

MOISTURE AND AIR

Householder's Guide—Problems and Remedies





CMHC—HOME TO CANADIANS

Canada Mortgage and Housing Corporation (CMHC) has been Canada's national housing agency for more than 60 years.

Together with other housing stakeholders, we help ensure that the Canadian housing system remains one of the best in the world. We are committed to helping Canadians access a wide choice of quality, environmentally sustainable and affordable homes – homes that will continue to create vibrant and healthy communities and cities across the country.

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INTRODUCTION

This booklet is intended to assist you to identify the signs and probable causes of moisture and moisture-related indoor air quality problems in your home, and to propose practical solutions.

Many household problems can be solved if you do one or more of the following:

- adopt strategies to prevent excess moisture in the home;
- perform maintenance or minor repairs;
- hire a professional contractor to make major repairs.

Renters: Report all plumbing leaks and moisture problems immediately to your building owner, manager, or superintendent. In cases where persistent water problems are not addressed, you may want to contact local or provincial health or housing authorities.



MOISTURE AND AIR QUALITY PROBLEMS

Moisture is continually being released inside your home: 10 to 50 litres (2 to 10 gallons) every day. In a heating season lasting 200 days, when your home is typically closed up, 2,000 to 10,000 litres (400 to 2,000 gallons) of moisture can be trapped. A cord of wood stored in your home, for example, can release more than 270 litres of moisture. Excess moisture can result in moisture problems, which can lead to air quality problems.

Moisture Problems

There are two types of moisture problems—leaks and condensation. This publication focuses on condensation problems.

Leaks from roofs and plumbing often cause moisture problems in homes. This topic is dealt with more extensively in other CMHC publications. See the back cover for details.

When warm, moist air comes into contact with a surface that is too cold, moisture condenses. The water and frost that you see collecting on windows is a visible example.

Condensation may also be collecting in your attic, and inside the exterior walls.

Over time, if the air in your house is too humid, the result may be damage to the house structure, your possessions and possibly your health. Controlling humidity in your home is the best step to preventing mold problems.

Air Quality Problems

The air you breathe in your home should be clean (i.e. as free from pollutants as possible). For your health and comfort, your home should have an exchange of air between the indoors and outdoors. Without the air exchange, your home can accumulate moisture, mold can become a problem, and you can experience poor air quality.

Mold growing in your home can release mold spores, toxins from mold, and moldy odours.

Harmful chemicals can be released from synthetic fabrics, furnishings, and household products. Additional contributing sources of indoor air

pollutants are cigarette smoke, burning candles, or improperly maintained or vented combustion devices, such as gas or propane cooking stoves, furnaces, water heaters, wood stoves and fireplaces.

The exchange of stale air with fresh air reduces potential air quality problems.



Causes

Condensation occurs on cold surfaces.

It results from:

- excessive moisture production:
 - ventilating with warm outdoor air during spring and summer can cause lots of condensation in basements;
 - from inappropriate use of humidifiers;



- by evaporation from showers, washing dishes and clothes, cooking, aquariums, standing water, people, pets and plants;
- in damp basements;
- from earth floor basements or crawlspaces.
- inadequate ventilation with outdoor air:
 - air inside the house is not exchanged with outdoor air (in general outside air in cold weather will help dry the air inside the house).
- cold surfaces due to:
 - inadequate heat or insufficient heat provided to areas of the home (i.e. spare bedroom heat blocked off if the room isn't used regularly, unheated basement);
 - wide swings in inside temperature (i.e. thermostat setbacks, uneven heat distribution from use of wood stoves, unheated room);
 - poor air circulation within a room due to furnishings against the exterior walls;
 - poor quality windows or heat blocked by blinds or drapes;
 - poorly insulated walls and ceilings.
- cool basement surfaces in summer.

Solutions

Reduction of moisture is the priority:

- remove moisture sources;
- reduce basement moisture entry;
- discontinue use of humidifiers; and
- use a dehumidifier in the basement during fall, spring and summer.

Keeping surfaces warm is the next priority:

- upgrade windows with energy-efficient ones;
- keep walls and ceilings warm through adequate insulation;
- provide sufficient heat to all indoor areas in your home.

Adequate ventilation, good air circulation and maintaining adequate heat throughout your home are important and effective methods to help prevent moisture problems.

