INSULATION MATERIALS SELECTION AND INSTALLATION

Insulation slows down the conduction of heat through walls, ceilings and floors in both winter and summer. It was first used extensively during the 1940's and 50's, not to save fuel (which was relatively inexpensive) but to increase comfort. A couple of inches of fiberglass or rockwool were sufficient.

With today's energy prices, however, we need to be considerably more conscientious. Proper insulation is among the most important tools in controlling fuel costs. Increasing existing levels of insulation or insulating areas that are uninsulated, represent one of the most cost-effective things a homeowner can do. The payback and benefits are almost immediate. This chapter describes the various types of insulation and how they are installed.

R-value – The Power Of Insulation

Insulation is rated by "R-value" which stands for "thermal resistance". R-value is a measure of a material's ability to slow down heat flow. The higher the R-value, the better. With a temperature difference of 1 degree Fahrenheit, insulation with R=1 allows 1 Btu per hour heat flow for each square foot of surface area. In general,

Heat Flow (Btu per hour per square foot) =
Temperature Difference (degree F) x R-value

The R-value of an insulation material is usually listed in terms of R per inch. For any thickness, the total R-value equals the rated R per inch multiplied by the thickness in inches. For example, cellulose attic insulation has an R-value of R-3.7 per inch. A 6-inch-thick installation will therefore have a total R-value of R-22.2 (6 inches x 3.7 per inch).

For insulation manufactured in a particular thickness, the R-value of the manufactured piece is given. For instance, one manufacturer's fiberglass blanket insulation might have an R-value of R-13. Another manufacturer's rigid foam panels might have an R-value of R-10. If more than one layer of insulation is used, the total R-value can be calculated by adding the R-values of the layers.

Throughout this chapter we will refer to representative R-values for various types of insulation. Keep in mind however, that the actual R-value for a specific type of insulation varies somewhat between manufacturers and even between different products from the same manufacturer. Manufacturers are required to label their insulation products according to strict regulations set forth by the Federal Trade Commission. The R-value is always listed prominently either on the insulation material (batts and rigid foam) or on the bag (loose-fill). When the R-value given in this book differs from the R-value used on the manufacturer's label, use the label R-value.

Five Categories Of Insulation

Residential insulation falls into five basic categories: loose-fill, batts and blankets, rigid plastic foam, spray-applied products, and reflective materials. These categories and the specific types which fall into each are described below.

Loose-fill Insulation

As the name implies, loose-fill insulation consists of granular or fluffy material that can be blown into hollow cavities or open attics. Its main advantage is that when properly installed, it completely fills the installation space without having to be cut and fitted. If an attic floor has lots of obstructions, loose-fill is probably the appropriate choice. Stores where you purchase your insulation often provide the use of a blowing machine at no cost. Other-

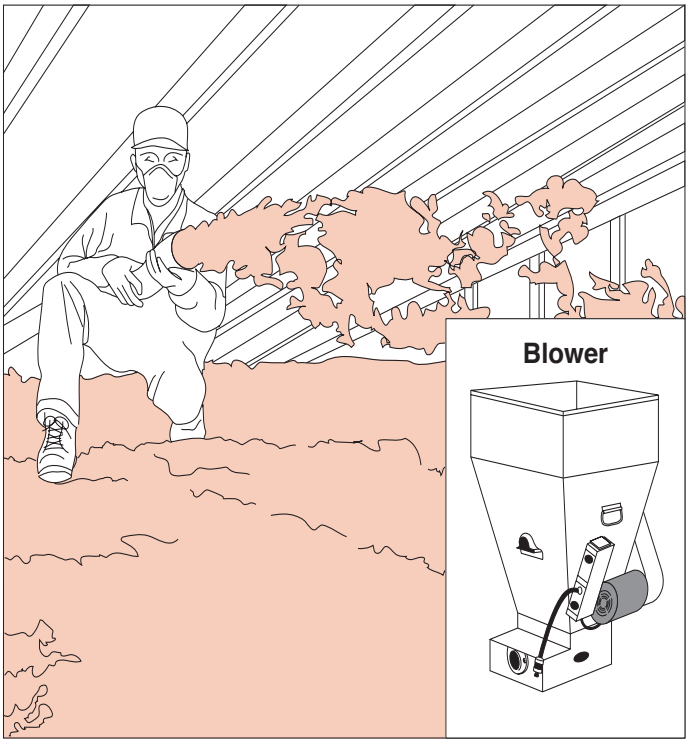


Figure 3-1 - Loose fill insulation can be blown into attics. Machine blowing produces thorough coverage.

wise a blowing machine can be rented at a minimal expense. Be sure to use all safety procedures in operating a blowing machine and always wear protective clothing, goggles, and the appropriate type of dust mask. Pouring insulation by hand is not recommended.

Cellulose fiber - R-3.7 per inch

Loose-fill cellulose fiber insulation is made from recycled paper products, such as newspapers and telephone books, which are pulverized into a fibrous material and then chemically treated for fire and pest resistance. It is suitable for both attics and exterior walls and for both new construction and retrofit work, although it is particularly effective for retrofit.

When tightly packed into walls, cellulose fiber not only adds R-value, but drastically reduces air leakage as well. Research has shown that densely packed cellulose insulation in the walls can reduce a house's overall air leakage rate by as much as 50%! Cellulose is best installed with a blowing machine. Installing cellulose without a machine gives uneven coverage and is not recommended.

Some loose-fill cellulose is intended for damp application into attics. Called "stabilized" cellulose due to its semi-rigid texture and resistance to settling, these products require special installation equipment that mixes water into the insulation as it is blown into the attic.

Fiberglass - R-2.3 to 2.8 per inch

Fiberglass is the most common type of loose-fill insulation used in homes. It is made by spinning molten glass into long thin fibers that are bound together and then cut into small tufts or cubes.

Mineral wool (Slag and Rock wool) - R-3.2 per inch

Mineral wool is made by spinning molten slag into long fibers, a process similar to that used to make fiberglass. One advantage of mineral wool is that it is totally fireproof and won't melt or burn in a house fire. (Fiberglass insulation doesn't burn, but it does melt.)

Mineral wool is fairly dense and should be installed with a blowing machine.

Vermiculite - R-2.4 per inch

Vermiculite is made by expanding mica under high temperature and pressure. Because it can withstand wetting better than any other loose-fill, it is commonly used to fill the cores of blocks in foundations. It is not commonly used in attics, partly because of its heaviness and partly because it is not as widely available as other materials.

According to the U.S. Environmental Protection Agency (EPA), all vermiculite is likely to contain small trace amounts of asbestos. A number of manufacturers produced insulation from vermiculite, but one mine in the United States produced over 70% of the world's vermiculite before the mine was closed in 1990. Vermiculite products generated from this mine were likely to have been contaminated with asbestos. If you suspect that you may have vermiculite in your attic, do not disturb it in any manner. Seek professional guidance and have the product tested for asbestos and then follow professional procedures if it must be removed or disturbed in any way.

