Deciding if more insulation is needed
Buying and installing insulation
Types of insulation

The energy efficiency of most homes can be improved, substantially reducing costs and – perhaps even more important – creating a healthier and more comfortable home environment. Furthermore, such improvements can extend the life of the house itself, reducing repair and maintenance costs.

How do we improve home energy efficiency? Increasing insulation is perhaps the first answer that comes to mind, but it is only part of the answer. Improving our home's energy efficiency involves an understanding of the "thermal envelope," that barrier to heat loss (and summer heat gain) that protects and separates the indoor living space from the outdoor climate. (See Figure 1.)

Insulation is the heart of the thermal envelope, but it is only one part of an entire system that also includes siding, sheathing, sheetrock, and other materials that prevent heat loss through air leaks and keep wind and moisture from penetrating the thermal envelope, reducing the effectiveness of the insulation.

Any program to improve home energy efficiency must pay attention to the entire thermal envelope. Before insulation is added, two important steps need to be taken: first, a system for controlling the intake of air into the home (and venting stale air out) must be supplied, and second, air leaks in the thermal envelope should be sealed. See the Sidebars on Attic Bypasses and Air Ventilation for information on how to proceed with these important steps before increasing insulation.

The role of insulation

Heat naturally flows from a warm to a cool place. In winter, heat flow is from indoors to outdoors; in summer, the movement is reversed. Insulation resists this heat flow, which is why an insulated home is warmer in winter and cooler in summer.

How well insulation works in resisting heat flow depends on where and how it is placed and on what and how much material is used.

Figure 1 shows a home and indicates where insulation would be placed to create a barrier to heat loss.

The type and amount of material used also affects how well the insulation works. Insulation material is rated according to its R-value, or resistance to heat flow. The higher the R-value the better the insulation is in reducing heat flow.

Is more insulation needed?

Checking current insulation level. To determine if you need more insulation, you must first find out how much insulation you have. One way to do this is to check for yourself. Look at Figure 1. You will want to see if you have insulation (and how much) in these key locations – the basement walls, exterior walls, floors above cold spaces, and ceilings below cold spaces. In unfinished areas such as attics, where structural frame elements are exposed, you can see the type of insulation and measure its thickness.

Related Guides:

Basement Insulation
Caulking & Weatherstripping
Windows & Doors
Home Heating
Home Cooling
Combustion and Makeup Air
Indoor Ventilation
Attic Bypasses

HOME

INSULATION

Minnesota Department of Commerce Energy Information Center

A comfortable home – warm in winter and cool in summer – is a major priority for most homeowners . . . and they pay for it! Heating and cooling account for approximately 60 to 80 percent of the average Minnesota household's energy costs. Yet in most cases, such high costs are not necessary.

Radiant Barriers:

Do They Work?

Radiant barriers (or reflective barriers) consist of a reflective film installed over the top of attic insulation in existing homes or between the roof deck and rafters in new construction and are also promoted for application below grade beneath concrete slab floors. They are frequently sold as an energy saving product, with claims of significant reductions in both heating and cooling costs.

Radiant barrier materials must face an open air space to have any significant effect, which means they will not work in sub-slab applications and are ineffective when placed against other materials or surfaces. Additional problems with radiant barriers include possible condensation or moisture trapping in the attic insulation, and the effect of dust accumulation on the surface of the film, reducing the reflectivity.

An Oak Ridge National Laboratory study concludes that attic radiant barriers are not an effective way to reduce heating or cooling loads in Minnesota. Adding conventional attic insulation would be a much better option for saving energy. In fact, as the attic insulation level increases, the potential benefits from a radiant barrier decrease. Radiant barriers in Minnesota are generally not worth the investment in terms of energy savings.

Checking insulation in finished walls and areas is more difficult. One way to check for wall insulation is to look directly into the wall cavity, either by removing a switchplate or by drilling holes into outer walls. After turning off the power, you can remove a switchplate cover and probe the wall around the electric outlet box with a plastic crochet hook – or other non-metal instrument – and a flashlight. The drawback to this method is that it is difficult to get an opening large enough to make an accurate check.

A more reliable check can be made by drilling holes directly into an outer wall in a closet or cupboard or other hidden area. Cut a 1- or 1-1/2-inch hole with a keyhole, reciprocating, or hole saw, and determine whether there is any insulation and, if so, how much. These holes should be filled and finished with patching plaster and touch-up paint.

Don't be concerned that old wall insulation may have "settled" into the lower part of the walls. The insulation level you see, whether at a high or low section of the wall, should give you an accurate picture of the insulation level for the entire wall.