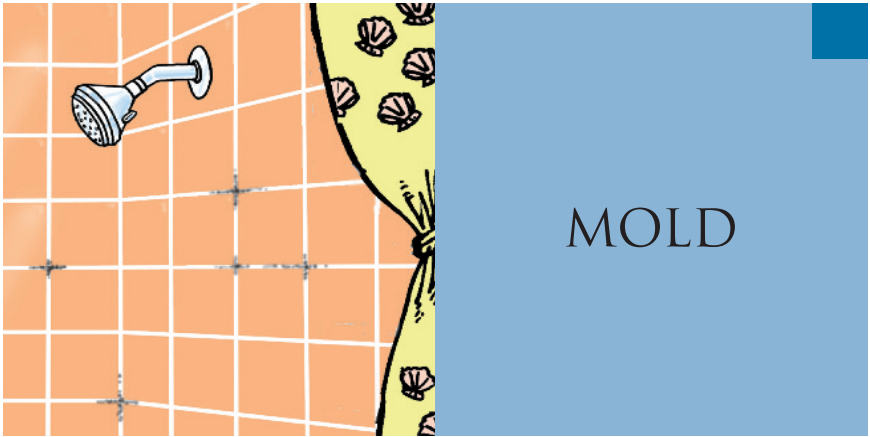
Find the moisture level in your house

The amount of moisture in the air is normally measured as its relative humidity.

- A relative humidity sensor (hygrometer) can measure the moisture level of your home.
- Hygrometers can be purchased at your local hardware or building supply store.

- In very cold weather, a level of 30 per cent or lower may be needed to prevent window condensation.
- In the winter heating season, the relative humidity should not exceed 45 per cent.
- Upgraded, energy-efficient windows can support a higher level of relative humidity without condensation occurring.





Molds are part of a group of microorganisms called fungi that also include mushrooms and yeasts. Molds are familiar to most people as food spoilers on items such as bread or fruit. Molds are nature's decomposers in the food chain. If allowed to grow inside your house, mold can be a problem.

Mold Problems

Mold can cause:

- unsightly stains;
- damage to paints, wood, drywall, ceiling tiles and fabrics;
- damage to personal items;
- allergies; and
- illness.

Some symptoms

- discolouration on surfaces such as walls, ceilings, or furnishings
- stains on carpets
- mold on drapes and backs of furniture
- stains on personal items close to affected areas such as storage boxes and clothing
- musty smells
- rotting wood

Prevention

Mold requires high humidity levels to grow. Some molds require condensation to start growing.

If mold is present, clean the affected area as soon as possible, and identify the source of moisture that allowed the mold to grow in that location. This booklet will help you identify potential causes of the moisture and suggest ways to fix the problem.

Clean-up Methods

You can clean small areas of mold yourself using an unscented detergent and water. The mold area is considered “small” if there are fewer than three patches, each patch smaller than one (1) square meter. If you have more than three patches or the areas are larger, you need a trained professional to assess your house. You may also need a trained contractor to clean extensive areas of mold.

When cleaning:

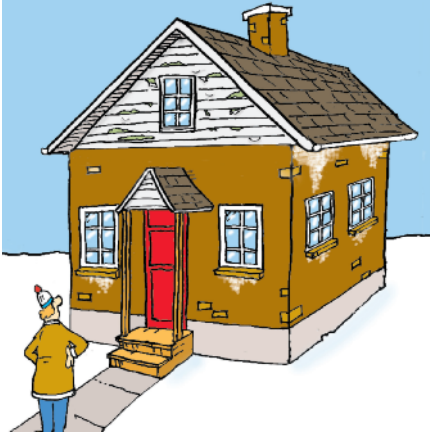
- use household rubber gloves;
- use a mask, rated N95, capable of filtering fine particles;
- use protective glasses;
- rinse well with a clean, wet rag;
- dry.

TO AVOID
MOST MOLD
PROBLEMS, KEEP
MATERIALS DRY.

Moldy ceiling tiles and carpets should be removed and discarded. Drywall that remains stained after cleaning with detergent and water may need to be removed. Try washing fabrics. If the mold odour or stain persists, discard.

The proper cleaning procedure involves removing the mold. Chemicals, such as bleach and fungicides are not recommended. It is important to remove all mold residues as they can cause allergies or illness.





GENERAL INSPECTION OF YOUR HOME

Now that you have a general idea of what causes moisture and air quality problems in your home, how to stop excessive moisture, and what your home's relative humidity is, take this booklet with you on a general inspection of your home. For each room, it specifically describes typical signs, possible causes and practical solutions.

