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SOLUTIONS Huck Fairman

Pennington architect designs passive houses

Pennington architect Douglas Schotland grew up in Hopewell and Montgomery and graduated from The Lawrenceville School before going on to college and architecture school. Now he offers, among a range of architectural services, designs for passive houses.

These are not homes that will accept any abuse or neglect a homeowner dishes out, but rather are homes conforming to construction standards set by the Passive House Institute US and carefully designed to be extremely energy efficient, saving 60-70 percent of overall energy costs, and 90 percent space heating costs, and this is without applying solar powered or geothermal heating and cooling systems.

With these significant savings, passive houses can present an important, sustainable, money saving alternative to both conventionally heated and cooled homes and to houses using solar or geothermal systems. To glean the full benefits of this concept, a house must be designed to include many of the features that contribute to a passive house's high energy efficiency.

What are these features? First, the goal in designing a passive house is to minimize energy losses and maximize energy gains. To minimize losses, air-tight construction is required along with "superinsulation." To build this "shell" around the primary living space, walls are designed to be as much as three times thicker (up to 17 inches thick) than conventional walls. Additionally, the house sits on a concrete slab (basement or not) which in turn rests on a 15-inch-thick layer of rigid foam insulation separated by a sheet of polyethylene. The walls are in fact several layers that include the siding, an air barrier, cellulose insulation, another air barrier and the interior wall. The roof insulation is also 17 inches thick, substantially more than

average. This is a key improvement because in traditional houses most heat escapes through the roof.

In addition, passive house windows are triple-glazed to minimize heat loss. And coated glass helps reflect heat back into the house while reducing the amount of summer heat entering.

A third part of the strategy to minimize energy loss is to eliminate or reduce the number of thermal bridges, that is, framing and other components that reach between outside and inside without insulation or additional layers, allowing the cold or heat to be transferred. Also, the location, number, and construction of windows should be calculated to contribute to the overall house efficiency, and the largest windows should face south. Finally, all potential air leaks should be eliminated during construction.

When all these steps have been incorporated in a design to minimize heat loss, the next phase of design is to include means for capturing (maximizing) naturally occurring heat, from the sun, from within the earth, and from within the house itself (such as cooking or even people) Again, and first, a house's primary side, and its largest windows, should face south so that it can avail itself of passive solar energy coming through those properly glazed windows. A roof overhang should be considered in terms of either shading sunlight in the summer, or allowing it in during the winter months.

Within the house, certain materials for counters and floors (tiles, concrete, stone) or other interior structures or furniture, have better "thermal storage capacities." In short, they absorb the heat brought into the house from the several sources. The PHI recommends five to six thermal storage surfaces per room.

Rather than a conventional furnace to heat the house and air-conditioning to cool it, a smaller unit — a heat exchanger, or fresh-air furnace — is installed. It is significantly cheaper to buy and run (using only a small amount of electricity) and requires reduced ductwork, which fits into the thick walls. The exchanger continually

draws in fresh air from outside, piping it to main rooms, while drawing stale air out.

But in doing so, it transfers the inside warmth to the incoming fresh air, thus preserving that heat to be then circulated through the house. It is possible to boost the system's efficiency by routing the fresh air through "earth tubes" 10 to 12 feet below grade before it enters the heat exchanger. The earth's relatively stable temperature pre-heats the air in winter and pre-cools it in summer.

To heat the house's hot water, a roof-top solar thermal system is included and is supplemented by an electric- or gas-fired water heater for extra cold or cloudy days. This hot water, when connected to the fresh air system via coils, can provide valuable space heating. A photovoltaic solar array can be installed and combined with a net-metering system to help offset electric power costs.

It is estimated that passive house construction costs are 10 percent higher than normal house construction. It is therefore recommended that a prospective passive house owner plan to occupy that house over time, if the owner wants to pay off the construction premium through energy savings. Adding solar panels or geothermal heating can further reduce energy cost and even produce income.

But there are other benefits to living in a passive house beyond savings. By controlling and exchanging the house air continuously, the passive house avoids poor interior air quality, excessive moisture and mold. The air feels comfortable and fresh, and the house uses far less fossil fuel (for electricity) and is thus thoroughly green.

Additionally, the super-insulated and thermal bridge-free construction ensures that interior surfaces — even windows — are warm to the touch on the coldest winter day.

LEED and Energy Star are two programs that aim for at least 15 percent energy efficiency improvements over conventional houses. Passive houses can achieve up to 80 percent more energy efficiency. With fossil fuel energy prices likely to rise over the foreseeable future, that efficiency can result in substantial savings. Depending on the

state the passive house is located in, these energy savings may make it eligible for rebates, no-interest loans for 10 years, and federal tax write-offs.

There are many benefits to building a passive house, and Douglas Schotland can provide further information on this innovative approach to house construction. It should be noted that while this idea is a relatively new in this country, Europe is far ahead in passive building construction, with some 25,000 certified structures completed. Now, as energy cost increase here, along with awareness of the problems of high CO2 emissions, many New Jersey residents, businesses and institutions are exploring, building and installing alternative systems.

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Huck Fairman is a local writer who in the course of researching another project was confronted by the overwhelming evidence that we are changing the earth's environment. And that will affect life as we have known it. He hopes to present the many good local responses to this situation that are already underway.