Drilling holes in the walls can also reveal any obstructions in the wall. For instance, some homes built between 1910 and 1945 have a sheet of tar paper or other material in the wall cavity to reduce heat-robbing air convection (air movement) within the walls.

Another type of convection barrier often used in homes built before 1930 is backplaster, which is another layer of plaster within the wall cavity.

Backplaster makes insulating walls more difficult, but it is still worthwhile to do. Discuss your options with an insulation contractor and call the Energy Information Center.

If you do not wish to check for insulation yourself, a second possibility is to have your utility do an energy “audit” or evaluation. A number of utility companies in Minnesota will do energy audits. Call your utility and ask for an energy audit.

Another possibility is to have a qualified independent energy contractor do an evaluation, possibly using such technology as infrared thermography and blower door technology. Such an evaluation is reliable and provides valuable information about your home. If you have any questions about applying these techniques to your house, call the Energy Information Center.

Evaluating benefit of added insulation. The decision whether to add insulation will depend on a number of factors. A better insulated home is more comfortable and quiet. It will save you money on utility bills for years to come. And by using less energy to heat and cool your home, you reduce the negative impacts on the environment caused by energy use.

The graph “Insulation—The Difference it Makes,” compares the annual heating bills for three versions of the same home – one with limited insulation and the others with improved levels of insulation. The heating bill for your home may differ considerably from amounts on the graph, depending on the size of your home, the type of heating fuel you use, the insulation levels, furnace efficiency, etc. The numbers will, however, give you an idea of the potential energy savings to be gained by weatherizing your home, depending on its present insulation level. The costs of various improvements can help you decide which improvements to make.

Basement. Insulating the basement is relatively expensive, but it makes a significant difference in comfort and energy use and adds to the living space of the home. A description of the two methods of insulating a basement—exterior and interior—is provided in the publication “Basement Insulation,” available from the Energy Information Center. The information in this guide focuses on attic-ceiling and wall insulation.

Attic/ceiling. If your attic is poorly insulated, you could save significantly on your heating bill by insulating to adequate levels—provided, of course, you first seal attic bypasses (page 4). Adding attic insulation is relatively inexpensive; in the examples accompanying the graph, increasing the Rvalue of attic insulation from 6 to 40 costs about $465 and reduces heat loss by about 14 percent! If your present attic-ceiling insulation R-value is less than 30, adding more insulation would be well worthwhile.

You can figure out your present R-value by noting the type and amount of insulation you have and checking it with information on insulation materi-

als and their approximate R-values listed in the Types of Insulation Table.

In unfinished attics, insulation should be put between the floor joists to seal off living spaces below.

In finished attics with or without dormers, insulation should go between the studs of knee walls, between the studs and rafters of exterior walls, and in ceilings with cold spaces above (Figure 1).

In deciding whether to add insulation, you should check not only the present level of insulation, but also its condition. Is it level, or are there bare spots or piles of material? Look for signs of moisture damage – wet or compacted insulation, water staining on rafters or joists. Moisture problems can seriously damage the house structure and insulation, and therefore they must be solved before insulation is added. (See page 4.)

Walls. Insulating an unfinished attic or crawl space is simple and fairly inexpensive compared to adding insulation to finished walls. As shown in the graph and examples, adding wall insulation costs approximately $1,250. You should definitely consider adding wall insulation when:

• Your wall cavity has a void or air space. Filling in this space with blown-in insulation would probably result in significant savings.

Figure 1:

Insulation is the heart of the thermal envelope. Asterisks indicate key points along the layer of insulation that encloses the home.

• You are planning to add new exterior siding. Insulation should be blown into wall cavities at this time. Blowing in insulation under new siding does not require the expense of resurfacing exterior access holes. Once the new siding is in place, it will be difficult and expensive to add blown-in insulation.

For added heat loss protection, you should also consider adding one-inch of rigid insulation to the exterior walls before installing the new siding. This further strengthens the thermal envelope, reducing outside air penetration and preventing wet siding from transmitting moisture into the wall cavity. Because rigid insulation is an excellent moisture retarder, and because it keeps the wood in the wall cavity warmer, walls with exterior insulating sheathing are significantly drier than walls without it.

• You are planning extensive interior renovation. If you plan to gut the walls of your home during a major rehabilitation project, you should spend the extra time and money to fill the cavities with insulation as long as they're open anyway. (If you plan to repaint or wallpaper rather than rebuild the walls, you can blow insulation into the walls from the inside.)