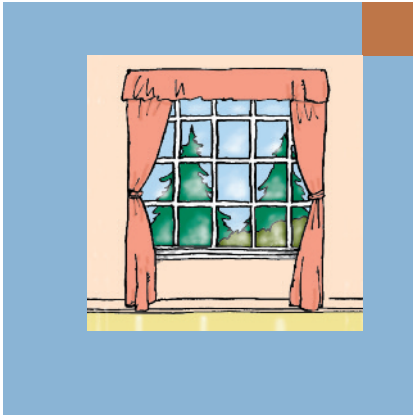
As you inspect each room, use the checklists provided in the next pages to keep track of signs that are present in your home, of possible causes that are relevant to your situation, and of practical solutions that you could apply.

When inspecting your home, keep in mind that moisture may not originate from the same room. The source may be located elsewhere inside or outside your home.

Problems in All Living Areas

Typical signs

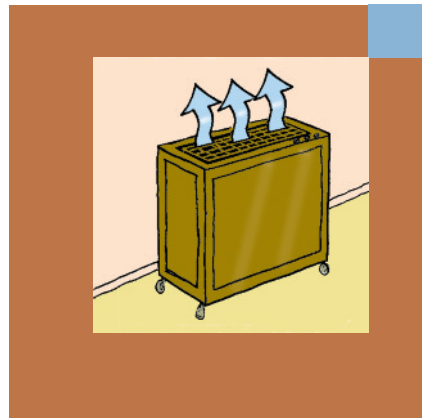
- Condensation on windows
- Rotting window sills
- Damaged gypsum board
- Musty smell
- Mold on walls
- Moldy drapes, carpets or furniture
- Mold in closets



- Firewood stored inside
- Poor air circulation between rooms or within a room
- Cold surfaces due to inadequate insulation
- Large air leaks at electrical fixtures, window frames, etc.
- Closed drapes preventing warm room air from warming window surfaces
- Closet contents stuffed against exterior wall
- Rooms kept too cool
- Inadequate ventilation
- Air conditioner poorly maintained

Possible causes

- Humidifiers
- Excessive moisture from basement or crawl spaces
- Many moisture-producing activities by occupants
- Too many people/pets
- Uncovered aquarium
- Large number of plants



Practical solutions

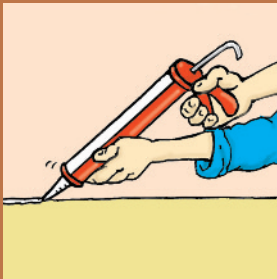
- Discontinue use of humidifiers.
- In summer use dehumidifier.
- Fix sources of moisture in basement or crawlspace.

- Caulk basement floor to wall joint.
- Install and use kitchen and bathroom exhaust fans.
- Cover aquarium.
- Reduce number of potted plants.
- Circulate air between rooms.
- Properly insulate cold surfaces.
- Seal large air leaks.
- Reduce stored items.
- Open drapes.
- Ensure one inch gap at the bottom of closets and doors; leave closet doors open.
- Provide heat to all areas.
- Install a balanced ventilation system—and use it regularly.
- Keep air conditioning drip pans clean and the drain lines unobstructed and flowing properly.

Problems in Your Basement

Typical signs

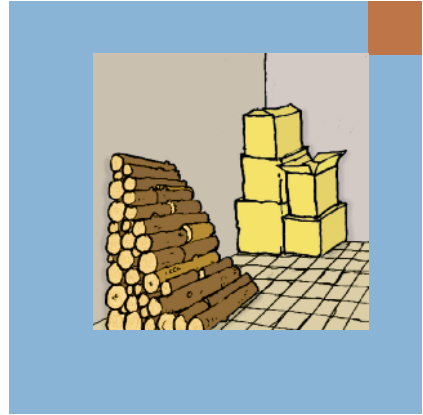
- Wet or damp floors or walls
- White powdery stains on exposed concrete walls or floor
- Stains on carpet
- Condensation on windows
- Rotting window sills
- A stuffy, damp smell
- Mold on joists behind insulation
- Mold developing on stored items (i.e. cardboard, clothing, etc.)
- Mold in cold cellar
- Mold in corners of outside walls or ceiling
- Water seeping through cracks in chimney
- Condensation dripping from cold water pipes



A DAMP OR WET BASEMENT, ESPECIALLY IF HEATED, MAY GENERATE MUCH MORE MOISTURE THAN ALL OTHER SOURCES COMBINED.