Batts and blankets

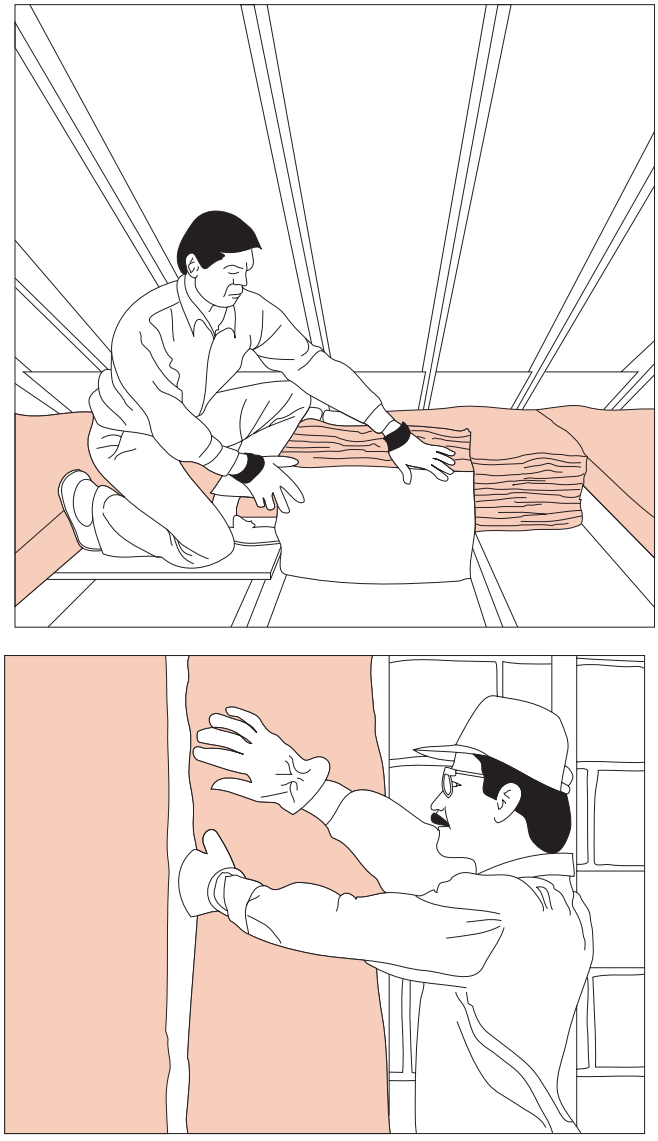


Figure 3-2 - Fiberglass batts are installed in open walls and floors. Wearing a dust mask, gloves, and goggles can help avoid irritation from fiberglass dust.

Batts and blankets are made of either fiberglass, mineral wool, or recycled cotton material that is spun into a cohesive mat. Fiberglass batts are the most common, accounting for roughly 90% of the material used to insulate walls in new homes. Mineral wool batts and blankets are relatively rare. Cotton or natural fiber insulation is fairly new to the market. An advantage to using cotton batts is that it is non-toxic and there is no itch or irritation associated with its use.

Batts and blankets can be used to insulate attics, cathedral ceilings, and basement ceilings. One advantage of batts and blankets is their ease of installation in open cavities.

The difference between batts and blankets is simply packaging. Batts are precut to roughly 4-foot or 8-foot lengths so that they will fit into a standard-height wall.

Blankets are long rolls of material that are cut to length on site, usually to be used in attic floors.

Fiberglass batts are available in the following thickness and R-values:

Thickness	R-value
3-1/2"	R-11
3-1/2"	R-13
3-1/2"	R-15
6-1/4"	R-19
5-1/2"	R-21
8-1/2"	R-30
12"	R-38

Notice that 3-1/2" batts come in three different R-values. The reason for this is that with fiberglass, as with some other insulation materials, the R-value per inch varies with density of the material. Manufacturers are able to pack more R's into a batt by increasing the density without changing the thickness.

Faced versus unfaced batts

Fiberglass batts are available with or without paper or foil facing on one side. The choice between faced versus unfaced is usually a matter of personal preference. The facers help control moisture movement into walls and floors and also have flanges for attachment to studs or joists. Unfaced batts are also suitable for any application as long as proper attention is paid to moisture control. Unfaced batts are typically made slightly wider than faced batts in order to "friction fit" into stud wall cavities without sagging. Be sure to wear protective clothing, goggles, and an appropriate dust mask whenever you work with fiberglass.

Rigid foam insulation R-4.0 to R-8.7 per inch

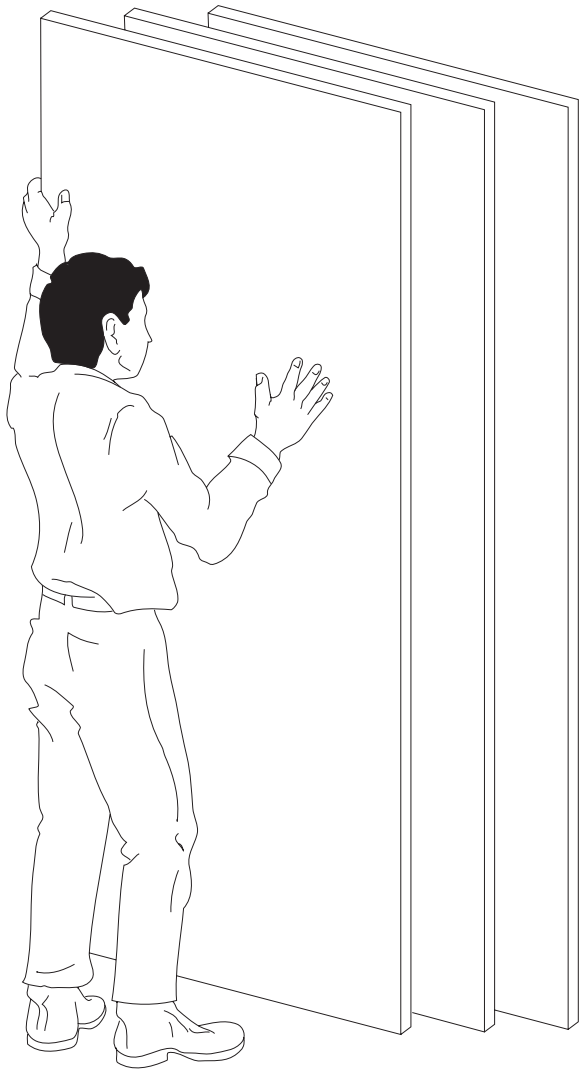


Figure 3-3 - Rigid foam insulation is made from several different types of plastic foam, each with a different R-value. The most common application for rigid foam is as exterior insulative wall sheathing. Some rigid foam insulation has the significant advantage of being resistant to water, and so is the best insulation for below grade foundation insulation.

Extruded polystyrene: R-5.0 per inch

Extruded polystyrene is made by four manufacturers in the United States, each of which uses a distinctive color: blue, pink, green and yellow. From the user's standpoint, all four are basically the same. Extruded polystyrene is very resistant to water penetration and is a good material for insulating foundations below grade.

Expanded molded bead polystyrene: R-3.5 to R-4.5 per inch

Sometimes referred to as "beadboard", expanded polystyrene insulation is very similar to the material used to make common coffee cups -- both are made of tiny beads fused together. The R-value varies with density. Expanded polystyrene is resistant to water penetration and is suitable for below grade use except in very wet sites.

Polyisocyanurate: R-7.2 to R-8.7 per inch

Most commonly sold with a shiny foil facing on one or both sides, polyisocyanurate or "iso board" has the highest R-value of any common insulation material. Though somewhat water resistant, iso board is not recommended for below-grade application.

Foam and fire - Caution!

Almost all the rigid foam insulation boards are flammable and must be protected by a fire-rated covering if installed in the living space or basement. Some building codes also require that rigid foam be covered when installed in crawl spaces.

Foam and the environment - the CFCs and HCFCs

Producing foam insulation requires use of a "blowing agent": a gas that forms the many tiny cavities in the foam and fills them after they are formed. Until recently, many of the foam products described above were made with chlorofluorocarbon blowing agents (CFCs). In fact, the CFCs helped give them their impressively high R-values.

Because scientists have discovered that CFCs are causing damage to the Earth's ozone layer, they are being phased out of production and are now banned in the US. Foam manufacturers are working to find alternative blowing agents for rigid foam insulation. Some manufacturers have already switched to hydrochlorofluorocarbons (HCFCs). HCFCs also damage the ozone layer, but they break down more quickly than CFCs in the atmosphere.

As a result, they have only 1/20 the deleterious effect on the ozone layer that CFCs have.

Because HCFCs still do some damage to the ozone layer, they are gradually being phased out of production and will be fully replaced by other blowing agents by 2030.