Seal Attic Bypasses First

Preventing air leaks into walls and ceiling is essential for insulation to be effective. One-third to one-half of the home's heated air in winter (and cooled air in summer) is lost to the outdoors through leaks around doors and windows, pipes and ducts, electric outlets, chimneys, and other openings. At other times, depending on wind speed and direction, cold (or heated) air comes in through the same passages. Before you insulate, you should eliminate these air leaks.

Attic bypasses are a major source of air leaks. Bypasses are hidden air passageways that lead from the heated space into the attic. Because warm air rises, it continuously moves up these passageways and escapes into the attic during cold weather.

In addition to being a source of heat loss, attic bypasses also cause indoor moisture problems. Warm air leaking into the attic causes moisture to condense onto cool surfaces, such as wood joists

and insulation. This moisture can rot the wood and reduce the effectiveness of the insulation. Ice build-up on the roof is still another problem caused by attic bypasses. Heat escaping into the attic melts the underside of snow on the roof, causing water to flow to the edge of the roof where it freezes, eventually forming an ice dam. Common attic bypasses are located around chimneys, ceiling light fixtures, heating ducts, kitchen and bath exhaust fans, plumbing and electrical penetrations, and at the tops of interior walls and junctions of ceiling and exterior walls. The Home Energy Guide, “Attic Bypasses,” provides instructions on how to seal bypasses.

Important Considerations: Knob & Tube Wiring

Knob-and-tube wiring gets the name from the porcelain knob and tubes that were used to attach wires under, over and through framing members of a structure. This was the original electrical distribution system developed and used until about 1950.

Older homes are still likely to have this system.

Knob and tube wiring uses only two wires called conductors to create a circuit. The two wires are independent of each other, running parallel, but separate through the house joining only when they reach the electrical device. Each wire is insulated with cloth and held in place with porcelain “knobs.” When the wires run through a joist or stud, porcelain “tubes” are used to keep them away from the wood.

Modern wires are bundled together in a plastic sheathing or metal conduit and include a ground wire. Connections between modern wires are completed within enclosed electrical junction boxes.

Knob-and-tube wiring had visible connections. The wires were spliced and soldered together and then wrapped with electrical tape. These connections are called “pig-tail” connections because one wire is wrapped several times around the other wire before the two are soldered together and then wrapped with cloth electrical tape. Ceramic knobs were strategically placed to protect the splice ensuring that inadvertent tugging on the wire would not stress the electrical connection.

While the differences between knob-and-tube and modern wiring are considerable, there is nothing.

What Is a Vapor Retarder?

You may wonder if you have a vapor retarder in the walls or ceiling of your home. Houses built prior to 1955 likely have a vapor retarder in place, in the paint applied to walls and ceiling of the home. Two or more coats of oil or alkyd paints applied to a surface perform as a vapor retarder. Other vapor retarders include foil-faced gypsum board and foilfaced and Kraft-faced fiberglass mineral wool insulation. If you are not certain whether you have a vapor retarder, call the Energy Information Center and talk to one of the energy specialists. Phone 651-296-5175 in the Twin Cities; statewide call toll free, 1-800-657-3710.

inherently dangerous about properly installed knob-and-tube wiring. The safety concerns are not about the original wiring, but with changes that may have been made over time. Homes with knob-and-tube wiring were usually supplied with 60-amp service, with a limited number of circuits and electrical outlets per room. Most knob-andtube systems predate television, computers, and dozens of other appliances that are today taken for granted. This may have been adequate initially, but over the years the demand for household electrical capacity has grown dramatically.

Many knob-and-tube systems were modified to respond to the need for greater household electric capacity. In some cases, these modifications put undue stress on the wiring system. Because a homeowner often may not know what modifications or stress has been placed on the knob-andtube system, the Energy Information Center recommends that knob-and-tube wiring be replaced in older homes prior to adding insulation.

Buying insulation

Once you make the decision to add insulation, your next major decision will be selecting the type and amount of insulation. Your selection will be based on a number of factors, such as the structure of your home, where you are going to add insulation (walls and/or ceiling), whether you intend to install the insulation yourself, and perhaps most important, the insulation R-value.

