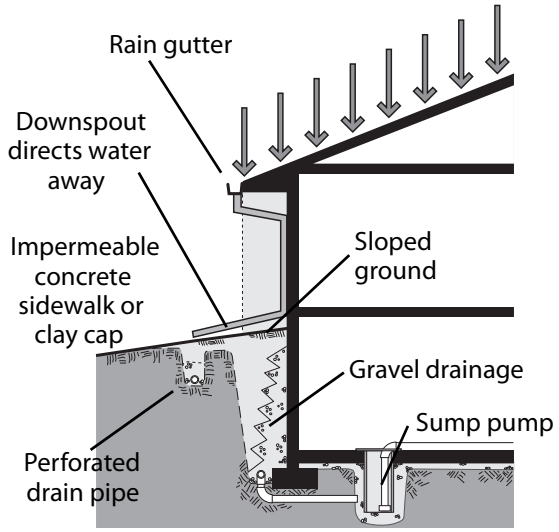
Preventing Water Damage



Depending on the amount of wetness in the environment, builders and housing specialists use a variety of strategies to prevent water damage.

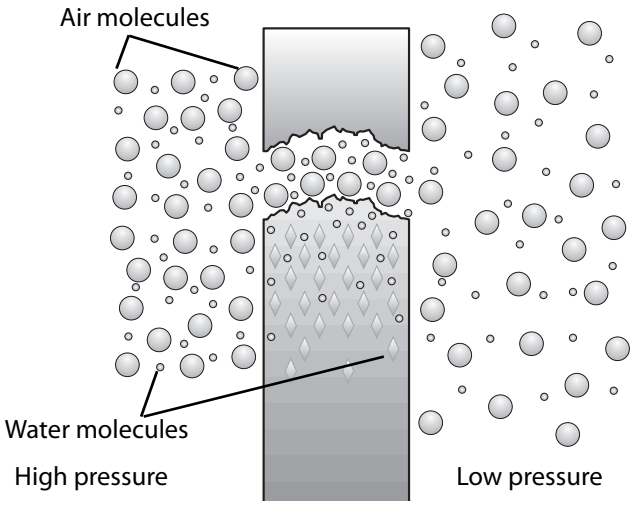
Controlling Water Vapor

High relative humidity in indoor air can cause comfort problems in summer and condensation problems in both summer and winter. Experts on cooling say the indoor air should be less than 60% relative humidity for adequate indoor comfort in summer. Experts on winter conditions say that indoor relative humidity in cold climates should be less than 40% to avoid moisture condensation problems.

See "Window Condensation Chart" on page 129 for more information on the relationship between temperature and condensation.

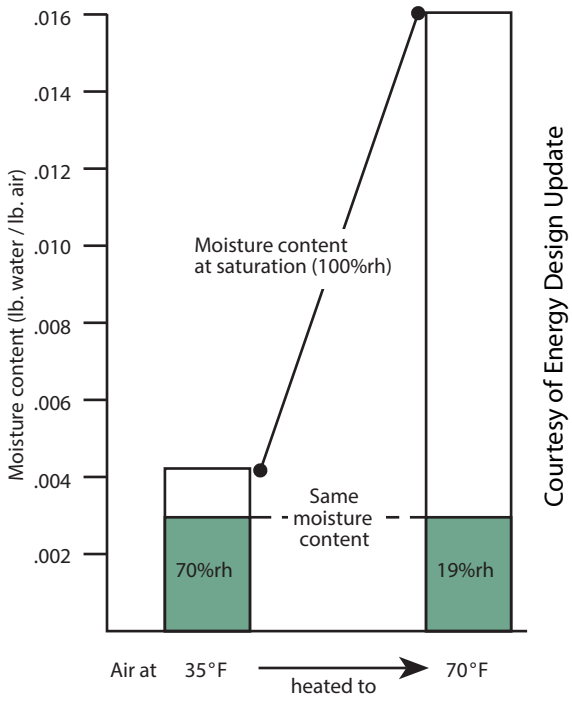
Sources of water vapor — The average person evaporates 4 pints of water into the air daily through respiration or perspiration. Showers, housecleaning, and cooking can add up to another 3 pints per person daily. Water tracked into the home on shoes or clothing evaporates and increases humidity. Moist firewood and house plants put additional moisture into the air.

