FEATURES:

A Plan for All Seasons

Passive House grows beyond the grassroots with a new wave of high-performance projects.

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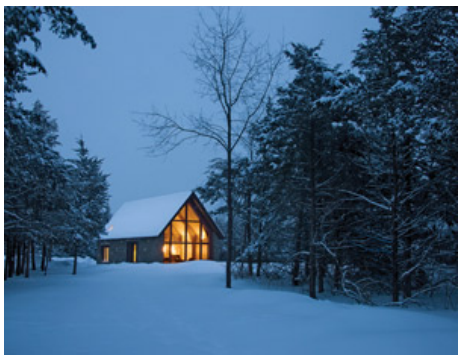
By Michael Cockram



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Dennis Wedlick's Hudson Passive Project, in Claverack, New York, is the first certified Passive House in the state. The project has set a national record for airtightness among certified homes—it has the best (i.e., lowest) score at 0.149 ACH at 50 pascals. This puts it among the most energy-efficient homes in the country. Slide show

The new kid on the block is stout, thick-skinned, and wears a heavy airtight overcoat. This recent arrival has a German accent and is passive by nature, but the newcomer's followers are aggressive in getting their message out: Passive House has arrived on the U.S. green building scene as a muscular, superinsulated alternative for those seeking a defined high-performance energy standard.

The Passive House standard is distinguished from LEED and other green building programs in that it's based solely on building energy. While LEED's complex matrix tallies points for everything from recycled content of materials to stormwater management, Passive House has only three criteria: (1) a frugal annual heating/cooling allowance of 4,733 Btu per square foot; (2) an annual cap on primary energy of 11.1 kilowatt hours per square foot for all energy needs including heating and cooling, along with water heating, appliances, and other devices; (3) the building must be essentially airtight with 0.6 air changes per hour at 50 pascals of pressure. Each benchmark is many times lower than the targets set by current U.S. energy codes and guidelines.

"What our office loves about it is that you can get incredibly high performance design using low-tech means," says Garrick Jones. Jones was the project manager for Della Valle Bernheimer Architects on R-House, a joint project with the Manhattan-based firm Architecture Research Office (ARO). The house recently received a 2011 AIA Housing Award and was developed from the firm's winning entry in a competition sponsored by Syracuse University called From the Ground Up. The 1,100-square-foot house has an eccentric and compact geometry. The roof ridge skews diagonally in a reinterpretation of the gable roof. The sloping exterior walls and roof are folded into a seamless form that is wrapped in corrugated steel siding. Entering on the north side, the visitor is pulled through a double-height space to the living area on the south side of the house, where the glazing is concentrated to take advantage of solar heat gain. As with most Passive House structures, the walls and roof are thick to accommodate copious insulation—in this case, engineered-wood I-joists are used as framing members, then filled with blown-in insulation.

The first certified Passive House project in the United States was actually an educational building (in German, passivhaus means passive building). Completed in 2006, the BioHaus was designed by architect Stephan Tanner for the Concordia Language Villages campus in Bemidji, Minnesota. Partially funded by the German Foundation for the Environment, the project is a showcase for German advancements in green building. As one of the most efficient buildings in the country, the BioHaus helped establish the Passive House movement in the United States.

The concept began as the brainchild of building scientists Wolfgang Feist of Germany and Bo Adamson of Sweden. Their research essentially combined the two prevalent approaches to energy efficiency: superinsulation and passive solar. The United States was central in developing the two strategies following the energy crisis of the 1970s, but when political and economic forces that supported green building waned in the 1980s, the impetus shifted to Europe. In 1996 Feist founded the Passive House Institute in Darmstadt, Germany, and set up the certification process. The Passive House Institute United States (PHIUS) was founded in 2008, and began training consultants. PHIUS has trained more than 200 consultants and has certified over a dozen projects, with many more in the pipeline.

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At the 2010 North American Passive House Conference in Portland, Oregon, one of the projects on the conference's home tour was Corehaus by architect Robert Hawthorne. Hawthorne's design/build firm started the project as an energy-efficient spec home and discovered the Passive House approach in the process. "It didn't require a lot of retooling to switch to Passive House," Hawthorne relates, since most of the techniques involve conventional construction. One of the tenets of Passive House is to reduce or eliminate thermal bridging. The designers created walls using 2-by-8-inch studs with insulated cavities and wrapped the frame in 3 inches of foil-faced rigid insulation to reduce thermal bridging to a minimum.

Benefitting from 20 years of development, European components are generally more available and often more advanced than their U.S. counterparts. Designers and clients have to weigh the costs of imports against more affordable, but perhaps less efficient, North American products.

Hawthorne opted for U.S.-made high-performance windows on the project. The architect specified glazing that has a higher Solar Heat Gain Coefficient (SHGC) for the south-facing windows to facilitate solar heating. On the east and west elevations (which are more difficult to shade), he specified windows with a lower SHGC to prevent overheating in the summer months. The windows on the project have U-values that range from 0.15 (R-6.6) to 0.11 (R-9).

Since the structures need to be essentially airtight, the Passive House system uses an efficient air-to-air heat exchanger to supply plentiful fresh air. For the Corehaus, Hawthorne used a heat recovery ventilator (HRV) made in Switzerland. "The HRV was an important piece of the project—I looked at the units made in the U.S. but the European HRVs are still more efficient, so we were willing to pay a bit more," Hawthorne explains. The HRV's cousin, the Energy Recovery Ventilator (ERV), also has the capacity to transfer humidity from the incoming air to the exhaust air.

One of the biggest challenges for designers and builders is the air infiltration limit. Standard frame construction needs to be totally sealed with an air barrier—often construction joints need to be caulked, taped, or gasketed. The Hudson Passive House in Claverack, New York, was built using an alternative to frame construction to achieve the lowest infiltration rate recorded in the United States. Architect Dennis Wedlick wrapped the walls and roof with structural insulated panels (SIPs). The SIPs form a tight, highly insulated layer that floats outside the structure. But the south facade is almost totally glazed, which opens the house up to the sun and, from the outside, exposes the lofty 25-foot interior.

The certification process involves verification of the three requirements in the Passive House Planning Package (PHPP). The package includes software that analyzes energy use of a particular design. The infiltration level is documented in a blower door test that verifies the number of air changes. A Passive House consultant usually shepherds the project through the pre-certification process. The final package is sent to PHIUS for final certification.

Passive House does have its detractors in the green building sphere. German architect and engineer Werner Sobek points to the embodied energy used in large amounts of rigid insulation. "Passive House was important for a decade in attacking the problem of energy consumption," Sobek says. "But I think the next generation is the 'active house.' " Sobek promotes a concept of building that is more open to the environment with glazing and ventilation, and uses active systems to absorb or deflect energy according to specific environmental conditions.

Even so, Passive House adherents hold up the standard as the most organized, effective, and affordable approach to making deep reductions in energy consumption and greenhouse gas emissions from the building sector. About one in every five houses built in Germany is currently built to the standard; Europe as a whole has completed over 15,000 Passive House projects. Perhaps most important is that, globally, Passive House encourages ingenuity and innovation in the push for more rigorous models in sustainable design.

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