No foams now on the market (unless they've been in a warehouse for years) contain CFCs. Many contain HCFCs, while many others use neither CFCs nor HCFCs. Insulation labels are not required to disclose the blowing agent used in foams. Many manufacturers advertise that their foams are "CFC-free", but this is in fact a legal requirement for all foams. A few manufacturers advertise that their foams contain neither CFCs nor HCFCs, and these materials are the best for the environment. Insulating with an HCFC-containing foam, however, is much better for the environment than not insulating at all.

Spray-applied insulation

Figure 3-4 - Several types of insulation can be applied as a liquid or wet slurry. These "spray-applied" insulation materials are used mostly in new construction of walls, but some contractors use them in attics for both new construction and retrofits.

Urethane: R- 6.0 per inch

Urethane is a spray-applied foam that is chemically similar to the material used to make rigid isocyanurate. Like the iso-board, it is made using HCFCs or some other a blowing agents.

In addition to its high R-value, urethane has advantages in its air sealing properties and strength. When sprayed into a wall or attic, it forms an extremely effective air seal and adds rigidity to the structure.

One very effective use of urethane as a retrofit material is to spray a skim coat onto the attic floor, followed by loose-fill fiberglass or cellulose. The urethane will automatically seal air leakage sites and attic bypasses.

Wet-spray cellulose

Cellulose insulation can be applied wet using special equipment that mixes water into the insulation as it is blown out of a hose. Sometimes a small amount of adhesive is added. When installed in wall cavities, the wet cellulose sticks and forms a monolithic "batt". The same technique is sometimes used in attics to reduce dust during installation.

Except for attic application, wet cellulose would not be useful for retrofit situations unless the home is being rehabilitated and the interior has been gutted so the existing wall cavities are exposed.

"Blow-in-Blanket" system - R-3.9 per inch

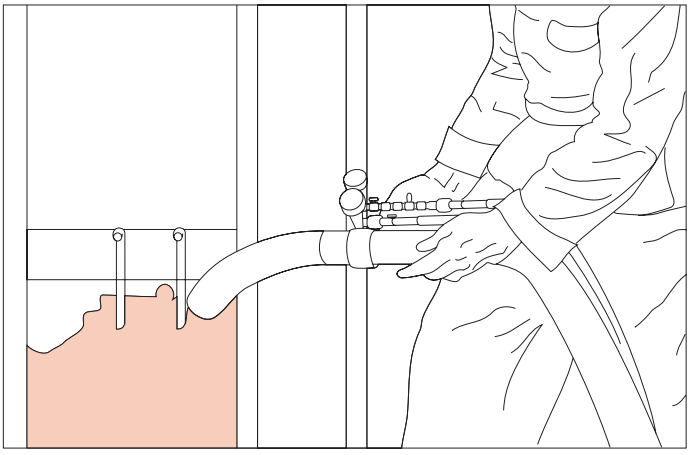


Figure 3-5 - One unique method for installing either loose-fill fiberglass or cellulose in walls is called the "blow-in-blanket" or "BIB" system.

With the BIB system, the insulation is mixed with a small amount of water and adhesive and is then pumped into wall cavities behind a nylon scrim that is stapled to the stud faces. The glue dries to form a lightweight monolithic "batt".

Reflective insulation and radiant barriers

Another type of reflective insulation, rarely used in homes, consists of multiple layers of foil, separated by spacers to create several reflective airspaces. These products are used mostly in industrial applications.

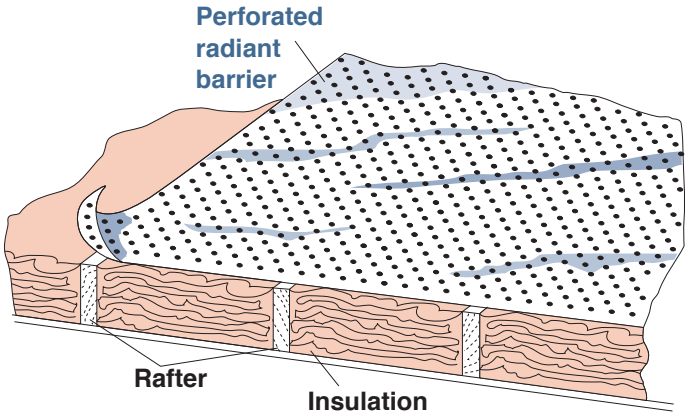


Figure 3-6 - Reflective insulation works differently from all the other types of insulation described above. When installed over attic insulation, reflective foil or metalized plastic products reflect heat away from the attic floor in summer. Referred to as "radiant barriers", these products will save up to an additional 8% on your cooling bill if installed over R-19 attic insulation. One source of moisture is water vapor in indoor air. Indoor moisture is carried into insulation primarily by air leakage into walls, ceilings, and floors. It can also diffuse through some solid surfaces such as unpainted drywall (see Figure 3-7).

Protecting Your Insulation From Moisture

Whenever you install insulation, you should protect it from all moisture sources. Wet insulation is less effective than dry insulation and can also lead to other moisture problems such as wood rot.

One source of moisture is water vapor in indoor air. Indoor moisture is carried into insulation primarily by air leakage into walls, ceilings, and floors. It can also diffuse through some solid surfaces such as unpainted drywall (see Figure 3-7).

To protect the insulation against water vapor from indoors, you should seal all air leakage pathways into walls or attic before installing the insulation. Proper air sealing should eliminate most chances of moisture problems.

The second line of defense against indoor moisture is

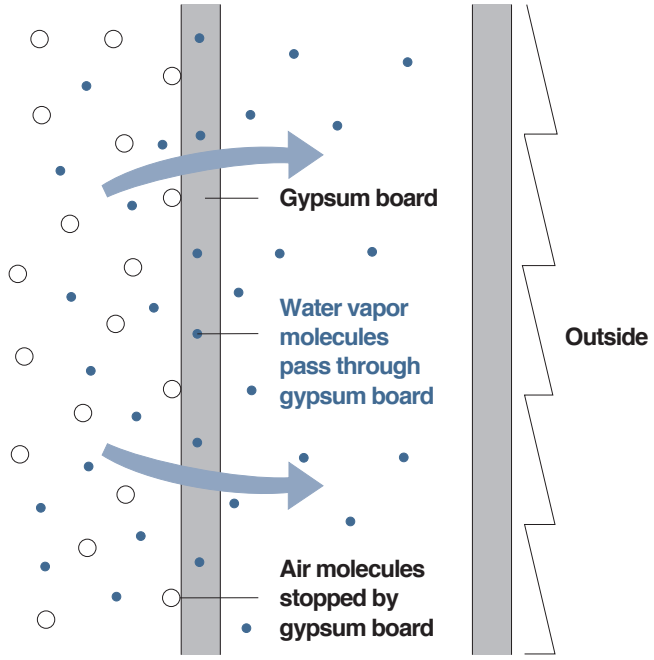
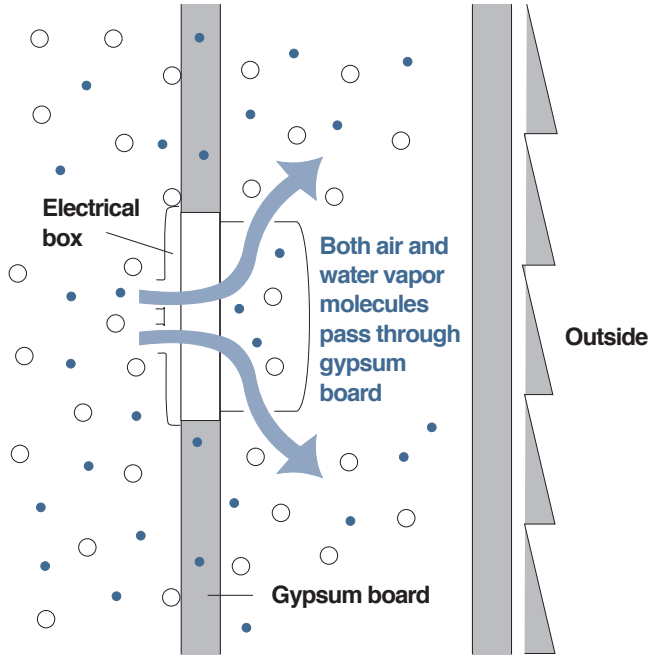


Figure 3-7a

Figure 3-7 - Moisture in indoor air can get into wall cavities either by diffusion through solid wall surfaces (Figure 7a) or by air leakage through electrical outlets and other penetrations (Figure 7b).