Minnesota requires that all residential thermal insulation sold in the state meet certain standards regarding fire resistance, accuracy in R-value rating, recommended use, and other important characteristics.
The Federal Trade Commission (FIC) requires manufacturers to provide fact sheets listing important characteristics, including the Rvalue per specified amount. In Minnesota, the manufacturer must also state the R-value for that material at winter design conditions. The table lists information on various kinds of insulation, including the approximate R-value per inch. Ask to see the FTC Fact Sheet for a precise and accurate R-value listing.
If you have insulation installed, the installer is required to provide a receipt. In the case of attic or ceiling insulation, the installer must provide a completed insulation receipt or "attic card." This

Insulation – the Difference it Makes

The bar graph below illustrates the drop in annual home heating costs—anywhere from 35 to 65 percent—when insulation is added. The calculations are based on a pre World War II, two-story home with a 28-by-26 foot foundation.
The low-level home has a minimum amount of attic insulation; the walls, rim joist, and basement walls are not insulated. The house has its original doors and windows.
The mid-level home has added attic insulation (to R-44), and the walls are insulated with a "densepack" insulation system, which uses a higher level of density than is normal: 3 lbs. per cubic foot for cellulose or fiberglass, and 4-6 lbs. per cubic foot for mineral wool. Insulation is also added to the rim joist. The cost of these improvements totals about $1,843: $129 for rim joint insulation, $465 for added ceiling insulation, and $1,248 for wall insulation. The mid-level home also includes replacement of window sashes at a cost of $4,675. This is an expensive improvement that does not substantially reduce window heat loss unless storm windows continue to be used. Compare with the home described below, where for about $900 more, high performance windows providing R-4 insulating value (and eliminating the need for storms) can be installed. Improving the low-level home to this mid-level costs about $6,500 and saves about $325 a year in heating costs in the Twin Cities and about $379 a year in Duluth.
The high-level home has the same insulation as the mid-level home, but in addition, basement walls are insulated and windows and doors have been improved. Air leaks in the attic and rim joist also have been sealed. Costs for these improvements are: $2,030 for insulating interior basement walls (or $2,592 for insulating exterior basement walls), $5,582 for upgrading windows, and $500 for improving doors. Total cost of improving the low-level home to highlevel is about $9,900 and saves $600 to $700 a year in heating costs.
The pie chart shows the percentage of total heat loss from various parts of the high-level home described above. Biggest sources of heat loss are air leaks and the foundation. Insulating basement walls substantially reduces heat loss from the foundation, but the uninsulated basement floor continues to account for about a third of the home's total heat loss.

$1,200
$1,000
$800
$600
$400
$200
$0
low level
mid level
high level
T.C.

Duluth
infiltration
23%
ceiling
3%

foundation
32%

card identifies the type of insulation installed, the manufacturer, the installer, the R-value, the design settled thickness, the square footage of attic coverage area, and the number of bags installed. The card is signed and dated by the installer.

Installing insulation yourself

Putting insulation in unfinished floors, ceilings, and walls is fairly easy for the do-it-yourselfer. Installing insulation in the cavity of exterior walls is more difficult and usually performed by a contractor. Doit-yourselfers may rent equipment for sidewall insulation. If new siding is to be installed, make sure the existing walls are filled and then add one inch of rigid insulation beneath the new siding.

Research indicates that installation of blown insulation at higher densities performs better than insulation installed at traditional densities. For cellulose insulation installed in walls, densities of more than 3.5 pounds are desired. This is roughly 10 pounds of cellulose per stud cavity, or two stud cavities per 20-pound bag. Fiberglass insulation will need a three-pound density and mineral wool will need a four- to six-pound density.

When installing attic insulation, place baffles around the perimeter of the attic to prevent “wind wash.” Wind wash occurs when cold air enters the soffit vents and blows through the insulation, creating cold areas where moisture condenses and reduces the effectiveness of the insulation. A baffle need be nothing more than a piece of sheathing (see Figure 4).

When installing insulation, take these precautions:

• Wear protective clothing (Figure 2). Consider buying a disposable coverall to use over clothing. Handling insulation can temporarily irritate the skin, so keep shirt sleeves rolled down and wear gloves and always use a face mask rated for the insulation you are installing. When handling cellulose, do not wear contact lens. Always wear goggles. When you are done, take a cold shower. The cold water closes your pores and allows you to wash off the insulation. If you are working around old vermiculite, do not stir it up, since this material contains asbestos. (See page 11)

- On hot, sunny summer days, work early in the morning. Late afternoon attic temperatures can reach 140°F. in the summertime.
- When working in the attic, put up a wide board that you can stand on. Don't step between the joists or your foot may go through the ceiling.
- Use a portable light with plenty of extension cord if your attic isn't lighted.
- Do not cover or hand pack insulation around bare stove pipes, electrical fixtures, motors, or any heat-producing equipment such as recessed lighting fixtures (unless they are IC —insulation contact—rated). Keep at least a three-inch space between these materials and insulation (Figure 3). The "Attic bypasses" Home Energy Guide gives detailed instructions on how to seal air leaks around these fixtures.
- When insulating the ceiling, be sure to install as much insulation as possible—and extend it as far as possible—over the top of the exterior wall, making sure there are no gaps.
- Be sure to provide fire protection for polystyrene and other insulation, per manufacturer's instructions.

