INTRODUCTION

THE IMPORTANCE OF INSULATION DEPENDS ON WHERE YOU LIVE. HOMES IN THE NORTH BENEFIT MORE FROM INSULATION THAN HOMES IN THE SOUTH. DIFFERENT REGIONS HAVE DIFFERENT STRATEGIES TO DEAL WITH MOISTURE MOVEMENT AND VENTILATION.

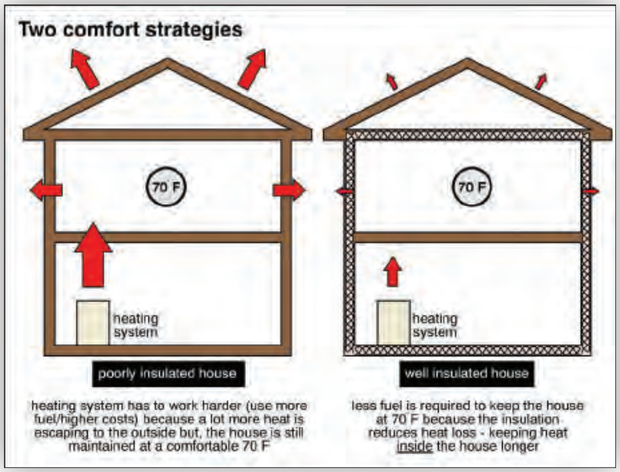
POORLY INSULATED HOMES ARE EXPENSIVE TO HEAT BUT MAY BE COMFORTABLE. ALMOST ANY HOUSE CAN BE WARM IF THE THERMOSTAT IS SET HIGH ENOUGH.

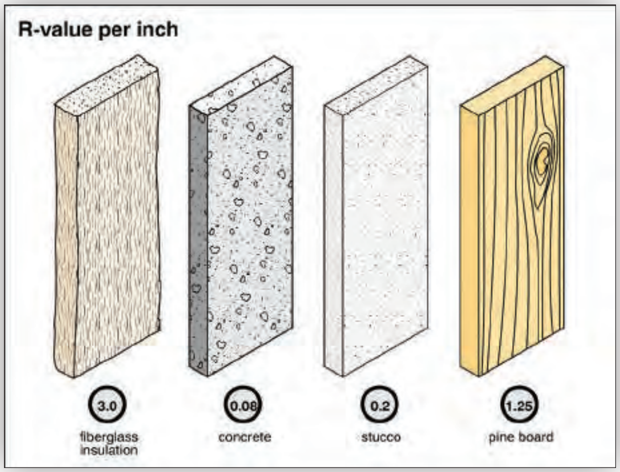
1.0 The Basics

INSULATION Insulation slows the rate of heat transfer into or out of a house. Air is a very good insulator, but only if it does not move. The problem is that air moves around and heat moves with the air. A good insulation material traps air, keeping it still.

R-VALUE Insulation materials have a common measurement system. An R-value indicates resistance to heat transfer – the higher the R-value, the better. R-values are usually defined for a one-inch thickness of insulation. For example, if the insulation has an R-value of 4.0 per inch, a 4-inch thick batt of that insulation would have a value of R-16 (R-4/in. x 4in.).

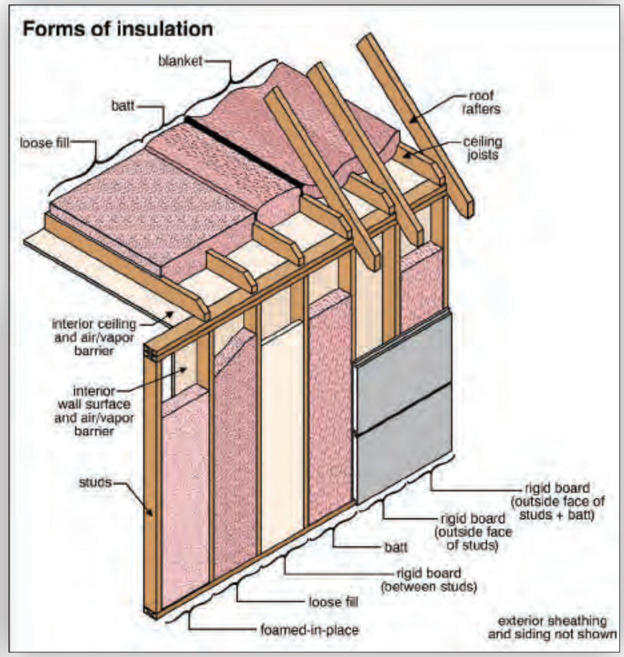
Most building materials are not good thermal insulators, as you can see from the illustration.

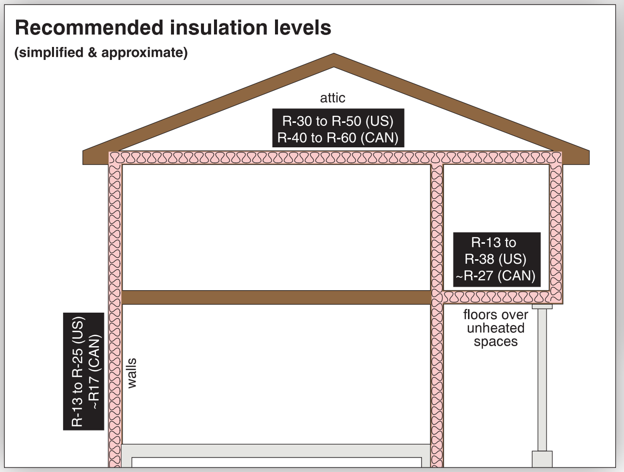




FORMS OF INSULATION Insulation can be batts, blankets, loose fill, boards, or sprayed-in-place.

INSULATION LEVELS The illustration below provides a guideline for insulation levels in heating climates.





Let's look at some common insulation materials.

2.0 Common Insulation Materials

2.1 Fiberglass (R-Value 2.9-4.2 per inch)

DESCRIPTION Fiberglass insulation is one of the most common insulation materials available and is made from threads of glass glued together with phenolic resins. It is available in batt form, rigid board and loose fill. It is resistant to moisture, mildew, fungus and vermin, and some types are non-combustible. It is, however, a skin and eye irritant and inhaling small threads of fiberglass is not healthy. These irritations are only common during installation, and once the material is in place it is not considered to be a problem.

2.2 Mineral Wool (R-Value 3.0-3.2 per inch)

Mineral wool is similar to fiberglass except that mineral waste is used to form the wool-like material. It, too, is available in batt form, rigid board or as loose fill. Its insulating value is comparable to fiberglass and it has very good resistance to fire and rot. It is less irritating to work with than fiberglass.

2.3 Cellulose Fiber (R-Value 3.4-3.6 per inch)

Cellulose fiber is essentially paper, finely shredded and chemically treated to resist moisture, fire, rot and vermin. It is usually blown in or poured. It is prone to settling. Due to its relatively low cost, this material is very popular. Usually gray in color, it has a similar texture to lint. Cellulose fiber absorbs water, which reduces its effectiveness.

2.4 Plastic Board (R-Value 3.7-6.0 per inch)

Most plastic board type insulations used in homes are polystyrene or polyurethane. Both pose fire hazards if left exposed. If applied on interior walls or ceilings, they should be covered with drywall. While these materials have a good R-value per inch of thickness, they are more expensive than most other types.

2.5 Sprayed Foam (R-Value 3.5-7.0 per inch)

These insulation materials can be used in open environments or, in special cases, in closed wall cavities. They are often used in new work, before walls or ceilings are closed in. These products are plastic – typically polyurethane and polyicynene, a water-based sprayed foam. They are combustible and must be covered. Some expand aggressively and are not suitable for injecting into closed wall cavities.

