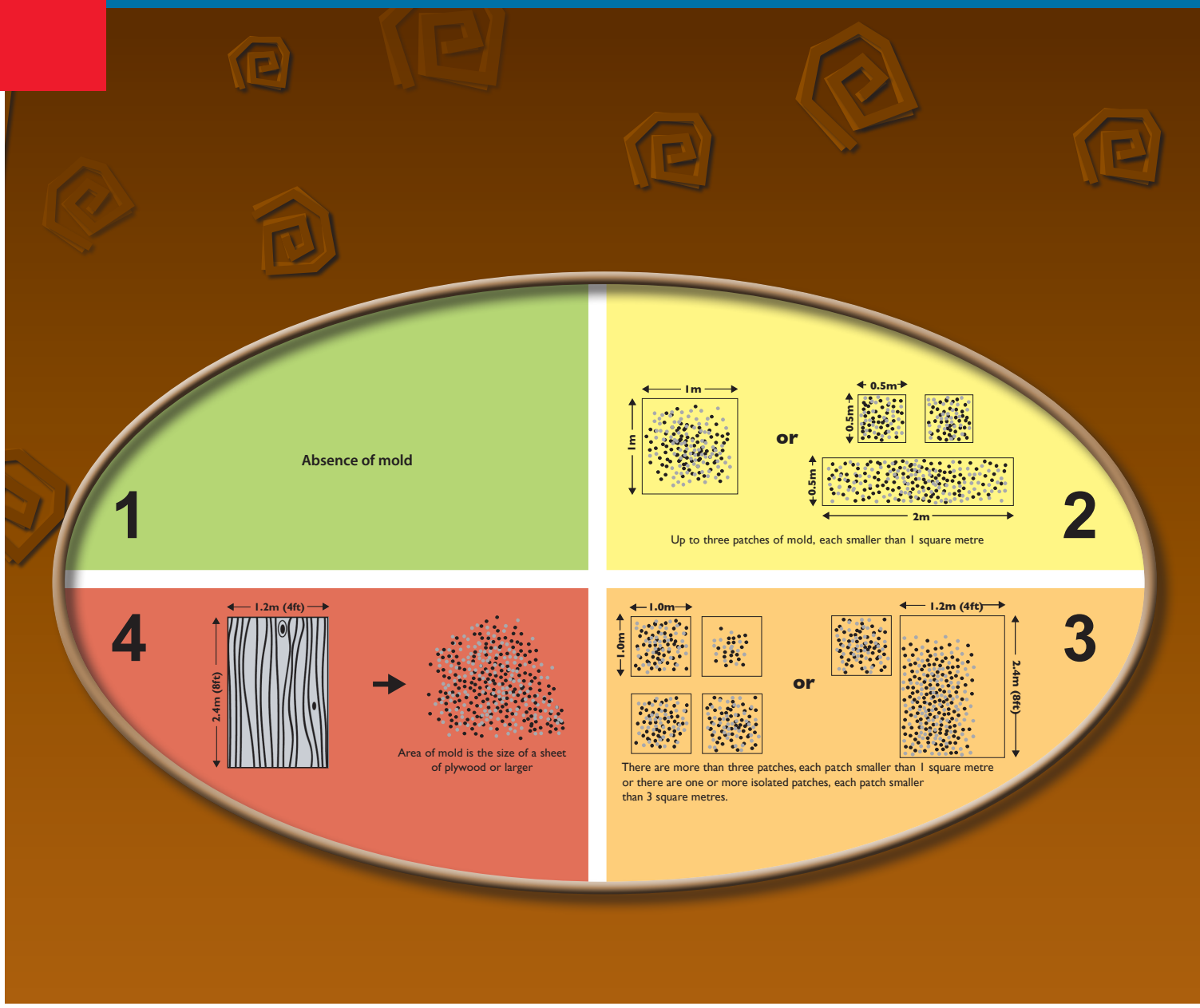
MOLD IN HOUSING
REFERENCE GUIDE



Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
Health Canada
Santé Canada
CMHC SCHL

1. Mold prevention

2. Light degree of mold

3. Moderate degree of mold

4. Advanced stage of mold

1. Mold prevention

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.

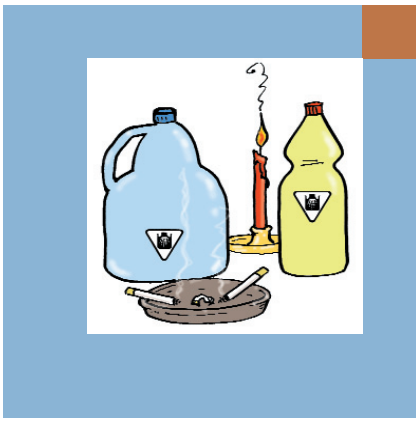
Air Quality Problems

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:

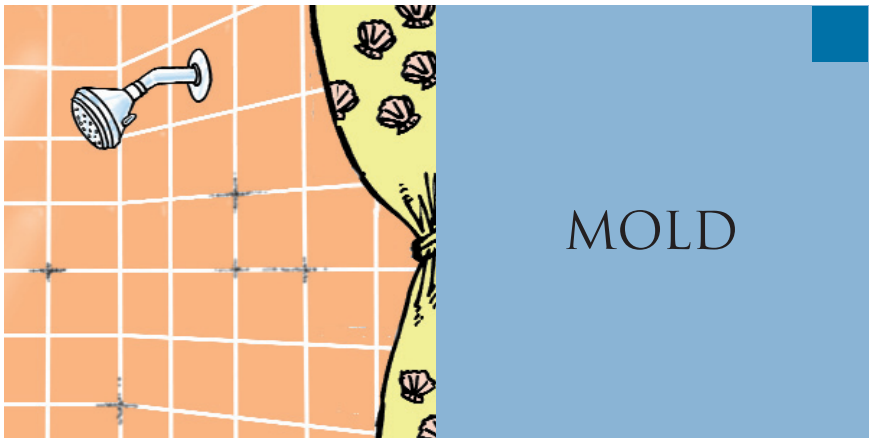
- upgrade windows with energy-efficient ones;
- keep walls and ceilings warm through adequate insulation;
- provide sufficient heat to all indoor areas in your home.

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.

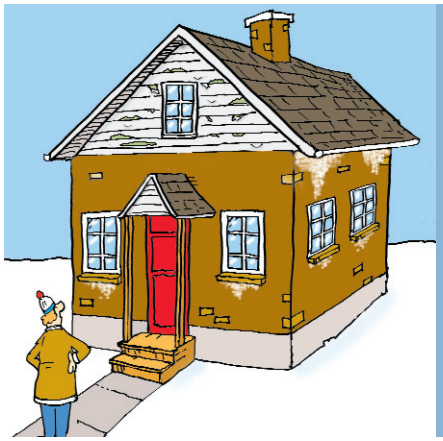
When cleaning:

- 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.

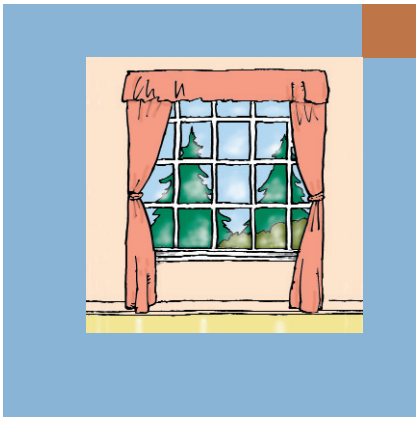
As you inspect each room, use the checklists provided in the next pages to keep track of signs that are present in your home, of possible causes that are relevant to your situation, and of practical solutions that you could apply.

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

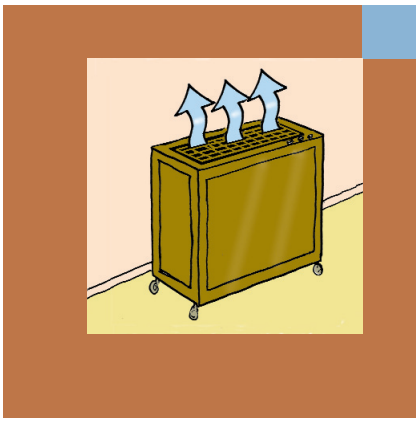
Typical signs

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



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
- ❑ 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



Practical solutions

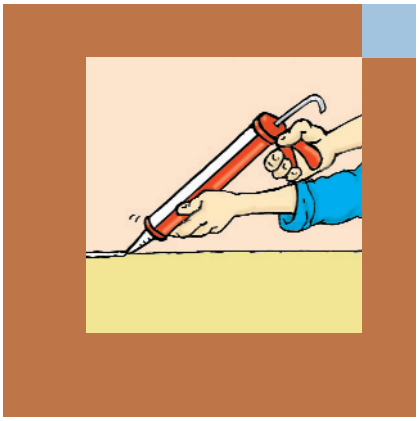
- ❑ Discontinue use of humidifiers.
- ❑ In summer use dehumidifier.
- ❑ Fix sources of moisture in basement or crawlspace.