Tips for installing various types of insulation:

Batts and blankets: On walls, begin at the top and work down. If you use batts or blankets with a facing (air-vapor retarder), place the retarder toward the inside of the house. Fit the insulation snugly between the wood frame studs, cut off the excess length where necessary, and staple or tack the facing to the edge of the stud. Use a broad blade putty knife to "tool" the batt into the stud cavity. (Figure 5) Where there already is some insulation, place batts over existing insulation. After the insulation is in place, cover the entire wall with 6 mil polyethylene to serve as a vapor retarder.

On unfinished attic floors, loose fill insulation is preferred. If you choose to use batts and blankets, they must be cut and installed around such obstructions as cross bracing between floor joists and truss webbing. Strips of insulation may be cut off and placed into tight spaces by hand. Be as precise as possible in trimming the insulation pieces to fit the spaces. Do not fold or bunch the insulation.

If there is already some insulation on the floor, simply lay blankets (without an air vapor retarder) on top of the existing insulation.

Figure 2:
Wear protective clothing when installing insulation.

Figure 3
Keep at least a three-inch space between insulation and bare stove pipes, motors, and other heat-producing equipment.

Subsequent layers of blankets should be placed at right angles to the layer below, and they can be placed on top of the joists.

Make sure additional layers do not have air-vapor retarders, and make sure there are no gaps. Air gaps reduce the effectiveness of insulation.

Loose-fill: Blow loose-fill insulation into place. This insulation can be placed over existing loose-fill or over batts and blankets. Remember to seal attic bypasses before installing the insulation. To keep loose-fill from shifting into vents or eaves use baffels or chutes to keep insulation from coming into contact with fan motors or other heat-producing equipment, place sheet metal flashing or other nonflammable material around these areas (Figure 6).

Install the insulation from the outer edges inward. Dividing the attic into segments and installing the proportionate amount of insulation in each segment will help you cover the entire attic area evenly.

Special problem areas. Three types of areas fairly common in houses are likely to give the do-ityourselfer some problems:

Crawl spaces. Often one or more rooms – in some cases the whole house – will not rest on a basement foundation but have only a crawl space underneath. Any part of the house that is heated should be included in the thermal envelope and should be separated from unheated space by an insulation barrier (see Figure 1).

If the crawl space has a bare earth floor, you should completely cover the earth with a sheet of plastic (polyethylene film – at least 6 mils thick) to prevent moisture from coming up into the house (Figure 7). Spread it over the smoothed ground and extend it up four to six inches onto the walls of the crawl space. Hold it in place with bricks or sand. (Do this immediately, whether or not you insulate.)

You have two choices as to where to place the insulation
barrier: between the floor joists of the heated
area, or on the interior or exterior walls of the
crawl space. Placing nine-inch thick batts or blankets
between the floor joists will provide you with
the minimum recommended R-value of 30.
Installing the insulation may be difficult, however,
requiring you to lie on your back if the crawl space
is very shallow. Secondly, because the insulation is

Figure 4:
Air chutes or baffles prevent wind blowing through insulation.

Figure 5:
The facing (air-vapor retarder) on
batts and blankets should be toward
the inside of the house.

Figure 6:
Use sheet metal flashing or other non-flammable material to prevent loose-fill insulation from coming into contact
with heat-producing equipment. If the fixture is insulation-contact rated, it is not necessary to keep insulation from
contact with the fixture.

Loose-fill Cellulose
Fiberglass
Mineral Wool
3.1 – 3.7
2.5 – 4.0
2.4 – 4.0
Note: at extreme winter
temperatures, R-values of
fiberglass and mineral wool
loose-fill insulation may be
reduced.
Blown into place by machine Finished walls. Unfinished
attic floors and hard to
reach places. Enclosed cavities.
Generally installed by contractor.
Skilled do-it-yourselfer
can rent a machine to
blow in loose cellulose. Easy
to use for irregularly shaped
areas and around obstructions.
Blankets or Batts Fiberglass
Mineral Wood
3.1 – 3.4
3.1 – 3.4
4.0 for high density fiberglass
and mineral wool
Fitted between studs, joists,
and beams. Some may be
formed in place.
All unfinished walls, floors
and ceilings.
Suited to do-it-yourselfer.

