The Oil Drum: Campfire

Discussions about Energy and Our Future

US Housing and the Passive Home Standard

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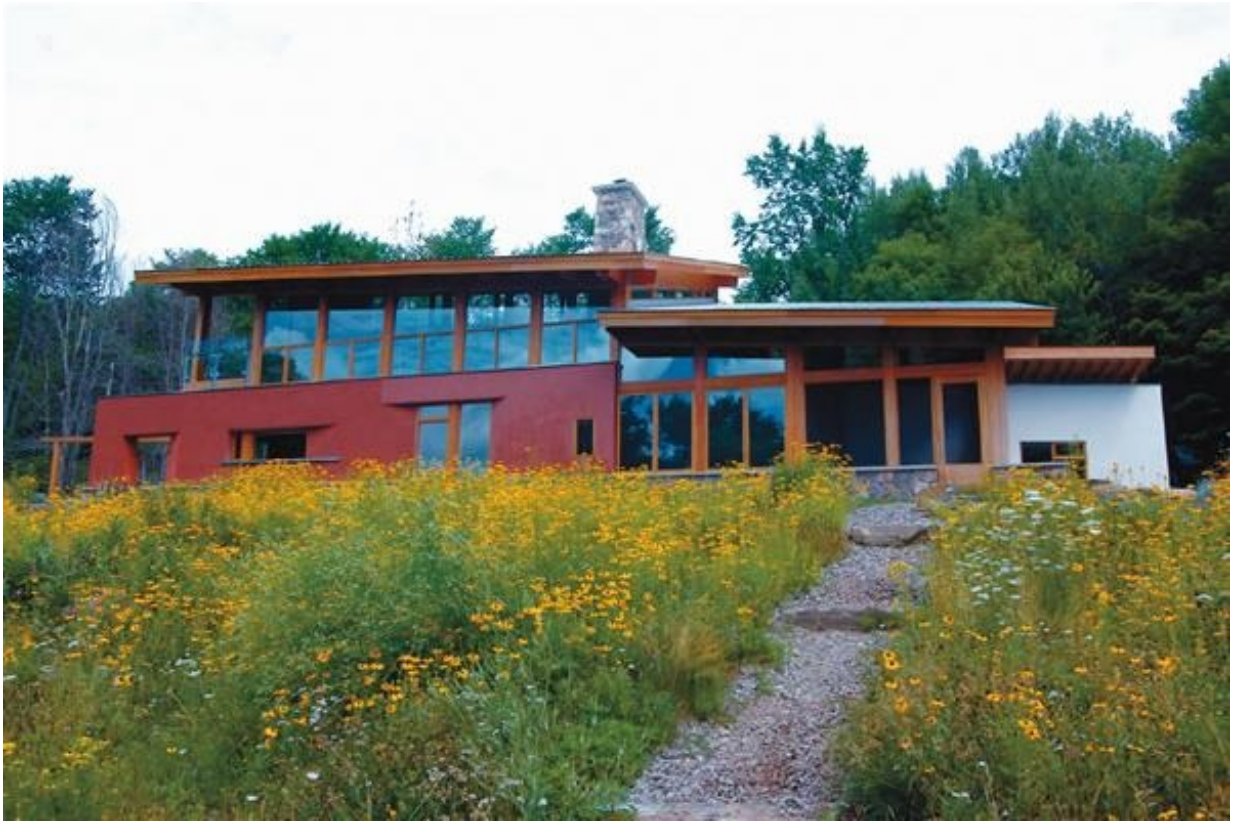
Earlier this week we had a post on Passive Solar by Will Stewart. Today we have another post on Passive Solar Houses by TOD poster, Majorian, giving an overview of how much energy can be saved by building passive solar homes.



US Housing and the Passive House Standard

In 2000, almost 20 quads of primary energy, about 20% of US total energy consumption, was used for US residences. This is approximately the same amount of raw energy as was produced by all US coal mines in that year. About 1/3 of the 20 quads used is US residential construction came from coal via electricity.

In 2000, 60% of all US households lived in single family detached houses, serving almost 70 million households. By contrast, 20 million households (17%) lived in apartment buildings of 5 or more units and 10.5 million (10%) lived in apartment buildings of 2-4 units. The remainder were located in townhouses (single family attached) and mobile homes. At the 2005 peak the industry

was producing over 2 million units per year.

These facts suggest that regardless of falling home prices and wages, the need for housing continues to grow. It is also apparent that the age of the housing stock is growing particularly in urban areas; as much as half of the housing stock in a typical city is over 40 years old. Older buildings can be more than 33% less energy efficient than a new buildings of the same size.