- ❑ 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

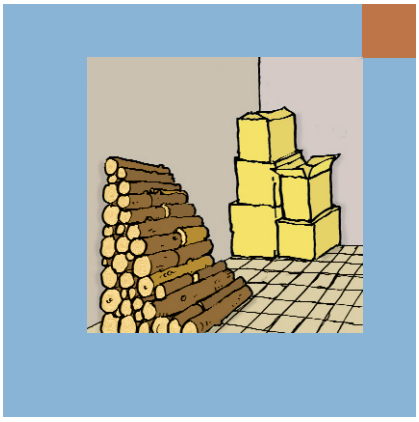
- ❑ Wet or damp floors or walls
- ❑ White powdery stains on exposed concrete walls or floor
- ❑ Stains on carpet
- ❑ Condensation on windows
- ❑ Rotting window sills
- ❑ A stuffy, damp smell
- ❑ Mold on joists behind insulation
- ❑ Mold developing on stored items (i.e. cardboard, clothing, etc.)
- ❑ 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

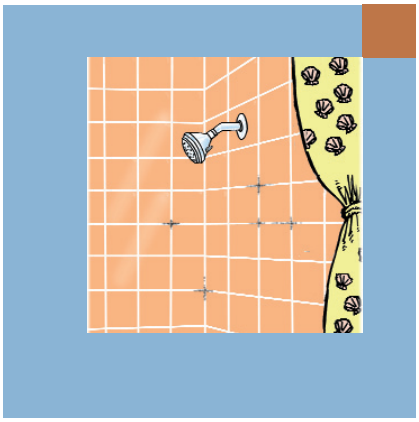
Typical signs

- ❑ 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.

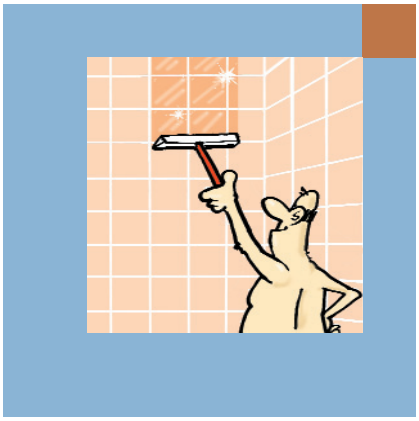
Possible causes

- ❑ 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

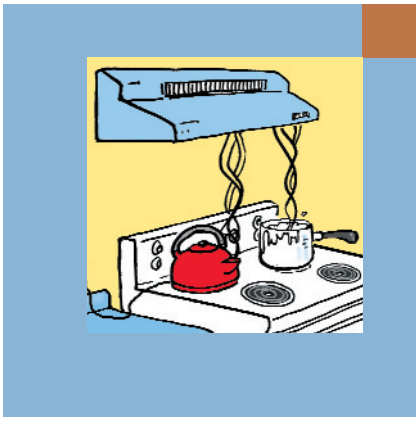
Possible causes

- ❑ 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.



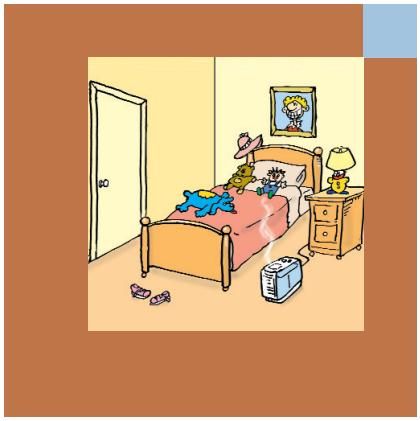
Problems in Your Bedrooms

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

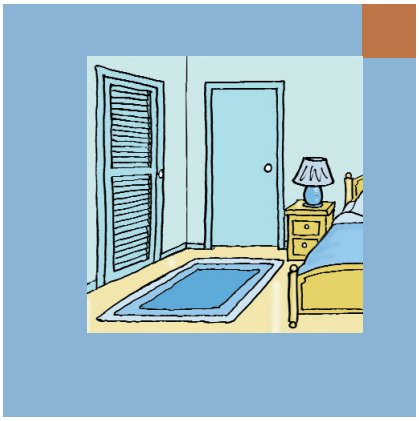


- ❑ Excessive house humidity levels (moisture may be coming from another part of the house)
- ❑ Lack of air circulation within room
- ❑ Energy-inefficient windows
- ❑ Closed drapes and blinds preventing heat from reaching window
- ❑ Lack of air circulation in closet
- ❑ Inadequate gap at bottom of closet 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.

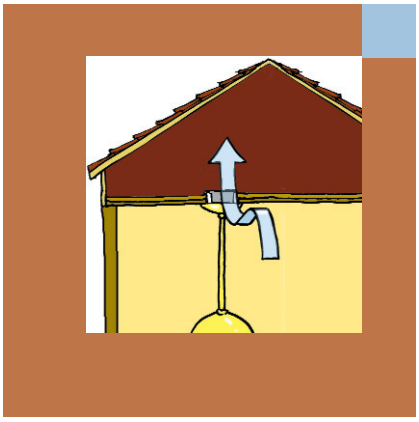
- ❑ Leave bedroom door open to allow better circulation or trim bottom of door to create a gap.
- ❑ Windows may need upgrading.
- ❑ Open drapes or blinds to warm window surfaces.
- ❑ Do not store items in closet from floor to ceiling on outside walls.
- ❑ Open closet door to allow air to circulate, or 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

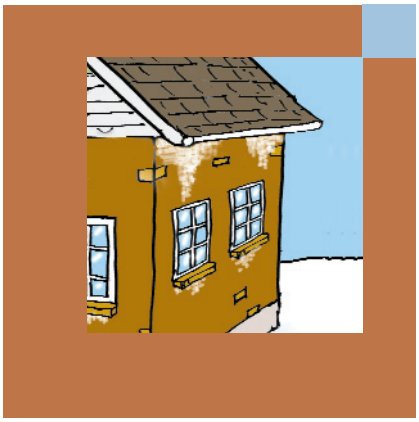
- ❑ Bulging, buckled or rotting siding
- ❑ Blistering or flaking paint
- ❑ Appearance of frost condensation
- ❑ Wet stains or chalky deposits on brick or stucco
- ❑ Cracks on foundation
- ❑ Puddles next to foundation

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

Possible causes

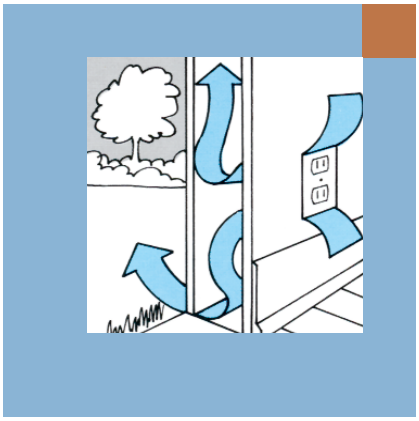
- ❑ Warm moist, inside air leaking out through break in air barrier in wall
- ❑ Wind-driven rain causing water to penetrate the wall cladding from outside
- ❑ Inadequate or missing flashings
- ❑ Overflow of rain barrel not directed away from foundation
- ❑ Broken downspout, or downspout termination on 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.



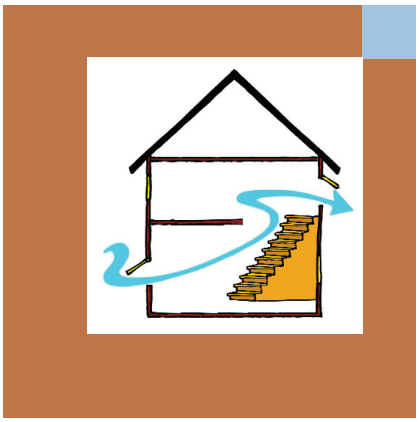
VENTILATION OPTIONS

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

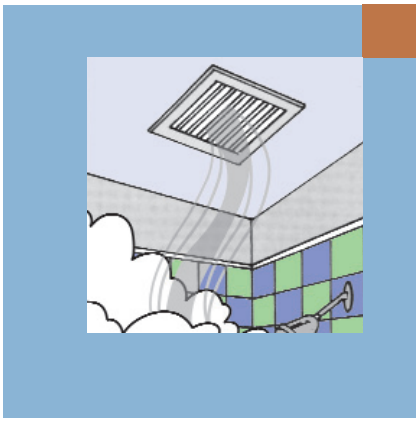
Passive ventilation

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



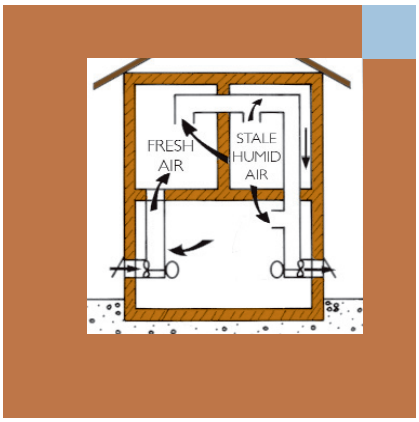
Exhaust-only ventilation

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.



