Part I

Insulation And The Old House

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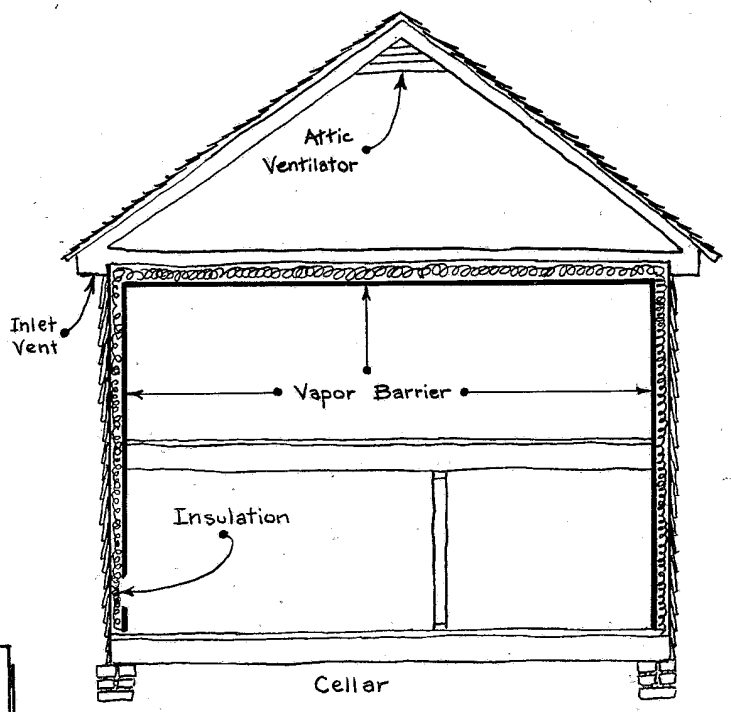
Installing insulation in an old house is not a simple task—especially in the walls. A badly done job will cause more problems than no insulation at all. In this article, the author reviews some basic principles. In Part II, he will discuss some problems peculiar to old houses.



Ideal location of vapor barriers, insulation and ventilation in a 2-storey house with full basement.

INSULATION'S JOB is to impede the flow of heat. In cold weather, you want to keep the heat inside; in hot weather you want to keep the heat out. Heat travels in three ways: By conduction, by radiation, and by convection. An effective insulation job takes account of all three.

CONDUCTION—Most heavy, dense materials are good heat conductors, e.g., metal, masonry, etc. Less dense materials, such as wood, are intermediate. Lightweight materials, such as fabrics, foamed plastics, spun fiberglass, etc., are poor conductors.

RADIATION—Heat travels through space, just as light does, by radiation. To block heat radiation, you need only insert an opaque material in the path of the rays. Most building materials—except glass—are opaque to heat radiation.

CONVECTION—Heated fluids, whether gases or liquids, rise and promote general mixing within the fluid. Thus, air convection helps to heat an entire room from a single wall "radiator" or baseboard convector. Convection is reduced by compartmenting and mechanically blocking fluid movement.

Insulation Values

EFFECTIVE HOUSE INSULATION has to do all three things: Conduct poorly, block radiation and reduce convection. For example, fiberglass batting is a good insulation, even though glass is an intermediate conductor. The reason: The air that makes up the greatest volume of the material is about the poorest heat conductor we know. In addition, the several-inch-thick mat is opaque to light and heat radiation. And the great amount of air in the mat is largely blocked and compartmented into tiny volumes so that both internal and pass-through convection is kept very low.

THE FOLLOWING TABLE gives a rough indication of the relative insulation value of some ordinary building materials. You'll see that the best insulator in the table (expanded urethane) has almost 60 times the insulating value of the poorest material in the table (concrete).

	Resistance, R, per inch of thickness
Concrete	0.1
Gypsum Plaster	0.2
Brick	0.2
Wood	1.3
Impregnated Sheathing	2.6
Fiberglass Blanket	3.4
Expanded Urethane	5.9

WITH THESE PRINCIPLES in mind, let's look at some of the commercial materials and methods.

Foamed Plastics

FOAMED PLASTICS are available primarily as boards (Styrofoam, for example). They havethe highest insulation values—and are also the most expensive. Because the boards can be neither bent nor stuffed to fill a space tightly, this form is useful primarily in new construction or for fastening to basement walls. The foamed plastics are generally good vapor barriers.