Suited for standard stud
and joist spacing that is relatively
free from obstruction.
Comes with or without
vapor retarder facing. If
used with facing, vapor
retarder must be on the
side toward the inside of
the house.
Rigid Board Expanded polystyrene
(beadboard)
Extruded polystyrene (colored
styrene)
Polyisocyann-urate (foil
faced)
Rigid fiberglass
3.5 –5
5
5.4 – 7.5
4.2
Rigid board insulations are
typically cut to fit and glued,
caulked, or mechanically
fastened into place.
Polystyrene must be covered
with 1/2-inch sheetrock
for fire protection.
All used on exterior sheathing
or basement interior
walls. May be used below
grade (the exterior or interior
of foundation walls).
Also used on flat rook and
cathedral ceiling.
Spray-in Insulation and
high-density blown-in products
Cellulose
Fiberglass
Mineral wool
Polyurethane
Polyicynene
3.2 – 3.7
3.2 – 4.1
3.4
5.4 – 7
3.6
Spray applied to surfaces.
Spray applied behind a net
facing. Also can be blown
into cavities.
Walls
Ceilings
Other enclosed cavities
such as flat roofs.
40° or above for 72 hours
after application. Specifically

formulated polyurethane may
be applied at below 40°F.
Reflective Aluminum foil (single sheet
and multiple sheet)
Varies depending on heat
flow direction. See FTC fact
sheet for the particular
product.
Staple to studs or joists. Floors and walls. Works best when heat flow
is downward (i.e., in floors).
Air space between foil and
adjacent surface is essential
for performance.
Others Perlite
Vermiculite
Polystyrene beads
Urea formalde-hyde
Air entrained cement
Other foam plastics
Approximately 4 or more,
depending on product
Pour into place.
Contractor installed.
Pour-in products are not as
readily available as other
insulation systems. They
also allow for considerable
air movement, thus reducing
their performance. Urea
formald-hyde is not recommended
for residential applications.
Suited for do-it-yourself.
Perlite, vermiculite, and
polystyrene beads are
expensive and have lower
R-value than other types of
insulation. Vermiculite contains
asbestos.

Type Materials R-value/inch Installation Method Where Applicable Characteristics

applied from underneath (the unfinished side), there is the problem of how to hold it in place. You can use snap-in wire holders (placed at intervals between the joists and available from building suppliers), or chicken wire can be stretched across the entire area (Figure 7). You should use unfaced fiberglass insulation for this location. Flooring generally will serve as a vapor retarder.

A second—and prefered—choice is not to insulate the floor of the heated area, but to insulate the walls of the crawl space. A rigid board insulation (see table) could be applied either to the outside or inside of the walls, following essentially the same techniques as when insulating a basement. (Call the Energy Information Center for the basement insulation Home Energy Guide.) If the added insulation is applied to the exterior wall, the above grade portion also will need to be covered with material to protect the plastic board from the ultraviolet rays of the sun.

Cape Cod or Story-and-a-half house. This house features a finished "expansion attic" which is a problem area when adding insulation. As Figure 8 shows, unheated attic spaces are often created when these attics are finished. These spaces are the source of air leaks—mainly through the open space between the first floor ceiling and the second floor floring—and result in energy loss and often lead to severe moisture problems. Instructions for blocking these air leaks are included in the "Attic Bypasses" Home Energy Guide.

The finished area of the attic should be included in the thermal envelope, with insulation placed in the knee walls, ceiling (both flat and sloping), and the floors outside the heated space. The space outside the knee walls usually can be reached through doors in closets or other openings. One easy way to achieve an R-30 value in knee walls is to fill them with a 3-1/2-inch high density fiberglass batt. Then cover with a 6-inch faced high density fiberglass batt, placing it horizontally (at right angles to the first batt), with the faced side next to the 3-1/2-inch batt. Use a staple gun to fasten the faced batt to the wall. (The facing is between the insulation layers rather than on the inner side of the thermal envelope, but this isn't a problem.) If you plan to use the outer attic space for storage and therefore will be going in and out of the area, reduce your exposure to the insulation by cov-

Figure 7:
Insulation can be put between the floor joists of the heated area above the crawl space (Figure 7).

