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Canada Mortgage and Housing Corporation
Société canadienne d'hypothèques et de logement

Condensation in the Home: Where, Why, and What to Do About It

Canada

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CMHC
Canada's Housing Agency

Condensation in the Home: Where, Why, and What to Do About It

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AIR MOISTURE IN THE HOME

Stained ceilings, water streaming from windows and mould on walls — the villain is a common one — excessive water vapour in the air. Cracking furniture, static electricity build-up and dry, scratchy throats are symptoms of the reciprocal problem, that is, too little water vapour in the air.

Both these problems can be corrected, although it is more difficult to control excessive humidity (the term used to indicate the amount of water vapour in the air), than it is to add moisture to the air.

A few basic principles will serve to simplify a complex problem and make you a condensation troubleshooter.

What is Condensation?

Condensation problems arise because air can hold only a limited amount of water vapour, an amount that varies with temperature, cold air being able to hold less water than warm air.

When air at a given temperature contains all the water vapour it can hold, it is said to have a relative humidity of 100 per cent. If it contains only half the water vapour it can hold at that temperature, then the relative humidity is 50 per cent. If the temperature changes, but no water vapour is added or removed, then the relative humidity will also change and will increase as the temperature falls. The relative humidity will continue to rise with the falling temperature until the dew point is reached, that is, the temperature at which the relative humidity becomes 100 per cent (dew point temperature). Any further decrease in temperature will force some of the vapour to condense as water (Figure 1), (when the temperature is above freezing), or as frost (when the temperature is

Figure 1. Condensation.

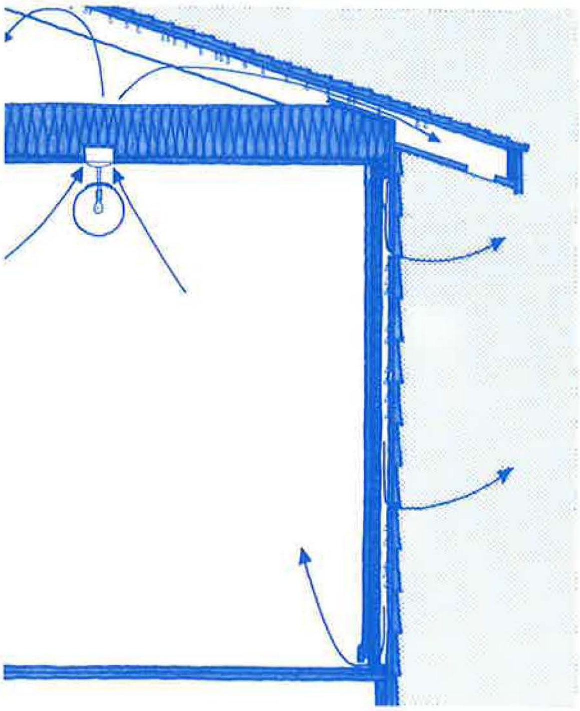

Figure 2. Structural causes of excessive condensation.

below freezing). Air cooled by contact with cold surfaces such as windows will therefore deposit some of its water vapour on the glass or the metal sash whenever it has more water vapour than it can hold at its new temperature. This surface condensation is an indication of excessive water vapour in the air.

Basically there are two types of problems resulting from the moisture in the air; those from interior **surface** condensation on the building components, such as walls, windows, ceilings or floors, and those from **concealed** condensation within the building assembly, such as exterior wall cavities and attics. The major factors contributing to the amount of moisture in the two problem areas, **surface** or **concealed** are different. Interior **surface** condensation is caused by high humidity in the building and can occur even if it is well built. **Concealed** condensation on the other hand is caused mainly by the movement of moist air into the building envelope. Water vapour is also able to diffuse through the materials which make up the building envelope, but this is generally not as important as air leakage.

