INSULATION

Overview: Many existing U.S. homes are not insulated to the optimum level. Adding higher insulation levels will most certainly reduce heating/cooling costs. Often times it will save enough money in reduced energy costs to pay for itself within a few years. After the "pay back," the insulation continues to save money for the life of the home. It also increases the resale value of a house, and, of course, increases comfort.

Proper insulation saves money and our planet's limited energy resources. It also makes homes more comfortable by helping to maintain a more stable mean radiant temperature and air temperature throughout the house. Walls, ceilings, and floors will be warmer in the winter and cooler in the summer. Insulation also acts as a sound absorber/barrier, reducing noise pollution.

Heat Flow & R-values: Heat flows naturally from warm to cool. In the winter, heat moves from all heated living spaces to adjacent unheated attics, garages, basements and to the outdoors: wherever there is a difference in temperature.

Insulation is rated in terms of thermal resistance, called R-value. By installing more insulation you increase the R-value, therefore increasing the resistance to heat flow.

Installation: The effectiveness of an insulated wall or ceiling depends on how and where the insulation is installed. For example, fiberglass insulation, when compressed, will not give the full rated R-value. Insulation only performs to its R-value (i.e., insulation level) if it is properly installed. Fiberglass batts that have been crushed and compressed into the wall spaces will not provide an optimal level of thermal control. According to the Energy & Environmental Building Association (EEBA)™,

Improper installation can result in a 60% loss of batt insulation's effectiveness. It only works if the insulation is touching on ALL four sides and there is no air leakage or gaps for convective air loops.

Types of Insulation:

Fiberglass- Fiberglass is the standard cavity insulation in North America. It is inexpensive, fire-resistant, inert and bugs avoid it. The R-value runs about R-3 per inch. However, fiberglass provides very little reduction of air leakage, so cracks must be sealed before installing most fiberglass insulation products.

Fiberglass is made primarily from sand and glass. Related products such as mineral wool (minerals) and slag wool (iron ore) are non-combustible and do not absorb water. These products will return to their original R-value after drying. Mineral and slag wool do not support the growth of mold and mildew.

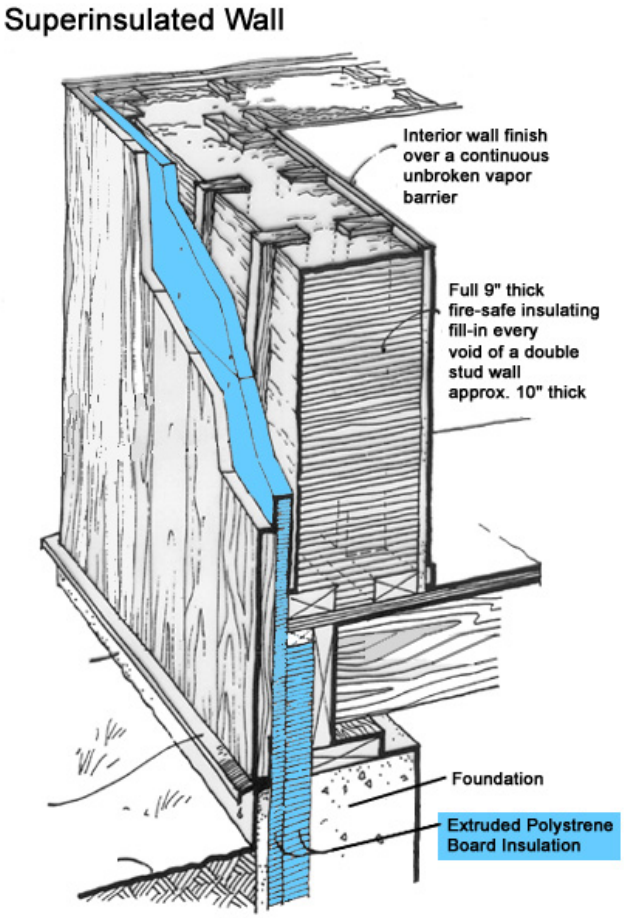
Fiberglass comes in solid board, blankets or batts. Some board varieties are good for wrapping the exterior of foundation walls because they drain water vertically. Blankets and batts fit in floors, walls and ceiling cavities. Fiberglass can also be blown as a loose fill insulation into walls, behind drywall and in attics. Blown in blankets (BIBs) are a denser product that fills cracks and reduces convection. It also can be packed around pipes and ducts. There are health hazards related to fiberglass insulation. It must be installed with gloves, a respirator and other protective clothing. For more general information about fiberglass insulation health hazards see: http://www.sustainableenterprises.com/fin/

Cellulose - Cellulose insulation is made of recycled newspaper and is generally considered a "greener" insulation. However, some natural house builders argue that the fire-retardant that is added is toxic. Dry cellulose comes in loose form and can help reduce air leakage since it can be blown into difficult to reach spaces. The loose or blown-in type has an R-3.2 per inch. It may settle and leave voids in cavities. Wet cellulose is "wet" with water and glue. It is blown into open wall cavities and has an R-value of 3.5 per inch. The excess cellulose is shaved off flush with interior framing. It can be more expensive than fiberglass or dry cellulose. *The Cellulose Insulation Manufactures Association* is the comprehensive authority on consumer information: www.cellulose.org.

