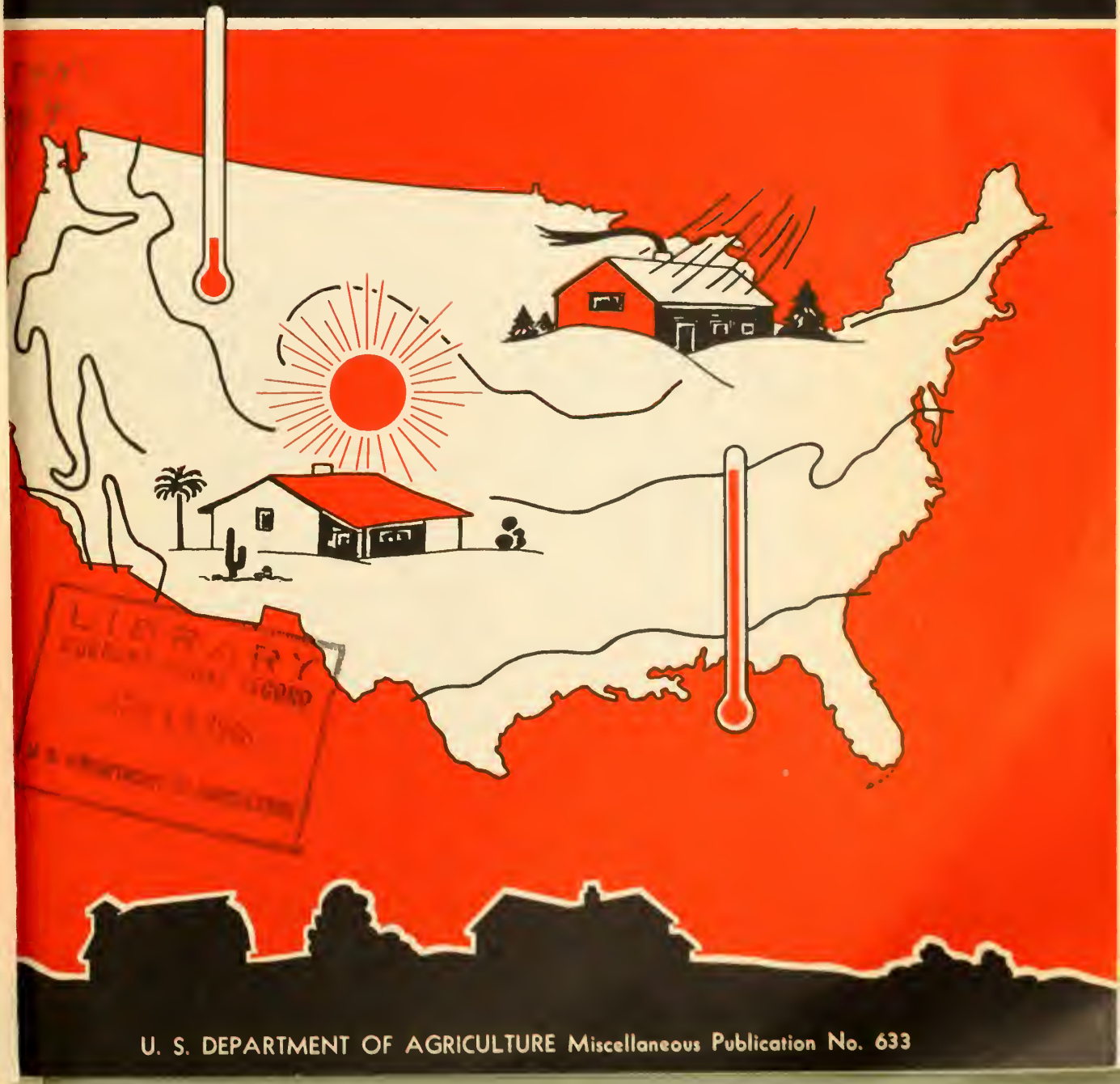
YOUR FARMHOUSE . . .

INSULATION AND WEATHERPROOFING



U. S. DEPARTMENT OF AGRICULTURE Miscellaneous Publication No. 633

Why Insulate and Weatherproof?

Insulating the farmhouse has two advantages. It adds to the comfort of your home in both winter and summer. And it saves you money on fuel bills.

Weatherproofing—which includes storm sash and doors, weatherstripping, and calking—is very important in cold climates. It, like insulation, contributes to winter comfort. And it increases your fuel savings.

Heat always moves toward cold.

Much of the heat is wasted in winter if the house is loosely built, the doors and windows poorly fitted, and the house not insulated. The heat moves from the warm house to the cold outside. It goes through the ceiling and roof, the walls, the floors, and the cracks around the windows and doors (fig. 1).

In hot weather the sun's heat enters the house through the roof and outside walls as well as through unshaded windows and doors (fig. 2).

Even when a house is well constructed and in good condition, insulation and weatherproofing cut down on the waste of heat (fig. 3). Less fuel will heat the house comfortably. The heat is spread more nearly uniformly through the whole house. The walls and floor of a room will be just about as warm as the air in the center of the room, and there will be less difference between the temperature of the air near the floor and that at the ceiling. There are fewer cold drafts.

In summer, insulation serves to keep out much

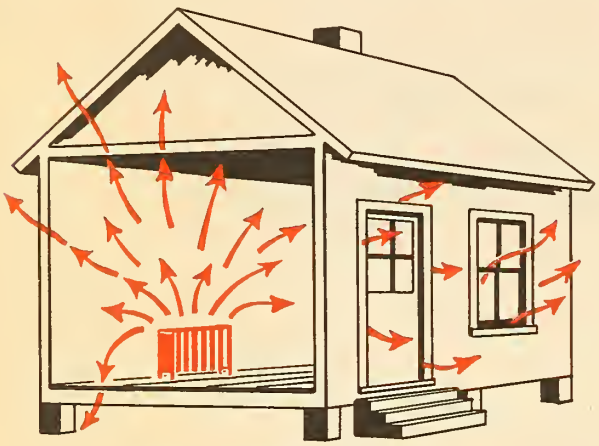


Figure 1.—Heat is wasted in winter.

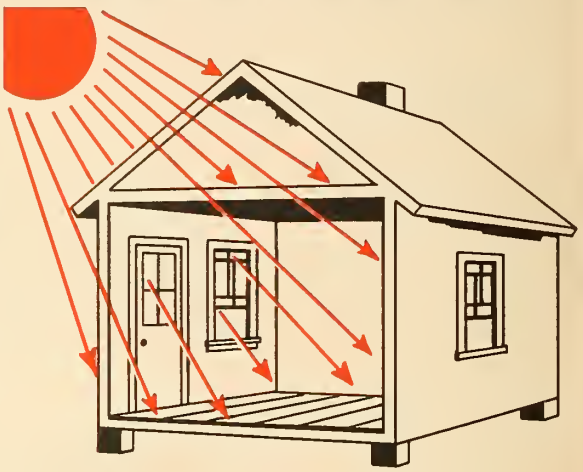


Figure 2.—Heat enters in summer.

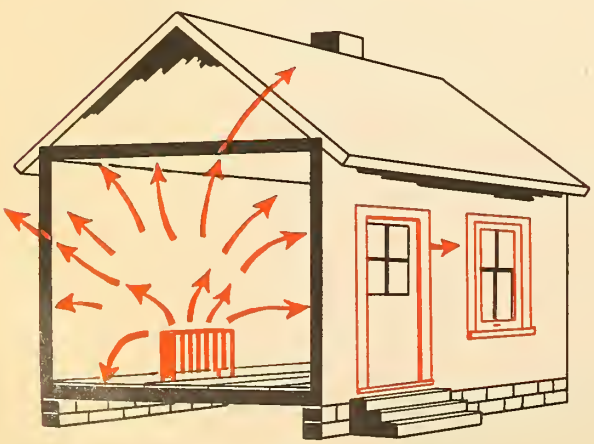


Figure 3.—Insulation saves heat in winter.