Figure 3-7b



to install a "vapor retarder" (sometimes called a "vapor barrier") on the warm side of the insulation to prevent vapor diffusion into the wall cavity or attic. A vapor

retarder is any material that is impermeable to water vapor. Suitable vapor retarder materials include polyethylene film, kraft or foil-faced batts, and oil-based paint.

It is usually difficult to install a polyethylene vapor retarder during retrofit work. In attics, it involves removing all existing insulation to get the vapor retarder against the attic floor. It is not possible to install polyethylene in closed-in walls without removing all dry wall or plaster.

Experience has shown that installing insulation without a vapor retarder does not usually cause problems. Proper air leakage control should prevent moisture problems in your new insulation. Nonetheless, it is probably good insurance to add a vapor retarder whenever possible, especially when insulating rooms with high indoor humidity. The most practical vapor retarder for walls is one coat of oil-based paint or special "vapor retarder" paints which are available at most paint stores.

Insulation Techniques and Applications

If your attic has less than R-19 insulation, you will need to add more. The recommended minimum R-value in Virginia is R-30. If the attic is open, (no floorboards), you have a choice of either batts, blankets or loose-fill. If there are floorboards, your only alternative is blown-in loose-fill.

General considerations and precautions

Air sealing before insulation

Make sure the attic floor has been properly air sealed before installing the insulation. Keep in mind that your attic will be colder during winter after you insulate it. Any air leakage up into the cold attic will carry indoor humidity that could condense and cause moisture problems.

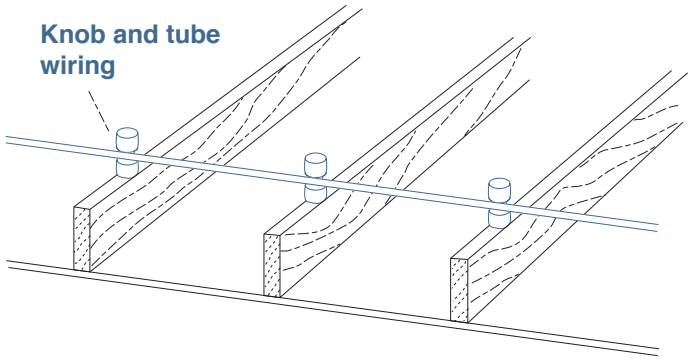


Figure 3-8 - Knob and tube wiring

See Chapter 2 for how to seal attic bypasses and other air leakage pathways into the attic.

Check for wiring hazards

Look for worn or frayed wiring that should be replaced before insulating. If you have knob and tube wiring, it must be replaced before insulating since it has exposed copper conductors.

Check for recessed light fixtures

Unless they are specifically rated for insulation contact (IC rated), you should not install insulation on top of recessed light fixtures. Non-IC-rated fixtures must be protected from contact with the insulation by a barrier on all sides and must not be covered.

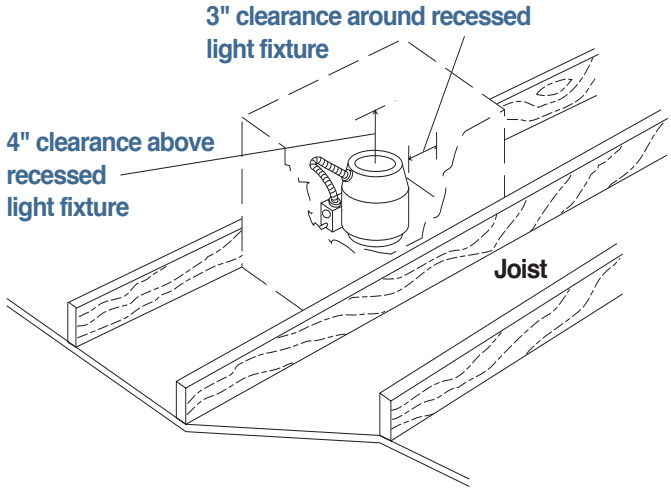


Figure 3-9 - Protected recessed light fixture

Make sure the attic is adequately ventilated

Attic ventilation serves two purposes. It removes excess heat in summer to prevent overheating, and it removes moisture in winter. Ventilation is particularly important after you add insulation because the insulation will make the attic colder in winter and thus more prone to moisture condensation. If you ventilate your attic without air sealing the attic floor, you will increase the potential for a moisture problem.

There are several types of ventilators to suit almost any attic configuration. They can be installed in the soffits, on the gable walls, or on the roof.

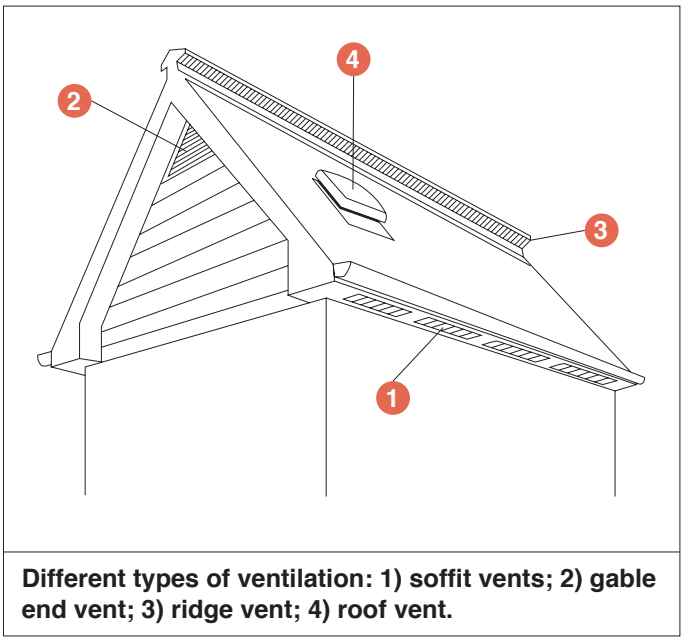
As a rule of thumb, you should install roughly one square foot of "net free" ventilation area per 300 square

feet of attic floor area. (Net free vent area refers to the actual area of open holes in a manufactured vent. It is usually about one-half the total vent hole area.)

Repair any roof leaks

Look for signs of roof leaks and repair them before installing any new insulation. *Make sure you don't block off soffit vents with insulation*

If your attic has soffit vents, or if you install soffit vents, you should make sure not to cover the vents with insulation. If you are using loose-fill, install a baffle at the edge of the floor joists (Figure 3-11a). With batts, keep them back far enough to allow at least a two-inch airspace between the batt surface and the underside of the roof sheathing (Figure 3-11b).



Different types of ventilation: 1) soffit vents; 2) gable end vent; 3) ridge vent; 4) roof vent.