Air and Vapor Migration



Water vapor travels through most porous materials, because water vapor molecules are small enough to migrate through the interstitial spaces in materials. Air molecules are larger and need a crack to pass through the same relatively porous material.

Relative Humidity



When air at 35°F and 70% relative humidity (rh) is heated to 70°F, its relative humidity drops to 19%.

Dryers and exhaust fans should always be vented outdoors and not into living spaces, crawl spaces, basements, or attics. Humidifiers should be avoided, unless there is a medical reason for their use. Home owners should know that some furnaces have automatic humidifiers that add moisture to the air in the home without occupants being aware of their operation.

Unvented combustion space heaters and gas ranges add moisture and other pollutants to indoor air. Backdrafting furnaces and boilers can also be a source of water vapor and other dangerous combustion by-products.

Moisture condensation problems — Moisture condenses on cold surfaces, such as windows and outside walls, due to a combination of relative humidity and temperature. As air cools, caused by its contact with cool surfaces, the relative humidity of the air increases until it reaches saturation. When that saturated air is cooled, some of its water vapor turns to liquid water and clings to the cold surfaces that cooled the air. Condensation occurs most frequently and plentifully on the room's coldest surfaces. Condensation increases as relative humidity increases and as surface temperatures decrease.

Effective strategies for reducing moisture condensation include these.

- Reducing relative humidity by reducing the moisture sources mentioned previously.
- Equalizing pressure between indoors and outdoors.
- Installing or improving air and vapor barriers to prevent air leakage and vapor diffusion from transporting moisture into building cavities.
- Ventilating with drier outdoor air to dilute the more humid indoor air.
- Removing moisture from indoor air by cooling the air to below its dew point, with refrigerated air conditioning systems and dehumidifiers.
- Adding insulation to the walls, floor, and ceiling of a home to keep the indoor surfaces warmer, and therefore more resistant to condensation. During cold weather, well-insulated homes can tolerate higher humidity, without causing condensation, than poorly insulated homes.

Preventing Moisture Problems

Preventing moisture problems is the best way to guarantee a building's durability, and its occupant's respiratory health. Besides the source-reduction strategies listed in the above sections, air and vapor barriers, ventilation, air conditioning, and dehumidification can mitigate moisture problems.

Air and moisture barriers — Air barriers and vapor barriers stop water vapor from migrating into building cavities and condensing.

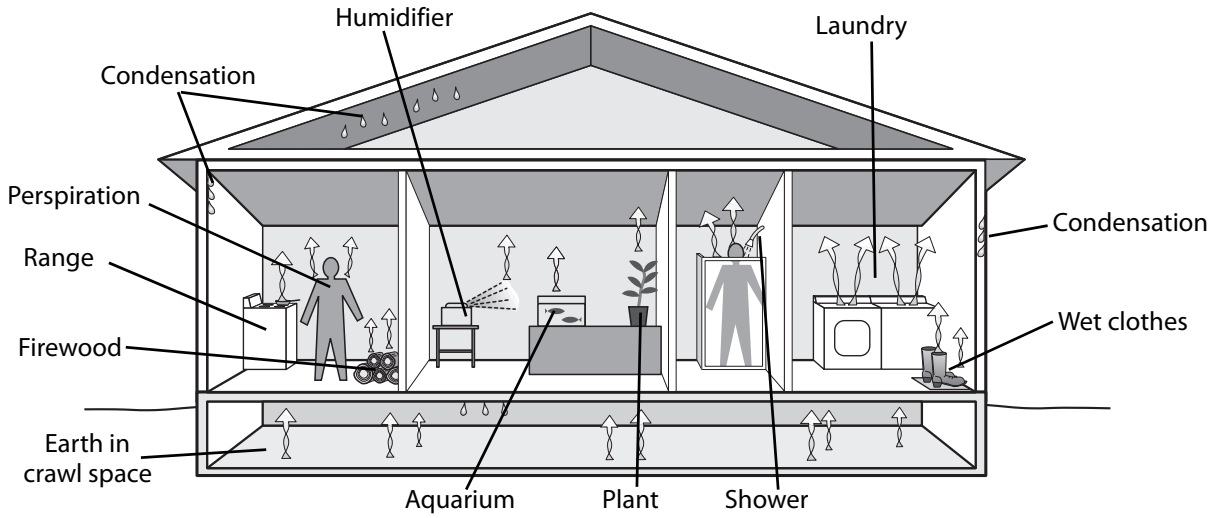
It's important to stop the air, because the warm, moist air from the home can carry moisture rapidly from a source into the building cavities. Sealing all penetrations in the interior membrane of the home creates an *air barrier.*

This air sealing would include:

- Identifying and plugging air conduits like plumbing chases, chimney enclosures, and wire holes.
- Installing gaskets on all outlets and switches.
- Sealing window and door frames; patching holes and cracks in ceilings and walls.
- Sealing the floor/wall junction.