Figure 8
Unheated attic spaces often are the source of air leaks

Figure 9
A system of cross-strapping provides a deeper space for ceiling insulation

ering it with a "house wrap" or "air barrier," a thin paper-like sheet often used in new construction.

Insulating the ceiling in the heated area is more difficult because of access problems. If the sloped ceiling is unfinished, with rafters exposed, the job is relatively easy since it can be done from the inside. A simple method is to cut and fit rigid board insulation between the exposed rafters, leav

Air Ventilation – Indoor and Attic

An indoor-outdoor exchange of air in the home is necessary for the health, safety, and comfort of occupants. It is also necessary to remove excess moisture that can severely damage the house.

The furnace and other fuel burning appliances in the home use large amounts of air in the combustion process and therefore require a reliable supply of outdoor air. Recent model, high efficiency furnaces and water heaters have “sealed combustion,” meaning they bring in fresh air directly from the outdoors, and do not use air from inside the home. Furnaces, water heaters, and fireplaces without sealed combustion must rely on indoor air for combustion. If the room supply of fresh air is inadequate, combustion gases – including deadly carbon monoxide – can spill out of the draft hood rather than being taken up through the chimney. This is called backdrafting.

When tightening up your house to prevent heat loss, you must be sure to provide for an adequate intake of fresh air.

The Energy Information Center offers information on this important subject, including publications on combustion makeup air for furnaces and other fuel-burning appliances, preventing moisture buildup, and ventilation systems and equipment. Call 651-296-5175 in the Twin Cities; statewide, call toll free, 1-800-657-3710, or e-mail: energy.info@state.mn.us.

Some ventilation of the unheated attic space is also necessary to prevent over heating in the summer. How much ventilation is needed? Here is a rule-of-thumb to follow:

Probe the attic insulation to see if there is a vapor retarder (see sidebar “What is a Vapor Retarder?”) The retarder, often a polyethylene film or foil-faced sheetrock, will be on the bottom side, toward the house. If there is a vapor retarder or if there is a threefoot or more rise from the eave to the roof peak, one square foot of outside ventilation should be provided for each 300 square feet of attic floor area. If there is no vapor retarder and the roof has less than a three foot rise from eave to peak, one square foot of ventilation is needed for every 150 square feet of attic space. In both cases, the amount of ventilation should be split evenly between high and low roof locations (see illustration).

ing a 1-1/2 to 2-inch space between the insulation and outer roof to allow for ventilation. Be sure to caulk the seam between the insulation board and the framing or rafters. Other methods use a system of gussets, cross strapping, etc. to provide a deeper space for insulation, thereby improving the R-value (Figure 9). Adding insulation to the exterior side of the ceiling (both sloping and flat) is more difficult for the do-it-yourselfer. If your home has such an expansion area and you are uncertain how to proceed, call the Energy information Center and discuss your options with someone on our staff.

Tuckunder garages (see Figure 1) also need special consideration. The usual and best practice is to separate the tuckunder garage from the thermal envelope, insulating the floor above the garage and wall(s) separating the garage from the basement. Duct work is often found in the ceiling above the tuckunder garage. If this is the case in your house, be sure to seal the duct work (using mastic coating rather than duct tape). Blown-in insulation is the best choice for this area because it is easier to install and also reduces air movement more effectively than batts or blankets do.

Hiring a contractor

If you decide to have your insulation installed by a professional contractor, you will want good quality work at a reasonable price. You should talk with the contractor about the R-value of the insulation and the need for sealing attic bypasses and taking other measures to control air leaks. You will also want to discuss ensuring adequate ventilation and combustion, and makeup air for the furnace and water heater and other fuel-burning appliances.
Ask the contractor to show you the FTC fact sheet that lists how much insulation is needed to provide different levels of R-value per square foot of area.
As noted earlier under the heading “Buying insulation,” the installer also should provide an “attic card” that identifies the specific type and mount of insulation installed. You could also verify sealing of air leaks by a follow-up infrared thermography or blower door test.

For more information

For copies of publications mentioned in this guide, or for answers to questions regarding home energy use, contact the Energy Information Center, 121 7th Place East, St. Paul MN 55101-2145, Phone: Twin Cities: 651-296-5175, MN toll free: 800-657-3710.

Consumer Alert: Vermiculite Insulation

The federal Environmental Protection Agency has issued a general warning about vermiculite insulation. Vermiculite was used to insulate thousands of homes before 1990. According to the EPA, the product contains asbestos fibers. Disturbing vermiculite has the potential to release the fibers in the air. If the fibers are inhaled, they may cause diseases such as asbestosis, lung cancer, and mesothelioma.

