Fact Sheet EES-25

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Insulation: Selection and Installation[1]

Gary D. Cook[2]

Much too often, a building designed to certain insulation value standards (R-value) will not perform as expected after it is built. Investigations have shown the most likely cause for this lower-than-expected performance is due to improper amount, selection, and/or installation of insulation.

SELECTION AND INSTALLATION

Proper selection and installation of insulation are very important if the theoretical R-value of the insulation is to be accomplished. Tests supervised by ASTM, Owens-Corning, and the University of Florida have shown that walls insulated with R-11 batts often performed at only R-7 or less because of shoddy installation techniques.

For example, an R-11 fiberglass batt will perform at less than R-5 if compressed to half the designed thickness (3 1/2 inches). Also, if insulation is blown or poured into an attic, it will not perform as expected unless it is evenly raked to the proper depth and density.

Gaps left around wiring, electrical outlet boxes, piping runs, and next to framing members create heat short circuits and convective thermal drafts. This causes a disproportionate degradation of insulation performance. In fact, research has shown that gaps in insulation within wall cavities amounting to only 3 percent of the total area will degrade the actual performance up to 20 percent.

It is important to seal the openings where wiring and piping run through floors and ceilings at the sole and top plates. In residential construction, up to 20 percent of infiltration heat-losses occur by not attending to this problem. There are a variety of caulking and foam products suitable for this purpose.

Installation of a vapor barrier, such as a 6 mil polyethylene plastic sheet, between the insulation and the living space is not recommended on the conditioned side of the walls and ceilings in Florida homes because water vapor may condense inside the wall cavity. If insulation such as fiberglass becomes wet from condensation, it loses its effectiveness. When this happens, mold, mildew, and damage to the wood members in the wall and ceiling may occur. Rigid closed-cell insulation, such as polyisocyanurate and polystyrene foam boards, are inherently vapor retarders, particularly if they are foil faced. These materials are very effective as exterior sheathing in addition to the structural requirements. A standard 2"x 4" stud wall with R-11 insulation batts and foam sheathing will provide a better insulation system than

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2. Gary D. Cook, Energy Extension Specialist and Assistant Professor, M.E. Rinker, Sr., School of Building and Construction, University of Florida, Energy Extension Service, Institute of Food and Agricultural Sciences, Gainesville.

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the use of a 2"x 6" stud wall with R-19 insulation batts alone, as the sheathing serves to insulate the studs and any gaps left in the batt insulation.

Certain considerations should be made in selecting the type of insulation for a particular application. For example, it is important that insulation selected for wall cavities will not shrink or settle with time. In the past, there were many cases where the initial performance of the insulation was excellent, but after a few years, performance declined considerably because of settling and moisture absorption. New manufacturing standards have now minimized these problems.

CELLULOSE INSULATION: A BETTER ALTERNATIVE

Use of blown dry or damp cellulose is becoming more and more popular because it has excellent insulating ability, cost is low, and it is made from recycled paper. (Cellulose insulation has an R-value between 3.3 and 3.5 per inch, about the same as fiberglass or rockwool insulation.) When cellulose was first used in the 1960s and 1970s, it was treated with a sulfate-based chemical to make it fire-resistant. This salt absorbed moisture from the air and became a weak acid, making the insulation less effective and causing it to slump and corrode surrounding pipes and metal.

All this has changed. New product specifications require the use of boron-based chemicals to make the insulation fire-retardant. These chemicals are more environmentally benign and have the additional benefit of repelling fleas, cockroaches, and many other insects. Cellulose insulation may also avoid potential air-quality problems linked to fiberglass and rockwool that is not encapsulated.

New techniques for spraying cellulose have made it an option for wall insulation. Blowing damp cellulose between wall cavities on the exterior sheathing provides for complete cavity filling— including around wires and piping. The excess can be scraped smooth and reused. This insulation should be completely dry before sheetrock is installed to prevent future mildew and moisture problems.

FIBERGLASS INSULATION

Fiberglass insulation comes in several forms: batts, blown, and boards. Blown insulation can be used in attic applications, while batts can be used in wall cavities and the attic, although blown insulation will give better coverage. Fiberglass boards are used in the construction of ducts and in certain heating, air conditioning, and ventilation applications.