2.6 Urea Formaldehyde Foam Insulation (UFFI) (R-Value 5.0 per inch)

This foamed-in-place insulation was briefly banned in the United States due to concerns about the material being a cancer-causing agent. The ban was lifted in 1983. In Canada, the ban remains in effect as of 2010. The insulation had a relatively high R-value, although some of the early installations were prone to shrinkage that resulted in a loss of insulating value.

2.7 Vermiculite (R-Value 2.1-2.5 per inch)

Vermiculite is a mineral substance made from mica. This insulation is available as loose fill and can be identified by the small rectangular shape of the individual pieces. Vermiculite is non-combustible but is relatively expensive.

ZONOLITE One brand of vermiculite insulation, Zonolite, came from ore that contained some asbestos. Although the vermiculite is not typically in living areas of the house, some consider this to be a health issue. Identification of Zonolite or asbestos cannot be done visually and is outside the scope of a home inspection. For more information on asbestos, please refer to the Supplementary section.

2.8 Wood Shavings (R-Value 2.4 per inch)

Wood shavings used as insulation today are treated with fire retardant chemicals and can be made moisture resistant. This was not the case many years ago.

2.9 Other Materials (R value less than 3.0 per inch)

Other materials were used as insulation over the years, although most of these are not commonly installed now. These include leather, gypsum slag and cork.

3.0 Location of Insulation

Insulation is found in several places in the home. Let's have a look.

3.1 Attic

DESCRIPTION The goal is for the attic temperature to be the same as the outdoor temperature. We want to keep the heat in the house. If the attic is warm, we are losing heat from where we want it.

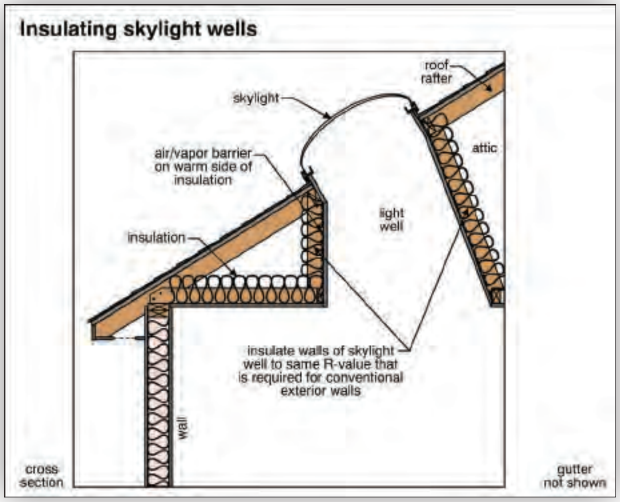
INSULATE THE ATTIC FLOOR Insulation should be provided on the attic floor, not the underside of the roof for several reasons. The first is gravity. It is easier to lay insulation on the floor than secure it to the underside of the roof. The second is heating costs. There is no advantage to heating the attic space. The third reason is prevention of condensation. Insulation on the floor of the attic allows better ventilation of the attic space. Good air movement through the attic removes any moist air from the living space that finds its way into the attic. Refer to "Ventilation" in this section.

THE EXCEPTION/ COUNTERPOINT Homes that have the heating system and part of the ductwork system in the attic present a different situation. The ducts are usually leaky, and a significant amount of heated air escapes into the attic. This heat is lost to the home, and creates condensation problems in the attic as it cools.

INSULATE THE ATTIC ROOF? Where air leakage cannot be easily controlled, it may make sense to treat the attic as conditioned (heated) space and insulate the underside of the roof. There are many variables to consider, including not only the climate temperature, but prevailing humidity levels, the building configuration, whether insulation is impermeable to air movement or not, etc.

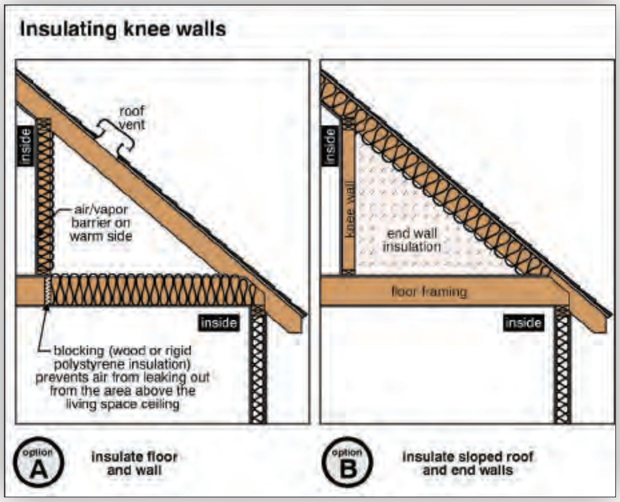
MORE THAN ONE APPROACH There are several design philosophies and arguments about whether attic and roof spaces should be ventilated or not. As long as building science issues are understood and addressed, there can be more than one successful approach. Professional home inspectors do not perform a design analysis but look for the results of an unsuccessful approach.

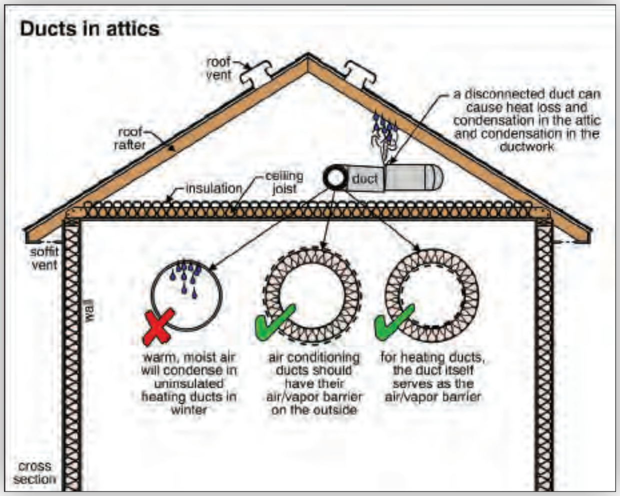
SKYLIGHT WELLS (LIGHT SHAFTS) Depending upon the configuration of the roof and the ceilings below, the light shaft (Skylight well) often passes through an unheated attic. The walls of the skylight well should be insulated where they pass through an attic. There should be an air/vapor barrier on the warm side of the insulation in cold climates.



KNEE WALLS A knee wall is found in 1-1/2 or 2-1/2 story houses. The knee wall separates the upper living space from the side attic areas. Insulation is usually provided on the unfinished side of the knee wall and the floor of the attic. No insulation is needed on the end (outside) walls of side attics. A less effective alternative is to insulate the underside of the roof and the end walls of the attic. This allows heat into the unused attic area – a waste of heat.

DUCTWORK Exhaust ducts from fans and ductwork for cooling and/or heating located in attics should be insulated (minimum R-7) to prevent heat gain or heat loss and to prevent condensation as the warm moist house air cools in the duct. Some ductwork comes pre-insulated. In some instances, the insulation is on the interior of the ductwork and is not visible.





Common Problems with Attic Insulation

BELOW CURRENT STANDARDS Increasing insulation levels is an improvement rather than a repair. The right amount of insulation depends on climate, fuel costs, the cost involved in adding insulation and the length of time one is planning to stay in the house. The decision to upgrade may be different for different owners.

Adding insulation provides a quick return on investment in severe climates where existing insulation levels are low. Cellulose, mineral wool, and fiberglass insulations are most commonly used on a retrofit basis.

WET INSULATION Insulation may be wet as a result of snow blowing into the roof through vents, roof leaks or condensation. Insulation is not effective when it is wet. Some types of insulation recover their insulating properties when they dry out. Others do not.