The air barrier — achieved with caulking, gaskets, and tight joints between building materials — may be separate from the vapor barrier. Many new homes employ a water-resistive barrier on the outside of the exterior sheathing that also serves as an air barrier. This water-resistive barrier or house wrap is permeable to water vapor, allowing water vapor to escape.

Sources of Water Vapor



A variety of household sources release water vapor into the air. When the relative humidity rises and outdoor temperatures fall, the water vapor changes to liquid water — a process called condensation. Condensation occurs near the sources of water vapor and in the colder areas of the building. Insulation keeps surfaces warmer, reducing condensation.

Vapor barriers are important in cold climates, where the difference in humidity between cold dry outdoor air and warm moist indoor air forces moisture through the walls and ceiling. The vapor barrier in cold climates should face the indoors.

If an impermeable material like polyethylene, installed as a vapor barrier, is attached in an air-tight manner to framing lumber, the result is an *air/vapor barrier*. Vapor-barrier paints are often the only practical way to achieve a vapor barrier in existing homes.

In homes with significant air conditioning and heating seasons, moisture travels from outdoors to indoors during the summer and from indoors to outdoors during the winter. In these climates, avoid installing materials that are vapor barriers. Instead allow building cavities to be vapor permeable. This facilitates drying to either the indoors or the outdoors.

The ground under a crawl space or basement can be the major source of water vapor from air migration through the ground and also evaporation from damp ground. *Ground moisture barriers* stop water vapor rising through the ground and into the home and also prevent evaporation from damp ground. Ground moisture barriers should be installed over dirt floors in crawl spaces and under basement concrete slabs. Reinforced polyethylene plastic makes a durable ground moisture barrier where people access the space.

If the seams of the barrier are sealed with a durable tape and/or sealant, this ground covering can also be an air barrier. Ground-moisture barriers aren't effective in crawl spaces with standing water, unless the ground moisture barrier drains water into a sump.

See "Air-sealing Materials and Application" on page 100 and "Facings and Barriers" on page 114.

Ventilating Attics and Crawl Spaces

Attic and crawl spaces provide a number of benefits related to moisture control.

Attic ventilation — Attic ventilation removes moisture deposited in attics by roof leakage and condensation. Most attic moisture problems come from moist home air leaking through the ceiling in winter. The preferred strategy for attic moisture control is to prevent the moisture intrusion into attics by air sealing the ceiling.

Attic ventilation also prevents uneven snow melt in cold climates. Snow melting in one part of the roof and freezing in another causes destructive ice damming. One goal of attic ventilation in cold climates is to keep the entire roof cold. This requires the entire roof to have outdoor air circulating beneath it in the attic.

The International Residential Code (IRC) recommends one square foot of vent for every 150 square feet of attic with no ceiling vapor retarder at the ceiling. If there is a vapor retarder, the code recommends one square foot of vent for every 300 square feet of attic space area.

During periods of high outdoor relative humidity, when the attic is cooler than the outdoor air, ventilation may cause condensation in an attic. The IRC recognizes this possibility and exempts humid climates with approval from a local building official.

Crawl-space ventilation — The IRC allows crawl spaces to be ventilated by passive vents or exhaust fans. Contractors also condition crawl spaces to include the crawl space within the home's thermal boundary and this option serves the same moisture-control purpose as ventilation. If the crawl space has an airtight ground moisture barrier, the vent openings are only required to be a ratio of 1 square foot of vent for 1500 square feet of crawl space floor.

In cooler and drier climates, the passive ventilation option, which complements floor insulation, is still the best choice. In warmer and damper climates, insulating the crawl space walls seems to work well with crawl-space exhaust ventilation or crawl space conditioning, with exhaust ventilation being preferable in most cases.