How can we make up the shortfall?

People could rent rooms assuming there aren't zoning conflicts. More multifamily apartment buildings can be built though these are restricted by zoning ordinances as well. There's also the fact that people prefer single unit housing over apartment living. Therefore the amount of new single family housing units is certain to grow in the near future.

There is also Stuart's hypothesis that people will tend to live in larger families, reversing the move from people living alone or in small nuclear families to more extended family co-habitation.

How can we significantly reduce our energy demand of our housing per unit?

We can significantly reduce our energy demand per housing unit by raising the energy standards, by building more apartment buildings and by phasing out old inefficient units. An Energy Star certified home would reduce energy consumption by 15% over a conventional home.

A LEED certified home would reduce consumption significantly depending on the level of LEED certification and the points that the builder chooses to focus on. There are several levels of LEED certification, and the credits can be applied across any number of areas (energy consumption, water reuse, materials resources, etc.).

A DOE 'zero-energy' home would reduce consumption by 70%.

Can we do better?

The Passive House Standard home is +90% more efficient than a new conventional home, without relying on PV solar arrays and passive solar space heating.

What is the Passive House Standard?

In 1988, Dr. Wolfgang Feist and Professor Bo Adamson began developing the concept of a building so tight and well-insulated that a building heating system would not be required. The result was the world's first Passive House prototype. The house was built at Darmstadt Kranichstein in Germany in 1990, and was designed to meet a specific standard of 15 kwh (kilowatt-hours) per m^2 (meter squared) per year for heating; 15 kwh per m^2 per year for cooling; 120 kwh per m^2 per year for the overall consumption of primary energy; and air tightness to 0.6 air changes per hour. The overall consumption requirement ties residential energy consumption directly to the issues of carbon footprint and Peak Oil. The Standard conforms to the goals of the Swiss 2000 Watt Society. There is also a Passive House Standard for multifamily housing.

This represents a 90% reduction in energy consumption over a new conventional house; a 1600 square foot house could be heated by a 1500 watt hair dryer!

The idea is to reduce energy consumption as much as possible before incorporating solar technologies such as photovoltaics or solar heating. The exception is for solar panel domestic hot water heating because in such a well insulated house this becomes the greatest heat demand, and it needs to be reduced to meet the 120 kwh per m^2 per year restriction on energy use.

The first step is to correctly design the residence to meet the Standard, and that can be a real challenge depending on the local climate. It is one thing to build a Passive House in Oakland, California and quite another to build one in Duluth, Minnesota or Orlando, Florida. All the thermal bridges in the building design must be found and minimized, exterior insulation must be made continuous, and the whole envelope must be made practically airtight. The foundation can be particularly difficult to insulate.

These buildings typically are geometrically compact to minimize the surface to volume ratio. Balconies are independently supported to reduce cantilevers which compromise the thermal envelope. Basements are either eliminated or serve as unheated storage only.

The various high efficiency appliances must be carefully selected as they will be a source of potential overheating and will exceed the primary energy requirement of the Standard.

The Passive House consultant will do a takeoff from the building plans and input the appropriate data into the Passive House Planning Package (PHPP) to find out whether or not the design conforms to the Standard. Typically, this may be done a number of times before the building design actually passes.

You may be surprised to find out that these houses are generally no more expensive to build than conventional houses. The major hurdle is finding a contractor who is capable of building these precision designed structures and who can obtain the Passive House certified elements, particularly the super-insulated windows, the super-efficient ventilator, and high efficiency solar water heating panels. Once completed, before it becomes a certified Passive House, the house must undergo thermal image inspection and a blower door test to verify the construction.

Passive House is a European standard and the Europeans live in significantly smaller homes, use fewer gadgets, use less hot water, have less 'stuff', etc., so owning a Passive House is definitely a lifestyle statement and demonstrates a commitment to energy conservation. Certainly well-off individuals have built large houses to the Standard, but the idea of putting a large cooking hood or a sauna inside a Passive House would violate the principle and would almost certainly cause the house to fail the certification process.

In Europe, a Passive House represents a level of superior comfort. The quiet interior environment features warm walls, fresh air, no drafts, reduced levels of dust and a surprising amount of natural light. Over 10,000 Passive House Standard buildings have been constructed as of 2007.

Why should you choose a certified Passive House over other standards?

Passive House is a measure specifically designed to minimize overall energy use and to minimize the building's carbon footprint. The designation also serves as a guarantee of low future building

energy costs assuming the building is not modified after being certified.

[Editor's note: What's a better marketing term than "Passive" for extremely low energy input housing?]