COMPRESSED Compressed insulation loses much of its effectiveness because the air is removed. The goal of insulation is to hold pockets of air still. Adding insulation in localized areas is not a difficult improvement.

MISSING Insulation may be displaced by activities in the attic, or by wind entering through roof vents. Low spots can be filled in relatively easily, given proper access.

UN-INSULATED EXHAUST DUCTS Bathroom exhaust fans are often connected to un-insulated ducts in the attic. The warm moist air from the bathroom condenses on the inside of the ductwork. It runs back down the duct and drips out of the exhaust fan. This is dangerous as the water is dripping past the electric motor of the fan. Ductwork in the attic should be insulated.

RECESSED LIGHTS (POT LIGHTS) – RISK OF OVERHEATING Recessed lights covered with insulation can overheat and start a fire. Special barriers should be provided over recessed lights to allow for insulation above the ventilation/cooling space around recessed lights. A three-inch clearance between the fixture and insulation is often recommended. Alternatively, special lights designed for this application can be used. (IC – Insulated Ceiling or Insulation Contact) These have a double casing to keep things cool and safe, and many have a gasket to prevent air leakage past the fixture into the attic. Some recessed lights have lower bulb wattage ratings if they are installed in an insulated ceiling.

3.2 Flat Roofs and Cathedral Roofs/Sloped Ceilings

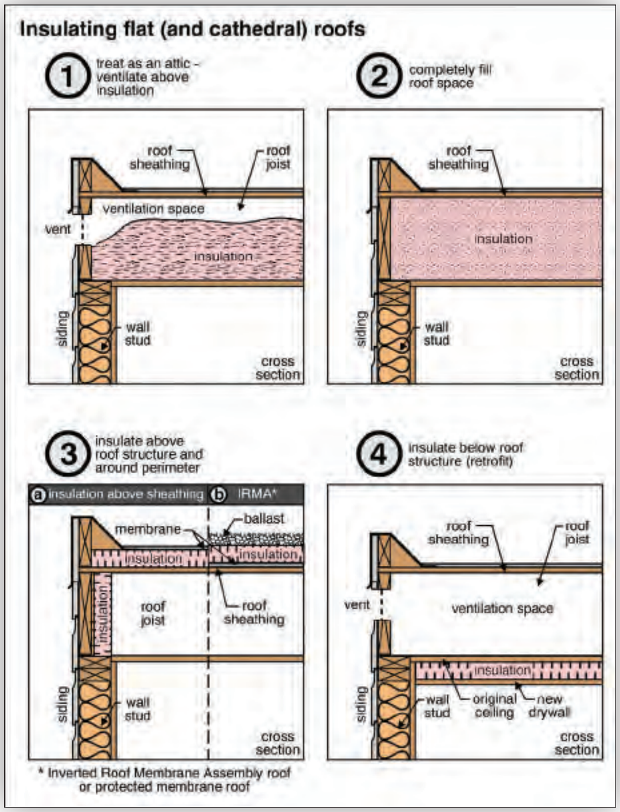
DESCRIPTION These roofs have no attics and less room for insulation and ventilation than roofs with attics. It is not usually possible to determine the amount of insulation in this type of roof.

Common Problems with Flat Roof/Cathedral Roof Insulation

NO INSULATION Insulation can be blown in from above or below; however, this requires drilling holes through the ceiling or roof membrane. In some cases, it can be blown in at the eaves. Regardless of the approach, assessing the quality of the completed job is difficult. Batt-type insulation can be installed; however, it requires the removal of the ceiling finish or roof sheathing. This is usually not cost-effective. With either approach, the amount of insulation is limited by the size of the roof cavity.

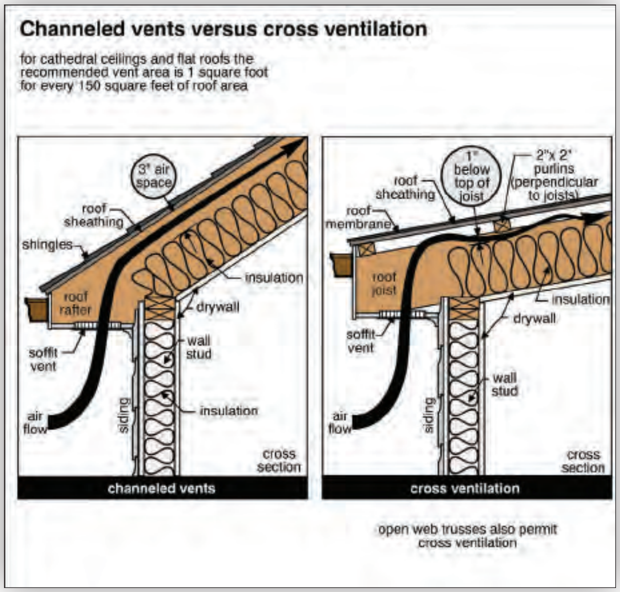
INSULATION ABOVE ROOF SHEATHING OR BELOW THE CEILING An alternative is to install insulation above the roof sheathing. This approach only makes sense when re-roofing and, even at that, the amount of rigid insulation that can be installed typically falls short of current residential standards. Without insulating at the eaves, the new insulation above the sheathing can be "short-circuited" by cold air travelling through the roof cavity and out the sides.

Insulation can be added to the underside of ceilings and a new ceiling finish provided below. This is typically done with plastic board insulation. The loss of room height is often an issue with this approach.



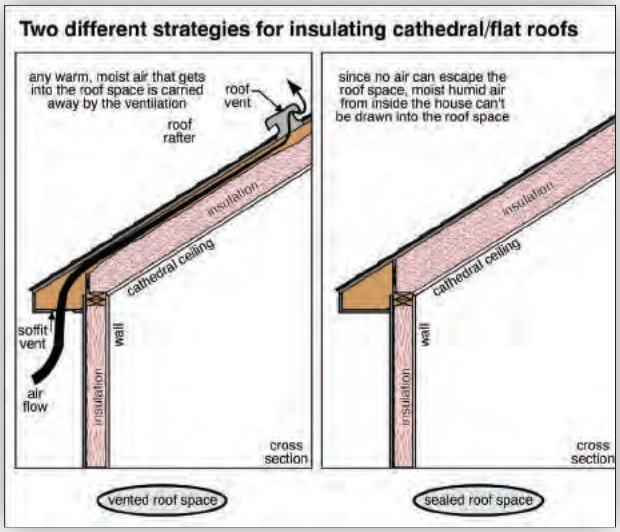
Condensation Problems in Cold Climates

Condensation can cause considerable concealed damage in flat and cathedral roofs. If warm moist air from the house gets into the roof space, it cools and condenses. This can cause mold and rot. Typical roof construction limits the space available for ventilation above the insulation, and makes it nearly impossible to retrofit an air/vapor barrier. The limited space makes it difficult to use the strategy used in attics, where warm moist air is quickly carried outdoors.



ALTERNATIVE TO VENTILATION Filling the cavity with an insulation that acts as an air and vapor barrier may be practical. The thought here is that if the roof space is sealed, warm moist air from the house can't get into the roof space and condense.

RECESSED LIGHTS (POT LIGHTS) Recessed lights in insulated ceilings should be rated IC to avoid overheating.



3.3 Walls

BATTS **3.3.1 Wood Frame Walls:** The most common method of insulating wood and steel frame walls during initial construction is with batts of insulation filling the spaces between the studs, although foamed-in-place plastic insulation is also used. Insulated sheathing is also used on the exterior of the studs, behind the siding. This adds insulation and reduces thermal bridges through the studs by covering the outer edges.