Possible causes

- Earth floor in crawl space or basement
- Cracks in walls or floors
- Leaky appliance or plumbing
- Rain entering wall
- Flooding
- High water table
- Groundwater running down walls and across floors into sump
- Improper exterior grading of ground near basement walls
- Sump pump not operating properly
- Open sump pump
- Humidifying device on your furnace
- Carpet on concrete floor
- Hot tub or pool inside home
- Firewood stored in basement
- Unvented dryer
- Wet clothes hung inside
- No exhaust fan in bathroom
- Items stored against wall or on floor
- Unheated basement or crawlspace
- Blocked footing drains
- Flue gas condensation leaking from chimney
- Spillage of combustion gases from furnace or water heater



Practical solutions

- Cover earth floor in crawl space or basement with polyethylene or install a cement floor.
- Fix cracks and leaks in basement.
- Fix leaky plumbing and appliances.
- If the water and/or mold damage was caused by sewage or other contaminated water, call in a professional who has experience cleaning and fixing buildings damaged by contaminated water.
- Fix landscape grading around the house.
- Repair sump pump.
- Install a tight-fitting cover on the sump pump.
- Do not humidify the whole house unless absolutely necessary.

- Remove carpets.
- Cover or empty hot tub when not in use to prevent evaporation.
- Store firewood outside the house.
- Install dryer vent to outside.
- Do not hang clothes to dry in the basement.
- Install bathroom fan exhausted to the outside.
- Minimize stored materials in the basement.
- Provide sufficient heat to the basement.
- Have footing drains inspected and improved, if necessary.
- Dehumidify basement during the warm months.
- Remove ceiling tiles if they have mold.
- Insulate cold water pipes.



Problems in Your Bathrooms

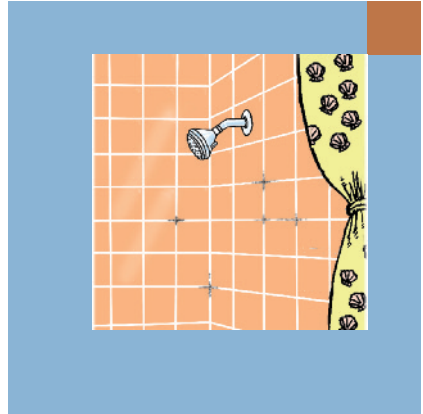
Typical signs

- Condensation on windows
- Condensation or staining on walls or ceilings
- Water dripping from exhaust grill
- Mold between ceramic tiles
- Rotting window sills
- Damaged gypsum board under windows
- Bulging gypsum board
- Peeling paint or wallpaper
- Musty smells
- Visible mold damage, staining or growth on floor or carpet
- Curling floor tiles
- Water pooling around toilet, sink or tub
- Unexplained increase in water bill
- Mold on walls or ceiling
- Condensation on toilet tank
- Mold under toilet tank

YOU MAY NOT SEE SIGNS IN YOUR BATHROOM, BUT THE MOISTURE MAY END UP IN OTHER PARTS OF YOUR HOUSE.

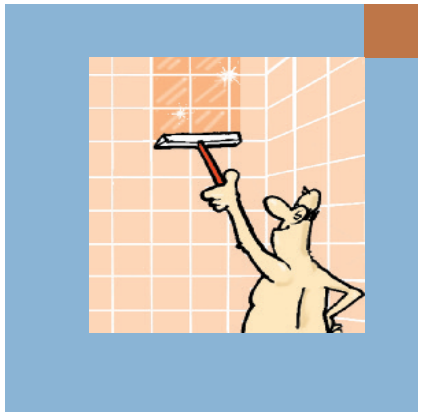
Possible causes

- Too much moisture in bathroom
- Moisture from hot baths and showers
- There is no bathroom fan
- Bathroom fan not being used
- Uninsulated fan ducts
- Backdraft damper on fan housing inadequate
- Leaky plumbing
- Plumbing leaking behind walls
- Dampness from wet bath mats, towels and drying clothes
- Inadequate ventilation
- Temperature kept too low
- Seal lost around shower stall or tub
- Uninsulated vent ducts
- Uninsulated toilet tank



Practical solutions

- Turn on fan when showering or taking a bath.
- Install a bathroom fan exhausted to outside (windows only cannot be relied upon).



- Allow fan to run for 15 minutes or longer to remove moisture.
- Squeegee or towel dry surfaces in the shower stall or bath enclosure after use.
- Close bathroom door when showering.
- Install a humidistat that turns exhaust fan on and off automatically.
- Fix leaky plumbing.
- Supply adequate heat and ventilation.
- Caulk shower stall, tub and sink.
- Properly insulate walls and ceilings.
- Consult a professional contractor for replacement of moldy walls.
- Have vent ducts properly installed.
- Remove carpet.
- Install a 6-litre toilet—these do not sweat.
- Clean surfaces regularly.

