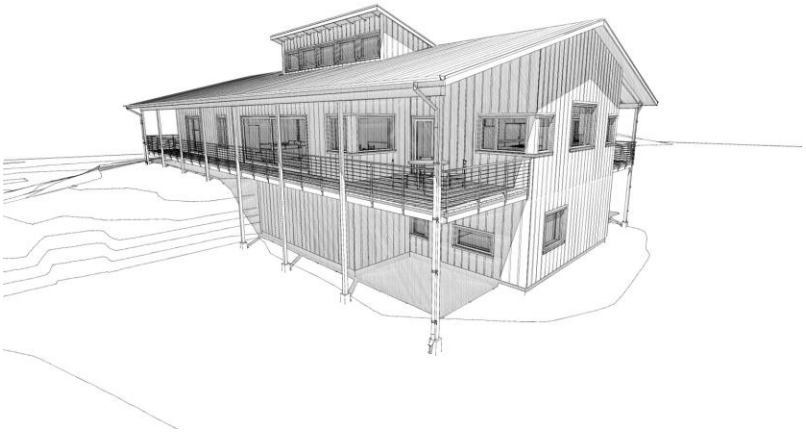
That's it. No checklists, no points, no stars. Either you achieve Passivhaus or you don't.

See also this comprehensive description on Passipedia.com, the web's central resource for information on Passivhaus.

Comfortable

You will find no hair shirts in the closets of Passive Houses! By virtue of their advanced and well-insulated design, the temperature within Passive Houses is remarkably consistent from room to room and between the inside and outside walls. There are no drafts. You can sit right next to their high-performance windows and not feel the chill of the outside. Indoor air quality is demonstrably better than in standard construction, with more fresh air. By virtue of their triple-pane windows and thick walls (in our climate) Passive Houses are quieter than most houses. The high-performance windows and tuned-to-the-climate design mean that those windows can be large and let in plenty of natural daylight. You can of course *open* all those windows, to let in even more fresh air whenever you want.

Cost-Effective



In Europe, where the Passivhaus standard has been in place and widely implemented for a number of years, Passivhaus projects are built for the same cost as conventional construction. In the United States, where Passivhaus is in its infancy, the premium for early adopters can be as much as fifteen per cent compared to a code-minimum house with no other green features. (On the other hand, ballpark prices on our first Passive House design (on the right) put the premium at 3%, 5% and 7% from three different contractors. The premium depends on the starting point. With a high-end custom home, the premium is likely to be less than five percent.) Assuming a ten percent premium and a *very* conservative two per cent per year increase in energy costs, and a 20% downpayment, the investment in Passivhaus recoups the additional downpayment within ten years and thereafter earns money for the building's owner. That's a 13.8% return on investment! Larger increases in energy costs will result in even faster payback and bigger earnings.

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Well-Proven

An estimated 37,000 Passivhaus buildings have been built in Europe since the first one, designed by Dr. Feist, debuted in 1991. There are Passivhaus schools, factories, office buildings, multi-family buildings and houses. About 1,500 of those buildings have been certified by the Passivhaus Institute. There is a 286 acre all-Passivhaus development in Heidelberg, Germany. In the Brussells region of Belgium 1.5 million square feet of Passivhaus buildings have been built as part of the Exemplary Buildings program, and on January 1, 2015 the Passivhaus standard will become mandatory for all housing, schools and offices in the region. (As of this writing there are about 50 certified Passivhaus buildings in the United States.)

Predictable

A longitudinal study of the energy use of a group of 221 Passivhaus buildings in Europe showed results that closely track their energy use as predicted by the Passive House Planning Package software. This compares quite favorably to other software energy modeling tools.

What It Isn't

Passivhaus is not "passive solar." The term "passive" was partly a nod by Dr. Feist to the inspiration for the standard, the passive solar and super-insulated houses built in Canada and the US in the late seventies and early eighties--which though they were headed in the right direction, had significant issues with indoor air quality and durability. While PHPP does intimately consider the relationship of the orientation, size, solar heat gain coefficient and U-value of windows to the energy use of the building, a Passivhaus building will not have large walls of south-facing glass and no windows elsewhere. It will not have Trombe walls, large amounts of thermal mass such as columns of water stored in black barrels inside, or attached greenhouses with rock beds for thermal storage. It will not be earth-bermed. It certainly does not have to *look* like a solar house from the seventies. (Thank goodness.)

Passivhaus is not "net-zero energy." While many Passive buildings will undoubtedly have solar panels on the roofs, and some may have wind mills or other means of producing energy on-site, energy produced by those means is not required or indeed even *counted* toward meeting the Passive House standard. Passive House, by reducing heating energy use to 10% of typical, does make it *easier* to achieve net-zero energy, since you are making up a much smaller proportion of energy needs with on-site generation, instead of the 20%-30% or 50% left after applying other means or standards of reducing energy use.

Passivhaus is not a style. A Passive House building can be any "style" its owners wish. In the United States there have been both traditional and modern Passive Houses. The rigorous energy requirements would make it challenging and expensive to create a McMansion-style Passive House with elaborate roofs and bump-outs, but it is theoretically possible. We do think the standard lends itself superbly to Northwest Romantic Modernism.