Fiberglass should be selected and used with caution. The July 1994 issue of *Energy Design Update* indicated that glasswool will be listed as "reasonably anticipated to be a carcinogen" in Health and Human Service's *Seventh Annual Report on Carcinogens* (ARC). The use of fiberglass batts in wall cavities will probably pose no risk to occupants as it is reasonably confined or encapsulated by the exterior and interior sheathing. It should not be used as ductboard unless it is faced with aluminum foil or other mildew-resistant plastic coatings on both sides. When fiberglass ductboard is unfaced on the inside, it can pose moisture-related indoor air-quality problems as well as introducing a potential carcinogen into the home's air conditioning system. If the ductboard becomes wet, it can harbor mold and mildew, dust mites, and other contaminants, as well as reduce the effectiveness of the ductboard insulation.

Fiberglass is not recommended for use in the attic as it will expose the building occupants or workers to fiberglass particles if access to the attic is needed for maintenance or storage. Recent research by Oak Ridge National Laboratory has shown that fiberglass insulation in the attic is not as effective as cellulose insulation because of the capability of fiberglass insulation to support convective air currents. If an existing attic space has fiberglass insulation, either batt or blown, it can be made more effective and less risky by blowing a layer of cellulose insulation over it. This will increase the overall insulation value of the attic, encapsulate the fiberglass insulation, and reduce the possibility of convective air currents in the insulation system.

UREA-FORMALDEHYDE FOAM

After a two-year ban, urea-formaldehyde foam insulation (UFFI) is now allowed for use in residential application. Urea-formaldehyde foams must be mixed with great accuracy; otherwise, excess shrinkage and harmful, unpleasant fumes can occur. Only about 0.2 percent of the occupants living in the more than 500,000 homes with UFFI insulation have reported health-related problems such as headaches, eye irritations, and respiratory problems.

If unacceptable levels of formaldehyde fumes are determined to originate from UFFI, contact an

Table 1. Generic Building Insulation Comparison

Generic Insulation	R/inch	lb/ft^3	Advantages	Disadvantages
Batts and blankets				
Fiber glass	3.2	0.6-1.0	Low cost, noncombustible without facings, stable	Facings may be combustible, binders may burn, suspected carcinogen
Rock wool	3.6-3.7	1.5-2.5	Low cost, noncombustible without facings, stable	Facings may be combustible, binders may burn, suspected carcinogen
Boards				
Cellular glass	2.63	8.5	High compressive strength, noncombustible, impermeable to moisture, stable	High cost, low R per inch, freeze-thaw damage possible when in contact with water
Mineral fiber with binder	3.45	15	Provides structural support, fire resistant, stable	Moderate cost, modest R per inch, binder may be combustible
Polyurethane and polyisocyanurate foam	Unfaced: 6.2-5.8; Faced: 7.1-7.7	2.0	High R per inch, may provide infiltration seal, low moisture absorption, stable	Moderate cost, combustible (polyisocyanurate less so than polyurethane), nonstructural
Fiber glass	4.25	3.0	Good R per inch, low combustibility, good acoustical absorption, stable	High cost, binders may burn, suspected carcinogen
Expanded polystyrene foam	Extruded: 5.0; Molded: 3.9-4.4	0.8-3.0	Good R per inch, may provide infiltration seal, low moisture absorption, stable	Combustible, nonstructural
Insulating concrete	0.8-2.0	20-40	Noncombustible, can provide structural support, stable	Low R per inch
Loose fill				
Cellulose	3.2-3.7	2.2-3.0	Low cost, good R per inch, availability, environmentally friendly, repels insects	High moisture permeability and some absorption, may settle 0-20% if installed at too low a density.
Fiber glass	2.2	0.6-1.0	Low cost, noncombustible	Air and moisture permeability, may settle, suspected carcinogen
Rock wool	2.9	1.5-2.5	Low cost, noncombustible	High moisture permeability, may settle, suspected carcinogen
Perlite and Vermiculite	2.5-3.7	2-11	Low cost, noncombustible, stable	High moisture permeability
Foam in place				
Polyurethane/ polyisocyanurate	5.8-6.2	2	High R per inch, may provide infiltration seal, low moisture absorption	Moderate cost, combustible (polyisocyanurate less so than polyurethane), may suffer some shrinkage
Urea based mixtures	4.2	0.6-0.9	High R per inch, may provide infiltration seal	Moderate cost, combustible; improperly installed foam may shrink significantly and/or cause lingering formaldehyde vapors
Reflective insulation				
Two layer	R-5		Low-cost, non-combustible, can provide infiltration seal, low thermal mass, very effective as a radiant heat barrier	Dust on reflective surfaces may reduce performance, best when used with conventional insulation
Three layer	R-7.5			

Adapted from U.S. Navy's Building Material Compilation insulation contractor who may take or recommend certain steps to minimize the danger.

Table 1 can assist the builder and contractor in selecting the proper insulation for a job.

REFERENCES

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