Surface Condensation

Where surface condensation is evident it should be considered as a warning sign. However, each person has his or her own level of personal comfort and the amount of condensation they are willing to accept to maintain that level. If the occupants insist on a high level of humidity within the house, surface condensation must be expected when outside temperatures are low. Some indications of **surface condensation** are illustrated in Figure 4.

First Floor

1 Frost on door handles and hinges.
2 Water or ice on windows.
3 Damp spots or mildew on walls and ceiling.
4 Damp spots or mildew on closet walls.
5 Moisture on light fixtures.
6 Moisture on water closets.

Basement

7 Moisture on cold water pipes, walls and floors.

If you have too much surface condensation, the problem can usually be rectified by following the simple corrective action listed in this booklet.

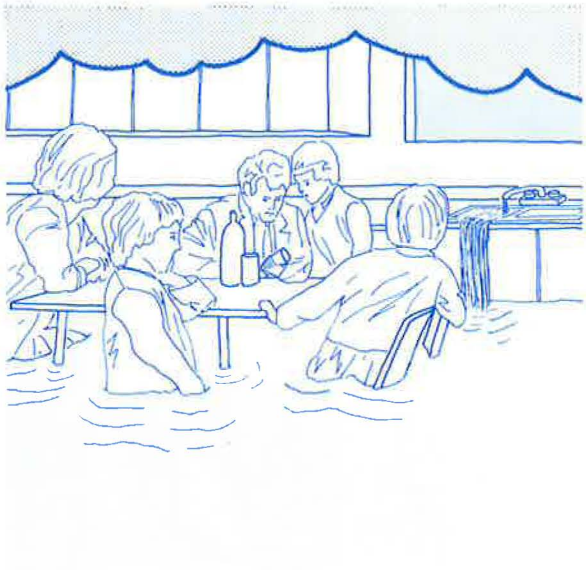

Figure 3. Set your own comfort level.

Figure 4. Surface condensation.

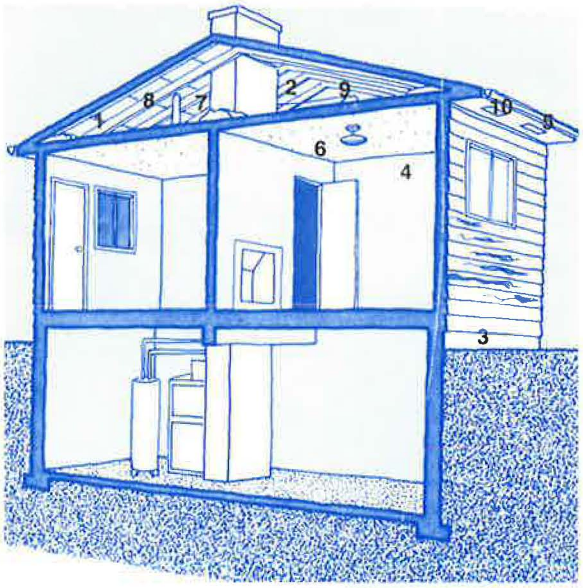

Figure 5. Concealed condensation.

Concealed Condensation

Concealed condensation problems, when identified, usually require remedial action, since serious damage can result to the structure. Some indications of concealed condensation resulting from excessive air leakage from inside the structure are:

1 Apparent leaky roof.
2 Moisture or mildew staining of roof sheathing as observed from attic.
3 Paint peeling.
4 Damp spots on walls and ceilings.
5 Water or ice forming near soffit vents.
6 Damp spots around light fixtures or water collecting in light fixtures.

The following conditions occur in most attics at some time during the winter, but if excessive, they would require further investigation:

7 Frost on underside of roof sheathing, over interior partitions, and where services penetrate the ceiling membrane.
8 Frost or water on soil, vent or waste-pipes.
9 Frost or water on nails penetrating roof sheathing.
10 Frost on cold surfaces over soffit.

One difficulty in identifying the source of these problems is that some of them may be caused by a leaky roof or water penetrating the wall cladding.