It is often difficult during a home inspection to determine whether walls are insulated, more difficult to determine the amount of insulation, and impossible to evaluate the installation and effectiveness. Upgrading wall insulation may not be cost effective except when remodelling.

POURING Existing wood frame walls can be insulated by pouring insulation into the wall cavity. Pouring insulation into wall cavities is usually only possible if the wall space is open in the attic and is continuous down to the foundation walls. Windows and doors interrupt the wall cavities, complicating the process.

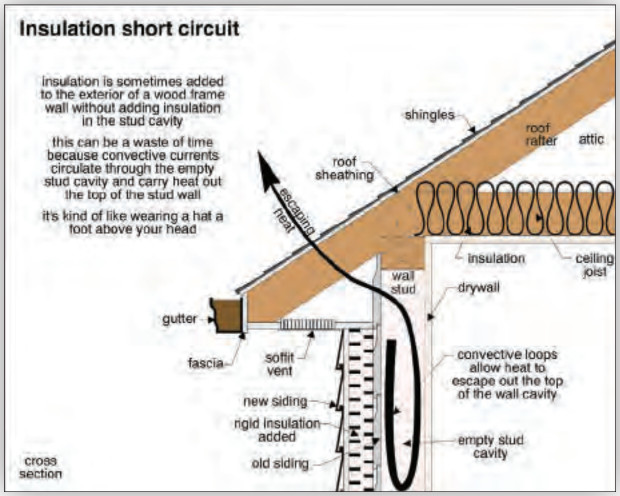
BLOWING Insulation can be blown into stud spaces. Holes are typically created at the top and bottom of the cavities, with insulation blown in one hole until it comes out the other. Blown-in insulation can be installed from the inside or outside. In some cases, it is also possible to install from the basement or from the attic by drilling through the wall plates.

INTERIOR APPROACH Interior finishes can be removed and batt-type insulation can be installed in the stud cavities. An air/vapor barrier can also be installed. This may make sense during remodeling.

INSULATION

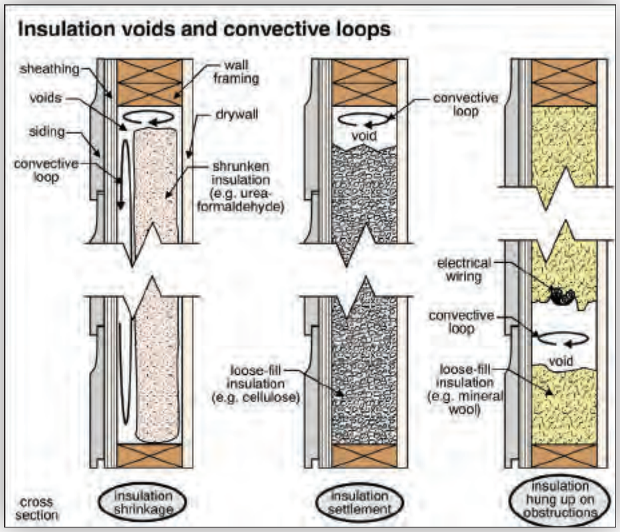
EXTERIOR APPROACH Insulation can be installed from the exterior if the siding is to be replaced. Installing strapping, insulation, and new siding over the old siding is not usually practical or effective because of the short circuits that are often created.

It is often not possible during a home inspection to determine whether wall insulation has been added. Many older walls have no insulation at all.



Common Problems with Wood Frame Wall Insulation

VOIDS There may be gaps between insulation and framing members. Blown or poured insulation in walls can settle leaving uninsulated spaces at the top. Foamed-in-place insulations sometimes shrink, reducing their effectiveness dramatically. Voids in insulation will not only reduce the effectiveness of the insulation, but can also result in cold wall sections that are prone to condensation and peeling paint.



LITTLE/NO INSULATION While standards change to reflect energy concerns, many older buildings' walls have little or no insulation. There is a good opportunity to improve comfort and heating costs. Insulation work is very cost effective if done with remodelling work, but is expensive on its own.

DESCRIPTION **3.3.2 Solid Walls:** There are numerous types of solid exterior walls, most of which have little insulation. Many older walls have no insulation at all, although this is difficult to determine without opening the wall.

Types of Solid Walls

MASONRY – BRICK OR STONE Masonry walls usually consist of two thicknesses of brick/stone or a layer of brick/stone and a layer of block (concrete or cinder block). There is often a one-inch space between the two layers of masonry or in the cores of the block; not enough room to insulate. There is also typically a small space between the inside layer of masonry and the interior wall finish. Again, this space is too small to insulate, usually less than an inch.

OTHER WALLS Other examples of solid walls include log or solid timber, adobe, rammed earth, straw bale and poured concrete walls. These materials have varying degrees of inherent insulation ability. Insulation can be added on the interior or the exterior of the existing walls; however, this is expensive and may change the exterior appearance of the house or reduce interior room dimensions.

ICF Insulating Concrete Form (ICF) walls are also solid, however the forms that are used in these systems are made from polystyrene, a good insulating material. These walls have a good insulating value, similar to insulated wood frame walls.

Common Problems with Solid Wall Insulation

LITTLE/NO INSULATION While standards continue to change to reflect energy concerns, many older buildings have exterior walls with little or no insulation. Solid walls can be insulated by providing a false wall on the interior or exterior of the existing wall. This not only changes the outside appearance of the house or reduces interior room dimensions; it also affects such things as baseboards, windows, doors, electrical outlets, ceiling moldings, etc. Adding wall insulation in masonry houses may not be cost-effective, except during significant remodelling.

AIR SEALING AS ALTERNATIVE A good deal of the heat loss in homes is through air leakage. Sealing air leaks is often more cost-effective than adding wall insulation.

3.4 Basement and Crawlspace

DESCRIPTION **3.4.1 Interior of Walls:** Insulating the inside of basement/crawlspace walls makes sense in cold climates, and is inexpensive if the walls are unfinished. The cost is higher if the basement walls are already finished since the finishes have to be removed.

DON'T INSULATE WET WALLS If the basement has chronic moisture problems, the interior of the walls should not be insulated. It is better to insulate on the outside, correcting the moisture problem at the same time. This is more expensive but protects the foundation walls as well as upgrading the insulation. Secondly, if the foundation walls are wet, interior insulation could result in frost damage to the foundation, since the walls will be colder after insulating. The third issue when insulating from the interior is obstructions such as electrical panels, plumbing, oil tanks, etc.

AIR/VAPOR AND MOISTURE BARRIERS

A wood stud wall is often added inside the foundation wall. The stud cavities are filled with batt-type insulation. A moisture barrier is installed against the foundation wall (before constructing the stud wall) and an air/vapor barrier is installed on the warm side of the insulation. The bottom plate of the stud wall is often kept off the floor with a sill gasket, and the plate itself may be pressure-treated wood to resist rot if the basement/crawlspace leaks.

Under some circumstances, combustible plastic insulation can be glued to existing foundation walls; however, it must be covered with drywall or some other non-combustible material to reduce the fire risk. No moisture barrier or air/vapor barrier is required.