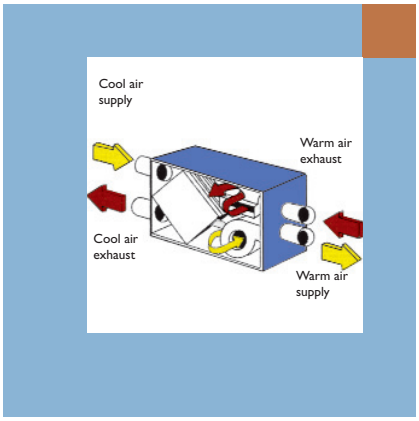
Balanced ventilation systems

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

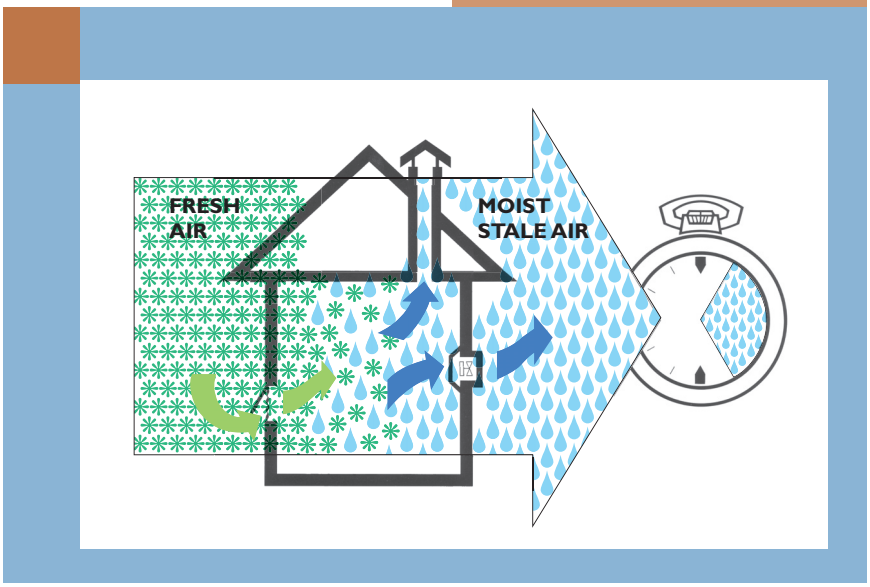
If you have a forced air system, operate the fan continuously or intermittently. Combined with opening windows or using an exhaust fan, this will result in improved air quality through the whole house. A drawback is that most fans have a high energy consumption.

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 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.

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.

Maintaining houses to prevent mold

Target audience for the information in this chapter: First Nations housing departments, bands and technical service providers.

Key point:

- Many moisture problems can be prevented through good maintenance.

First Nations housing departments and bands can minimize mold contamination problems by means of:

- following a simple maintenance checklist to find any problems with roofs, exterior finish, basements, plumbing, heating and ventilating systems;
- fixing any reported leaks or problems as quickly as possible; and
- educating and encouraging occupants to follow the recommendations listed above.

Suggestions for specific areas of the house

Basements and crawlspaces

- Cover any dirt floors with a sealed 6 mil poly layer complete with 50 mm (2 in.) of clean crushed stone or bricks or a 75 mm (3 in.) minimum concrete slab.
- Provide the foundation with proper dampproofing, insulation (preferably on the outside) and drainage.

- Discourage cold cellars in basements. The favourable conditions for storing food (cool and damp) are also the conditions that encourage mold growth. The technical service provider should advise on recommendations for the cellar. If mold is not a serious concern, the cellar may be maintained with periodic cleaning with trisodium phosphate and be isolated from the rest of the house with tight-fitting, weather-sealed doors. The cellar should have its own cold air supply and exhaust (a small fan). A cold cellar that is very moldy and is a continual source of molds for the whole house should be cleaned up thoroughly and maintained as part of the heated living space.
- Install a tight-fitting cover on the sump pit. If a manufactured cover is unavailable, use a piece of metal or plywood wrapped with plastic.
- Install an air-sealing type retrofit backwater valve in the floor drain.
- Interior insulation is discouraged. However, if there is exposed insulation in the basement, seal any air/vapour barriers that cover the insulation on the interior of basement walls or between floor joists.
- Carpets on the slab in basements are discouraged. The concrete floor can be painted. Raised floors are also not recommended since the created cavities can become good hiding places for molds.

Bathrooms

- Install a direct exhaust fan or central heat recovery ventilation system to exhaust stale, humid air.

Kitchens

- Install a range hood that exhausts directly outside.

Laundry areas

- Make sure dryers are vented directly outside with short, straight runs of aluminum duct with sealed joints.

Closets

- Cold walls and poor air circulation in closets can result in condensation and mold growth. Ensure that outside walls are insulated complete with an effective air/vapour barrier.

All living areas

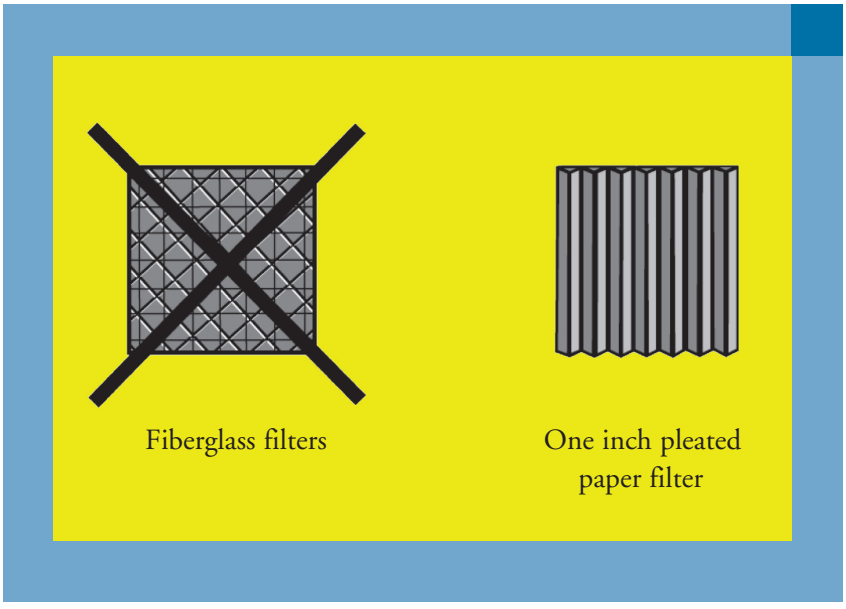
- Replace any carpets with vinyl composition tile.
- Seal all openings and leaks in the wall or ceiling air/vapour barrier.

Exterior

- Regularly check the condition of the roof and exterior finish for any places where water might enter. Fix any problems promptly.
- Install eavestroughs, downspouts (which extend at least 3 m or 10 ft. from any wall) and grading to direct water away from the house.
- Caulk and weatherstrip the house to prevent entry of dust, pollen and other particulates from outdoors.

Mechanical systems

- Do not install furnace humidifiers.
- Make sure any forced air system is capable of circulating air freely throughout the house. Undercut room doors to allow air to circulate back to central returns, if required. Continuous air circulation is preferred through the use of energy-efficient, two-speed furnace fans.
- Provide portable dehumidifiers for damp basements to lower the humidity in summer, helping to prevent condensation on cool surfaces.
- Replace fibreglass furnace filters with one inch pleated paper filters.
- Install a whole house heat recovery ventilation system following recommended installation practices.



Renovating houses to prevent mold

Target audience for the information in this chapter: First Nation housing departments, homebuilders, renovators, housing policy developers, technical service providers.

Key points:

- Correct conditions that led to mold growth.
- Keep house dry.
- Fix all water leaks through roofs, windows, doors, siding and foundations.
- Fix any plumbing leaks.
- Ventilate and dehumidify to keep relative humidity between 30 and 45 per cent.

Strategy

Any long-term solution for mold problems should start with an understanding of why mold grew in the first place. Steps must be taken to prevent the mold from growing again. Temperature and air conditions that are right for people are also often right for mold. The only factor we can control is moisture. Houses must be kept dry!

For the building envelope

- Stop water leaks through any part of the roof, exterior walls or below gradefoundation.
- Cold surfaces can lead to condensation and mold growth; insulate to keep all interior surfaces warm.
- Air seal to control random air leakage.

For the mechanical and ventilation systems

- Fix any plumbing leaks.
- Manage the relative humidity (keep between 30 and 45 per cent).
- Exhaust stale air and supply fresh air.
- Circulate the fresh air to all living spaces.

Renovate with the idea that the house is a system where the building envelope, mechanical system and lifestyle practices of the occupants all have effects on each other.

Many mold-troubled houses have damp crawl spaces. The crawl space must be treated either as open to the outside air or as being part of the living space in the house, not somewhere in between. Any crawl space containing furnace or duct systems should be treated as part of the living space. It must be maintained as clean as the rest of the house.

Other houses have basements with framed, insulated and finished walls on the inside of a poured concrete or block foundation. This provides a hidden cavity for moisture and mold problems inside that frame wall. It also leads to more difficulty and expense for renovation in the event of any basement leakage or flooding. Re-insulating any moldy basements on the interior is strongly discouraged. Insulating on the exterior eliminates hidden cavities and allows any future mold problems to be found and fixed much more easily.

Basement bedrooms and carpeted basement floors are also not recommended.

Building envelope renovations

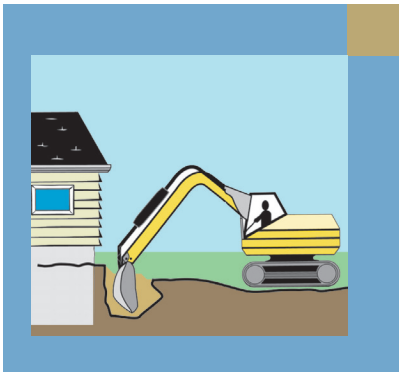
Lower cost foundation options

- Any exposed soil in the basement or crawlspace should be covered with a sealed layer to prevent water or soil gases from entering the house. The soil can be covered with a continuous, intact 6 mil polyethylene sheet (extend above the soil level and seal to the walls). The polyethylene sheet must be secured either by covering with a 50 mm (2 in.) layer of clean stone or gravel or weighting it down with bricks. A more expensive option is to cover it with a 75 mm (3 in.) concrete floor.
- If required for drainage, install a sump pit with a sealed cover, and a basement floor drain with a backwater valve (backflow preventer). Install a submersible sump pump plumbed to a suitable exit point. If the sump pit is not connected to outside perimeter or under-floor drainage tiles, then a water pathway to the sump pit may have to be created, depending on the soil type. (A good source of information for foundation options is CMHC's Investigating, Diagnosing and Treating Your Damp Basement.)
- Seal any snap-tie holes, wall cracks or floor cracks from the inside using a suitable epoxy according to the manufacturer's recommendations.
- Insulate the foundation on the exterior from the top of the concrete or block wall to at least 600 mm (2 ft.) below finished grade with extruded polystyrene complete with a protective foundation coating and a metal drip cap. An added improvement would be to install a 600 mm (2 ft.)-wide skirt of extruded polystyrene laid horizontally (on a slight outward slope) at the bottom of the wall insulation. (See the first two suggestions under higher cost options below.)