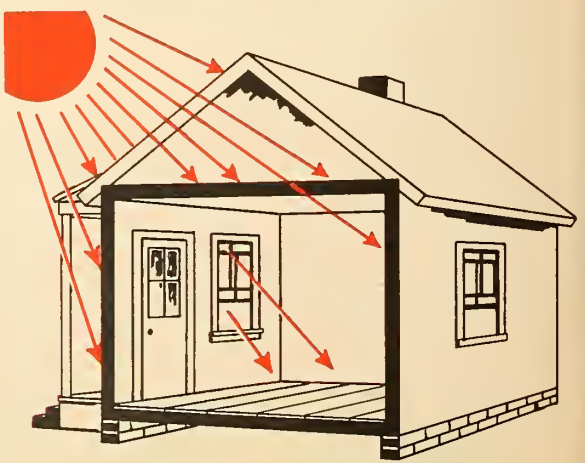
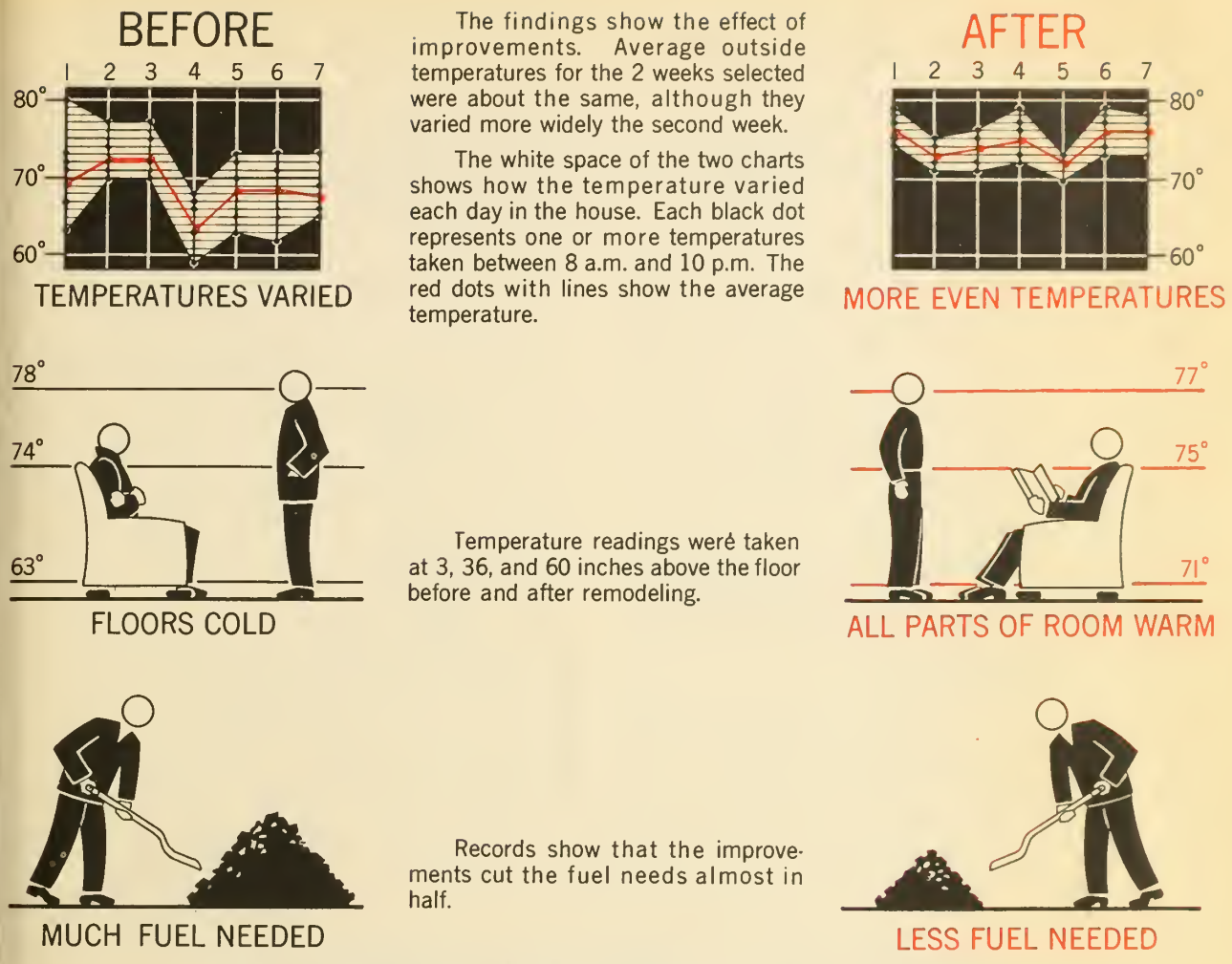


Figure 4.—Insulation keeps out summer heat.



The findings show the effect of improvements. Average outside temperatures for the 2 weeks selected were about the same, although they varied more widely the second week.

The white space of the two charts shows how the temperature varied each day in the house. Each black dot represents one or more temperatures taken between 8 a.m. and 10 p.m. The red dots with lines show the average temperature.

Temperature readings were taken at 3, 36, and 60 inches above the floor before and after remodeling.

Records show that the improvements cut the fuel needs almost in half.

Figure 5.—Insulation and weatherproofing increase comfort and save fuel.

of the sun's heat (fig. 4) but ventilation also is needed for comfort.

Insulation and storm sash serve still another purpose. They keep dew from forming on windows and walls.

Warm air can carry more moisture than cold air. But when the warm air touches a cold surface the moisture condenses and forms dew. For example, the outside of a pitcher of ice water is soon covered with dew when set in a warm room. Moisture may also condense on cold ceilings, walls, and windows.

The temperature at which vapor condenses on a surface is called the dew point. The more moisture there is in the air, the higher the dew point. Insulation and storm sash help to keep ceilings, walls, and windows at a temperature above the dew point.

The farm home of Mr. and Mrs. L. F. Hubbard, in Wisconsin, is an example of how insulation and weatherproofing work.

The Hubbards asked engineers of the United States Department of Agriculture and the University of Wisconsin to use their farm as a laboratory to study the causes of winter discomfort in the average farm house.

The engineers made a careful study of the house and the temperatures, moisture, and drafts that made for winter discomfort. Then they drew up a plan for improving the house. After the remodeling they repeated the studies.

On the advice of the engineers, the Hubbards added new siding, tight-fitting windows and doors, storm sash, and insulation in the walls and ceiling. And they put a blower in the furnace. Figure 5 shows the results.

Where to Insulate

Before you plan insulation, make sure there are no cracks or air leaks in walls, floors, or ceiling. A lot of heat can get out and cold air can come in even through small cracks.

The first step to a well-insulated house is to get your building in good condition. Engineers of the United States Department of Agriculture have found that tight construction, calking around window and door frames, storm sash, and weather-stripping are as important as insulation in making a house comfortable and in saving fuel.

Make a thorough check of your house to find what you need to do (fig. 6).

Perhaps as much as 25 percent or more of the heat moves out through and around the doors and windows. For this reason, if the winters are severe in your part of the country you will need storm doors and windows.

In the ordinary one-story house and in many two-story houses 25 percent or more of the total heat loss is through the top of the house. So if you can insulate only a part of the house at first, start with the ceiling or roof. It is usually easier to get at and less costly to insulate.

Whether you put the insulation in the ceiling or in the roof will depend on how you plan to use the attic space. Figure 7 shows three places where the insulation can be installed.