Problems in Your Kitchen

Typical signs

- Condensation on windows, ceilings and/or walls
- Damaged walls under windows
- Peeling paint or curling tiles
- Moisture under sinks or kitchen counters
- Rotting cabinetry under sinks
- Mold in cupboards and corners of interior surfaces of outside walls
- Musty odours

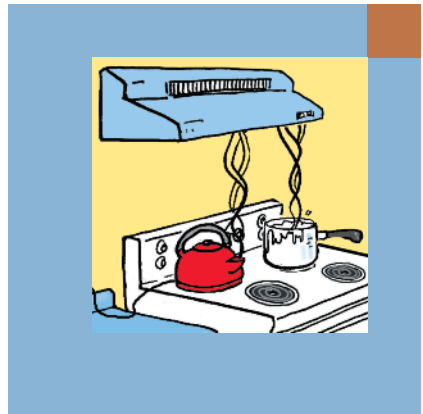
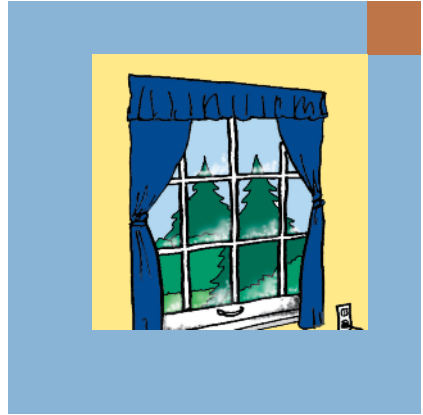
Possible causes

- Excessive moisture in home (there are moisture sources in other areas)
- No kitchen exhaust fan over stove
- Prolonged or continuous simmering and boiling of foods and liquids
- Combustion moisture from gas ranges
- Leaks around sinks and fittings
- Plumbing leaks
- Garbage or wet items contributing to moisture

- ❑ Mold growing behind refrigerator condensate pan
- ❑ Items in cupboard against outside walls preventing air circulation
- ❑ Temperature too low or fluctuating

Practical solutions

- ❑ Control overall house humidity.
- ❑ Install and use a quiet kitchen exhaust fan vented to the outdoors.
- ❑ Cover liquids and foods when simmering or boiling.
- ❑ Use range hood exhaust while operating stove.
- ❑ Caulk sink and fittings to counter.
- ❑ Repair leaks.
- ❑ Occasionally clean condensate pan.
- ❑ Keep items a few inches away from walls.
- ❑ Open cupboards occasionally to allow heat in.
- ❑ Keep compost or garbage in covered containers under the sink.



Problems in Your Bedrooms

Typical signs

- Condensation on windows
- Rotting window sills
- Mold around window sills
- Damage or stained, peeling paint on gypsum wallboards or ceiling
- Peeling wallpaper
- Cracked or bulging ceiling
- Musty odours
- A damp, musty closet
- Mold in closets, surfaces of outside walls, behind furniture or hanging artwork, etc.
- Water dripping from ceiling fixtures

Possible causes

- Frequent use of room humidifier

- Excessive house humidity levels (moisture may be coming from another part of the house)
- Lack of air circulation within room
- Energy-inefficient windows
- Closed drapes and blinds preventing heat from reaching window
- Lack of air circulation in closet
- Inadequate gap at bottom of closet door
- Bedroom temperature much lower than in other rooms
- Bed and bedroom furniture too close to outside walls, preventing air movement
- Too many furnishings preventing proper air flow in room
- Old, musty carpet
- Inadequate insulation in outer walls or attic



Practical solutions

- Run humidifier for a short time, monitor the relative humidity and ensure room dries after use.
- Control humidity throughout house.
- Keep air registers unobstructed.

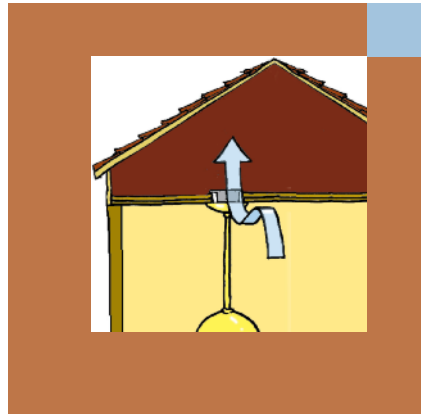
- ❑ Leave bedroom door open to allow better circulation or trim bottom of door to create a gap.
- ❑ Windows may need upgrading.
- ❑ Open drapes or blinds to warm window surfaces.
- ❑ Do not store items in closet from floor to ceiling on outside walls.
- ❑ Open closet door to allow air to circulate, or install louvred doors.
- ❑ Provide heat to bedroom.
- ❑ Keep furniture 15 cm (6 in.) from outside walls, ducts and cold air return.
- ❑ Properly insulate cold outer walls and ceiling.
- ❑ Reduce furnishings.
- ❑ Consider hard surface flooring.



