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ISSUE 19 • AUD$11.95 • NZ$10.95
SANCTUARYMAGAZINE.ORG.AU
ISSN 1833-1416
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A series of five gracefully curved timber buttresses supports the structural insulated panel walls and roof of the house. The frame was raised in a single day, reminiscent of the area's traditional communal "barn-raising" events.

Passive state of mind

When New York State architect Dennis Wedlick set out to build the most energy efficient home he could, passive house design principles were key.

WORDS Anna Cumming
PHOTOGRAPHY Peter Aaron

THE CLIMATE OF THE BEAUTIFUL HUDSON VALLEY IN UPSTATE NEW YORK, USA, can hardly be described as mild. With average daily temperatures hovering around minus five degrees Celsius in winter, and snowfall expected as much as six months of the year, building a home in the area that does not require an active heating system would seem an unlikely goal. Yet that is exactly what local architect Dennis Wedlick set out to do when he embarked on the Hudson Passive Project: design a high-performance home that was also beautiful and quick to build. The result was the state's first certified passive house.

With the support of the New York State Energy Research Development Authority, Wedlick designed his compact prototype house with the rigorous energy efficiency specifications of the Passive House Standard (PHS) firmly in mind. Developed as 'passivhaus' in Germany in the 1980s, the standard requires very low space heating and cooling demand and high air-tightness. In essence, a passive house is a very well insulated, airtight building that is able to maintain a comfortable internal temperature using primarily the sun and natural ventilation. [Ed note: For more on the Passive House Standard, see the article in *Sanctuary* 17.]

Remarkably, the home achieves a very low energy consumption without relying on solar panels, wind turbines, geothermal or other on-site energy systems. Wedlick explains that his firm saw the project as "a chance to prove that significant energy conservation could be achieved through architecture alone". →

The windows that make up the entire south wall of the home are triple-glazed with a high solar heat gain coefficient, to ensure maximum solar gain and minimum heat loss. Ceiling fans circulate warm air downwards in winter, and all lighting is energy efficient LED.

The Hudson Passive Project house sits on a part meadow, part forested three hectare lot in the picturesque Hudson Valley, USA.

Built on a three hectare site of meadow and forest, the three-bedroom home takes its aesthetic cues from the traditional barns of the Hudson Valley. It has a simple rectangular footprint and a steeply pitched roof, and the exterior is faced in stone. Gently curved beams made from glue-laminated Southern Yellow Pine rise almost eight metres to support the roof, which along with the walls is formed with structural insulated panels (SIPs). Consisting of a thick layer of expanded polystyrene (EPS) sandwiched between oriented strandboard cladding, these prefabricated panels are highly insulated – around R8.8 in the walls and R9.7 for the roof – and have the advantage of being very quick to install on-site. [Ed note: Read our article in *Sanctuary* 18 for more on SIPs and their benefits.]

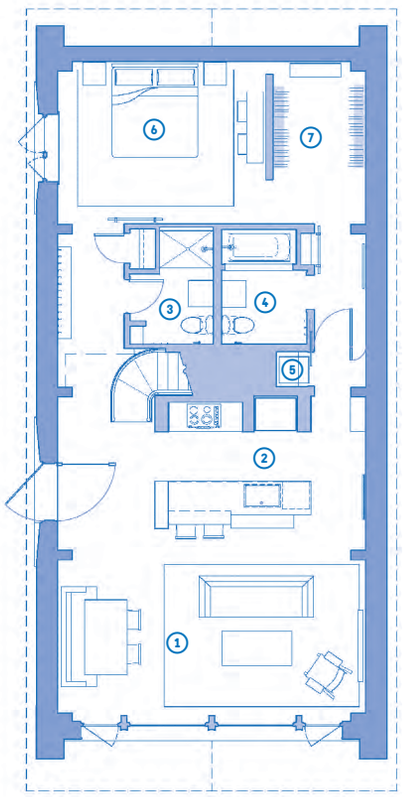
The building envelope is completed with an insulated concrete slab and high-performance triple-glazed windows that were constructed with careful attention to continuous thermal breaks, to ensure minimal heat loss. In this climate, in which keeping the house warm in winter is the main consideration and the bulk of the solar access is from the south, the designers were particularly careful to choose window units with a high solar heat gain coefficient (SHGC) for the floor-to-roof-peak south-facing glazed wall.

Within this carefully engineered building envelope, Wedlick designed an airy and functional living space of around 145 square metres. On ground level, the service areas of kitchen, bathroom, ensuite and laundry cupboard are placed in a central core, allowing plumbing efficiencies and minimal heat loss from hot water pipes. Tucked behind this core is the main bedroom and walk-in wardrobe. At the southern end, a full-height 'great room' for relaxing and dining takes full advantage of the wall of windows looking out to the surrounding woodland. A second level extends over the rear half of the space: a study area overlooks the great room and leads to two small bedrooms under the sloped roof.