If you expect to use the attic for storage only, you can probably save on cost by insulating the ceiling. But if you plan to heat the attic, then put the insulation in the roof. Leave an air space between the insulation and the shingles or other roofing material.

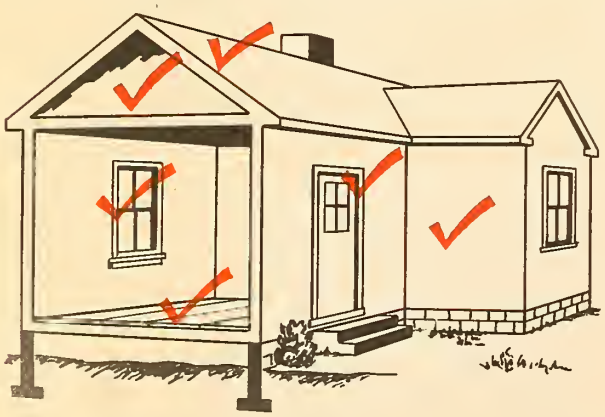


Figure 6.—Check your house for insulation and weatherproofing needs.

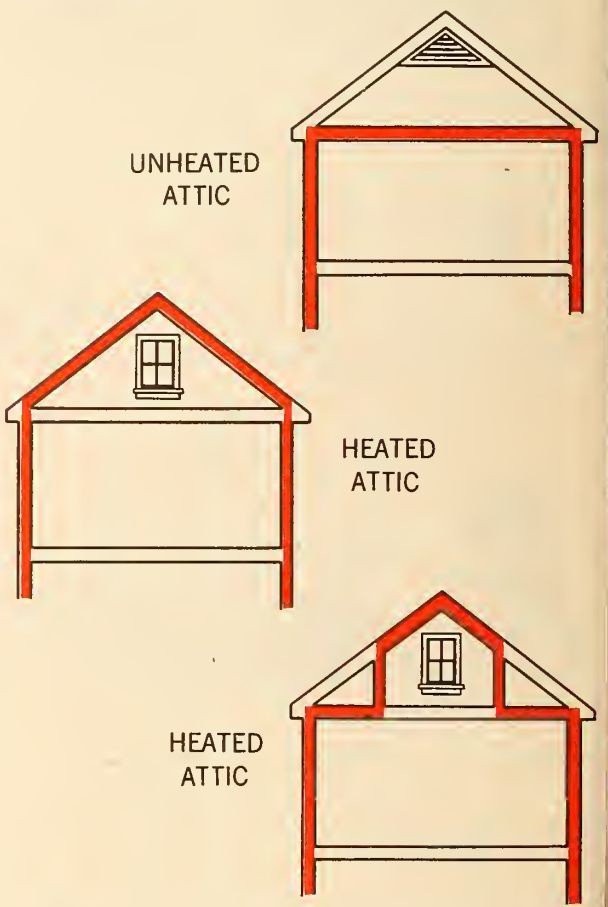


Figure 7.—Insulate ceiling under unheated attic.

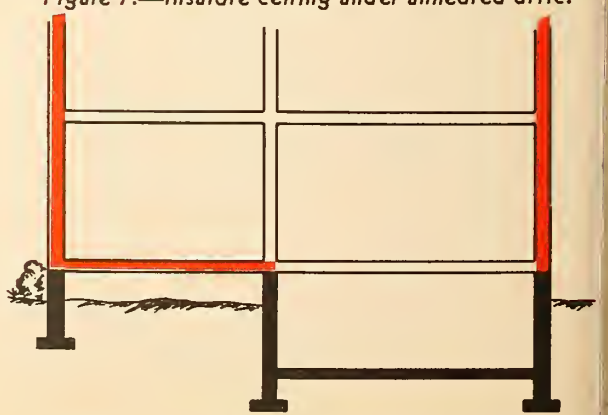


Figure 8.—Insulate floor over unheated space.

If there is no warm basement under the house, you may need insulation in the floor also (fig. 8).

Cooperative research at the University of Georgia shows that in southern farmhouses in poor condition much of the heat loss is through the floors. This loss is greater in houses set on piers than in houses with curtain walls between the piers (fig. 9). It is also greater through single than through double floors.

The Georgia studies show that in frame houses with no sheathing, good-quality building paper under the siding, calking around window and door frames, and weatherstripping (fig. 10) may result in fuel savings as great as 45 percent. And the total fuel saved by tight construction and curtain walls may amount to as much as 60 percent.

You may need insulation not only in the outside walls of your house but also in walls next to an unheated garage or store room. And you will need insulation in the floors of second-story rooms over porches.

Plan the insulation to keep the heat *in* the house during cold weather and it will also keep much of the sun's heat *out* of the house in summer.

If you plan to air condition your farmhouse, install insulation. It will cut initial costs and operating expenses.

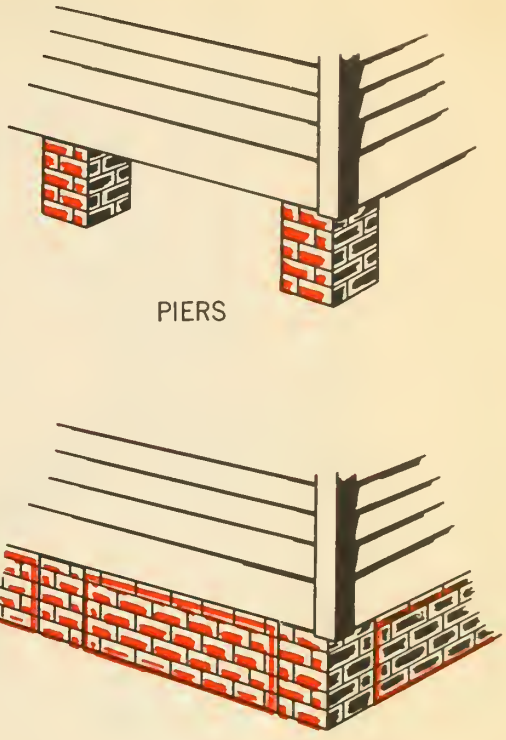


Figure 9.—Curtain wall saves heat.