- When backfilling against the insulation, make sure the finished grade slopes away from the foundation by at least 15 cm (6 in.) over 3 m (10 ft.). This may require installation of window wells. A window well must be placed so the top is clearly above the finished grade, it is securely fastened and sealed to the wall, and the bottom is connected to its own water collection and drainage system.
- Install insulation and a sealed air/vapour barrier in the joist spaces along the inside face of the rim joist, from the underside of the floor sheathing to the top of the foundation wall. Alternatively, when insulating the foundation on the exterior, remove the exterior finish up to the top of the floor framing and insulate that area in the same manner that the foundation wall is being insulated.

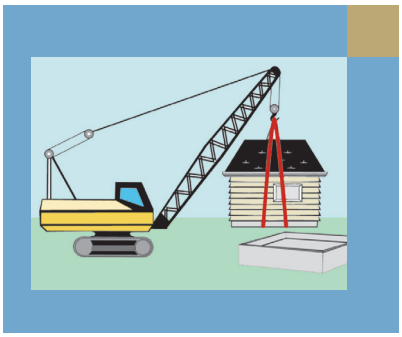
Higher cost foundation options

- Excavate and waterproof the exterior of the foundation walls. Install full height, free-draining exterior insulation. Install perimeter drainage that runs, at a slope of one in 50, to a clear exit or is connected to the community storm sewer system or to the sump pit. Install a waterproofing membrane over the present floor and pour a new concrete topping slab.



Or
If the present site is too wet and it is very difficult and costly to make sure water cannot get into the present basement, a new foundation may be required. If so, either on the present lot or on another drier site, do the following.

- Build a new 1.2 m (4 ft.)-high poured concrete crawlspace foundation with footings at, or close to, the existing grade.
- Dampproof and insulate the exterior of the foundation walls.
- Install perimeter drainage, floor drain and sump pit.
- Install under-slab insulation and poly air/vapour/moisture barrier.
- Pour a minimum 75 mm (3 in.) floor slab.
- Move the house onto the new foundation.
- Backfill with free-draining material (if available) and slope the finished grade away from the house.
- Use the existing stairwell, as space permits, for a laundry/utility/water heater area with an access hatch to the crawlspace.



If the house must be moved to a new foundation, it is important that the mold is cleaned up from the whole portion to be moved, from the furnishings and from any other possessions. Otherwise, the mold will just travel to the new foundation as well.

Above-grade building envelope recommendations

- Repair roofs. Replace any missing shingles or flashings as required. Design flashings to work without caulking. Ensure that all gable end or soffit vents are screened.
- Eavestroughs and downspouts should be installed with downspout extensions which discharge onto splash blocks at least 3 m (10 ft.) from the building.
- Repair the exterior finish. Make sure there are drip caps over windows and doors, as needed. Caulk around windows and doors. Replace any deteriorated siding.
- Replace any broken windowpanes or thermal units with broken seals. Replacement windows, if required, should be a minimum of double glazed thermal units with insulating edge spacers and effective seals. Ensure that all window installations are secure, square, plumb, level, operating properly, air sealed with polyurethane foam, caulked and properly capped.
- Tighten up the building envelope: replace drafty or loose weatherstripping on doors, windows or attic hatches. Seal holes around penetrations.

Interior water sources

Many mold problems are the result of plumbing leaks. Leaks under kitchen or bathroom sinks, from bathtub supplies or drains, or from toilet flanges can cause water to run into hidden cavities under cabinets or in floor framing, causing unseen mold growth. Water pumps and pressure tanks are also common sources of water leaks or condensation. Mold can grow in a small wet area even if the rest of the house is very dry.

Ventilation and mechanical systems

Common problems

Many houses have no mechanical ventilation. Because of our cold climate, there is often very little natural ventilation through windows that are kept closed for long periods. Moisture and other air pollutants can build up, especially in houses with many occupants.

Other houses may have mechanical ventilation consisting of poor quality bathroom fans that cannot exhaust moist, stale air adequately and recirculating range hoods that really are not ventilation equipment at all.

Fresh air intake ducts are often used to supply fresh air from outside to the return air trunk on a forced air furnace. Intake locations may be poor. Supply of fresh air is limited by the operation of the furnace fan.

Dryers are often vented inside or are vented outside through long winding loops of plastic flex duct.

Solutions

In many houses, the heating and ventilating equipment is a collection of parts, not a coordinated system. The requirements in *The National Building Code of Canada 1995* attempt to address this and should be considered a minimum standard.

Whole house, balanced, heat recovery ventilation systems are recommended to better deal with the moisture and pollutants generated by high occupancy rates in small houses in such severe climates.

Lower cost ventilation options

- Ensure that existing bathroom ceiling exhaust fans are vented directly to the outside with sheet metal ducting complete with sealed joints. Insulate over the duct and slope the duct to a clear hood termination on the exterior wall or clear of the soffit.Do not vent into the attic or soffit.
- Alternatively, install a new bathroom ceiling exhaust fan that has a centrifugal blower, a sound rating of 2.0 sones or less, and

is capable of meeting the principal exhaust fan requirements of *The National Building Code of Canada 1995*. This type of fan will provide more airflow. A quiet fan is also more likely to be used for longer periods. Note that a separate bathroom exhaust fan would not be needed if a heat recovery ventilator is installed (see Higher cost ventilation option below).

- Install or upgrade kitchen range hoods to units that exhaust directly outside. All units should have speed controls and short runs of rigid sheet metal duct with sealed joints. Any ducts passing through unheated space must be insulated. Ducts must either be accessible for cleaning or provided with a grease filter.
- Ensure that any existing fresh air intake duct hoods are not near driveways or other exhaust hoods, so they bring in clean air.
- Improved ventilation will not reduce humidity in the house if the weather outside is warmer and more humid that it is inside. Cool basement surfaces are particularly prone to condensation in summer when warm humid air may enter the basement. Dehumidification is often needed. Install a portable dehumidifier. Empty it as required or have it plumbed directly to a trapped drain. Clean the dehumidifier periodically.
- Replace any dryer flex duct with aluminum duct with taped joints, in short, direct runs.
- If the house has a forced air heating system, make sure that heating supply registers are located in every room. Return airflow from every room must be provided through individual room, return air ducts or through undercut or louvred doors that allow air to flow to central return air registers. Ideally, air should be circulated continuously, but this is not a comfortable, energy-efficient option with the use of a single-speed furnace fan. Two-speed furnace fans with energy-efficient fan motors are recommended.

When installing any exhaust equipment, ensure that the amount of air exhausted will not cause any woodstoves, fireplaces, wood, oil, gas or propane furnaces, or any other combustion appliances to backdraft. Installations must meet the safety requirements of *The National Building Code of Canada 1995* regarding make-up air systems and carbon monoxide detectors.

Higher cost ventilation option

- Install a balanced heat recovery ventilation system either with its own dedicated ducting system or integrated with an existing forced air heating system. This type of system renders individual bathroom fans and fresh air intakes unnecessary, in most situations. If the ventilation and heating systems are integrated, install a two-speed fan with a high-efficiency blower motor in the furnace and run the fan on continuous low speed for air circulation and on high speed when heat is required.

Interior finish

Renovating after mold clean-up often includes interior finishing. This is a good opportunity to make the house less likely to get moldy and also to reduce other indoor air pollutants. Install low pollution finishes such as:

- low-odour paints for drywall, that is paints with low emissions of volatile organic compounds (VOCs);
- vinyl composition tiles (Avoid carpets. Carpets may be sources of chemical pollutants and can also be a haven for dirt, mold and dust mites.);
- water-based low VOC finishes on doors and trim; and
- cabinet materials chosen for low emissions, such as locally available hardwood or laminated softwood plywood.

For further details, refer to the CMHC's *Building Materials for the Environmentally Hypersensitive.*

Designing and building houses that are less likely to get moldy

Key points:

- A house that is less likely to get moldy has:
- a simple, proven and affordable design;
- the lowest floor above the existing water table or expected flood level;
- no basement (It has a frost-protected, insulated slab-on-grade foundation);
- an energy-efficient, airtight envelope;
- an efficient heating, dehumidifying and air circulating system;
- heat recovery ventilation;
- an outside exhausting range hood; and
- materials chosen for durability, reduced chemical emissions and ease of maintenance.

Target audience for the information in this chapter: tribal councils, First Nations housing departments, bands, homebuilders, housing policy developers, technical service providers.

What to avoid

Moisture leading to mold growth in existing houses is often a result of one or more of the following conditions:

- poorly drained building sites;
- houses built to a standard that is not suitable for the location, site, climate or number of occupants;
- basements that leak;
- basements insulated on the interior creating a hidden cavity for mold growth;
- poorly maintained roofs that leak;
- plumbing that leaks;
- no mechanical ventilation;
- poor bathroom exhaust ventilation;
- poor kitchen ventilation including recirculating range hoods;
- little or no fresh air supply;

- uncontrolled air leakage; and
- cold interior surfaces.

Building sites

Past problems have sometimes been created by construction of houses, especially those with full basements, on wet sites. This has led to chronic basement leakage problems leading to mold growth.

Community planning must take into account the fact that some sites should be left vacant.