PLASTICS CAN ALSO BE FOAMED in place, a technique advertised for side-wall work in old houses. Polystyrene, polyurethane and urea-formaldehyde resins are all being foamed in place by specialized contractors. Results have been mixed. At one extreme, the foams—applied through holes in the exterior siding or the interior plaster—may leave unfilled cavities. At the other extreme, the foams may burst some walls through loss of control or through swelling. Also, the odor of the urea-formaldehyde resin may persist for some time.

AN ADDITIONAL CAUTIONARY NOTE: Some foamed plastics emit toxic fumes when burning under certain conditions. Before installing any plastic foam insulation, your local fire marshal's opinion should be solicited.

Aluminum Foil

ALUMINUM FOILS function primarily by reflecting radiation. In its simplest form it consists of a single sheet of foil so placed that it drastically reduces incoming or outgoing radiation. Aluminum is, of course, a good conductor, so that if both faces of a sheet touch adjacent surfaces it is no insulator at all. And if its reflective surface gets dirty, its insulating quality is reduced.

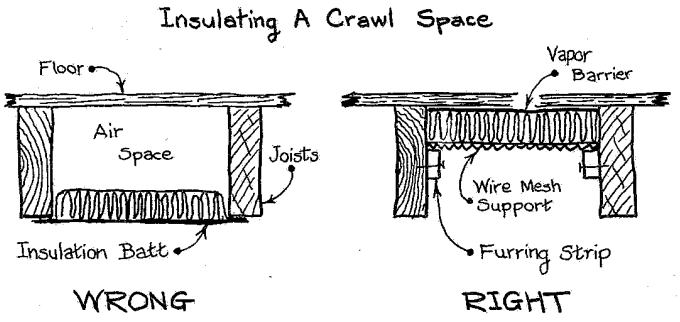
MOST COMMON FORM of foil insulation consists of several sheets of aluminum-faced paper separated from each other by short, angled strips of paper, also aluminized. The material comes flattened and rolled. A proper pull across the width of the material causes it to snap open and hold its shape, separating the shiny inside faces. Edge flanges allow for stapling to the studs of exterior walls during construction. A two-space type may yield an insulating value up to R-5. It is also a good vapor barrier when properly installed, is relatively fireproof, and impervious to damage from moisture or vermin. It is limited pretty much to new construction, however.

Fiberglass Blankets

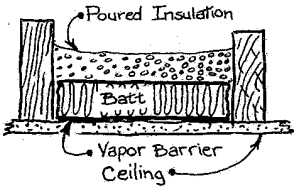
FIBERGLASS BLANKETS are available in rolls or batts (4-ft. sections), in two widths (15 or 23 in.) in thicknesses up to 6½ in. There are a variety of facings: Single, double, paper, aluminum foil or unfaced. R values run approximately 3 to 3½ per inch, and the facings provide good vapor barriers. The material can be hung by its flanges between studs, laid or stuffed in place, or wrapped around objects like ducts.

FIBERGLASS rolls or batts are excellent for accessible areas: Attics, crawlspaces, half open walls, etc. Vapor-barrier problems must be kept in mind (see below). And it is wise to staple additonal support under the material if it is placed in the ceilings of crawl spaces or between rafters from below.

ONE SPECIAL PRECAUTION should be taken with the blanket form of insulation. It should be installed so that gross air movements resulting from infiltrating wind or natural convec-



tion are effectively blocked. One example occurs when batts are stapled to the bottoms of the joists over a crawl space. This makes a neat-looking installation, but the air space between the batt and the subfloor is bound to cause trouble. There are bound to be leaks around the batting. These leaks will set up convection currents in the air space that will greatly reduce the insulation value.



SIMILAR PRECAUTIONS should be observed in insulating walls and floors. Careful stuffing and fitting is the only answer. For attic floors, additional protection against leaks and convection currents can be provided by adding some poured insulation on top of the fiberglass rolls or batts.

Poured And Blown

AMONG THE INSULATIONS that pour or blow well are expanded mica, spun fiberglass (commonly called blowing wool) and cellulosic fibers. Expanded mica (Vermiculite is one trade name) is not used much for home insulation. Although it handles well, its granularity causes it to dribble out of small holes. It also packs down to a higher density than desired. It is costlier, for a given insulation value, than other types. R values run between 2.5 and 3 per inch.