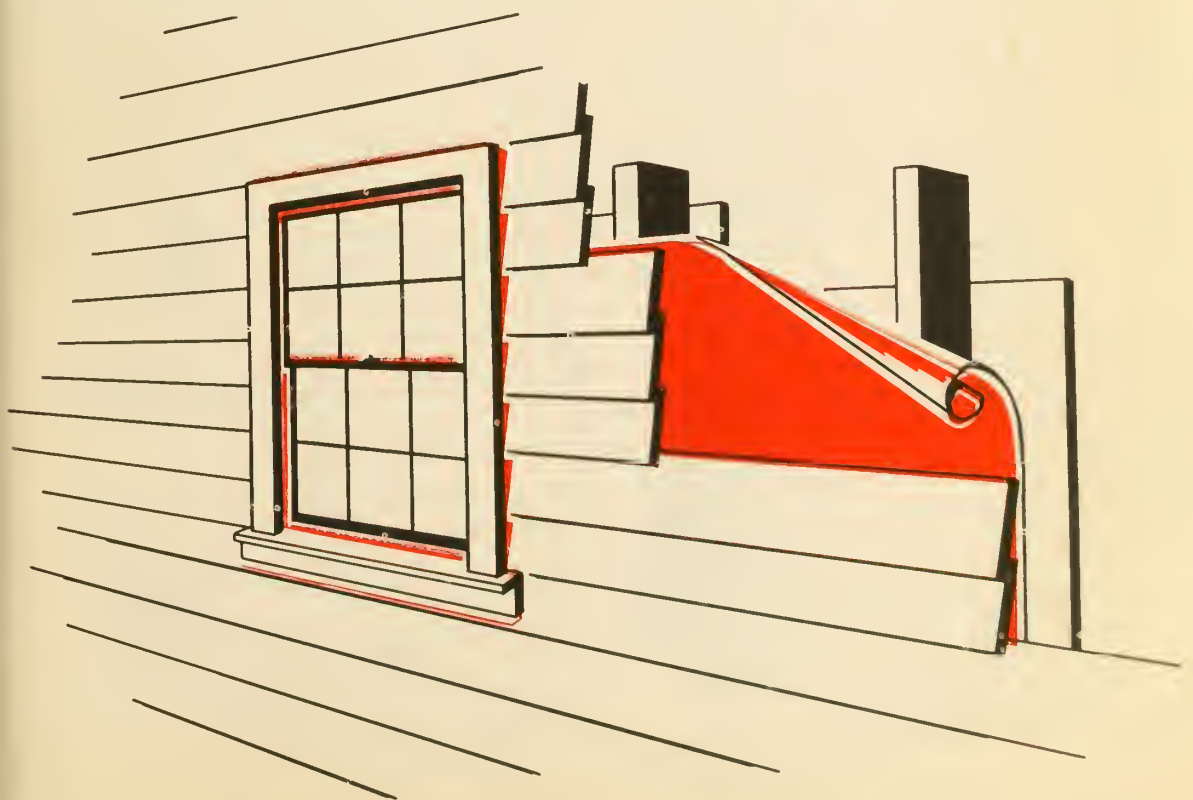


Figure 10.—Building paper, calking, weatherstripping increase comfort.

What Kind of Insulation?

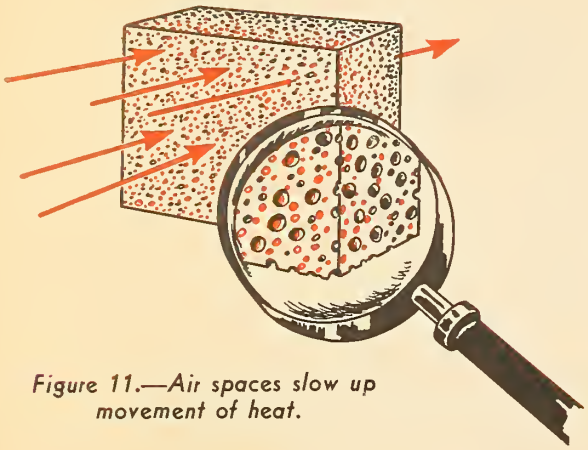


Figure 11.—Air spaces slow up movement of heat.

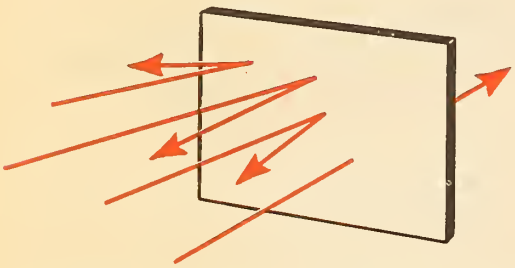


Figure 12.—Reflective insulation turns back heat.

Any material that slows down the movement of heat is an insulator. As a general thing, however, dense heavy materials are poor insulators.

The common building materials—wood, brick, and stone—have insulation value. Some are better than others.

Wood is a fair insulator. Solid masonry is poor. Hollow masonry, such as cinder blocks and clay tile, is better than solid masonry. The air spaces in the hollow masonry provide some insulation.

Some of the best insulating materials are mineral wools, including glass wools, mica products, cork, marine plants, cattle hair, and plant materials such as cane, cornstalks, cotton, planer shavings, redwood bark, and sawdust.

These materials are light in weight and are filled with tiny air spaces (fig. 11).

Some metal surfaces make good insulators because they slow down heat in another way. They reflect or turn back nearly all the heat that is radiated to their surfaces (fig. 12).

Light-weight insulating materials are on the market in four common forms—loose fill, blanket (or quilt), bat, and board.

Figure 13.—Loose-fill insulation is poured into place.

Reflective insulation comes as metal foil or bright metal sheets. Glossy white paint also reflects some heat.

The form of insulation best suited to your use will depend on: (1) How you intend to use it, that is, whether purely as insulation or as a wall finish; (2) how easy it is to put in; and (3) how much you want to spend.

When you are insulating the walls of an old frame house it is often easier to install loose-fill insulation than blanket or board. If you are repairing or replacing plaster or siding you may find board insulation more convenient to install. If you are insulating the ceiling—and the space between the ceiling joists is open—any of these types of insulation can be used.

It is possible that you may use two or more forms to give your farmhouse the insulation needed.

There is little difference in value per inch of thickness between the various commercial insulating materials. Whatever insulation you buy, make sure it is resistant to fire, moisture, and insects.

Loose fill.—Almost all the common insulating materials—the mineral wools, expanded mica, redwood bark, sawdust, and planer shavings—are made in this form.

Such materials come in bags. They can be placed by hand or blown with a special blower into walls and on the ceiling (fig. 13). Only a few boards need to be taken out in order to blow loose-fill insulation into the walls.

Blanket and bat.—These types are made of loosely matted plant fibers, hair, mineral wool, or crinkled paper. They are usually covered with paper on one or both sides to form a blanket or bat of 1-, 2-, or 3-inch thickness. They come in widths to fit between wall studs, joists, or rafters (fig. 14). Blankets come in lengths up to 100 feet.

Board.—You can use this form of insulation as a substitute for sheathing (fig. 15) or for lath. If you plan to use the insulating material to finish the inside walls or if you need added stiffness in the framework, use board insulation.

Board insulation is made from such materials as sawmill waste or plant fiber. The boards are usually 4 feet wide and 6 to 12 feet long. They vary in thickness, from ½ inch up to 2 inches. The edges may be cut square, beveled, shiplap, or tongue-and-groove.

Figure 14.—Blanket insulation fits between joists.

Figure 15.—Board insulation may also be used to stiffen walls.

Figure 16.—Reflective insulation adds to comfort in southern homes.

For inside walls and ceiling finish you can get boards with special finishes on one side. Some of these are cut into squares. Some insulating boards are also designed to deaden and absorb sound.

Board insulation is relatively soft. It dents and scratches easily. When you use it to finish inside walls, protect the boards to chair height with wainscoting.

A new form of rigid insulation on the market is made of glass. It comes in blocks 2 to 6 inches thick.

Reflective insulation.—Because reflective insulation does not store up heat, it is excellent for use in the South. There, the chief purpose of insulation is to keep the sun's heat out of the house during the day and to allow rapid cooling at night.

Reflective insulation also serves as a vapor barrier (see p. 11). You can get it combined with blanket insulation. There is also an aluminum-foil-surfaced plaster board on the market.

Because it turns back the heat by reflection, the bright surface of this insulation must be installed so it does not touch any other surface. If both sides are bright, it is best installed in the center of stud or joist spaces (fig. 16). Several sheets of reflective insulation separated by spaces may be used.

Farm-Grown Insulation

Very likely your farm produces many materials having high insulating value. Such products as straw, corncobs, cottonseed hulls, sawdust, and planer shavings can be used for insulation.

With special treatments, these farm-grown materials can be made fire-resistant and insectproof. And many farmers use them to insulate dairy barns, poultry houses, hog houses, and potato- and apple-storage houses.