A key factor in the amount of air leakage is the tightness of the exterior building envelope. A **vapour barrier** is used to reduce moisture entering the wall or ceiling by diffusion. If it has a minimum of unsealed joints, holes or other openings it may also act as a barrier against air movement from within the house into the wall or ceiling cavity and is therefore an **air barrier**. In most instances the amount of moisture entering the wall cavity by air leakage is far greater and more damaging than that from vapour diffusion.

TO THE HOUSEHOLDER

Sources of Moisture

The principal sources of moisture in the home are household activities. These vary with the living habits of the family. Some idea of the quantities of moisture released by these activities in a family of four is given in Table 1.

Approximately 7 to 9 kg of moisture per day may be introduced into a small house under normal living conditions This can rise to as much as 18 to 23 kg per day on wash days, so that the weekly total can amount to almost 64 kg. Heavy use of the moisture-producing utilities will increase this amount considerably.

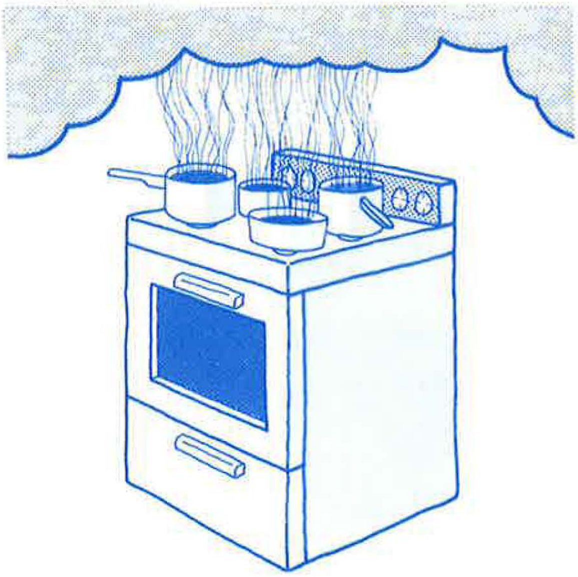

Figure 7. Cooking three meals a day releases 0.90 kg of moisture.

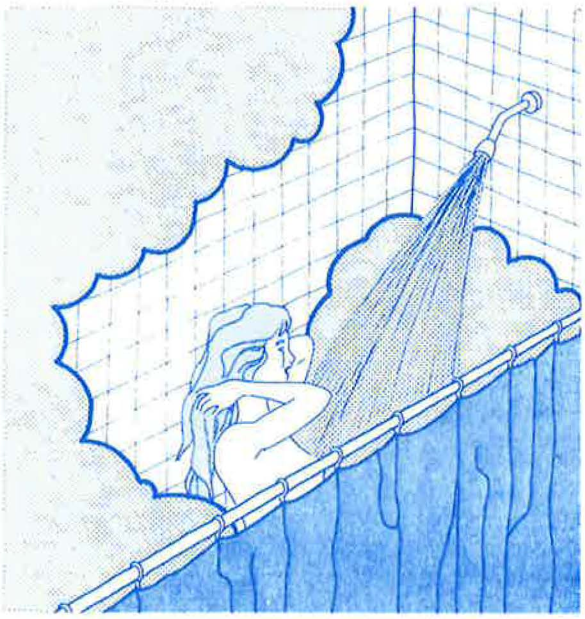

Figure 6. Showering releases 0.45 kg of humidity into the atmosphere.