FIBERGLASS WOOL (and it predecessor, rock or mineral wool) is the most frequently encountered in this class. It is not particularly suited for do-it-yourself application because it comes in a compacted form requiring a truck-mounted machine to shred and blow the stuff. It is fine for attic applications, with the following reservations: It is easily blown around by any wind or drafts in the attic, frequently being found piled back from eaves having soffit ventilation. It clings to shoes

and clothing. Finally, some people have skin and mucous-membrane sensitivities to fiberglass and its dust.

FIBERGLASS WOOL would be a good candidate for blowing into the sidewalls of an old house except for its propensity to catch on nail ends, splinters, etc., leaving serious voids. Blowing wool R values are about 2.25 per inch, a bit lower than batts (although under the right conditions wool will pack more uniformly to give better overall results).

Cellulosic Insulation

OF SPECIAL INTEREST to old-house owners is cellulosic insulation. This consists of short fibers of cellulose (often reclaimed paper) chemically treated to yield a reasonably fire-retardant material that pours or blows very well. Its R value is about 3.7 per inch, and it doesn't hang up unduly on small projections within walls. Although cost is slightly higher than its fiberglass counterpart, in my opinion this is the best material for side wall application in old houses.

CELLULOSIC INSULATION can be blown into side walls by a contractor with blowing equipment. In a typical house, holes 1 in. in dia. are made every 16 in. (to provide access to each between-stud cavity). This has to be repeated for each storey. In addition, fire-stops and between-storey framing may require additional holes. Holes can be made through the interior plaster or exterior siding. If large openings are available due to restoration activities, insulation may be poured in. Of course, it will trickle out if any holes or significant crevices exist below the pouring or blowing levels.

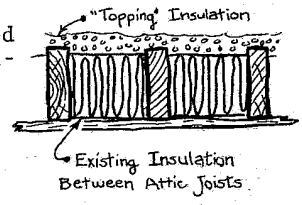
HOLES MADE FOR THE BLOWING NOZZLE are then closed with circular wooden plugs and finished over. It is possible for the adventurous do-it-yourselfer to rent equipment for blowing cellulosic insulation through 1 in. holes.

OF COURSE, pouring (or blowing) cellulosic insulation into between-joist spaces on attic floors is quite simple. It bothers sensitive skins and throats less than fiberglass, and is a bit more likely to stay in place.

MOST OF THE CELLULOSIC INSULATION used in the greater Washington, D.C., area is made by Cellin Manufacturing, P.O. Box 224, Lorton, Va. 22079. The root tradename for their product is "Cellin," followed by a suffix that indicates whether the product is for pouring (Cellin Craft), blowing (Cellin Pac), or spraying (Cellin Spray). Cost to have a contractor blow cellulose insulation into side walls varies from 35 to 75¢ per sq. ft. (depending on complexity of the job) including finishing over of the holes.

How Much?

BASED ON RECENT STUDIES—taking into account expected future prices—attics can profitably use insulation with total R values in the 20's or 30's. That corresponds to 6 to 8 in. of cellulosic fiber insulation. Side walls and crawl spaces can use half that amount. Pay-back periods (at present interest rates) are only a few years for installing that much insulation in uninsulated areas. Payout is closer to 10 years when doubling existing 1- or 2-in. amounts.



FOR AN UNUSUED and unfloored portion of an attic that already has some insulation, it is usually worth it to add additional insulation if an additional inch or so will provide some modest cover over the floor joists. Wood is an intermediate conductor, and the joists usually account for about 10% of the floor area.

ELECTRICALLY HEATED HOMES can use half again as much inslation as the above figures indicate.

Other Factors

INSULATION may actually be a secondary consideration in an old house that has loose fitting old doors and windows. The amount of heat loss through these apertures is enormous. In these cases, caulking, weather stripping and storm windows and doors may well have the first priority. A dollar invested in these first-line measures usually has a better payout than an insulation job.

ALTHOUGH THIS ARTICLE was written primarily with winter heating in mind, the insulating measures described will also help considerably with summer cooling. ■■

The Condensation Problem

MOST PROBLEMS caused by improperly installed insulation result from an inadequate understanding of condensation mechanics. Peeling paint and serious rot conditions inside the walls may be the consequence... even though the house was perfectly sound before the insulation was put in. A detailed analysis of condensation causes and cures will appear in Part II of this article.

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