Figure 3-10 - Attic ventilators

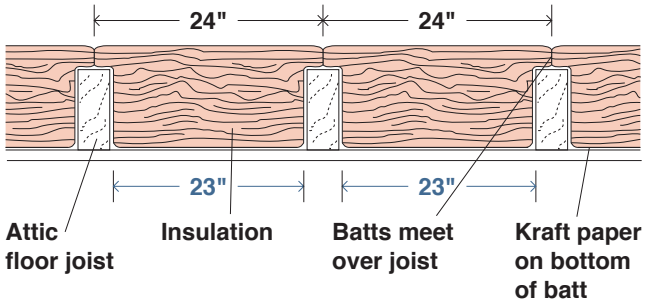
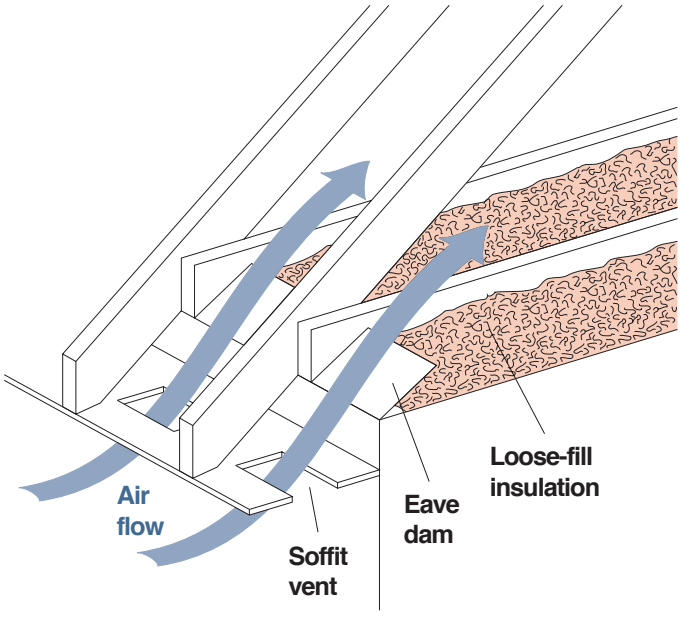
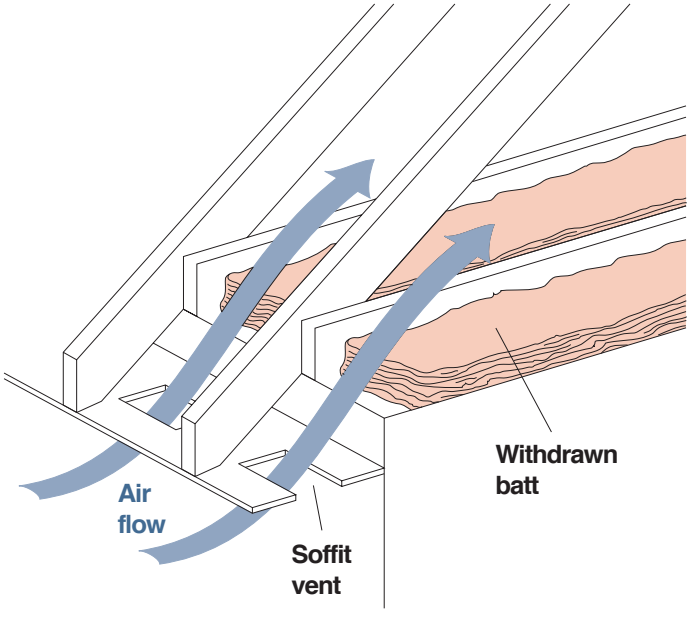


Figure 3-12 - Measure the spacing between your attic floor joists. It should be either 15" or 23". When purchasing the batts, be sure to get the proper width, made for attic application, not for walls. The proper width batts should come together above the attic floor joists. If you are installing the batts over existing insulation, buy unfaced batts. If there is no insulation in your attic, get kraft-faced batts and install them with the kraft paper facing down.



3-11a



3-11b

Figure 3-11 - Soffit vents must be protected against blockage by attic insulation.

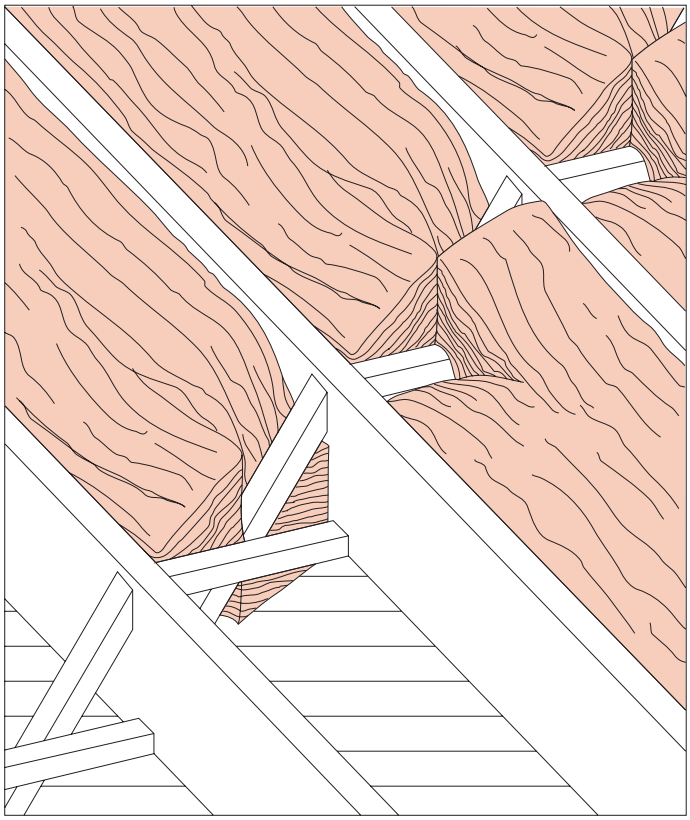


Figure 3-13 - Batts won't work well unless properly installed. It is very important that the batts are carefully fitted, as shown, to completely fill joist cavities with no gaps or voids. If even 5% of the space is left open, the R-value of the installation will be degraded by as much as 20%.

COVERAGE CHART FOR

SUPER-R

XL-100

R value @ 75˚ mean temperatures	Minimum inch Thickness	Bags per 1000 Sq. Ft.	Maximum Sw. Ft. Per Bag	Exposed Framing 16 in. O.C.	Minimum Wt./Sq. Ft.
50	13.2	70.18	14.25 14.90	none 2 x 6	1.75
40	10.5	56.15	17.81 18.75	none 2 x 6	1.41
32	8.4	44.90	22.27 23.89	none 2 x 6	1.12
30	7.9	42.10	23.75 25.60	none 2 x 6	1.06
24	6.3	33.68	29.69 32.64	none 2 x 6	.84
19	5.0	26.66	37.50 41.74	none 2 x 6	.67
13	3.4	18.24	54.81 61.00	none 2 x 6	.46
CAVITY FILL				Windows and Doors	
13	3.6	50	40.97 34.72	18% none	.72
21	5.6	50	26.33 22.32	18% none	1.12
28	7.6	50	19.41 16.45	18% none	1.52

Net Weight 25 lbs.

Figure 3-14 - Typical cellulose bag coverage chart.

Installing batts in attics

Avoid gaps and voids

If using batts, rather than blankets, butt the ends together. If you are installing two layers, run the top layer perpendicular to the bottom layer. Wherever there are obstructions such as cross bracing or plumbing stacks, cut the batts to fit around the obstructions.

Installing loose-fill cellulose in attics

Loose fill cellulose is installed by using an insulation blowing machine. Do-it-yourself machines are usually available from tool rental agencies or your insulation retailer. Installing loose fill cellulose by hand is not recommended. Using the "coverage chart" on the insulation bag, determine the thickness and number of bags required to obtain the desired R-value. For determining the required thickness, make sure to use the "installed thickness" listed in the coverage chart, not "settled thickness." Cellulose insulation always settles about 20% after it is installed.

When installing the cellulose, begin at the eaves and work your way back toward the center, making sure that the insulation completely fills all cavities. As you work back, spread the insulation evenly using a rake or other suitable tool.

It might take a little practice, but check your coverage as you go to make sure you are installing the proper number of bags for the area you are insulating. To obtain the desired R-value, you must install the proper thickness and the specified number of bags of insulation.

Make sure that you avoid gaps and voids due to

uneven or incomplete coverage of the attic area.

Installing loose-fill fiberglass in attics

Loose-fill fiberglass should be installed by a professional with an insulation blowing machine. As with cellulose, it is necessary to install both the required number of bags, as indicated on the coverage chart, and the indicated thickness to get the desired R-value.

Insulating cathedral ceilings

The only practical way to insulate cathedral ceilings is to blow in cellulose or fiberglass. This is a professional job.