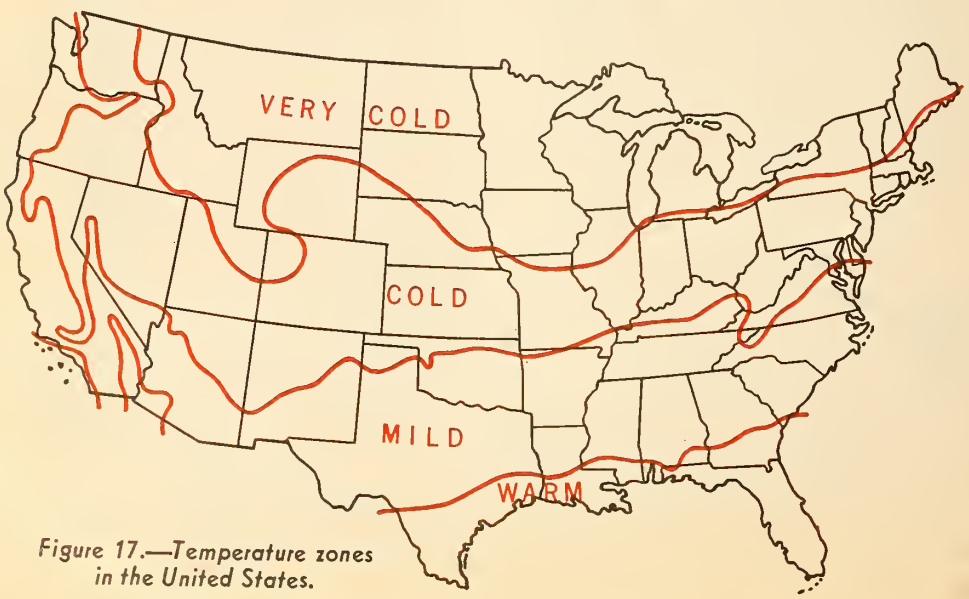


Figure 17.—Temperature zones in the United States.

But the farmhouse is better finished than other farm buildings. Once insulation is in, it is hard to take out. And unless you can be certain that the farm-grown product is safely fire-resistant and verminproof, it is better to buy commercial insulation for your farmhouse than to use the home-grown product.

How Much Insulation?

There is no set rule on how much insulation to use for best results.

The amount needed varies from building to building and from one locality to another. It depends partly on climate and to some extent on what the house is built of, how well it is built, and how well it has been kept in repair.

The amount of insulation needed also depends on how well the house is sheltered from cold winds. And in the South it depends on how well the house is protected from the sun by shade.

In the North, where the winters are severe, houses need more insulation than in sections of the country where the climate is mild. Even in the same latitude, however, there are differences in climate (fig. 17).

The thickness of the insulation needed depends in part on the difference between two temperatures—the average low outside temperature and the average temperature you wish to maintain inside the house.

In figure 18 you can see how the various types of wall construction compare in insulating value. The wall with drop-siding, paper, and wood sheathing gives you some idea of how additional thicknesses of wood, air spaces, and insulation increase the insulating value of the wall.

Notice the difference between walls C and E, or between walls C and F. If the entire space in the wall is not filled, the insulation may be placed so that there are two air spaces, as in E. Two small air spaces have a higher insulating value than one large one. Although air spaces add to the insulating value, they are not so effective as good fill insulation.

It is hard to say exactly how much fuel you can save by insulating. Figure 19 shows how you can estimate the heat savings in an average well-built house. Generally the heat loss is about 25

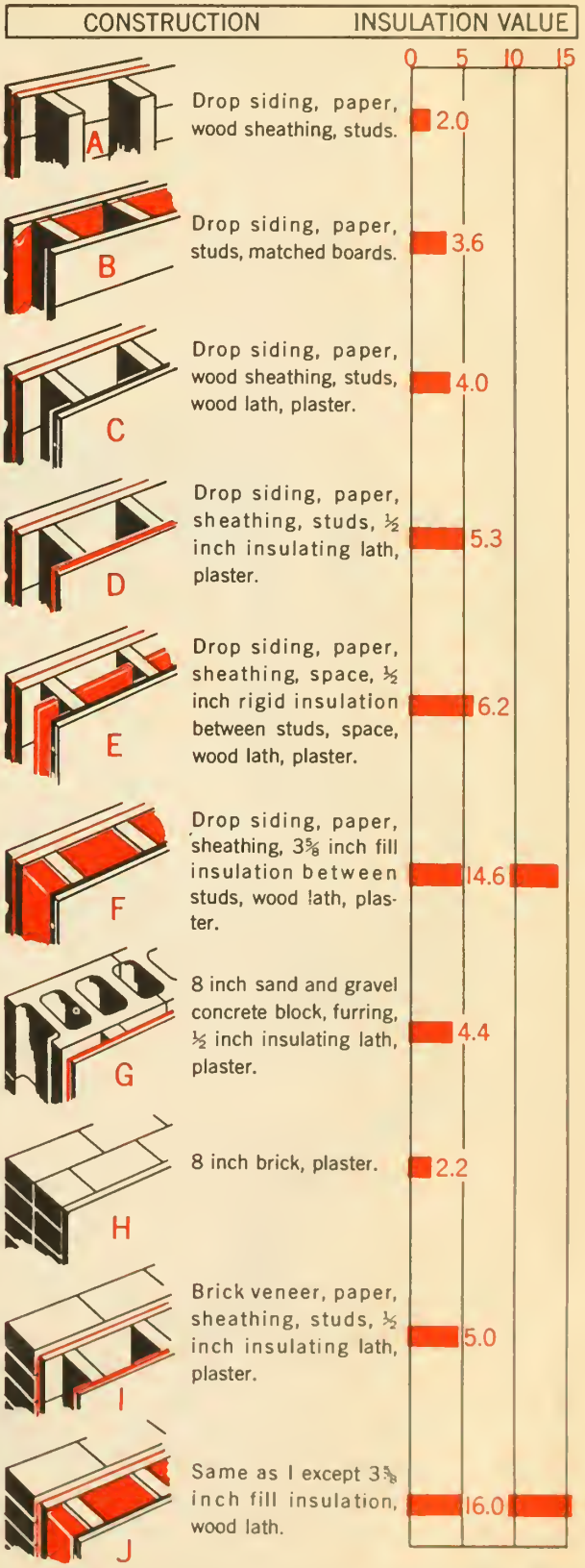


Figure 18.—Various building materials have different insulating values.

percent each through the outside walls, the ceiling or roof, the windows, and through air leakage in various parts of the house.

Notice that the greatest saving in fuel comes in the first inch of insulation. Increasing the insulation to 2 inches saves only 3.5 percent more fuel. Additional thickness increases fuel savings and comfort, especially in cold climates, and in many cases does not add greatly to the cost.

You can get a rough estimate of the total savings for the house in figure 19 by adding the different savings together. For example:

	Percent
3-inch insulation in the ceiling or roof saves	17.5
3⅝-inch insulation in the outside walls saves	18.0
Storm windows and doors save	12.5
And the total saving is	48.0