Problems in the Attic and Roof

Typical signs

- ❑ Ice dams
- ❑ Condensation, frost and mold on roof trusses and sheathing
- ❑ Condensation near vents or plumbing stack
- ❑ Condensation near wiring or electric fixtures
- ❑ Water draining from soffit vents



Possible causes

- ❑ Ice dams
- ❑ Gaps and cracks in ceiling, allowing warm air to escape to attic
- ❑ Uninsulated and unsealed attic hatch
- ❑ Missing chimney firestop

- Kitchen and bathroom exhaust fans vented into attic
- Unsealed electrical or plumbing fixtures, vents, etc.
- Leaking roof
- Leaky, uninsulated ducts in attic

Practical solutions

- Carefully seal all penetrations to prevent house air leaking into the attic.
- Seal and insulate attic hatch.
- Install and seal chimney firestop around chimney to reduce air leakage into attic.
- Exhaust all vents directly to outside.
- Seal light fixtures.
- Repair roof and flashings.
- Reduce excess humidity levels in the house.
- Seal and insulate ducts passing through attic.



Problems in Your Exterior Walls

Typical signs

- Bulging, buckled or rotting siding
- Blistering or flaking paint
- Appearance of frost condensation
- Wet stains or chalky deposits on brick or stucco
- Cracks on foundation
- Puddles next to foundation

Note: Poor surface drainage around your house may cause dampness inside your basement.

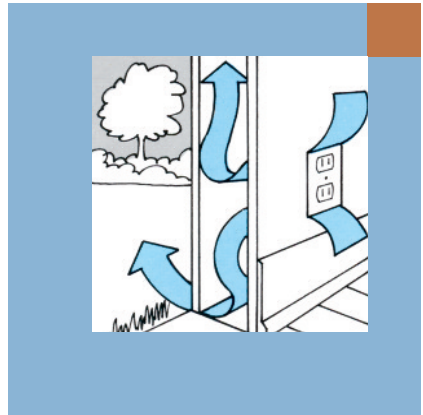
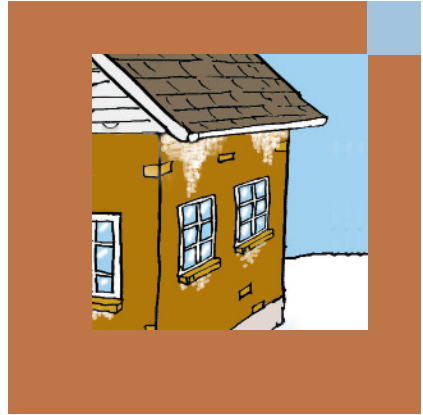
Possible causes

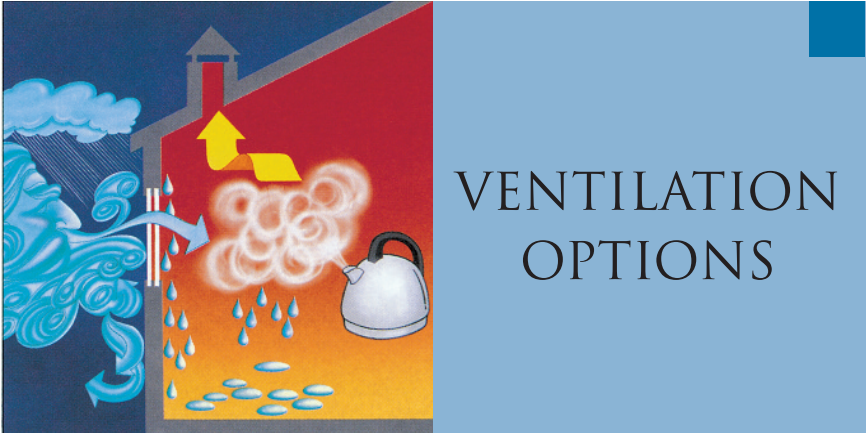
- Warm moist, inside air leaking out through break in air barrier in wall
- Wind-driven rain causing water to penetrate the wall cladding from outside
- Inadequate or missing flashings
- Overflow of rain barrel not directed away from foundation
- Broken downspout, or downspout termination on foundation
- No eavestroughs or gutters

- ❑ Broken or clogged eavestrough/gutter
- ❑ Poor drainage and grading and missing splash block
- ❑ Poor grading of landscape
- ❑ Poor grading under porches and decks
- ❑ Outdoor tap/garden hose leaking

Practical solutions

- ❑ Seal all openings into outer walls.
- ❑ Reduce excess moisture in the house.
- ❑ Improve house ventilation.
- ❑ Install or repair flashing to lead rain away from wall.
- ❑ Direct overflow spout of rain barrel away from foundation.
- ❑ Repair broken downspout.
- ❑ Install eavestroughs/gutters and extend away from house.
- ❑ Repair or clean out eavestroughs/gutters.
- ❑ Re-grade ground to drain surface water away from building.
- ❑ Fix leaky tap. Add hose extension to minimize water pooling under foundation.