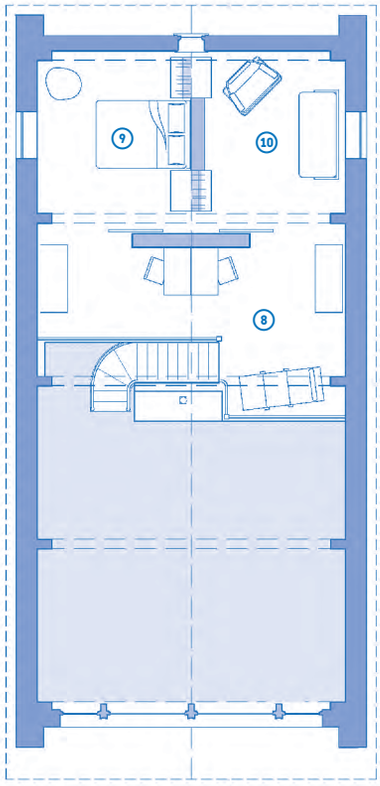
The concrete slab was polished and left exposed to act as important thermal mass for the home, helping to regulate the internal temperature. The lower walls were lined with Southern Yellow Pine to match the beams, and the upper walls and ceiling were finished with sheetrock in a neutral colour. Built by Bill Stratton Building Company, a local green builder, the house took only four months to be substantially completed, and the results have exceeded everyone's expectations.

The house achieved a depressurisation test result of only 0.15 air changes per hour, well under the Passive House Standard's requirement →

The designers saw the project as “a chance to prove that significant energy conservation could be achieved through architecture alone”.



GROUND FLOOR



UPPER FLOOR

LEGEND

1. Great room
2. Kitchen
3. Bathroom
4. Ensuite
5. Laundry cupboard
6. Main bedroom
7. Walk-in wardrobe
8. Study
9. Bedroom
10. Bedroom

of 0.6. While such air-tightness is excellent for heat retention, it's still important to ensure the internal air is kept fresh; to do this the Hudson house is fitted with a heat recovery ventilation (HRV) system that captures heat from outgoing air and passes it to incoming fresh air. It works in summer to cool incoming air, too.

Modelling estimated that the home would use around 12 kilowatt-hours of heating energy per square metre annually (the PHS specifies a maximum of 15), which Wedlick calculates represents a reduction of 90 per cent over a conventional New York State house of a similar size. As it turned out, although two small heat pumps and a baseboard heater were installed, the house's passive solar design performed so well during the first winter they were not needed. As for the PHS requirement of a total specific primary energy demand of under 120 kilowatt-hours per square metre per year, the house averages 109.

It's not only on a technical level that the house is appealing. Although it was built as a 'trial of concept', the builder and his wife fell so in love with it during the construction process that they have now moved in. Along with the home's efficiency, they particularly like the flow of the space: the way it incorporates soaring loft-like areas and private spaces.

And the take-home message? As Wedlick and his team learned: "Going 'passive' is not only eminently doable, it is a meaningful response to the energy crisis facing our nation." And, it seems clear, every nation.

The polished concrete slab floor is one part of the house's passive performance, acting as thermal mass to regulate the internal temperature. It's insulated from the ground underneath with a 30 centimetre thick layer of extruded polystyrene (XPS).

Upstairs, two rooms tucked under the sloped roof can be used as bedrooms or quiet retreats. The skylights are designed to open from the top for the views, or to pivot to allow for easy cleaning.

Hudson Passive Project

—Specifications

Credits

DESIGNER
Dennis Wedlick Architect LLC
www.denniswedlick.com
www.hudsonpassiveproject.com

BUILDER
Bill Stratton Building Company

PROJECT TYPE
New build

PROJECT LOCATION
Claverack, New York, USA

SIZE
House 145 sqm; land 3 ha

Sustainable Products

HOT WATER
– Stiebel Eltron Tempra 29 Plus electric tankless water heater

WATER SAVING
– Centrally-located interior core for the bathrooms and kitchen reduces length of hot water pipes and thus water and energy wastage
– Water saving plumbing fixtures

PASSIVE HEATING & COOLING
– Superinsulation, air-tightness and design for passive solar gain allows the home to be heated by the sun, occupants' body heat, appliances and lighting without an active heating requirement
– In summer, eave overhangs provide shade and insulation keeps the interior cool
– Compact and efficient layout and use of space

ACTIVE HEATING & COOLING
– Two Mitsubishi Mr Slim heat pumps and a Cadet electric baseboard heater were installed, but were not required by the occupants during the house's first winter

BUILDING MATERIALS
– Structure: five glue-laminated Southern Yellow Pine buttresses
– Walls: 31cm expanded polystyrene (EPS) structural insulated panels (SIPs), and roof: 31cm BASF Neopor SIPs containing graphite for greater insulation
– Slab: 15cm thick concrete, 25cm thick at perimeter, insulated underneath with 30cm of extruded polystyrene (XPS)

WINDOWS & GLAZING
– Serious Windows 725 series triple-glazed window units
– Roof: Fakro FPL PreSelect top-hung and pivoting skylights
– Thermal breaks wherever possible

LIGHTING
– LEDs from Philips Lighting

PAINTS, FINISHES & FLOOR COVERINGS
– Benjamin Moore paints

OTHER ESD FEATURES
– Zehnder ComfoAir 200 heat recovery ventilation (HRV) system has a heat recovery efficiency of 92 per cent.