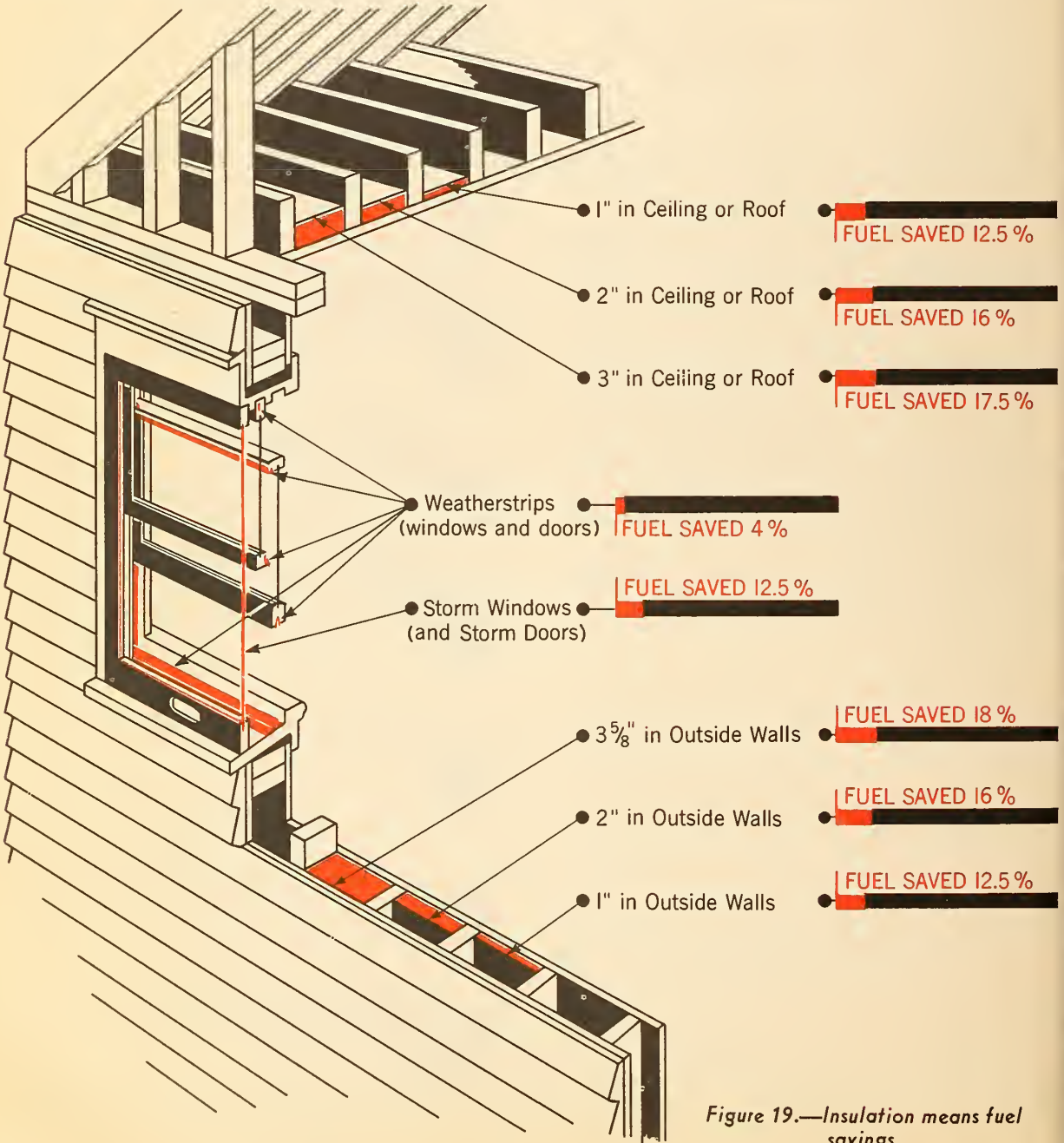


Figure 19.—Insulation means fuel savings.

Keep Insulation Dry

If you live in the northern part of the country—any section where the average temperature in January is 35° F. or less—you may need to install a vapor barrier to protect the insulation from dampness.

The warm air in the kitchen, bathroom, and laundry will carry more moisture than the cold air outside.

Dew will not form on the walls and ceiling of a well-insulated house. But it may condense in the insulation in the walls or on the sheathing or siding. The insulation and wood then become damp. In time this dampness may cause the wood to rot and the paint to peel off.

Vapor barriers come in two forms:

1. Paint barriers—among the best of these is aluminum paint with spar varnish as a vehicle. Paint barriers are used as finishes on inside walls.
2. Membrane barriers—usually a shiny-surfaced, asphalt-treated kraft paper or felt, smooth-surfaced roll roofing, or one of the metal foils.

When it is put in just right, a good membrane vapor barrier will last the life of the house. Since ordinary tar paper and roofing felts are not vaporproof, they will not serve as vapor barriers. Some insulations come with vaporproof paper or foil on them.

Put the paint type of vapor barrier on the inside surface of the wall and the underside of the ceiling. Use asphalt-base paint only where it will not show, because it is difficult to paint over it.

Apply membrane vapor barrier or reflective insulation when used as a vapor barrier to the inside of the studs. Put it underneath the inside wall finish. Fasten it carefully around all openings and lap and seal the edges (fig. 20). This will keep vapor from getting through to the insulation.

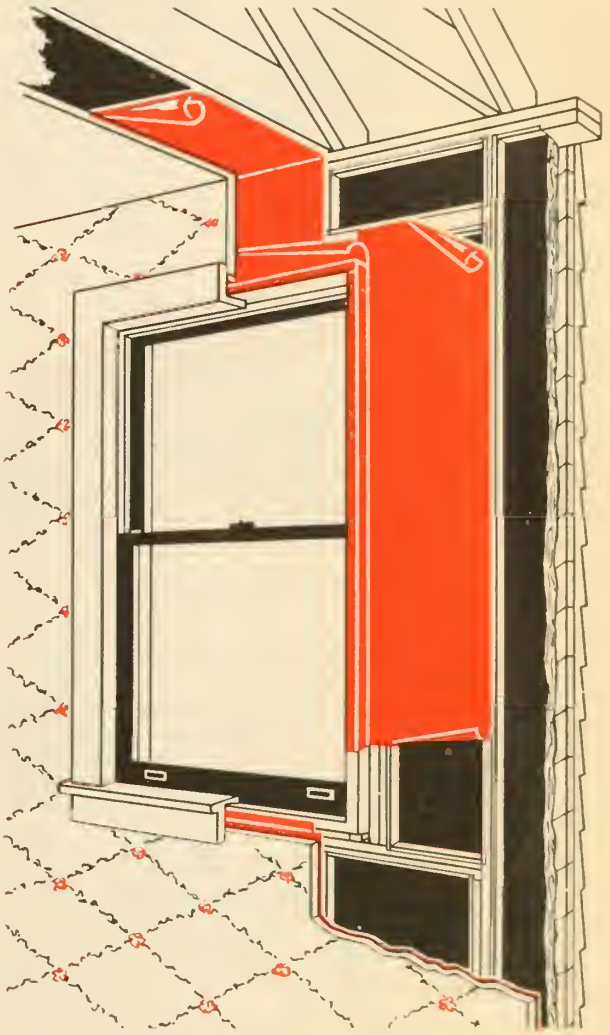


Figure 20.—Vapor barriers protect insulation from dampness.

Ventilation

Insulation is not complete without ventilation. When your house is tightly built, weatherproofed, and insulated, it is more necessary than ever to have good ventilation. You will need controlled ventilation through all parts of the house to carry off stale air and excess moisture. You will need ventilation in the kitchen to get rid of grease and cooking fumes as well. Plan some method of bringing in fresh air and carrying off stale air, fumes, and excess moisture.

Opening doors and windows and using electric ventilating fans to force out the warm moist air are the usual methods of ventilating homes. Locate windows to provide cross ventilation, especially in the kitchen and bedrooms. Install windows that open at least half their area.

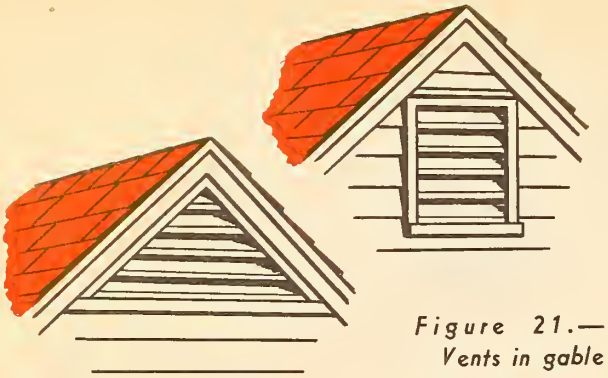


Figure 21.—Vents in gable help keep attic cool.