How can I tell if I have vermiculite insulation?

Vermiculite is a mineral that is shaped like a small nugget or granular, varies in color from silver-gold to gray-brown and is lightweight. It was commonly used as loose fill insulation in attics and walls.

All vermiculite is likely to contain asbestos, although the fibers are too small to be seen without magnification. The EPA is particularly concerned about vermiculite that came from one mine that was marketed as Zonolite. EPA states that although "the presence of the material is not cause for needless anxiety, it is important that people be informed so they can identify the product and properly manage it."

What should I do if I have vermiculite?

The EPA recommends the following:

- DO NOT attempt to remove the product yourself.
- Look at the insulation without disturbing it to determine if you have vermiculite. The asbestos particles will not become airborne if the insulation is not disturbed.
- If the insulation is sealed behind wallboards and floorboards or is isolated in an attic that is vented outside the best approach is to keep it in place.
- If you are planning to remodel or replace the insulation, use a trained asbestos removal professional that is licensed by the Minnesota Department of Health.

Where can I go for more information?

- Obtain the "Current Best Practices for Vermiculite Attic Insulation" brochure from the EPA (http://www.epa.gov/asbestos/insulation.html).
- The EPA plans to add information to its web site, as it becomes available. See www.epa.gov.
- A list of licensed asbestos contractors is available from the Minnesota Department of Health at 651-215-0900.
- Additional information on asbestos and asbestos removal is available from the Minnesota Department of Health web site (http://www.health.state.mn.us/).

Minnesota Department of Commerce

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Energy Information Center

Twin Cities:
651-296-5175
TTY: 651-297-3067
Statewide toll free:
1-800-657-3710
E-mail:
energy.info@state.mn.us

This information will be made available, upon request, in alternative formats such as large print, Braille, cassette tape, CD-ROM.

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Minnesota Home Energy Guides

This guide is one in a series of publications designed to help Minnesotans save energy in their homes. Copies of the titles listed below are available by calling or contacting the Minnesota Department of Commerce.

CD-ROM containing all of the Home Energy Guides as well as several other publications of interest to homeowners,
builders and contractors.

Appliances advises consumers on what to look for in energy efficient appliances and includes information on efficient operation and maintenance of refrigerators, freezers, washers, dryers, dishwashers, cooktops, ovens, and home office equipment.

Attic Bypasses explains how to find those “hidden air passageways” and fix them to prevent costly heat loss and damage to roofs, ceilings, walls, and insulation.

Basement Insulation discusses options to improving basement comfort, many not even involving insulation. It also provides details on exterior basement insulation, special foundation products and recommendations on interior insulation.

Caulking and Weatherstripping describes how to identify sources of air leaks, lists various types of caulk and weatherstripping, and provides illustrated how-to-apply instructions.

Combustion and Makeup Air describes the causes of dangerous combustion air problems and tells how to install an outside combustion air supply. It also tells how to test your home for combustion air problems.

Home Cooling tells you how to cool without air conditioning, and provides information on buying and operating energy efficient air conditioners.

Home Heating describes proper maintenance techniques and helps you become an educated shopper if you are buying a new heating system.

Home Insulation helps the homeowner evaluate the benefit of added insulation, providing information on buying and installing insulation.
Home Lighting looks at new technologies for residential lighting, identifying four basic strategies and providing examples for putting them into practice.
Home Moisture describes symptoms of moisture problems, lists common indoor and outdoor causes, and discusses preventive and corrective measures.
House Dianostics explains what it entails and helps you decide if you need these services.
Ice Dams describes what causes ice dams and how to fix them.
Indoor Ventilation describes the types of home mechanical ventilation systems that are available, the amount of ventilation air needed, and how best to operate and maintain the system.
Low Cost/No Cost addresses the often overlooked energy saving tips for all areas of your home.
New Homes discusses a wide range of options for increasing energy efficiency beyond the normal building code requirements. Subjects covered include insulation, ventilation, air-vapor controls, heating and cooling, windows, doors, and appliances.
Saving Energy With Trees describes how to use trees and shrubs for long-term energy savings, and lists trees appropriate for energy-savings.
Water Heating helps you determine whether to buy a new water heater or improve the old one. It explains the efficiency of different types of water heaters and provides installation tips.
Windows and Doors helps you decide whether to replace or repair windows or doors and gives a good summary of energy efficient replacement options.
Wood Heat offers advice on purchasing and installing a wood stove, with special emphasis on safety.
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