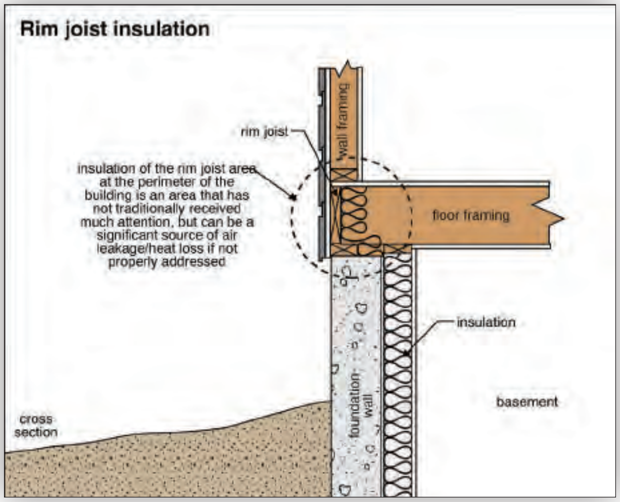
Sprayed-on foam insulation can also be used on the interior of foundation walls, although if the insulation is combustible, it should be covered. Tests have shown polyurethane performs well if applied to dry foundation walls.

NEW CONSTRUCTION

In northern climates new houses typically have insulation on basement/crawlspace walls from the ceiling down to about eight inches above the basement/crawlspace floor. The bottom few inches of the wall are often left un-insulated to ensure the foundation wall does not freeze.

HEADER/RIM JOIST

Insulation should be added in joist spaces at the top of the foundation wall. Depending upon the direction the joists run, this space may be a series of small spaces roughly 14 inches wide (between joists) or one long space parallel to the joists. Caulking the foundation/sill, header/sill, and headed/subfloor connections helps reduce heat loss due to air leakage.



DESCRIPTION

3.4.2 Exterior of Walls: Exterior wall insulation only makes sense if exterior digging is to be done for another reason, such as damp-proofing the basement/crawlspace walls. This work often includes an egg-crate type drainage layer installed against the foundation wall. Rigid or semi-rigid insulation is added, and the upper portion of the insulation (above ground level) is covered by a protective material such as cement board.

A flashing at the top of the insulation prevents water penetration in this location.

3.5 Floors above Unheated Areas

DESCRIPTION Floors over unheated spaces (crawl spaces, garages, porches, cantilevers, etc) are often cold unless well insulated. There are several strategies and materials for insulating these areas. Insulation batts, boards or sprayed-in-place foam and other insulation materials can be used.

Common Problems with Floors above Unheated Spaces

LITTLE/NO INSULATION Inadequate insulation levels can lead to cold floors, which is primarily a comfort issue. Increasing the insulation improves comfort and reduces energy costs, but in many cases floors are still cool in extreme weather. Insulation levels can't be determined during a home inspection.

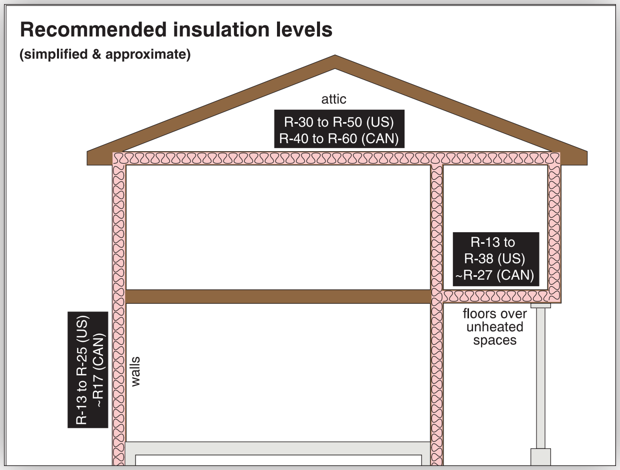
EXPOSED PLASTIC INSULATION Plastic insulation, such as polystyrene, is combustible and should be covered by drywall, with all joints properly sealed.

PIPES MAY FREEZE Plumbing and heating pipes passing through unheated areas should be insulated where freezing is a risk. In cold climates, it is often better to move the pipes to a heated area or provide electric heating cables on the pipes.

4.0 Current Insulation Standards

DESCRIPTION The numbers in the diagram are common insulation levels in new construction. The ranges reflect various climate zones. More insulation is used in colder climates. The R-value indicates resistance to heat transfer – the higher the R-value, the better.

Different insulation materials have different R-values per inch of thickness. Even the same type of insulation can have a different R-value, depending on its form. Fiberglass insulation, for example, has a higher R-value in batt form than in loose fill form.



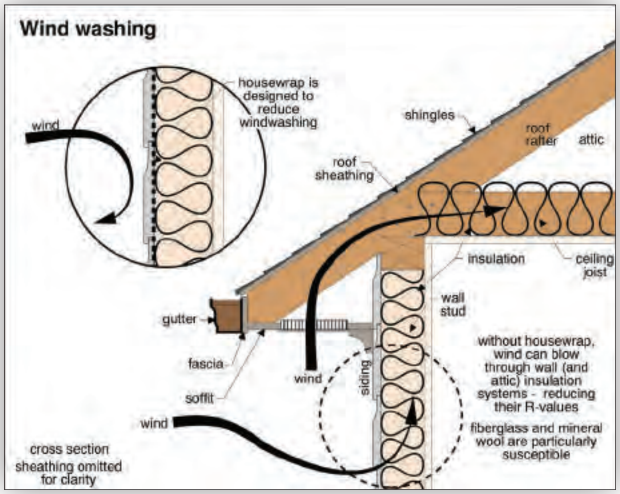
INSULATION

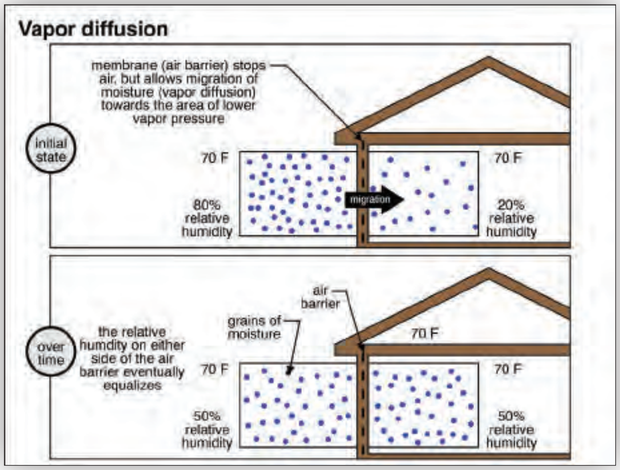
5.0 Air/Vapor Barriers (Vapor Retarders or Vapor Diffusion Retarders)

DESCRIPTION Air and vapor barriers help control the movement of heat and moisture through the walls, ceilings, and/or floors of the house. Their importance and placement depends on the climate, as well as the type of construction and insulation in the home.

AIR BARRIERS Most types of insulation let some air pass through them. Air carries heat with it, and this air can move heat into or out of the house, past the insulation. An air barrier prevents or reduces air movement. Air barriers can be installed on either side of the insulation. When installed on the exterior, air barriers help prevent wind-washing of the insulation. Wind-washing reduces the effectiveness of insulation.

In order to be effective, air barriers must be continuous and sealed at joints and edges.





VAPOR BARRIER Vapor barriers reduce vapor movement due to vapor diffusion, which is the natural tendency of water vapor to move from areas of high relative humidity to low relative humidity. Vapor diffusion does not require air movement; in fact water vapor can move through many solid materials.