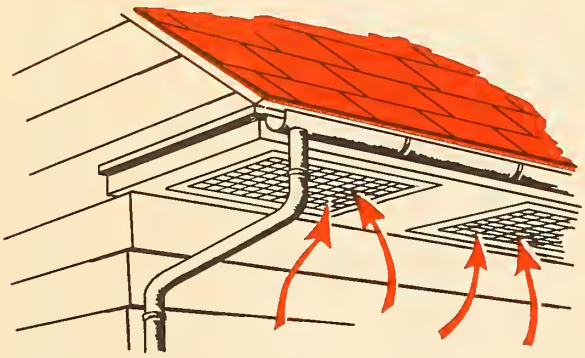


Figure 22.—Vents may be placed under eaves.

You may have heard it said that an insulated ceiling or roof takes a long time to cool off in summer. This is easy to understand, considering that insulation slows rather than stops the flow of heat.

In hot weather, it takes several hours for the sun's heat to get through fill, board, or blanket insulation. But when it gets through, the insulation continues to give off heat for some time after the sun goes down and the outside air becomes cool. Reflective insulation holds very little heat.

Attic vents help cool the house. Plan vents of about 4 square feet of clear opening for each 1,000 square feet of attic floor space. In a small house this will be two vents, each at least 24 by 28 inches (fig. 21). Even larger vents are desirable.

Put vents near the top of the gable. In warm climates many builders use screened vents between rafters under the eaves (fig. 22).

An attic fan will carry off summer heat rapidly and help cool the whole house.

Where vents serve chiefly to get rid of summer heat, build them so that they can be closed in winter. Some ventilation, however, is needed under an insulated roof at all times. It keeps dew from forming on the under side of the roof.

Vents are also needed in all foundation and curtain walls.

Windows and Doors

First of all, check to see whether there are air leaks around loose panes of glass in windows and doors and around the window and door frames. When a house is first built the frames may fit tightly. But after the house settles, cracks often appear.

Reputty all loose panes and close the air leaks around window and door frames with calking.

For a good calking job pack large cracks with oakum, jute, or similar material. Then cover this with calking compound, a puttylike plastic seal.

If walls are masonry it is well to remove the staff bead around the outside of the frame and calk between the frame and the masonry (fig. 23).

Figure 23.—Calking around windows closes air leaks.

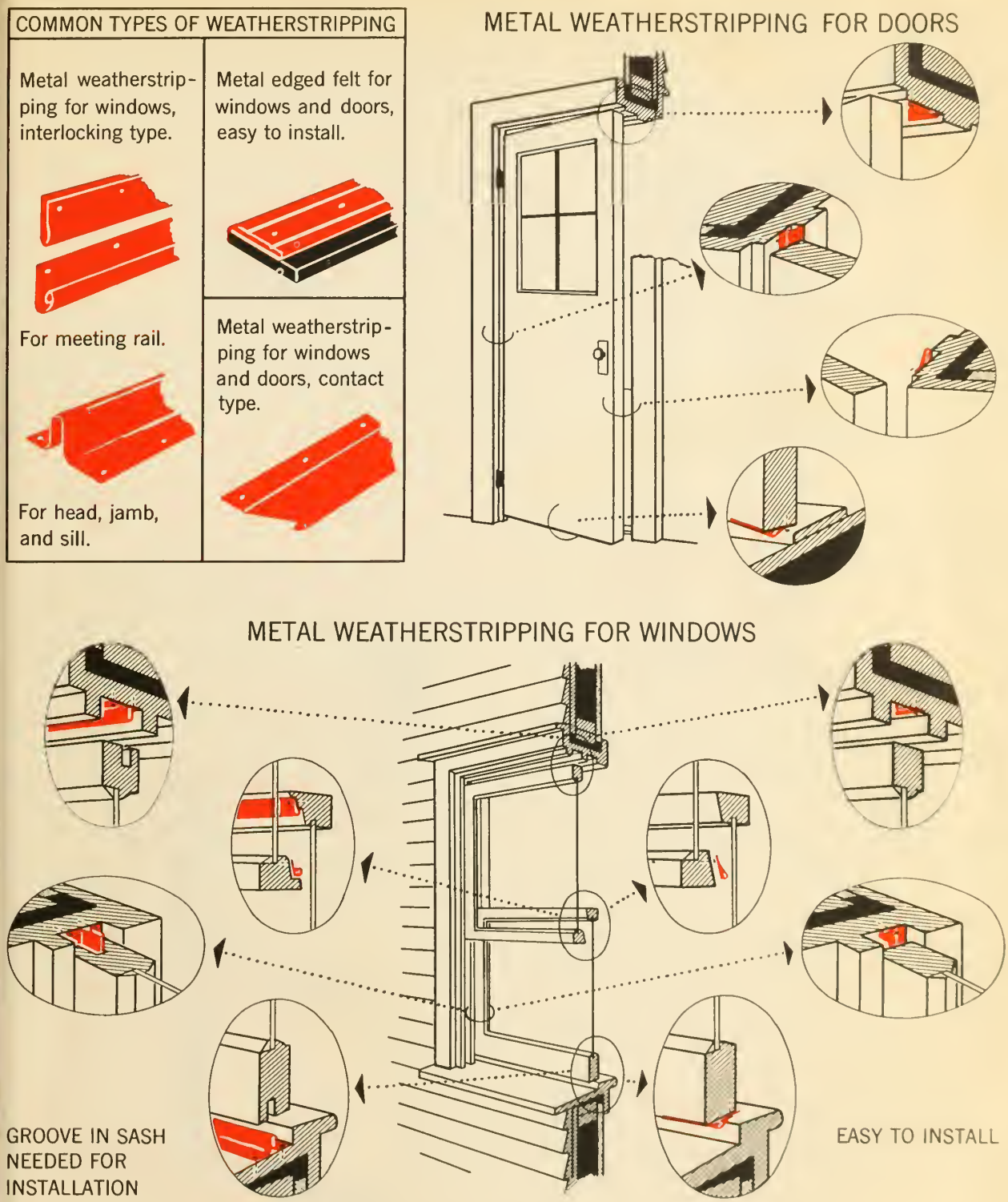


Figure 24.—Weatherstripping cuts heat losses through doors and windows.

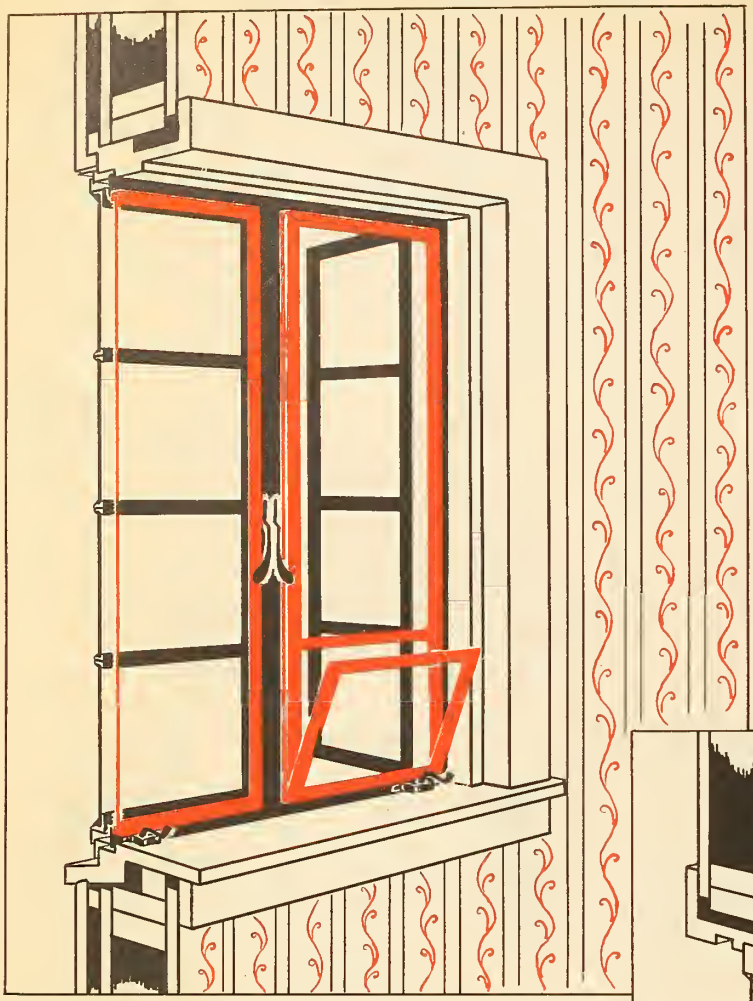
If this is hard to do fill the spaces between the bead and the wall with calking compound.