Specifications

To build houses that are less likely to get moldy, detailed specifications that both contractors and inspectors can follow are needed.

Occupants, as well, must be willing to adapt to changes in building construction. However, successful designs must meet the cultural and day-to-day activity requirements of the occupants. For example, particularly if basements are to be discouraged, designs must incorporate suitable workspaces for expected activities in individual homes or in common workspaces for the community.

The National Building Code of Canada 1995 provides a minimum standard. However, some poorly drained building sites, and even whole communities in wet locations, are not suitable for some allowable building practices such as full basements.

Some communities have made a commitment to new construction that meets the R-2000 standard, realizing that the increased capital costs are quickly offset by better comfort, durability, indoor air quality and energy efficiency.

New construction can all be developed from one set of model specifications incorporating details that meet *The National Building Code of Canada 1995* as well as the R-2000 standard and are suitable for the specific needs of a community in a particular location.

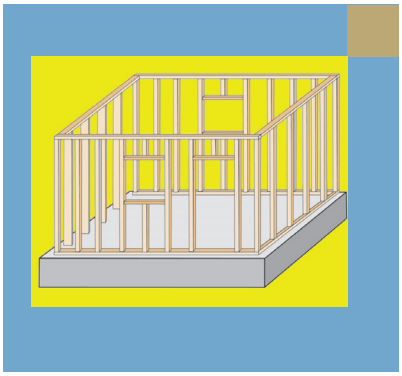
Variations in exterior appearance can be achieved by reversing plan layouts, using hip roofs or gable roofs on adjacent houses, and changing siding, roofing and

exterior trim colours. Changes in interior appearance can also be achieved with different wall, floor and trim colours, as well as different cabinet and door styles.

Improvements and different designs can be developed over time. But, the basic house system remains the same.

Basements

The easiest way to avoid basements with problems such as leaks, hidden cavities for mold growth, cool, damp surfaces and too much clutter creating food



for mold, is to avoid building basements at all. Frost-protected shallow foundations are a good alternative. (Details are available in training materials from CMHC's Assisted Housing Division, particularly the Building Technical Excellence workshop developed through cooperation between CMHC and the Ontario First Nations Technical Services Corporation.)

Slab-on-grade bungalows are recommended.

It must be recognized that crawl spaces are sometimes the only viable option. Unfortunately, many existing crawl spaces are very prone to moisture and mold problems that are easily transferred to the rest of the house. Most crawl spaces are built and maintained as if they are "outside" the house. Because they often contain forced air furnaces (with leaky ducts) and are only separated from the living areas by floors that are not airtight, they are, in fact, "inside" the house.

At the design stage, a decision must be made whether the crawl space is "conditioned" or "not conditioned." Conditioned crawl spaces are those that are not separated from the heated portions of the house. The temperature may be different but the crawl

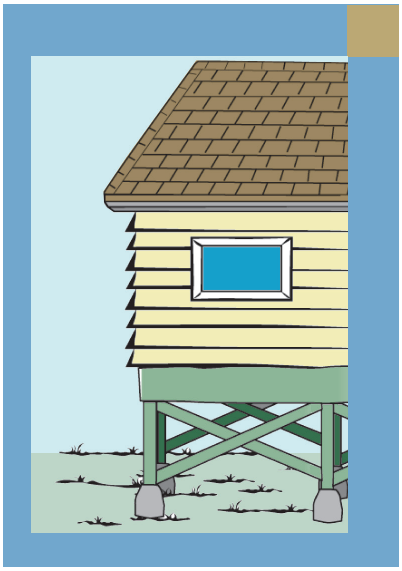
space air is connected to the house air. This type of crawl space must be built as if it is a shallow basement, with air barriers, vapour barriers, insulation, heating, cooling and ventilating similar to the rest of the house and suitable for the climate.

Unconditioned crawl spaces are separate from the heated/conditioned portions of the house. This type of crawl space is "outside," so the floor above it must be treated as the bottom of the building envelope, incorporating the air barrier, vapour barrier and insulation suitable for the climate. House services, including ductwork, in an unconditioned crawl space should be avoided.

Details of better crawl space construction practices are available in the CMHC publication *Crawl Spaces: How to Avoid Moisture and Soil Gas Problems.*

Main floor construction

There are many options for main floor construction. Refer to construction manuals such as the Canadian Home Builders' Association Builders' Manual



or CMHC publications such as Solving Moisture and Mold Problems in a Home.

Maintenance

Occupants must be informed about their responsibilities and provided with the tools/resources to carry out any maintenance responsibilities they may have.

Heating and ventilating

Construction of improved building envelopes will result in smaller heating systems being required. The choice of heating fuel depends mainly on price and availability. Any heating

fuel can be used in a house that is less likely to get moldy, if the necessary precautions for that fuel are taken. For example, both wood and oil are common fuels but both require precautions with regard to storage and combustion backdrafting. Any exhaust equipment must be carefully planned and matched with the heating system to avoid dangerous combustion spillage.

The heating and ventilating system can be used to wash air over surfaces, keeping them warmer; supply drier air and exhaust humid air. The heating and ventilating systems can be either combined or completely separate, but air circulation, fresh air supply and stale air exhaust are advisable.

Balanced heat recovery ventilation is recommended as the best method of exhausting stale, humid air and supplying an equal amount of fresh air.

Bathroom exhaust fans are not normally required if a central heat recovery ventilation system is installed. However, range hoods that exhaust outside are still recommended, to remove cooking odours and excessive humidity from the kitchen. Dryers must also be exhausted directly outside.

Interior finish

Install low pollution finishes:

- painted drywall using paint with low emissions of VOCs;
- composition vinyl tile or pre-finished hardwood floors;
- no carpets;
- water-based, low VOC finishes on doors and trim; and
- cabinet materials chosen for low emissions.

Details are available in several CMHC publications including *Building Materials for the Environmentally Hypersensitive*.

2. Light degree of mold

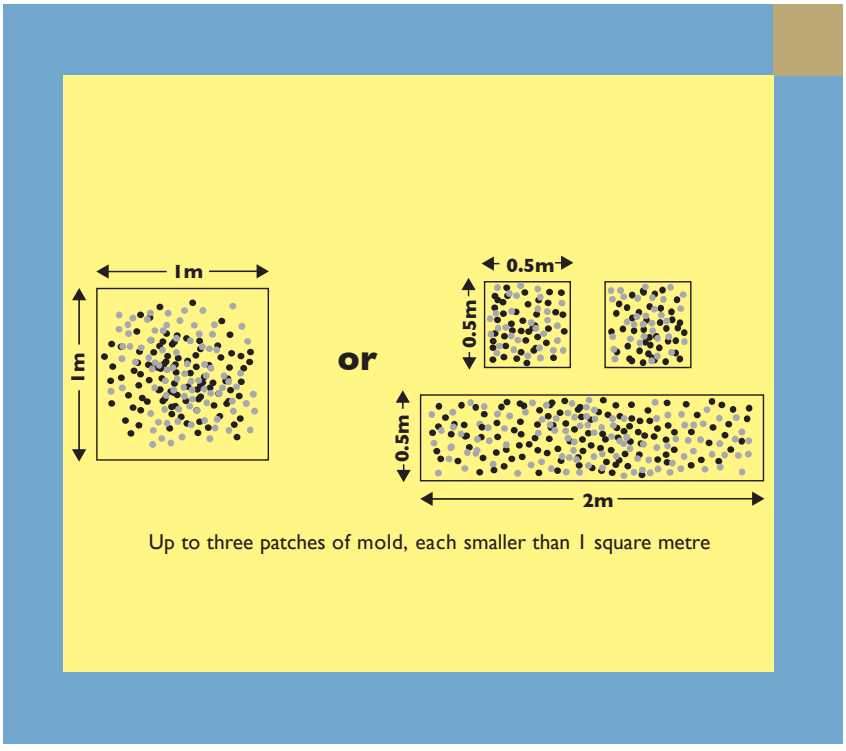
How much mold is growing?

One way is to estimate the area of the mold.

Mold is considered to cover a small area if there are 3 or fewer patches of mold, each patch smaller than 1 square metre. Clean up small areas yourself using a detergent solution, household rubber gloves and a dust mask for protection.

Small moldy areas in houses may become larger over time, if ignored, so it's important to clean up and remove even tiny patches of mold.

Note that asthmatic or allergic individuals should refrain from doing the cleaning.



Up to three patches of mold, each smaller than 1 square metre

How to clean up small mold problems

Key points:

- Occupants can clean small areas of mold themselves.
- A mask, safety goggles and rubber gloves must be worn.

Small area clean-up

You can clean up small areas of mold (one to three patches smaller than 1 square metre). The minimum protective wear needed includes:

- safety glasses or goggles;
- N95 respirator (3M 8210 or equivalent); and
- household rubber gloves

Occupants with asthma, allergies or other health problems should not be in the area being cleaned.

Steps to follow in cleaning up small areas of mold

Wear rubber gloves, glasses or safety goggles and a mask. When buying a mask, select one that is rated an N95 respirator. It captures small particles more effectively than an ordinary dust mask.

Washable Surfaces:

- Scrub with a detergent solution; then
- Sponge with a clean, wet rag and dry quickly.

Moldy drywall:

- Clean with a damp rag using baking soda or a bit of detergent. Do not allow the drywall to get too wet.

Moderate large or extensive amounts of mold require stricter precautions and more adequate protective wear.