The insulation is installed by drilling holes, usually from the inside, and pumping the insulation into the rafter cavities. The job should not be done unless you are sure that there will be no air leakage up into the ceiling cavity.

A good time to do this job is when re-roofing. The insulation can then be pumped in from the top, avoiding the mess indoors.

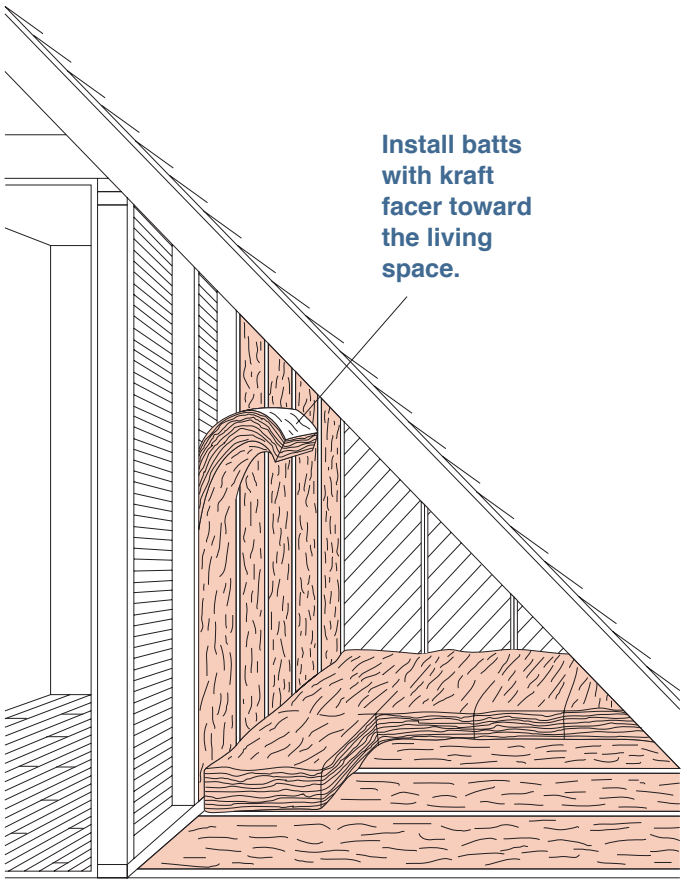


Figure 3-15 - In Cape Cod style homes, where a knee wall separates the second story from an unheated attic space, install batts in the stud cavities.

Insulating knee walls on 1-1/2 story houses

Use faced batts to create a vapor retarder and install the batts with the kraft facing inward, toward the living space. Ideally, you should also install insulation in the floor under the unheated space, but this is a tricky job. It is very important to air seal the area where the floor of the heated space interconnects with the opening to the un-heated attic space. This open area represents a very significant thermal bypass.

Installing basement insulation

If your basement is to be used as conditioned space, you should insulate the walls. For the Virginia climate, heated basements should have roughly R-10 to R-12 basement insulation. Before installing any type of basement insulation, be sure to seal any air leakage sites in the wall such as cracks or gaps around pipe penetrations. See Chapter 2.

Insulate on the outside or inside?

Your first decision is whether to insulate the walls on the inside or the outside.

Unless the inside wall surface is already finished or otherwise difficult to insulate, you are better off insulating the inside because exterior insulation requires excavation and is usually more expensive.

Framed wall insulated with batts

The most common basement wall insulation system is an insulated frame wall which can be finished to create livable space. Install a polyethylene moisture barrier against the basement wall to protect the insulation against ground moisture. The polyethylene need only extend up to grade level, but leave some excess at the bottom to run beneath the framed wall. The framed wall should be set off from the basement wall at least one inch to keep the lumber out of contact with the concrete. The bottom plate should sit on the polyethylene moisture barrier.

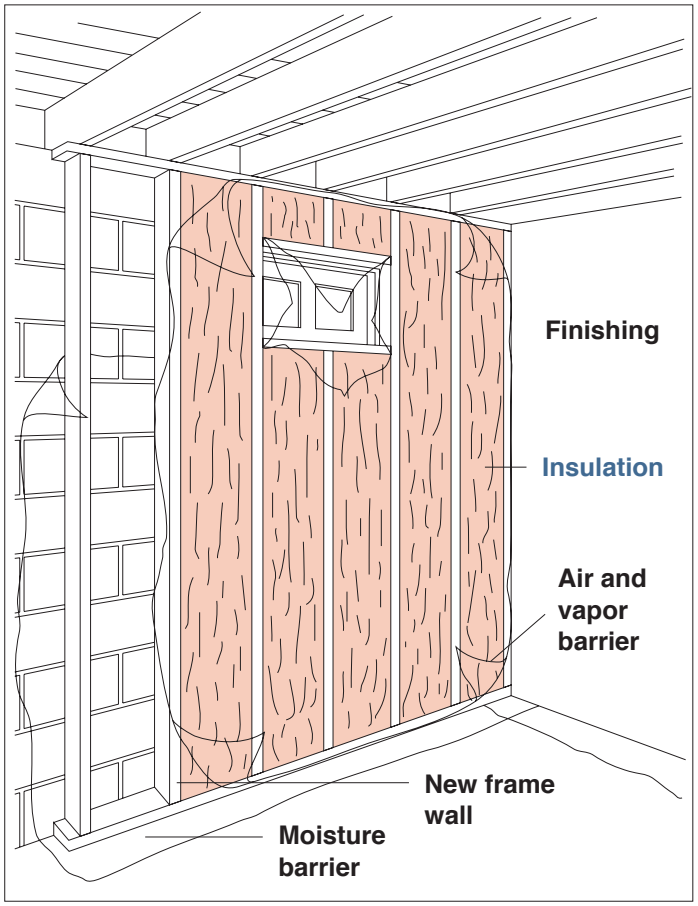


Figure 3-16 - Framed wall insulated with batts.

One situation where this system is not advisable is in very wet basements. Although the wall can be protected against moisture, you would still be taking a chance if the basement is very wet.

Rigid foam insulation

The most common alternative to a framed wall is to apply rigid foam insulation directly to the wall and cover it with an appropriate fire-rated sheathing. Special fastening systems are available that hold the foam in place and also serve as a screw base for gypsum wallboard. Another technique is to install wood furring strips which hold the foam in place and serve as a nail base for the wallboard.

Installing exterior insulation

The only practical way to insulate a basement on the outside is with rigid foam. To avoid excavation expense, the foam can be installed only on the top portion of the foundation, extending down a foot or so into the ground, where the greatest heat loss occurs.

The foam should be covered with either parging, fiberglass or metal sheathing to protect it from sunlight and physical damage.