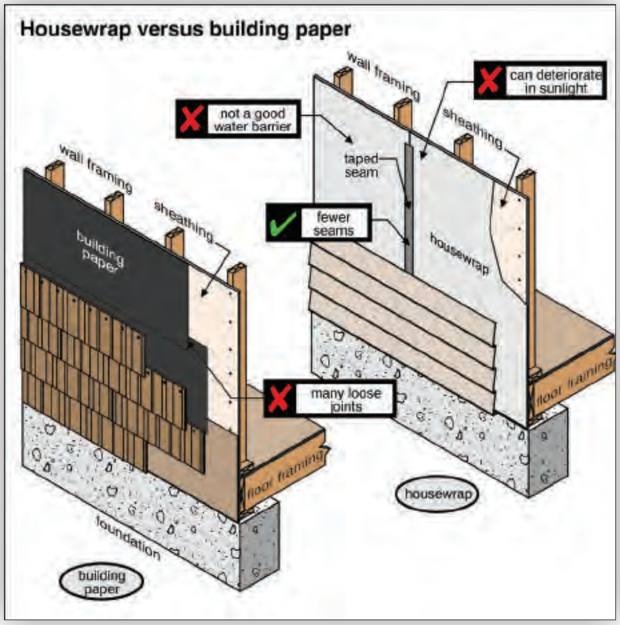
PREVENTING CONDENSATION As the air temperature drops, the relative humidity goes up. Air at 70°F and 40% relative humidity will reach 100% relative humidity as it is cooled to 45°F. When air in the insulation cools, it deposits moisture in the wall or attic insulation. This water reduces the effectiveness of the insulation, because water is a good conductor of heat. More importantly, water leads to rot, mold and peeling paint. In cold climates, a vapor barrier is required on the warm-in-winter side of insulation to stop vapor moving from the house into the insulation. The exceptions are insulations that are vapor barriers, like polystyrene and polyurethane.

In warmer climates, where air conditioning is more dominant than heating, vapor barriers are not used, because a vapor barrier in the inside of the insulation can cause problems during the cooling season. Even in cold climates, vapor barriers are not as important as air barriers.

Unlike air barriers, vapor barriers don't need to be continuous to be effective. Most vapor barriers are actually vapor retarders, or vapor diffusion retarders, since they don't stop vapor diffusion, but slow it down (the same way that thermal insulation does not stop the flow of heat, but slows it down). Let's look at some air and vapor barrier materials.

POLYETHYLENE Clear polyethylene sheets are common as both an air barrier and a vapor barrier.

HOUSEWRAP Synthetic housewraps, made of materials such as spun-bonded polyolefin or polypropylene, are often installed as air barriers. Because they allow vapor to pass through (they are not vapor barriers), they can be located on either side of the insulation and are often installed on the exterior of the home. While they allow water vapor to pass, they are water resistant and are effective as a replacement for sheathing paper.



Housewrap versus building paper

KRAFT PAPER Asphalt-coated kraft paper was used on batts of insulation in the 20th century as an air/ vapor barrier. Since adjacent sections of kraft paper were rarely sealed together, this is not a very good air barrier.

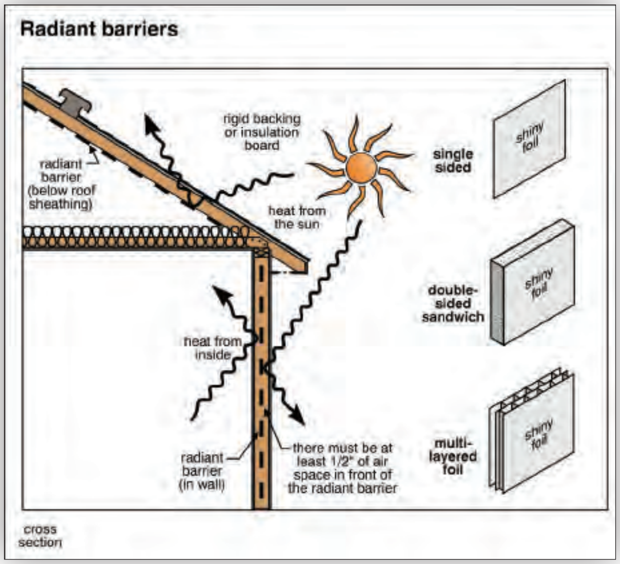
PAINT Many oil-based paints, varnishes and shellacs act as vapor barriers. Latex paints generally do not, unless they are specially formulated. Vinyl wallpapers are also vapor barriers, which can be a problem in hot, humid climates, since the wallpaper is installed on the wrong side of the insulation.

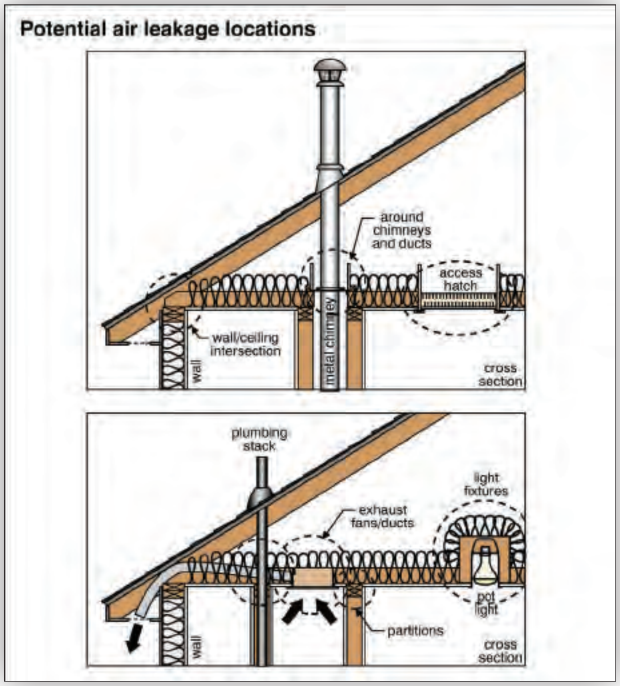
DRYWALL Drywall is a good air barrier, except that joints in walls and ceilings and holes around wires, lights and plumbing, for example, make it ineffective.

FOIL Aluminum foil is a vapor barrier, and can also be used as a radiant barrier to reflect heat. Foil may be attached to one side of a batt of insulation.

PLASTIC INSULATION Some types of plastic insulation are vapor barriers, if they are thick enough. This includes many rigid insulation boards and foamed-in-place insulations. Insulation boards can also be good air barriers if their joints are taped. Foamed in-place insulation is a very good air/vapor barrier as long as it is continuous.

SEALING THE ATTIC FLOOR Sealing holes in the floor where air may enter the attic around access hatches, lights, pipes, chimneys and wires helps keep warm moist air in the home, protecting the attic from condensation problems and reducing heat loss. Sealing openings in walls is also effective.

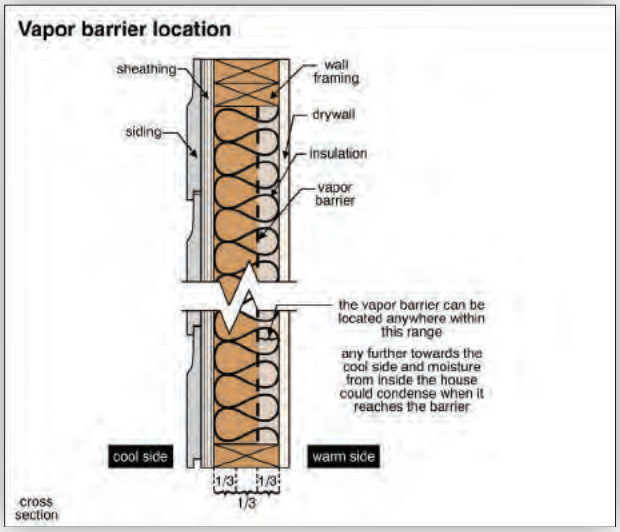




Common Problems with Air/Vapor Barriers

MISSING Many homes were built without either air or vapor barriers and perform perfectly well. While the lack of an air/vapor barrier can create problems in special circumstances, in most cases it is not practical to install one unless a house is being extensively renovated or unless there are moisture problems.