Small cracks can be closed with calking compound alone. You can apply this with a putty knife or a calking gun.

The next step is to weatherstrip loose-fitting windows and doors (fig. 24).

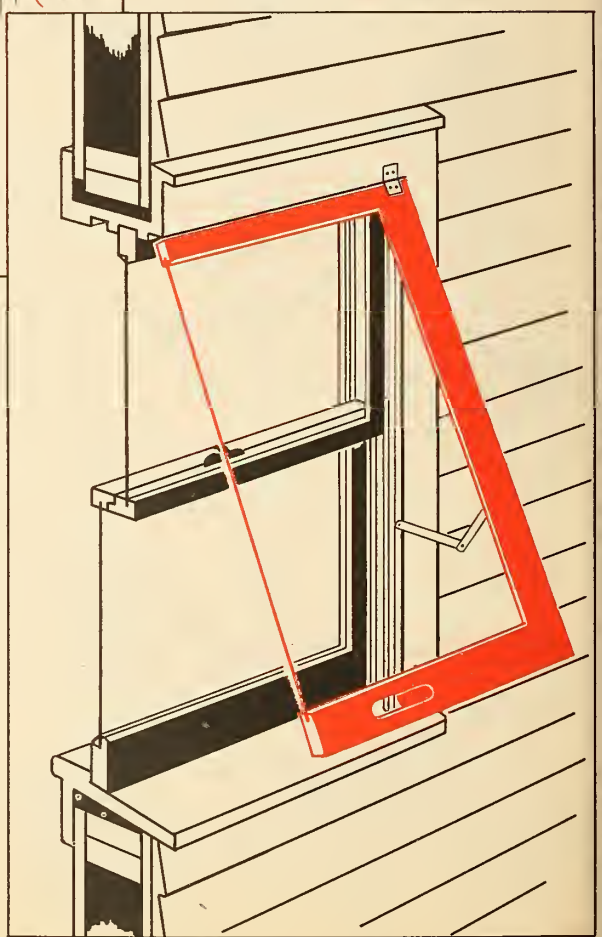
Metal weatherstripping of either the flat "contact" type or the interlocking kind gives the best long-time service. It takes a special tool to groove

Figure 25.—Reduce heat loss with storm sash.



. . . ON CASEMENT WINDOW

. . . ON DOUBLE HUNG WINDOW



sash for the interlocking weatherstripping. Get a skilled workman to install stripping of this type.

Felt contact strips will do for short-time use. Directions for installing usually come with the strips.

Metal casement windows in many cases come complete with weatherstripping. Look for this when you buy your windows.

Storm windows (fig. 25) or double glass help protect the inner glass from sweating or frosting in cold weather and materially reduce heat loss.

Make sure the window panes and sash fit tightly. If the putty has come loose around the panes of the inner window the storm windows will get frosty.

Awnings or outside shutters over the windows on the south and west exposures will add much to the comfort of the house during hot weather. Inside shades and blinds, on the other hand, do not

help as much toward keeping a room pleasantly cool. Once sunlight is in the house, the heat will be there also. Some sunshine, of course, is necessary in the house to dry it out after damp weather.

Shade trees help keep the house comfortable in summer. Plant them a little way from the house on the southwest or west side. Do not block windows or doors with dense shrubs or vines.

Trees planted a short way from the house and in the direction from which the prevailing cold winter wind blows will protect the house against it. See Farmers' Bulletin 1405, "The Windbreak as a Farm Asset."

Insulate Pipes

If yours is the average farm home, you will keep some of the rooms warmer than others during the winter months. For example, in most farmhouses the living room, bathroom, and kitchen are kept at higher temperatures than the bedrooms. On the other hand, the storage rooms may not be heated at all.

If you have central heat, insulate the hot-water and steam pipes or the hot-air ducts that go through unheated parts of the house, such as storage rooms and unenclosed places under the house (fig. 26). This not only makes it easier to keep the heat in the rooms where you need it but it also cuts down the fuel costs.

Commercial pipe coverings are formed to fit pipes of various sizes and are made in various thicknesses. Follow the manufacturer's directions for installing.

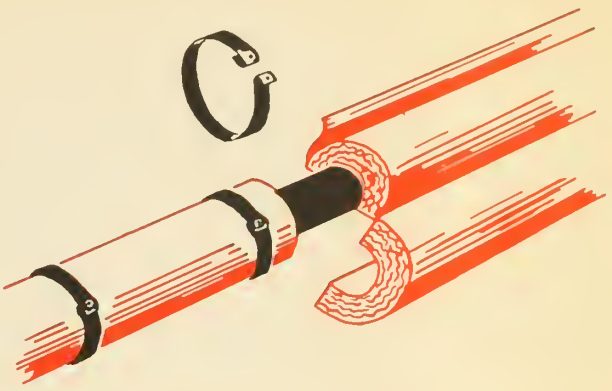


Figure 26.—Insulate pipes through unheated parts of the house.

When pipes must be placed underground, put them in a waterproof conduit and provide drainage to carry off water.

Cost

The cost of insulation varies with the amount used and also with the difficulty of installing. The costs of the material and labor also vary in different sections of the country.

Good insulation put in properly will last the life of the house. Weatherproofing well installed will give long wear.

And so, when you figure the cost of adding these improvements to your farmhouse, you can think of it as a long-time investment. And you can balance it against the savings in fuel for many years to come.

This publication was prepared by the Bureau of Plant Industry, Soils, and Agricultural Engineering
Agricultural Research Administration
Subject matter under the direction of Harry L. Garver, Division of Farm Buildings and Rural Housing
Assisted by Marguerite Gilstrap, Elinor Ulman, and J. Robert Dodge
Washington, D. C. *Issued February 1948*

Check Your Plan

Seven Important Points

1. To make your house weatherproof, will you need to—
   - Repair cracks or airleaks in walls, floors, or ceiling?
   - Calk window and door frames to make them tight?
   - Reputty loose panes?
   - Weatherstrip windows and doors?
   - Install storm sash and doors?
   - Build a curtain wall between foundation piers?
   - Lay double floors?

2. To make the greatest fuel savings, will you need insulation in—
   - Roof or ceiling?
   - Outside walls?
   - Inside walls next to unheated spaces?
   - Floors over unheated spaces?

3. Is the insulation you plan to use—
   - Of the right thickness?
   - Fire- and insect-resistant?
   - Easy to install?
   - Protected by a vapor barrier?

4. Have you planned a controlled ventilating system that provides—
   - Cross ventilation in all important rooms?
   - Windows that open at least half their area?
   - Vents in the attic?
   - An attic ventilating fan?
   - Room ventilating fan?
   - Some other cooling system?

5. Does your plan include trees for shade and windbreak?

6. Do you plan to insulate pipes that run through unheated spaces?

7. Have you balanced the cost of insulation and weatherproofing against fuel savings over a period of years?

U. S. GOVERNMENT PRINTING OFFICE: 1948—O-764152
For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. Price, 10 cents