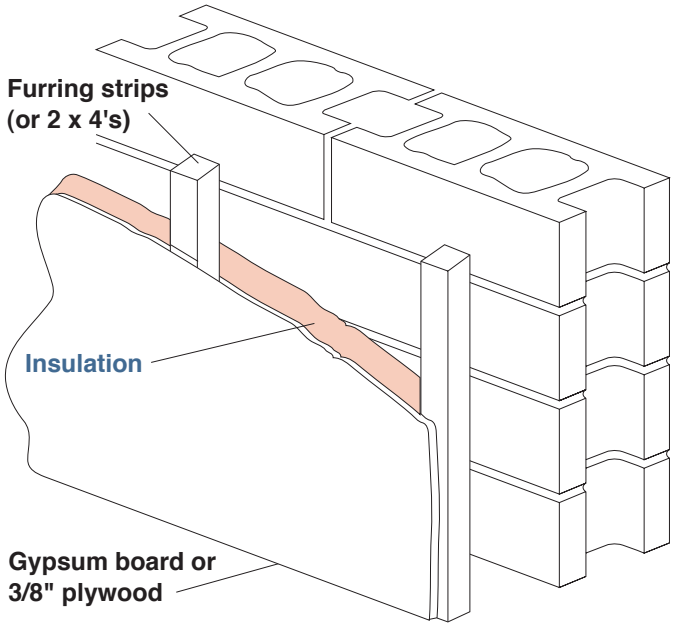


Figure 3-17 - Rigid foam interior insulation

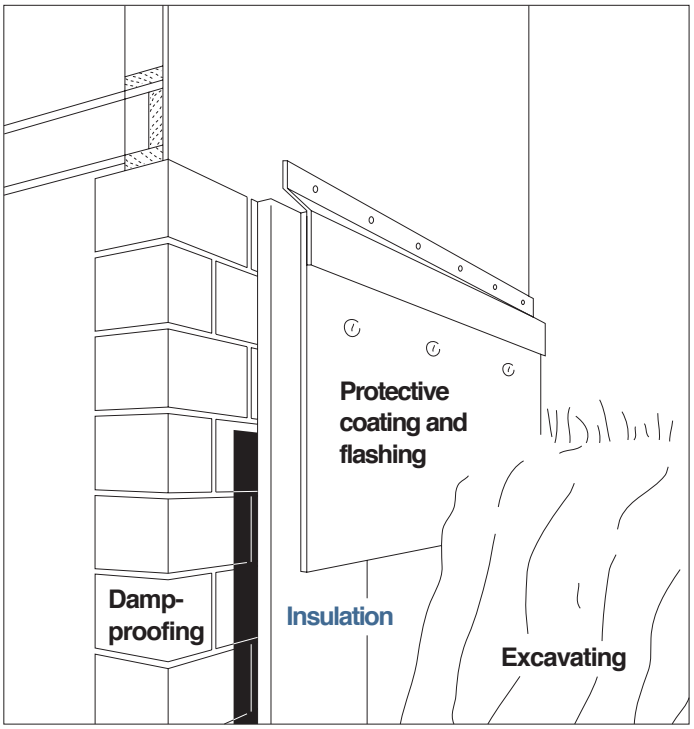


Figure 3-18 - Rigid foam exterior insulation

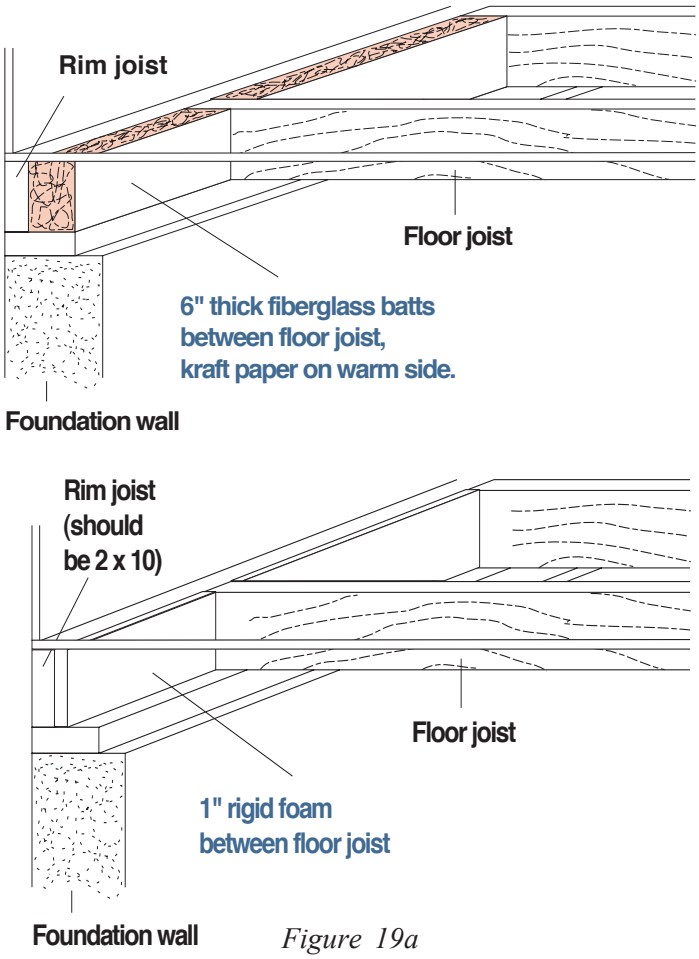


Figure 19a

Figure 3-19 - Insulating rim joist area

Don't forget the rim joist area

The final step when insulating a basement is to install insulation at the rim joist area. The most effective material for this application is rigid foam, caulked at the edges against each floor joist. This is a fairly tedious task and sometimes impractical in older homes. Alternatively, use faced batts, stapled to the floor joists.

Insulation of unconditioned basements

There is some disagreement among experts on the value of insulation in unconditioned (no heat or air conditioning) basements. In general, an unconditioned basement which is almost entirely below grade does not require insulation. If the basement has many walls above grade, however, insulation is probably worthwhile. Insulating an unconditioned basement has two benefits: it reduces energy transfer to the conditioned rooms above, and it increases winter comfort (especially in rooms with bare

Table 3-1 - Unconditioned Basement Insulation Options

	Basement Ceiling Insulation	*Basement Wall Insulation*
Advantages	• Joists are already in place for receiving batt insulation • Batt insulation on ceiling needs no protection from mechanical damage	• Basement walls easier to seal than ceiling • Protects ducts and pipes in basement • Insulated walls prepare the basement for conversion to living space
Disadvantages	• Basement ceiling may be difficult to seal because of many penetrations • Basement ceiling may be difficult to insuluate because of many obstructions • Basement ceiling area may be larger than basement wall area	• Batt wall insulation requires protection from moisture & mechanical damage • Foam wall insulation requires protection from fire, requires excavation • Required framing or furring and sheathing adds to inside insulation cost

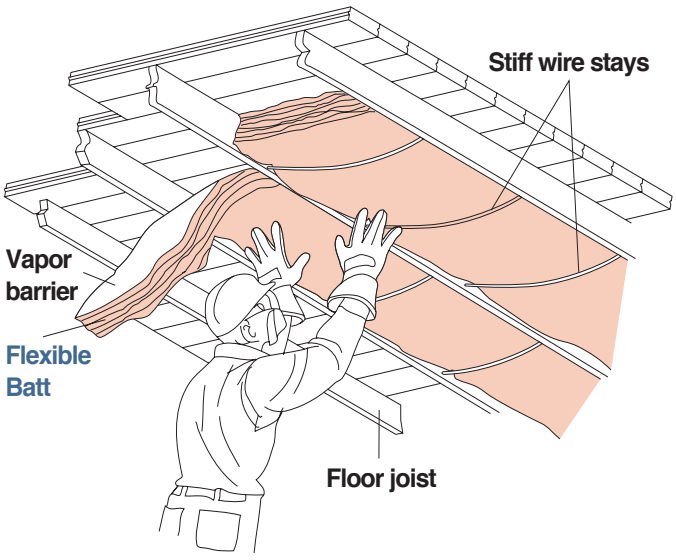


Figure 3-20 - Installing batts in basement ceiling.

floors) by making the floors above the basement warmer.

If you choose to insulate an unconditioned basement, you can either insulate the basement walls (to reduce heat transfer between the basement and the outdoors) or insulate the basement ceiling (to reduce heat transfer between the basement and the upstairs). Each approach has advantages and disadvantages, as shown in Table 3-1 on page 42.

If you insulate the ceiling, use unfaced batts rated at R-10 or R-12. Push them up snugly between the joists, against the basement ceiling, and secure them in place with wire stays. Before installing insulation, seal all air leakage points in the basement ceiling (see Chapter 2).

If you insulate the walls, use one of the techniques shown for conditioned basement spaces.

Crawl space insulation

Crawl space insulation can be installed either on the exterior walls or in the floor above. If your crawl space is not vented and appears dry, the best alternative is to insulate the walls, especially if there are ducts or other mechanical equipment located in the space. If the crawl space is vented, then the only alternative is to insulate the crawl space ceiling.