Minimum personal protective equipment (PPE) and other requirements

The following recommendations are in line with the New York City Department of Health Guidelines for Mold Remediation. In addition to mold area, the length of time it will take to fix problem should be a consideration. An N95 respirator is the minimum required for respiratory protection for a small clean-up. The mask may be upgraded to a half-face respirator if there is a lot of mold and the clean-up and remediation will take hours, instead of minutes. Work that will take many days may require a full face-respirator with HEPA filters. Small clean-ups do not require additional preparation of the work area. However, for larger clean-ups, isolation of the areas being cleaned would prevent contamination of other areas of the house. An exhaust fan, installed on a window, further prevents the air from moving into other parts of the house and provides ventilation to the workers.

Small area clean up

One to three patches smaller than 1 square metre; clean-up expected to take minutes.

PPE

- N95 respirator, for example 3M 8210 mask
- safety glasses or goggles
- household rubber gloves

Who does the clean up?

Home occupants who are reasonably healthy.

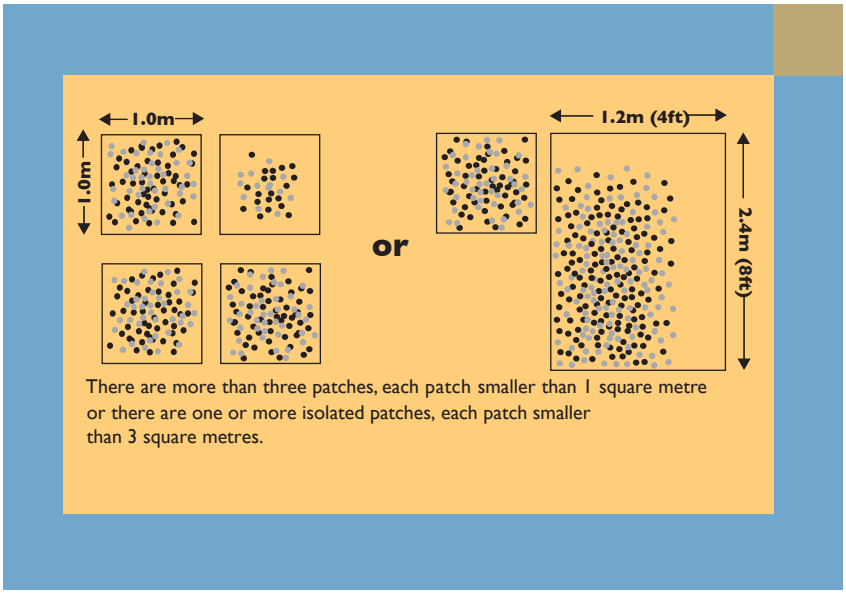
Preparation: no special preparation needed.

People at higher risk should not be in the work area.

3. Moderate degree of mold

What should be done if the mold area is larger?

The mold area is considered moderate if a) there are more than 3 patches, each patch smaller than 1 square metre, or b) there are one or more isolated patches, each patch smaller than 3 square metres (about the size of a sheet of plywood). Patches close together should be considered as one patch. You may clean up moderate amounts of mold only if you follow the proper procedures and are able to get the proper protective equipment— a dust mask (a half-face respirator with charcoal cartridges is optional), safety goggles and rubber gloves. Disturbing a moldy area will cause mold debris to become airborne and exposes you to more mold. Ask your First Nation housing department or band for the procedure for cleaning moderate amounts of mold, and buy a respirator and safety goggles.



There are more than three patches, each patch smaller than 1 square metre or there are one or more isolated patches, each patch smaller than 3 square metres.

Preparing the house for clean-up

Target audience for the information in this chapter: First Nations housing departments, bands.s

Key point:

- A plan is needed for every clean-up.
- The work area must be adequately prepared according to the size of the clean-up.
- Occupants and workers must be protected from exposure to mold during clean-up.

Making a work plan and estimate of cost

The smallest mold clean-ups may be done by the occupant or by community volunteers.

Larger jobs will probably require a contractor who specializes in mold clean-up. A separate contractor will often be needed to renovate the house to mold-resistant conditions. Agreements with both contractors must include clear specifications of the work and the costs. Discuss the plan with the contractors. Their experience can be valuable. However, be cautious about accepting all advice on mold clean-up and renovating to mold-resistant conditions from the contractors hired to do the work.

Independent inspections by an IAQ-trained technical service provider are needed to confirm the work is being done as planned and the original plan is still appropriate if unforeseen conditions arise.

Preparing for a successful clean-up

Depending on the type of mold and the size of area covered by mold, proper preparation may include the following steps.

- Ensure occupants are safe during clean-up.
- Review safety requirements.
- Ensure that the cost estimate is still current and covers all work required.
- Review the work procedure with workers, band housing representative, the technical service provider and the community health nurse/representative or environmental health officer.
- Follow the work area preparation appropriate for the size of the clean up.
- Seal all duct openings and penetrations to prevent mixing of air in the work area with the rest of the house.
- Organize the disposal of the moldy waste and other waste materials.
- Arrange for monitoring after clean-up.

Worker protection for working in mold-contaminated houses

Any individuals required to perform small area mold clean-ups or called on to remove and decontaminate possessions from very moldy houses before a mold clean-up contractor starts work should consider the following.

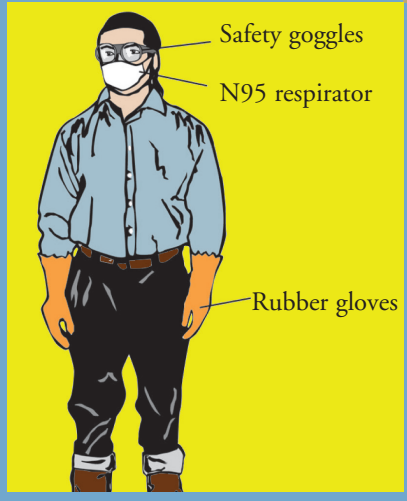
Basic requirements

No worker who has any sort of immune suppression, asthma or mold allergy should work at mold clean-up. The risk of serious reactions in the event of inadvertent exposure is too great. Any worker who recently had a severe cold or flu should delay working in moldy areas until fully recovered.

Contractors shall establish a worker protection program as required by provincial/federal regulations. Contact the provincial ministry of labour for information on occupational health and safety. Refer to the document *Recommended Interim Health and Safety Guidelines for Protection of Workers During Mold Remediation and Cleanup in Residential Homes (1998)* published by the Health Canada Medical Services Branch.

All individuals must be aware of, and familiar with, their personal protective equipment, its repair, maintenance and cleaning requirements and the hazards associated with handling moldcontaminated materials and bleach solutions.

Minimum personal protective equipment



Minimum personal protective equipment (PPE) and other requirements

The following recommendations are in line with the New York City Department of Health Guidelines for Mold Remediation. In addition to mold area, the length of time it will take to fix problem should be a consideration. An N95 respirator is the minimum required for respiratory protection for a small clean-up. The mask may be upgraded to a half-face respirator if there is a lot of mold and the clean-up and remediation will take hours, instead of minutes. Work that will take many days may require a full face-respirator with HEPA filters. Small clean-ups do not require additional preparation of the work area. However, for larger clean-ups, isolation of the areas being cleaned would prevent contamination of other areas of the house. An exhaust fan, installed on a window, further prevents the air from moving into other parts of the house and provides ventilation to the workers.

Small area clean up

One to three patches smaller than 1 square metre; clean-up expected to take minutes.

PPE

- N95 respirator, for example 3M 8210 mask
- safety glasses or goggles
- household rubber gloves

Who does the clean up?

Home occupants who are reasonably healthy.

Preparation: no special preparation needed.

People at higher risk should not be in the work area.

Moderate area clean up

More than three patches smaller than 1 square metre, or at least one patch larger than 1 square metre but smaller than a sheet of plywood; clean-up will take hours.

PPE

- N95 respirator, for example 3M 8210 mask is the minimum; a half-face respirator with charcoal would be preferable.
- safety goggles
- heavy-duty rubber gloves

Who does the clean up?

Maintenance personnel who have taken training on remediation for mold; occupants under the supervision of a trained individual

Work Area preparation:

isolate the area to be cleaned with plastic sheeting. An exhaust fan would be helpful.

People at higher risk (Chapter 9) should not be in the work area or in spaces adjacent to the work area.

4. Advanced stage of mold

The mold area is considered large if a single patch of mold is larger than a standard piece of plywood or drywall. The house is extensively contaminated when there are many large patches of mold. Being exposed to this much mold is not a good idea. Do not attempt to clean up large areas of mold yourself. Contact your First Nation housing department or band.

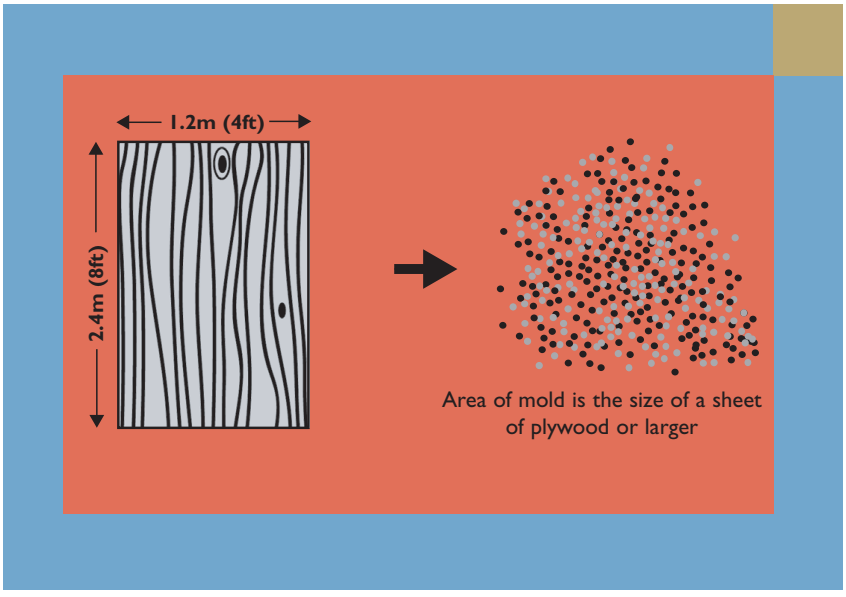
Large area clean up

(mold area the size of a standard sheet of plywood or larger; clean-up will take days)

PPE

- N95 respirator, for example 3M 8210 mask is a minimum; half-face respirators with charcoal cartridges are preferable.
- adequate eye protection
- heavy duty rubber or neoprene gloves
- disposable coveralls and head covering.

