
Industrial Revolution

Every home makes compromises among different and often competing goals: comfort, convenience, durability, energy consumption, maintenance, construction costs, appearance, strength, community acceptance, and resale value. Often consumers and developers making the tradeoffs among these goals do so with incomplete information, increasing the risks and slowing the adoption of innovative products and processes. This slow diffusion negatively affects productivity, quality, performance, and value. This department of Cityscape presents, in graphic form, a few promising technological improvements to the U.S. housing stock. If you have an idea for a future department feature, please send your diagram or photograph, along with a few, well-chosen words, to dana.b.bres@hud.gov.

Structural Insulated Panels: An Alternative to Wood Frame Construction

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Abstract

For years, the status quo for the construction of a single-family home has been wood frame construction, commonly called “stick framing” because of the dominant use of 2 by 4 lumber. Wood frame construction has served the homebuilding community well, but alternatives are beginning to capture market share. One alternative, structural insulated panels, provides energy efficiency and structural strength advantages over conventional wood frame construction.

The Status Quo

The typical American home is built on site. The crew frames the walls using dimensional lumber (typically 2 by 4 or 2 by 6). This method of construction is time consuming and can leave the structure of the home exposed to the elements for an extended period of time.

The status quo for wood frame construction in homes has several disadvantages. Wood frame construction—

- Has lower energy efficiency as measured by the R-value (the common measure of insulation effectiveness).
- Is a time-intensive process—it can take weeks for a home to be placed under roof.
- Requires installation by a skilled framing crew.
- Needs additional strengthening for homes built in high-wind and seismic areas.
- Uses a significant amount of timber resources.

Structural Insulated Panels

Structural insulated panels (SIPs) consist of a thick layer of foam (polystyrene or polyurethane) sandwiched between two layers of oriented strand board, plywood, fiber cement, or other cement board, which creates web-and-flange structural strength across the panel. SIPs can handle axial, bending, racking, and shear loads, and they easily replace conventional framing. SIPs are widely used for wall and roof framing, and some manufacturers also provide floor panels.

Typically, SIP wall panels are 4 to 24 feet wide and 8 or 9 feet high, made in standard thicknesses of 4 ½ to 6 ½ inches. The foam core is typically held back from the edge to allow the panel to accept 2 by 4 top and bottom plates. Thicknesses of up to 12 inches are available for roof panels, where greater R-value is needed. The core material of thicker panels usually corresponds to standard lumber dimensions, so board stock may be used for splines and plates. Panel lengths can vary to accommodate higher ceilings or roof spans up to 24 feet.

HUD assisted in an effort to include SIPs in the model residential building codes. This effort was similar to HUD's earlier support of insulating concrete forms and light-gauge steel framing code development. As a result, SIPs can be used more easily in residential construction.

Benefits

SIPs can be used in place of wood framing for most above-grade situations, including the roof. SIPs can be placed on slabs, basement walls, or crawlspace walls. Possible benefits of SIPs over wood framing include the following:

- Increased affordability by reduced labor due to ease of installation, minimal learning curve going from traditional materials, and fast assembly and erection.
- Increased energy efficiency by increased insulation (R-value) and reduced air infiltration.
- Improved environmental performance by reduced use of dimensional lumber and minimized waste.
- Improved durability by increased high-wind resistance.

- Decreased inspection time for some designs of SIP homes, for which the ENERGY STAR program recognized the performance of SIP construction by eliminating air infiltration testing requirements, substituting a visual inspection instead.

Exhibit 1

Structural Insulated Panels Provide Energy Efficiency and Structural Strength



Manufacturers

A number of manufacturers produce SIPs. The choice of which SIPs to use will be based on local availability, cost, and installers' familiarity with the system.

Sources

ToolBase TechSpecs: Structural Insulated Panels at <http://www.toolbase.org/Technology-Inventory/Whole-House-Systems/structural-insulated-panels>.

Additional Information

The PATH (Partnership for Advancing Technology in Housing) Technology Inventory on the toolbase.org website provides information on the use and sources of SIPs.

Author

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