In either case, if there is obvious visible wetness in the space (e.g. wet ground or wet joists), you must cure the moisture problem before installing insulation. Install a thick (6 mil) polyethylene moisture barrier on the ground if there is not one there already. Lap the seams 12 to 18 inches, but don't bother to seal them. If this doesn't

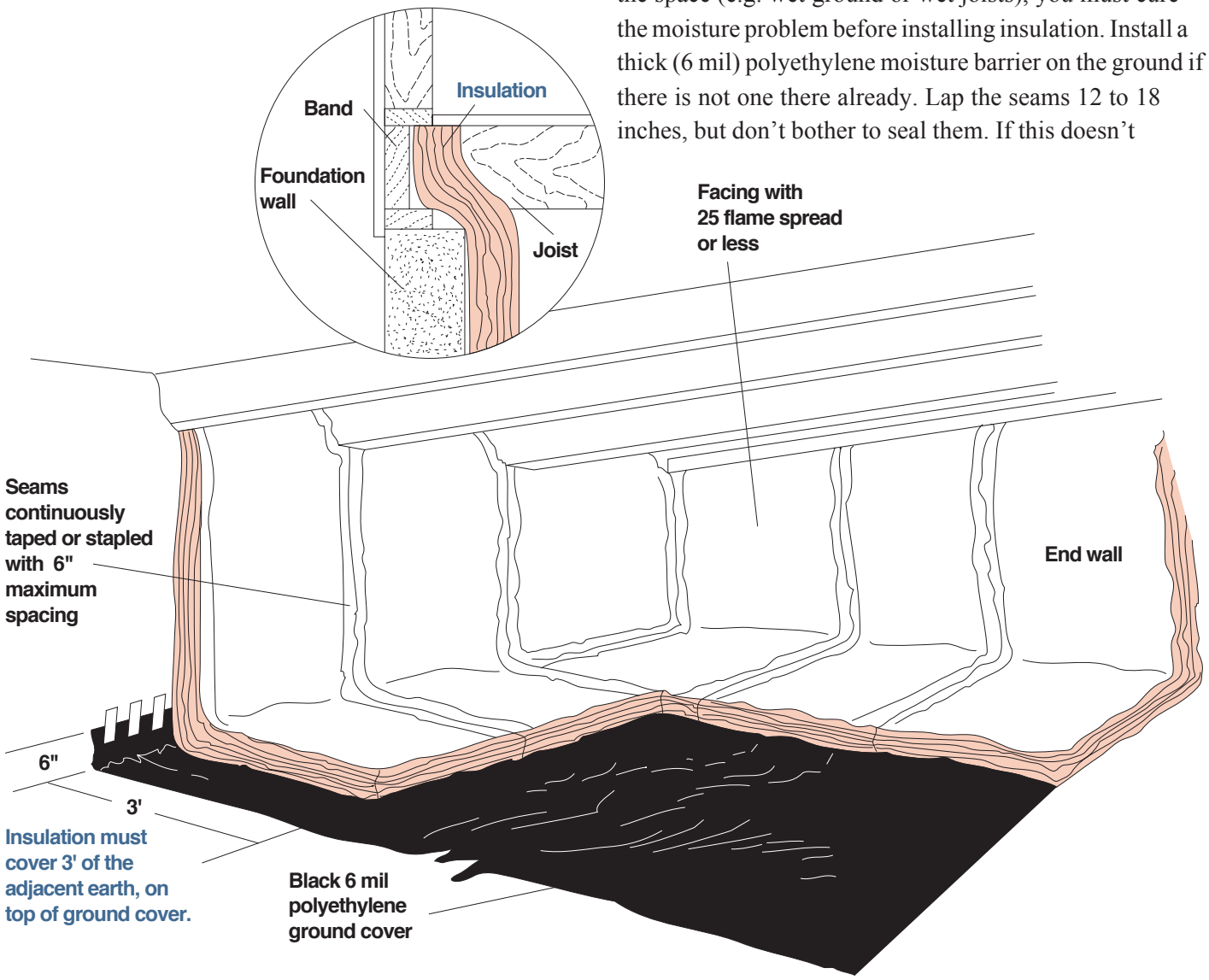


Figure 3-21 - The simplest way to insulate the inside surface of a crawl space is to staple faced batts to the rim joist and run the batts down the wall. Before installing the insulation, attach a polyethylene sheet over the wall and down onto the floor to protect the insulation from outdoor moisture.

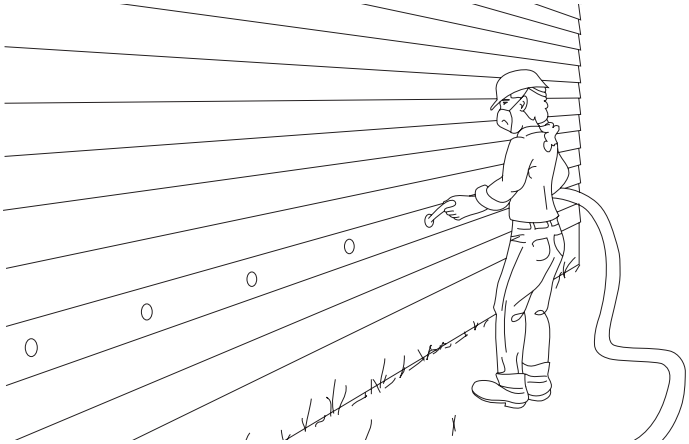


Figure 3-22 Blow-in fiberglass sidewall insulation

eliminate the visible wetness, you should consult a professional contractor before installing insulation.

The technique for insulating a crawl space ceiling is the same as for a basement ceiling (figure 3-20).

Crawl space walls, like basement walls, can be insulated either on the inside or outside. Unless access into the crawl space is difficult or impractical, insulating the inside is usually easier. Inside crawl space walls can be insulated with foam, but the foam must be covered with fire-rated sheathing (see figure 3-17). They can be insulated with fiberglass batts as shown figure 3-21, but a fairly high skill level is required to produce a neat, moisture-resistant job.

Exterior house walls

Installing insulation in the main walls of your home is a complex job that requires the skill and experience of a professional contractor. Your main decision is whether to install cellulose or fiberglass.

Dense-pack cellulose sidewall insulation

Contractors have developed a new and very effective technique for blowing cellulose into walls that not only insulates them, but drastically reduces air leakage. Called the "dense-pack" technique, it has been tried and proven in the Virginia Weatherization Assistance Program. (See Chapter One)

The "dense-pack" technique involves removing portions of the siding from the outside of the house and drilling a single hole in each stud cavity. The insulation is blown in under high pressure to about 3.5 pound per cubic foot density using a one- inch blowing hose. Exterior walls can also be blown from inside the house.

Blow-in fiberglass sidewall insulation

Blow-in fiberglass insulation is installed in the same manner as that described above for cellulose. Although fiberglass does not have the same air-sealing properties as cellulose, it still insulates quite well, adding almost R-4 per inch thickness.

Energy Tips and Recommendations

1. Insulation is one of the most important and cost-effective measures available in improving the energy performance of your home.
2. There are several different types of insulation available. Make an educated decision on what is right for your home. Consult with a professional insulation contractor if you have any questions.
3. Working with most types of insulation requires the use of protective clothing, safety goggles, and appropriate dust masks.
4. Be sure that all insulation is protected from moisture. Wet insulation is less effective and can lead to other moisture problems.
5. Be sure that the attic floor is properly air sealed before you install insulation or increase levels of existing insulation.
6. Make sure that all electrical outlets, fixtures, wiring and lighting are safe and properly covered before installing any type of insulation.
7. Loose fill insulation must be installed with a blowing machine. Make sure that there is complete and even coverage. Avoid any gaps and voids.
8. Batt insulation must be installed according to manufacturers specifications and be sure to avoid any gaps and voids.
9. Insulate your basement walls if the basement is to be used as a conditioned space.
10. Consider insulating your crawl space if it is dry. Install a 6-mil polyethylene moisture barrier on the ground.
11. Consider blowing cellulose insulation into the exterior walls of your house if there is no existing insulation. Use the dense pack method pioneered and proven to be effective by the Virginia Weatherization Program.