A health and safety professional should be consulted.



Who does the clean up?

Maintenance personnel and others who have taken training in remediation for mold

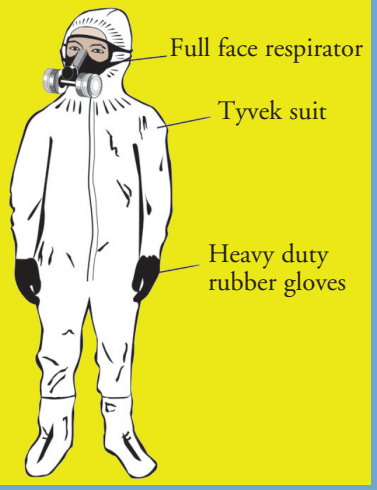
Work area preparation:

Isolate the area with plastic sheeting, taped to walls and ceilings. Use an exhaust fan to negatively pressurize the work area.

No one other than the clean up crew should be in the area.

Extensive contamination require personnel trained in handling hazardous materials and consultation with a health and safety professional who has experience in dealing with mold. Full-face respirators with HEPA filters and disposable clothing covering the head and shoes are required. The work area must be isolated and depressurized.

Required protective equipment



Common sense do's and don'ts

Do

- wear protective clothing to prevent yourself from being exposed to mold while cleaning up, handling moldy materials or renovating moldy houses;
- ensure that the respirator is properly fitted;
- follow the appropriate work area preparation procedure;
- remove mold-contaminated clothing and wash your hands before eating;
- wash your gloves (if washable) when finished;
- replace your disposable mask or filters for your respirator, as necessary, and store masks in clean plastic bags; and
- wash your work clothes separately and shower at the end of the working day (to prevent exposure of your family to the molds).

Don't

- assume that you are tough and mold will not affect you;
- work in a mold-contaminated area without personal protective equipment;
- eat in a moldy area; and
- touch your face or skin with your working gloves.

Mold clean-up

Target audience for the information in this chapter: First Nations housing departments, bands, mold clean-up contractors, renovators.

Key points:

- Clean-up and safety procedures depend on the type and area of mold.
- HEPA vacuuming is a very useful step for reducing exposure to mold before, during and after renovation.
- A mold problem in one area can contaminate the rest of the house.
- Furniture, clothes and possessions must all be cleaned before they are returned after mold clean-up or moved to another house.
- Clean-up is not complete without continued monitoring.

The mold clean-up and safety procedures required depend on the type and area of mold. Small amounts of mold may be cleaned up by the home occupant or by the community clean-up crew.

General guidelines

There are several general strategies used together:

- disposal of mold-contaminated possessions and furnishings;
- decontamination of possessions and furnishings;
- HEPA vacuuming;
- decontamination of wood;
- removal/replacementof moldy drywall;
- general cleaning; and
- decontamination of concrete surfaces.

Disposal of mold-contaminated possessions, furnishings and building materials

Furnishings that had been wet, or kept in a moldy area for a long time, or are visibly very moldy or smell musty and are not washable should be discarded. Disposal of contaminated possessions, furnishings or building materials should be done by double bagging and sealing them in sturdy garbage bags, labelled appropriately. Take them to a landfill site.

Decontamination of possessions and furnishings

Possessions to be salvaged should be cleaned as follows:

- Washable items should be washed with detergent, rinsed and dried. Repeat as necessary. It may help to air the item outside on a dry, sunny day. Discard the item if the moldy smell persists.
- Furniture that have a hard, washable surface can be scrubbed with detergent, rinsed and dried as above.

- Surfaces that are likely to be damaged by too much water can be cleaned with baking soda. Add just enough water to baking soda to make a paste. Apply to the surface to be cleaned and leave it on for half an hour or longer. Wipe off or vacuum. Repeat as necessary. Air the item out in the sun.
- Non-washable items should be thoroughly vacuumed with a HEPA vacuum cleaner. HEPA vacuuming removes dust and mold from the surface only. Heavily contaminated items, such as upholstery that was stored in a wet basement, should be discarded. Ensure that you are not retaining contaminated items which can become a source of molds after the house is cleaned.
- Selected clothing that are not washable can be dry-cleaned.

Enclose cleaned items in 6 mil plastic bags, tag and store them separately.

HEPA vacuuming

Exposure to mold can be reduced by vacuuming with a HEPA vacuum cleaner prior to cleaning mold-contaminated surfaces. The area can be vacuumed again during the cleaning and when the renovation is completed. HEPA vacuuming is also a useful interim measure for reducing the exposure to mold when the remediation cannot be undertaken immediately.

Decontamination of wood

Wood that is visibly rotting should be discarded and replaced. Framing and other wood surfaces can be cleaned by either of these two methods:

Method 1. HEPA vacuum mold from the surfaces. Skip the HEPA vacuuming step if the wood is wet. Wipe down with unscented detergent and water, then sponge with a clean, wet rag. Extract the moisture using a dry/wet vac and/or clean, dry rags to get water off the surfaces and out of

nooks and crannies. Accelerate the drying either with fans and open windows (if the relative humidity outside is low), or with dehumidifiers (keep windows closed). The wood should not be allowed to be wet for more than a day. Measure the relative humidity of the air next to the framing. It is dry enough when the air relative humidity is less than 60%.

Method 2. HEPA vacuum visibly moldy areas. Simultaneously sand and vacuum until no sign of mold is present. It is important to contain the dust while sanding.

Sander and vacuum combined

Sanding would be effective only if the mold is limited to the surface of the wood. Wood that is decayed should be replaced. Vacuum up all the mold and sanding debris.

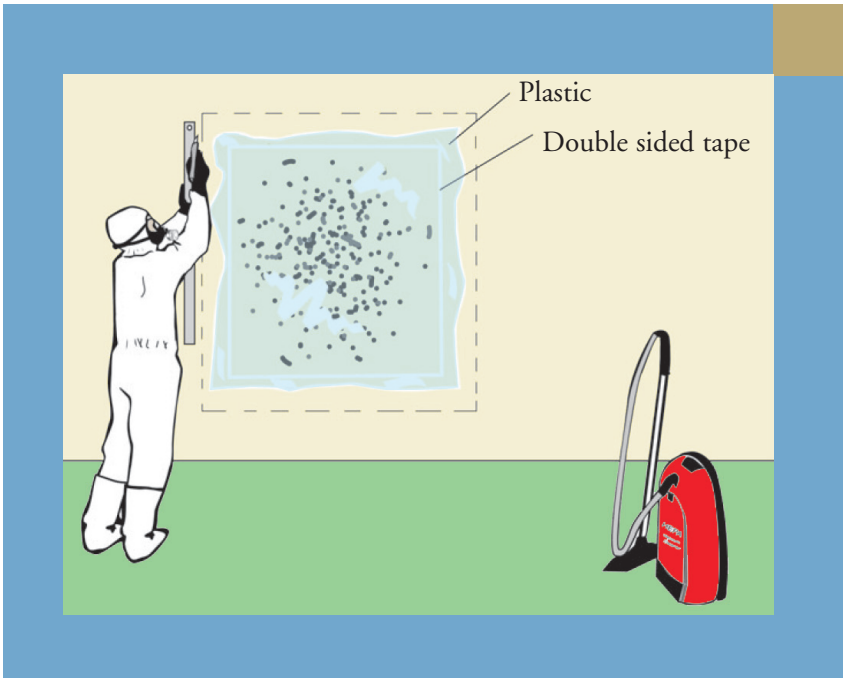
Removal/replacement of moldy drywall

- Cover the moldy area with a piece of 6 mil polyethylene large enough to cover the area and at least eight inches beyond.
- Secure the edges of the poly with sheathing or duct tape.
- Cut around the border of the taped area and remove the material.
- Bag the moldy material in heavy-duty garbage bags or wrap it in 6 mil polyethylene with taped joints. Take it to a landfill site.
- Wash the surrounding area with a mild detergent solution and dry quickly.

Visually check behind the cut out area. Evidence of mold inside the wall cavity indicates that much more work than replacing the cut out area is needed. Moldy insulation may need to be removed, the wood framing may need to be cleaned and more extensive area of drywall may need to be replaced. If the work is not done immediately, cover and secure the cut out area temporarily with polyethylene to prevent mold from being dispersed.

General cleaning

HEPA vacuum surfaces first, then scrub or brush the moldy area with a mild unscented detergent solution. Rinse by sponging with a clean, wet rag. Repeat. Dry quickly.



Decontamination of concrete surfaces
HEPA vacuum surfaces. Follow the general cleaning procedure given above for concrete surfaces that are not visibly moldy.

For concrete surfaces that are visibly moldy, use trisodium phosphate or TSP. Dissolve 1 cup of TSP in two gallons of warm water. Stir for two minutes. Note: TSP should not be allowed to come in contact with skin or eyes.

- Saturate the moldy concrete surface with the TSP solution using a sponge or rag. Keep the surface wetted for at least 15 minutes.
- Rinse the concrete surface twice with clean water. Wash sponge or rag well between wipings.
- Dry thoroughly, as quickly as possible.