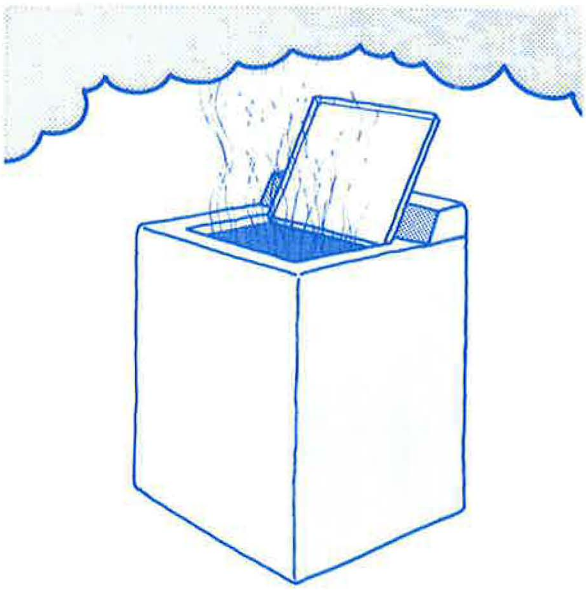

Figure 8. Moisture given off by a washing machine can amount to 1.81 kg per week.

Table 1

Moisture Produced by Various Household Activities for a Family of Four	
	Moisture Produced
Activity	**Kilograms**
Cooking (3 meals per day)	0.90
Dishwashing (3 meals per day)	0.45
Bathing — Shower	0.45
Bathing — Tub	0.45
Clothes washing (per week)	1.81
Clothes drying indoors or with unvented dryer (per week)	11.80
Floor mopping (per 10 m^2)	1.36
Occupants (family of 4 per day)	5.45

This table shows how the living habits of a family of four may produce up to 23 kilograms of moisture per day. As liquid water this would be 23 litres. If a container holding 23 litres were suddenly spilt on the floor there would be a lot of mopping up to do. Yet this much moisture can be added to a household atmosphere almost daily without the occupants being aware of it — simply because it cannot be seen.

In addition to the activities shown in Table 1, much more moisture will be generated if there are pets, plants, aquariums, self-defrosting refrigerators or freezers in the residence.

What we are talking about is **excessive** condensation, that is, condensation that covers windows with moisture or frost, or water that runs off to stain woodwork and walls. If this kind of condensation exists, then corrective action is necessary. A balance between desired comfort and surface condensation must be reached. Recommended steps are offered in this booklet to reduce surface condensation to an acceptable level.

The first step in solving condensation problems in your home is a willingness to reduce humidity.

The Great Humidity Myth

Some humidity is necessary for comfort and health. With many houses it is a struggle to keep enough moisture inside the house and maintain an acceptable comfort level for the occupants. Frequently humidifiers are installed to add moisture to the air but their use must be controlled or surface condensation problems may result. Unfortunately a dry house may indicate a high leakage rate, (depending on the amount of moisture added by the householder) and, this in turn, contributes to concealed condensation.

In some of the newer homes, however, air leakage has been controlled to such an extent that the problem really is how to get rid of moisture. Yet many householders go on adding moisture to the air. They aren't discouraged by the danger signs of condensation on windows, mould growth, or the damp spots on ceilings and room-side surfaces of exterior walls.

Because windows do not provide much resistance to heat loss, they are often the coldest component of a building enclosure, and can be an indicator of humidity problems. As condensation occurs on inside window surfaces whenever surface temperature falls below the dew point temperature of the room air, it may be a warning signal to reduce the humidity in your residence.

Table 2

Inside Relative Humidity for 21°C with Double Glazing

Outside Air Temp.	Indoor Relative Humidity Less Than
°C	%
15	85
10	70
5	60
0	55
-5	45
-10	40
-15	35
-20	30
-25	25
-30	20
-35	15
-40	5

If the moisture can be reduced to the humidity shown above, it may help cure troublesome surface condensation problems. Five per cent lower readings are needed in rooms with poor air circulation.

PRACTICAL STEPS TO CONTROL SURFACE CONDENSATION

Here are the steps you should take to **reduce surface condensation** in your home.

1 If the furnace is equipped with a humidifier or if you operate a separate humidifier, turn it off until the amount of condensation is reduced.