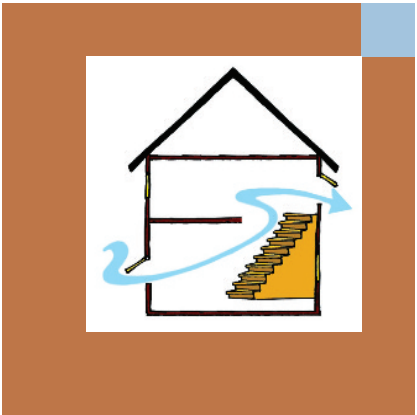


After reducing moisture sources, ventilation may be used to improve indoor air quality. All ventilation systems should be balanced—the amount of air in equals the amount of air out—with intakes sized to allow easy entry of enough air to supply all exhaust devices.

Types of Ventilation

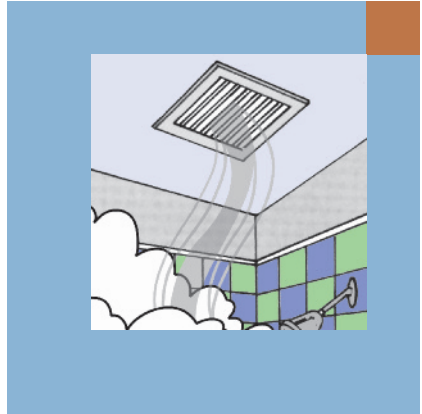
Passive ventilation

In the winter, open one or more windows for a short time. This can provide temporary ventilation, but is not always effective or economical.



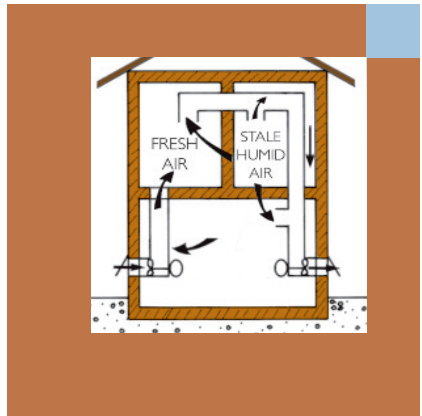
Exhaust-only ventilation

The minimum is exhaust fans in bathrooms and kitchen running for hours per day. **Caution:** when using large exhaust fans, combustion appliances with chimney may not operate properly.



Balanced ventilation systems

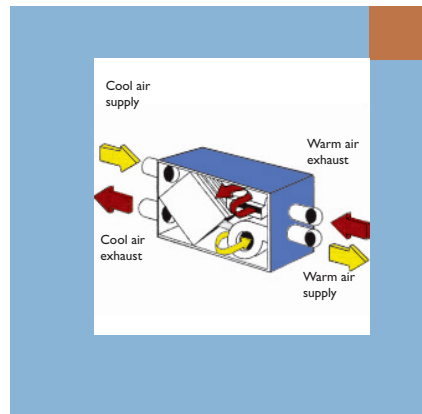
Exhaust fan runs in conjunction with fresh air intake to the furnace circulating air system.



Heat recovery ventilation

Combustion appliances with matched intakes and exhausts run smoothly.

In some houses that employ combustion devices, gas, oil or wood furnaces, water heaters, fireplaces, etc., a fresh air supply may be required to match the flows of exhaust-only ventilation systems.



Ventilation Combined with Air Circulation

If you have a forced air system, operate the fan continuously or intermittently. Combined with opening windows or using an exhaust fan, this will result in improved air quality through the whole house. A drawback is that most fans have a high energy consumption.

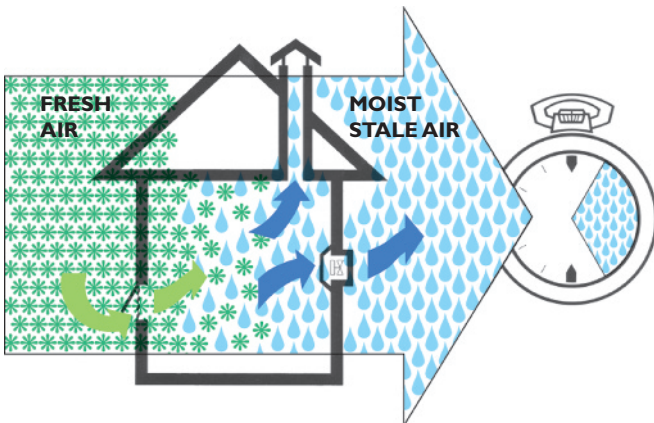
CMHC's *About Your House* series or consulting a competent heating and ventilation contractor.