Moderate area clean up

These guidelines apply for areas larger than a garbage bag folded in half, but smaller than a standard sheet of plywood.

- Follow the safety procedures listed in the previous chapter including occupant and worker protection, enclosing the affected area and ventilation.
- If possible, dispose of the moldy material as listed above.
- Remove affected carpets, underlay and furniture to be either cleaned or discarded.
- Decontaminate surfaces as listed above.

- Wash the surrounding area with a mild detergent solution.
- Power vacuum the ducts and furnace (more stringent measures may apply when the heating and ventilating system is directly affected by mold, see the section, *Whole House Clean-up*, later is this chapter). Do not use a biocide (a chemical claimed to kill molds) on the ducts.
- Ensure that all work areas are thoroughly dried before HEPA vacuuming as a final stage of remediation.

Any mold growing in the house can eventually lead to health effects. Conduct a thorough top-to-bottom "spring cleaning." Clean walls, ceilings and floors with a detergent solution. Use bleach on wood framing, as necessary, and TSP on concrete.

Large and extensive area clean-up

If the amount of mold in a single patch is larger than a standard piece of plywood and there are several patches in the house, stricter clean-up rules apply. This type of clean-up requires more knowledge and equipment and is best left to a trained specialist. Occupant and worker protection is much more stringent.

For any renovations

- If repair or renovation is in only one or two areas of the house, build an enclosure of framing and polyethylene sheeting or tarpaulins around the work areas. When the mold area is very large, use exhaust ventilation while working to prevent construction dust and debris from being scattered throughout the house.
- Store all debris in closed containers.
- Remove all demolition debris as soon as possible.
- Remove construction debris by the end of the job.
- Clean all surfaces that have been marked or soiled, and fix any damaged areas.
- Remove any enclosures and spot clean again.

Whole house "spring cleaning"

Because of the way air moves in a house, a mold problem in one area will result in mold spore contamination throughout the house. Even mold growing behind walls can get into the indoor air. Walls are never perfectly tight and airflows can carry mold spores out of the wall cavities. If conditions are right, the mold will start to grow in a new place. Cleaning the house thoroughly from top to bottom is recommended.

Vacuuming

It is best to use a vacuum equipped with a HEPA filter.

Heating and ventilating ducts

Heating, ventilating and air conditioning ducts in a mold-troubled house are certain to contain mold-contaminated dust. Both supply and return ducts should be dismantled, vacuumed and washed with a detergent solution. Air supply ducts from outdoors and exhaust ducts from the bathroom, kitchen range hood or vacuums, etc. should be accessed and cleaned.

Wet cleaning

All hard surfaces should be washed with a detergent solution, after vacuuming. Wipe dry, then rinse and wipe dry again.

Salvage or discard?

Any non-washable furnishings or possessions, such as sofas, cushions or mattresses, from moldy basements or obviously moldy main floor rooms must be discarded.

Any furnishings or possessions from other main floor rooms must be removed from the house during the house cleaning. They must either be discarded or cleaned before being returned to the house or taken to another house. Otherwise, they will be a source of mold spores.

To clean furnishings and clothes, follow the general guidelines.

Non-washable furnishings must be evaluated on a case-by-case basis for mold contamination. Moisture and mold can penetrate soft or upholstered furnishings. Any attempt to disinfect mold on the surface of such items is not likely to work, particularly if the furniture had been exposed over a long period of time to conditions favourable to mold. Furnishings subjected to very moist conditions for several weeks should be suspected of being sources of re-contamination and consequently discarded.

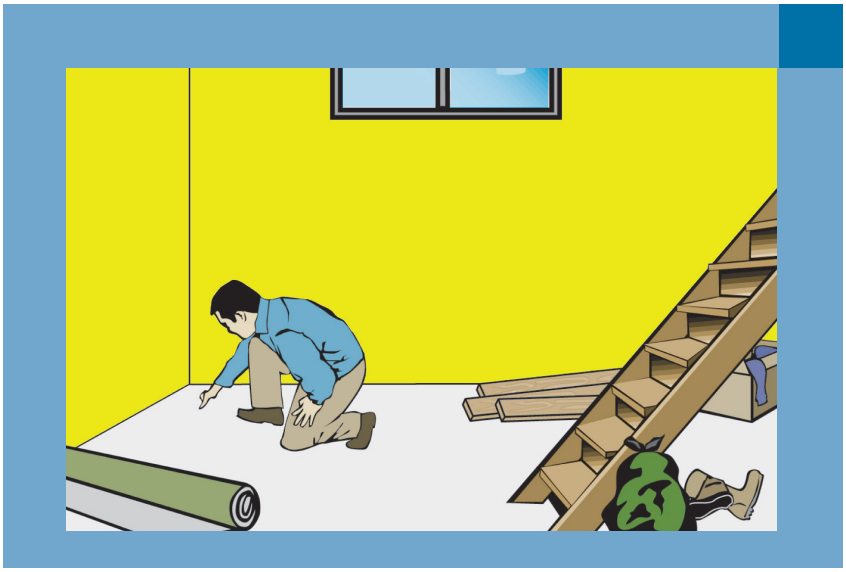
Monitoring houses for molds after clean-up

Target audience for the information in this chapter: First Nations housing departments, environmental health officers, community health nurse/ representative, technical service providers.

Key point:

- Monitoring is recommended to ensure all mold was removed and any new mold growth does not go unnoticed.

Once the clean-up has been completed, periodic visual inspections by a trained person are recommended to make sure any new mold growth does not go unnoticed. The occupant should also be advised to watch constantly for any sign of mold growth. The effectiveness of the renovation may also be monitored by testing the air and any surfaces that still appear marked or stained. Such testing is useful, especially if mold contamination was extensive or poisonous molds were identified. Decisions on testing will be made by the First Nation housing department together with



the environmental health officer and IAQ-trained technical service provider.

The community health nurse/ representative or environmental health officer will be responsible for the testing. These are the suggested steps:

- The indoor air may be tested one to three days after clean-up has been completed, in at least four places (two in the area of the visible mold and two elsewhere in the home). Testing should be done twice: once in the morning and once in the afternoon.
- The outdoor air upwind of the house should be tested once in the morning and once in the afternoon.
- Surfaces that are still marked or stained, or that have developed new markings, should be tested by surface scraping or swabs.
- Before the site is declared ready for re-occupancy, all test results must be within normal limits, for the time and place of test, as determined by a trained fieldsampling specialist. Examples of normal limits for mold contamination are the American Industrial Hygiene Association (AIHA) guidelines. As a rule, no species should be at significantly greater levels indoors than outdoors.

Before the occupants return

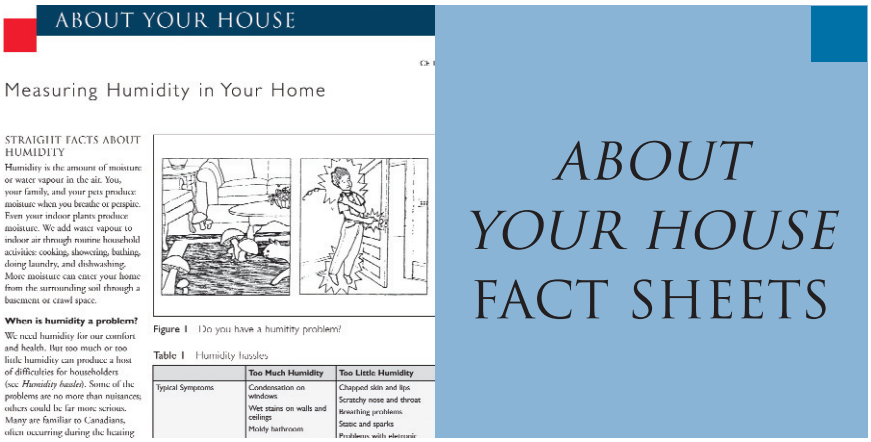
Target audience for the information in this chapter: First Nations housing departments, bands.

Key points:

- Construction damage or debris should be cleaned up.
- Confirm with the environmental health officer or community health nurse/ representative that the house is suitable for occupancy.
- The occupant should be shown how to use and maintain any new heating or ventilating equipment.
- Occupants must take steps to prevent mold growth.

A thorough clean-up is required after the mold clean-up and renovations have been completed. After the thorough clean-up, follow these steps:

- The house should be checked by the community health nurse/representative or environmental health officer to confirm that it is fit to be re-occupied.
- Any new heating or ventilating equipment, or other new features of the house should be explained to the occupants by the renovation contractor or another knowledgeable person. Printed instructions on maintenance of new, unfamiliar equipment, such as heat recovery ventilators, should be left with the occupants. Verbal instructions are likely to be forgotten.
- The occupants should be provided with a copy of *First Nations Home Occupants Guide to Mold* and urged to follow the preventive measures. They should be encouraged to recognize and clean up small mold problems.
- It is important to help occupants understand their responsibilities and know when and whom to call for help regarding any mold, maintenance or mechanical system questions.



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 Damns	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
The Tenant's Guide to Mold	Order No. 63902
Should You Test the Air in Your Home for Mold?	Order No. 63911
Fighting Asthma in Your House	Order No. 63349
Combustion Gases in Your Home—Things You Should Know About Combustion Spillage	Order No. 62028
Carbon Monoxide	Order No. 62046
How to Reduce Chemical Contaminants in Your Home	Order No. 64066
Lead in Older Homes	Order No. 64064
Buying a Toilet	Order No. 62935
Setback Thermostats	Order No. 65329
Home Maintenance Schedule	Order No. 63218
Hiring a Contractor	Order No. 62277