Meeting Passive House Standards with SIPS

by James Hodgson

Developed in Germany during the mid 1990s, Passive House (or Passivhaus) design criteria target an aggressive 90% reduction in a building's heating energy consumption compared to typical building methods. This includes commercial and institutional buildings, as well as homes. Structural Insulated Panels (SIPs) made of expanded polystyrene (EPS) and Oriented Strand Board (OSB) can provide the tight building envelope and superior insulation required by the Passive House criteria, as well as meet the design needs of other highly energy-efficient buildings.

Under the Passive House standards, designers approach the building's heating and ventilation needs in a comprehensive, systematic fashion that minimizes energy losses and maximizes energy gains. They achieve this by boosting the insulation, sealing air leaks and eliminating thermal bridging, while using passive solar heat and captured heat from people and equipment. As a result, a Passive House may not even need a furnace.

While other green building rating systems include energy efficiency elements, what sets Passive House apart is a zealous attention to virtually every building component, system and siting decision that influences energy consumption. A Passive House Planning Package (PHPP) – an energy modeling program – evaluates a building's materials and type of construction, orientation and local weather conditions, among other factors.

While Passive House buildings are still rare in the United States, more than 15,000 single-family homes, multifamily residences, schools, offices, and other buildings have been built or remodeled in Europe.

Passive House performance characteristics, as called for by the Passive House Institute U.S. (PHIUS), are:

- An airtight building shell with less than 0.6 air changes per hour at 50 pascal pressure, measured by a blower-door test
- Annual heating requirements less than 15 kWh/sq m/year (4.75 kBtu/sf/year)
- Primary energy use less than 120 kWh/sq m/year (38.1 kBtu/sf/year)

Depending on the climate additional recommendations include low U-value windows, energy-efficient ventilation systems with heat recovery, and construction free of thermal bridges.

Although Passive House standards do not require SIPs, the panels support the design goals and performance characteristics very well. The large size panels have fewer gaps needing sealing than other construction methods (especially compared to stick framing) and reduce thermal bridging. Because the insulation is integrated directly with the structural elements, it is continuous throughout the panels, and is produced within a controlled setting, it tends to perform much better than is possible with components built and installed separately on the job site.

Research on EPS core SIPs conducted by the USDOE's Oak Ridge National Laboratory underscores these points.

In blower door tests, the lab found that a SIP room was 15 times more airtight than one built with conventional wood framing (leakage rate of 8 cubic feet per minute at 50 pascals compared to 121 CFM50).

The lab's research also showed that SIPs outperform stick construction in whole-wall R-values, taking into account the entire wall assembly, including heat transfer through the structural members, at corners and other joints, and around windows. For walls of similar thickness, SIPs had approximately 47% greater resistance to heat flow (R-value of 14.09 for a 3.5-inch-thick foam core SIP compared to an R-value of 9.58 for 2x4 stud framing at 16 inches on center with fiberglass insulation).

Real-world applications of SIPs in a wide range of climates over several decades also support the lab's findings. Among such projects, Premier Building Systems has been working with several project teams that are designing and building Passive Houses with SIPs.

In a high-end custom home in Park City, Utah, 12-inch-thick SIP walls provide an insulating R-value of 48 compared to an R-value of about 19 for a typical wall built with 2X6 studs with fiberglass batt insulation. The SIP roof is also 12-inches-thick, with four additional inches of EPS attached, for an R-value of 68.

A more modest Hood River, Oregon, home meets the Passive House criteria in part with R-value 42 SIP walls and an R-value 60 SIP roof. The architect estimates that the total annual energy costs (not just heating and cooling) will be only about $185 per year – much lower than typical for that part of Oregon.

In Menlo Park, California, plans are underway for what is believed to be the Bay Area's first Passive House. The project team anticipates that the SIP home will be so well insulated that its heat exchange unit will require a filament only about the size of that found in a common hair dryer.

Whether Passive House standards will take-off in a big way remains to be seen, but building codes and homeowner/building owner preferences are increasingly driving demand for energy-efficient buildings. As a result, more design professionals are looking to advanced building methods such as SIPs to create high-performance building envelopes.

James Hodgson is the general manager for Premier Building Systems. ■

Additional Resources

Passive House Institute
http://www.passivehouse.us/passiveHouse/PHIUSHome.html

Our Passive House
http://www.ourpassivehouse.org

Passivhaus Institut
http://www.passivehouse.com

Cost Efficient Passive Houses as European Standards
http://cepheus.de/eng/index.html

THE CUTTING EDGE

Insulation materials have long been recognized for their energy efficiency. After all, that's their primary function. Now, a new era of energy policy is driving the demand for increased efficiency. Incentives from all levels of government, as well as local utilities, are raising the awareness, desirability and affordability of energy-efficient homes and buildings. The U.S. Department of Energy (DOE) has introduced its Weatherization and Intergovernmental Program that provides grants, technical assistance and informational tools to states, local governments and utilities for their energy programs. These programs coordinate with national goals to increase the energy efficiency of the economy and aim to increase the adoption of cost-effective and efficiency technologies that will result in lower energy bills, improved air quality and greenhouse gas reduction.

Expanded polystyrene (EPS) meets these new energy policy demands, whether used to increase the efficiency of the average home, multifamily structure or commercial building. This issue of *EPS Newsline* presents several insulation related studies that show EPS products can help reduce energy consumption and contribute toward a sustainable future. One feature explores how EPS meets stringent Passive House criteria, while another examines an Oregon life cycle analysis that determines how EPS provides superior energy efficiency gains. Finally, another piece examines how students at Montana State University are utilizing EPS in an Ecosmart house that will serve as a real world source of data to help meet green building certification standards.

To find out more about EPS insulation products visit our website at www.epsmolders.org. ■

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