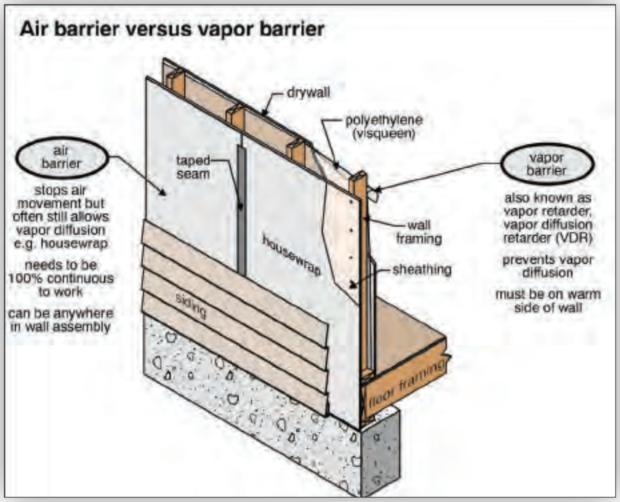
WRONG PLACE In cold climates, vapor barriers should be installed on the warm-in-winter side of the insulation, although some say they can be anywhere within the warm third of the insulation. Vapor barriers should not be on the cold side of insulation since this traps water vapor, allowing it to condense and rot building components.



WARM CLIMATES In warm climates, it's often best not to have a vapor barrier at all, since the direction of vapor flow can go in different directions at different times of the year. Occasionally, vapor barriers are inadvertently installed on the inside of the wall (vinyl wallpaper, for example), which can lead to water vapor being trapped in the wall and causing mold or rot.

INEFFECTIVE While vapor barriers do not need to be continuous to be effective, air barriers do. It is quite common for poorly-sealed joints, edges and penetrations, and damaged materials to render the air barrier system ineffective. In most cases, it is not practical to repair an ineffective air barrier.

In most cases, the air/vapor barrier is not visible and cannot be inspected.

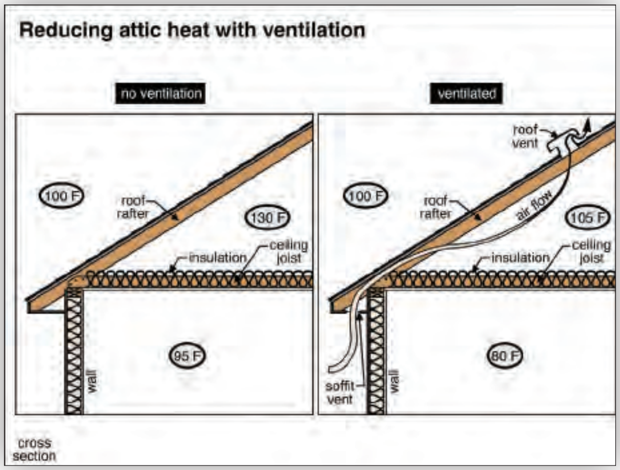


6.0 Ventilation

COLD CLIMATES An air/vapor barrier ideally prevents any moisture-laden air in a house from migrating through the insulation to cold areas. However, air/vapor barriers are rarely perfect. Therefore, we ventilate cold areas wherever possible.

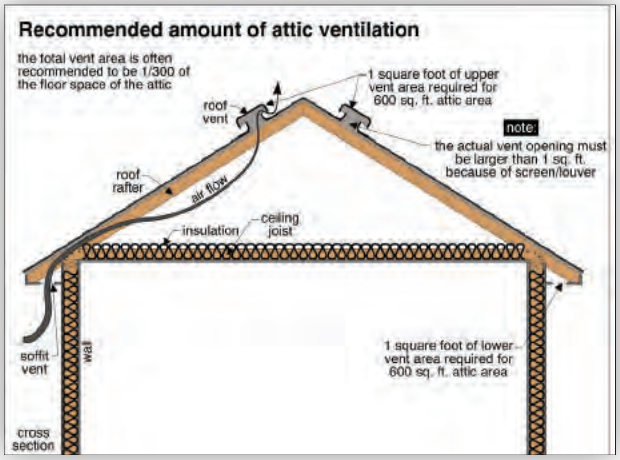
Ventilation also removes warm air from the attic, keeping the house cooler in the summer and helping to prevent ice dams in the winter.

WARM CLIMATES Ventilation is important in warm climates as well. Heat build-up in the attic deteriorates some roofing materials and makes the home more difficult to cool.



6.1 Attic Ventilation

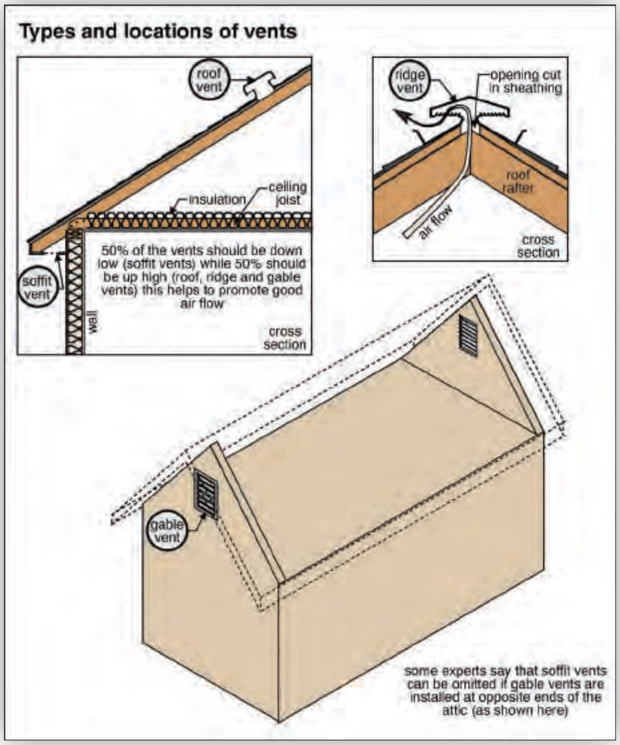
DESCRIPTION Attics are the easiest areas to ventilate. The commonly recommended ventilation rate is one square foot of ventilation for every 300 square feet of attic floor. Ventilation should allow for good air flow from end to end of an attic space and from bottom to top. Continuous soffit vents under the eaves and a continuous ridge vent work well.

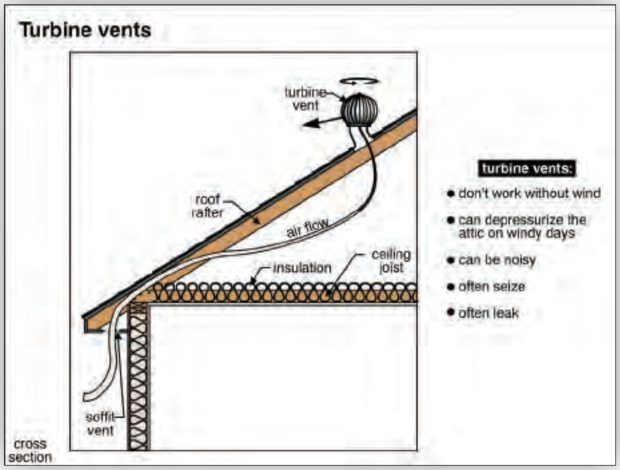


VENT LOCATION Roof vents (the common round or square metal vents) and/or gable vents should account for 50 to 80% of the total venting. They should have screens to keep insects and birds out of the attic. They are often located high on the downwind side of the house to help create a draft up through the eaves. The remaining ventilation is provided at the eaves. Baffles are used to keep soffit vents clear of insulation. On some houses, soffit venting is not practical.

If there is no air/vapor barrier below the insulation and no soffit vents, the minimum recommended ventilation rate is increased to one square foot of ventilation for every 150 square feet of attic space.