You can protect yourself from the worst effects of combustion appliance spillage through the use of a CSA certified carbon monoxide detector and smoke alarm.

Protect Your House and Your Health

Many ventilation options can affect the performance of combustion appliances, especially when large fans are used. Learn more by consulting

ALL MOIST STALE AIR SHOULD BE REPLACED WITH FRESH AIR EVERY 3 TO 4 HOURS.





GLOSSARY

Air sealing—The application of weather stripping such as caulking and expanding foam to close off wall cracks and spaces at windows and doors and on walls and ceilings to reduce air leakage and consequent heat loss.

Backdrafting (flow reversal)—The reverse flow of outdoor air into a building through the barometric damper, draft hood or burner unit as a result of chimney blockage or a pressure differential greater than can be drawn by the chimney. Backdrafting causes smell, smoke or toxic gases to escape into the interior of a building.

Condensation—The transformation of the vapour content of the air into water on cold surfaces.

Flashing—Sheet metal or other material used in roof and wall construction to shed water.

Forced air—Air circulated through ductwork within a house by means of a circulating fan located in the furnace housing.

IAQ—Acronym for Indoor Air Quality. A general term relating to the presence of chemical and biological contaminants in the air within a building and their potential health effects.

Sump—A watertight tank that receives the discharge of drainage water from a subdrain or a foundation drain and from which the discharge is ejected into drainage piping by pumping.

ABOUT YOUR HOUSE

Measuring Humidity in Your Home

STRAIGHT FACTS ABOUT HUMIDITY

Humidity is the amount of moisture or water vapour in the air. You, your family and your pets produce moisture when you breathe or perspire. Even your indoor plants produce moisture. We add water vapour to indoor air through many household activities: cooking, showering, bathing, doing laundry, and dishwashing. More moisture can enter your home from the sun radiating well through a furnace or crawl space.

When is humidity a problem?
We need humidity for our comfort and health. But too much or too little humidity can produce a host of difficulties for householders (see *Humidity Basics*). Some of the problems are no more than nuisances; others could be far more serious. Many are familiar to Canadians, often occurring during the heating



Figure 1 Do you have a humidity problem?

Table 1 Humidity Basics

Typical Symptoms	Too Much Humidity	Too Little Humidity
	Condensation on windows Water stains on walls and ceilings Mildly infectious	Chapped skin and lips Scratching nose and throat Breathing problems Static and sparks Problems with electronic

ABOUT YOUR HOUSE FACT SHEETS

About Your House fact sheets are intended to assist homeowners in taking appropriate measures to address existing problems in their house or to make informed decisions about changes or upgrades they may be planning.

The following fact sheets provide more information on issues related to the topic of moisture and indoor air quality.

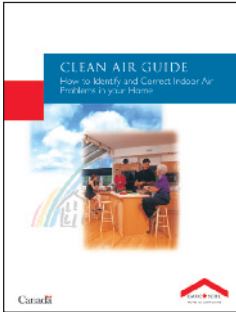
To find these *About Your House* fact sheets plus a wide variety of information products, visit our website at www.cmhc.ca

You can also reach us by telephone at 1-800-668-2642 or by fax at 1-800-245-9274.

Measuring Humidity in Your Home	Order No. 62027
Attic Venting, Attic Moisture, and Ice Dams	Order No. 62034
Choosing a Dehumidifier	Order No. 62045
The Importance of Bathroom and Kitchen Fans	Order No. 62037
Water Damage, Mold and House Insurance	Order No. 63322
Fighting Mold—The Homeowners' Guide	Order No. 60516
The Condominium Owners' Guide to Mold	Order No. 62341
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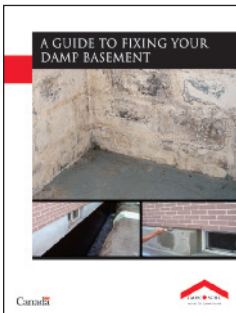
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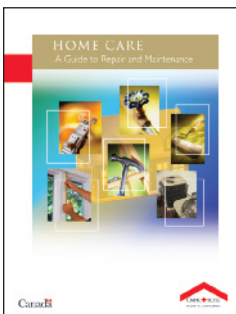
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