Cotton - Cotton insulation is non-toxic, biodegradable, and "friendlier" to install. It can be more expensive than more commonly used fiberglass or cellulose insulation. Made from recycled textile scraps, some cotton insulation is actually made from old blue jeans! The roll and batt insulation is approximately 95% post-industrial recycled fabrics, 25% of which is polyester fiber. The polyester improves strength and recoil characteristics of the product. The fabrics are treated with a non-toxic flame retardant, which is absorbed into the fibers.

Polystyrene – Polystyrene (Styrofoam) is a molded synthetic used as a rigid board insulation. This common place, molded synthetic is an excellent insulator, however it is somewhat expensive and flammable. It is manufactured in two ways: Extruded Polystyrene foam (XPS) has fine, closed air pockets, containing a mixture of air and refrigerant gas. Expanded Polystyrene (EPS) is molded or expanded, which produces coarse, closed cells containing air. (The ubiquitous styrofoam coffee cup is EPS).

Both types of polystyrene insulation have the advantages of a reasonably high R-value per inch, good moisture resistance. Polystyrene is usually sold in 2x8 and 4x8 panels. It is applied as sheathing and not typically used as“in cavity” insulation. Some panels are free of CFC's, HCFC's, HFC's and formaldehyde.



Both XPS and EPS are commonly used on above grade framewalls. XPS is recommended for below grade (underground) applications. It is much more impervious to moisture. Both XPS and EPS should not be left exposed to sunlight because UV light will degrade styrofoam. Metal flashing or stucco is often used to protect these styrofoam board insulations from sunlight. It's also used to insulate roofs where there's no attic space (for instance, vaulted ceilings or wood decking roofs). There they are sometimes sandwiched between two layers of sheathing above the roof framing. Thickness ranges from 3/4" to 12", with an R- value of 5 per inch.

Structural Insulated Panels (SIPs) - SIPs are examples of manufactured building systems that incorporate styrofoam (EPS). They provide superinsulation in exterior walls and roofs and eliminate the convective stud-cavity. SIPS are a strong structural system consisting of expanded polystyrene (EPS) insulation laminated on both sides to oriented-strand board (OSB) forming a solid structural panel. Panels are available in 4' x 8' to 8' x 24'. Standard panels come in different thickness and R-values. The panels fit on conventional solid wood, which is set in place on the floor slab, framed subfloor and roofs. Within a short time the building shell can be closed in. Roofing and siding materials are conventionally applied to the exterior faces. Interior and exterior finishing applications are simplified by the continuous wood surface.

(SIPS Panels)

Insulated Concrete Forms (ICF) – Forms made of Expanded Polystyrene (EPS) create a cavity for concrete. The two faces of 2" or 2 1/2" EPS achieve R-values of 18.3 to 22.5 for the wall system. The system remains in place after the concrete is poured, serving as a monolithic wall, insulation, and facing material. Floor and roof assemblies are connected to the wall in a similar way to any poured concrete wall. There are many different types of ICFs for use either above or below grade in any type of construction. The system snaps together and is very popular, though natural house building advocates point out that the poured concrete core is an energy intensive and environmental destructive material. ICFs are popular below-grade foundation systems because of their strength and they can reduced the concrete content compared with conventionally formed concrete walls/foundations. ICFs will need to be water-proofed in below-grade applications.

A desirable insulation feature of both SIPs & ICFs is the continuous nature of the insulation. With either system, there is little thermal bridging because there are few thermals

breaks. These engineered building systems are solid and have no cavity convection. Typically, they also have no need of additional air or vapor barriers. To learn more about SIPs in general, visit the Structural Insulated Panel Association at www.sips.org.

Polyurethane and Polyicynene - Polyurethane or 'urethane' and Polyicynene are spray-in, expandable foam insulations. They go in the walls after framing as a foam, and can expand to many times their initial size, filling in the cavity completely and forming a permanent air seal with an approximate R-value of 5 to 6 per inch (approx. R-20.9 in a 2x6 exterior wall). Polyicynene is modified urethane foam and is the only water-based insulation foam on the market. You can buy polyurethane foam in aerosol cans from your local hardware store, and it now comes in low-expansion formulas making it a good weatherization product for larger cracks and holes.

Some products have no detectable emissions, with no formaldehyde, CFC's or HCFC's and may be safe for some chemically sensitive people. However, during installation, it does give off an ammonia gas, which disappears quickly when ventilated. Other products use a freon base to blow the foam. Polyicynene uses steam and carbon dioxide, by-products of the water boiling off. (It's therefore claimed that there is no environmental danger to the ozone layer.) Both materials will eventually deteriorate with exposure to sunlight, so they should be covered (with paint or stucco) when exposed to direct sunlight. Polyicynene expands and sets within five to ten seconds whereas Polyurethane takes much longer to set.

Air Krete™ - Air Krete™ has been on the market since 1983. It is a foam product that must be installed by trained applicators. It is roughly the consistency of shaving cream when put in place, and quickly becomes more rigid. While it is easier to install it in an existing wall by injecting it into holes drilled in the siding, it can also be used in new open cavity construction. The R -value of Air Krete is approximately 3.9 per inch and dramatically reduces air leakage and does not shrink.

Unlike other synthetic foam products, Air Krete™ is a cementitious material. This means that it is more closely related to concrete than to plastic. As a result it is almost completely odor free. In fact, it is being promoted as being non-toxic, since it contains "no formaldehyde or any other known toxic substances." For more information see: http://www.airkrete.com/. Air Krete is more expensive than other foam insulations and is generally used in specialty applications.

Information from Solar Energy International (www.solarenergy.org)