Turbine type vents (air driven rotating vents) are not recommended as they only work on windy days, when they are not necessary. On still days, when more ventilation is required, they do no more good than a regular roof-top vent. They are also very noisy if not well balanced and lubricated.





POWER VENTILATORS These fans are sometimes installed for summer use only. Removing hot attic air in the summer helps keep the house cooler.

Power ventilators are not recommended for cold weather use because they put the attic under negative pressure, drawing more warm moist air up from the house into the attic. Also, motors in attics tend to be neglected and eventually malfunction.

6.2 Crawlspace Ventilation

DESCRIPTION Conventional wisdom has held that unconditioned crawl spaces should be ventilated to the exterior to remove moisture. A common recommendation is one square foot of vent area for every 150 square feet of crawlspace area. This practice has recently been challenged in warm, humid climates, where moist air may be drawn into the cool crawlspace. In these areas, vents are usually no longer installed. There still may be a benefit to ventilation in drier climates.

MOISTURE BARRIER Where ventilation is not provided, a sealed moisture barrier should be installed over the earth floor, and the perimeter walls should be insulated. The space should either be mechanically ventilated, or be heated or cooled with the house.

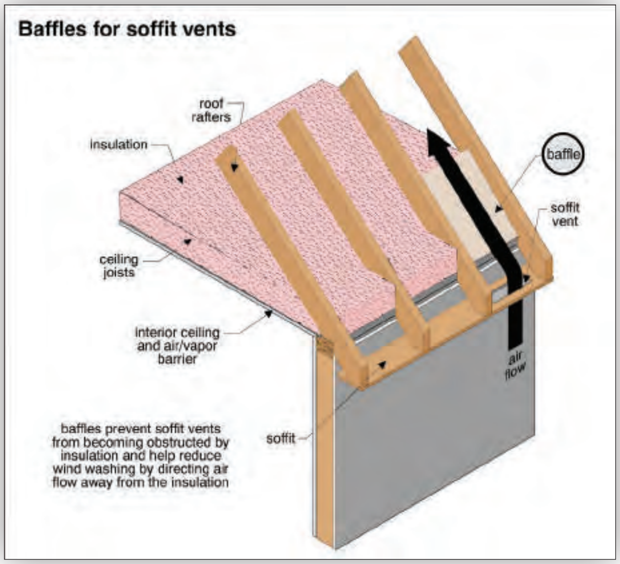
VENT LOCATION Ideally, vents are located within three feet of the corners of the crawlspace.

Common Problems with Ventilation

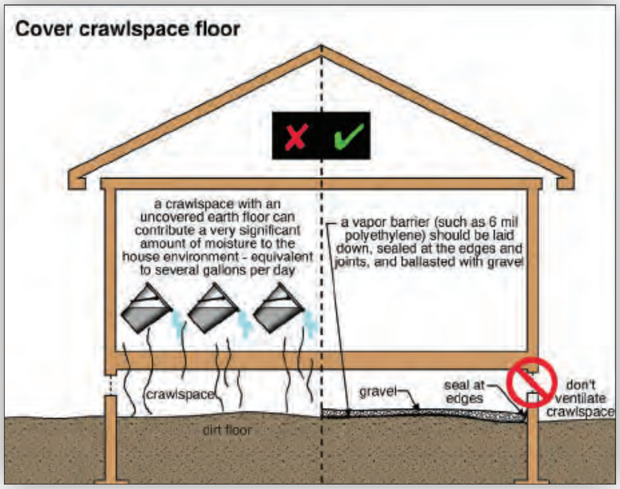
INADEQUATE VENTILATION Many older homes do not have sufficient ventilation. To avoid problems with excessive heat or humidity, vents can be readily added to most attics or crawlspaces. While it may not be practical to install them in the ideal configuration, the situation can usually be improved. Depending on the climate, it may be best to have no crawlspace ventilation at all. Your professional home inspector can provide guidance here.

BLOCKED VENTS Soffit vents that have been blocked by insulation will not be effective. Inexpensive baffles can be installed to keep insulation back. Roof vents that have been blocked by bird's nests should be cleared out.

DAMAGED Pests such as raccoons can damage roof vents, leaving an opening in the roof vulnerable to leakage. Damaged crawlspace vents will allow pest entry and should be replaced.

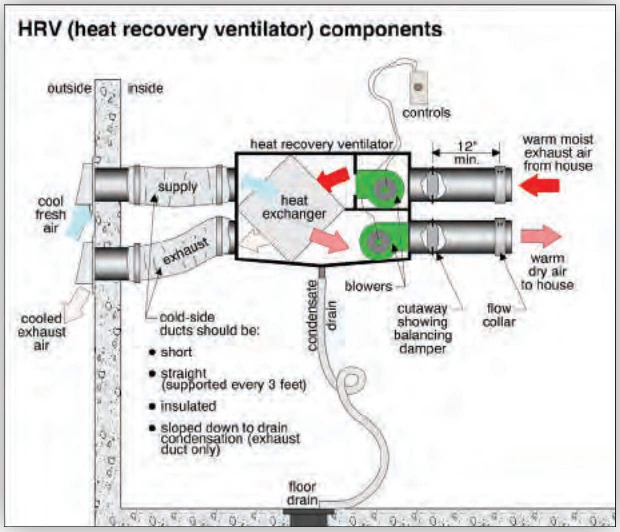


MISSING MOISTURE BARRIER Earth floors in crawlspaces should be covered with a sealed plastic sheet or equivalent to prevent moisture from the earth entering the crawlspace.



7.0 Heat Recovery Ventilators

DESCRIPTION Heat recovery ventilators, also known as air-to-air heat exchangers, are used in heating climates to maintain good house air quality. They bring fresh air into the home and exhaust stale air. This is more important in modern air-tight homes than older leaky homes. How is this different than opening a couple of windows? Heat recovery ventilators transfer some of the heat from the stale exhaust air to the incoming cold outdoor air. This reduces the amount of heat we waste getting fresh air into the home.



FRESH AIR DISTRIBUTION The fresh air coming into the home is filtered and then usually dumped into the return air ductwork for the furnace and mixed with the rest of the air. This distributes fresh air to all parts of the house.

EXHAUST AIR COLLECTION The exhaust air is typically taken from kitchens and bathrooms – areas where the air is likely to be stale and humid.

MOVING THE AIR One or more blowers move air across a heat exchanger transferring heat from the air being exhausted to the incoming air. The goal is to replace 1/3 to 1/2 of the house air every hour. In two or three hours, a heat recovery ventilator can change all the air in the home.

INTAKE AND EXHAUST HOODS The intake and exhaust hoods on the exterior should be at least six feet apart and three to four feet from the corner of the building. The intake hood should be at least 18 inches above grade and at least three feet away from driveways, gas meters or any exhaust vents. The exhaust hood should be at least eight inches above grade.

DEFROST CYCLE The warm moist house air may condense its moisture as it cools in the heat exchanger. The condensate is collected and drained away. Ice may accumulate in the system in cold weather, and a defrost cycle is used to melt the ice.

Common Problems with Heat Recovery Ventilators

Blowers and motors will wear out. Cold side ducts may be missing insulation. Balancing problems are common with more air drawn in than exhausted, or vice versa. Filters can be dirty or missing, resulting in clogging of the heat exchanger. A screen with openings that are approximately a quarter square inch are required on the intake located on the outside wall. This prevents vermin or debris entering the HRV system from the outside.

Defrosting systems may fail, condensate trays and lines can plug or leak. In corrosive environments (indoor swimming pools, hairdressing salons in the basement, etc.), the heat exchanger may be damaged unless it was specifically designed for that environment. There may also be problems with electric supply or controls.