2 Crawl spaces under the home should have the floor covered with a watertight membrane.

3 Use the kitchen exhaust fan while cooking pots are emitting steam (Figure 9).

4 Make certain the clothes dryer is vented to the exterior and not into your home, the basement or crawl space. Avoid hanging wet clothes inside the house; they contribute a substantial amount of moisture to the air (Figure 10).

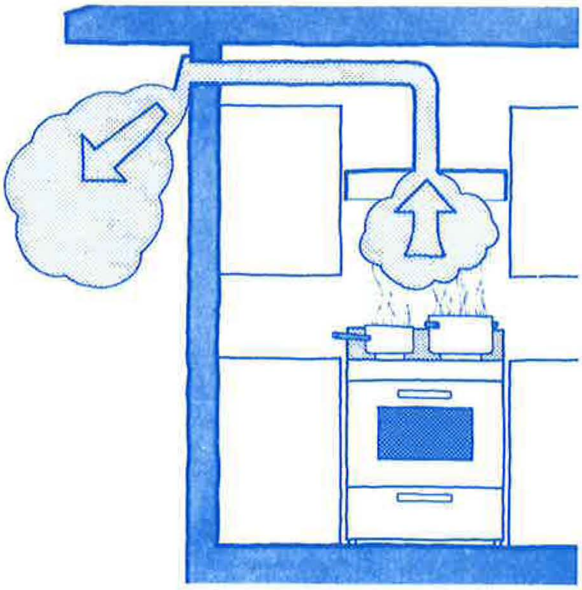

Figure 9. Kitchen exhaust fan.

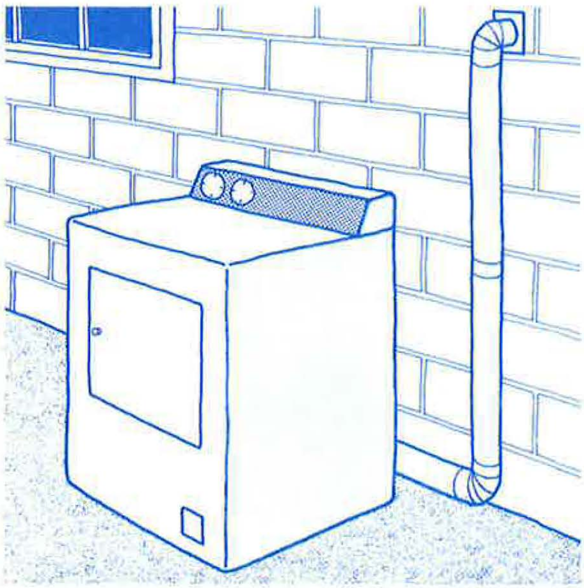

Figure 10. Clothes dryer vent.

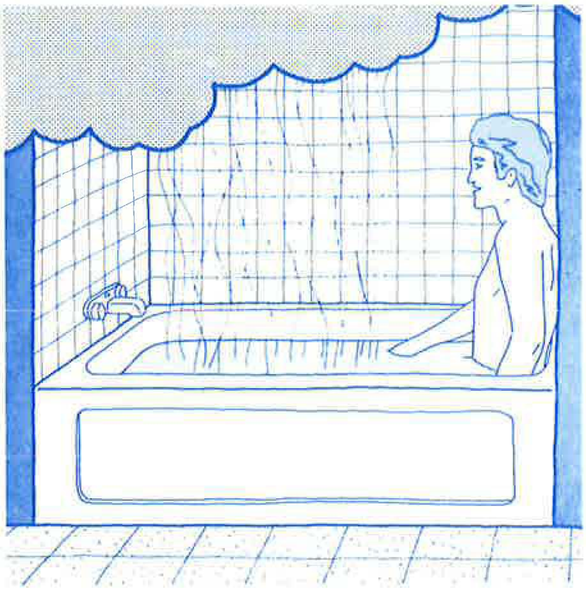

Figure 11. A bathroom exhaust fan can help reduce condensation in the house.

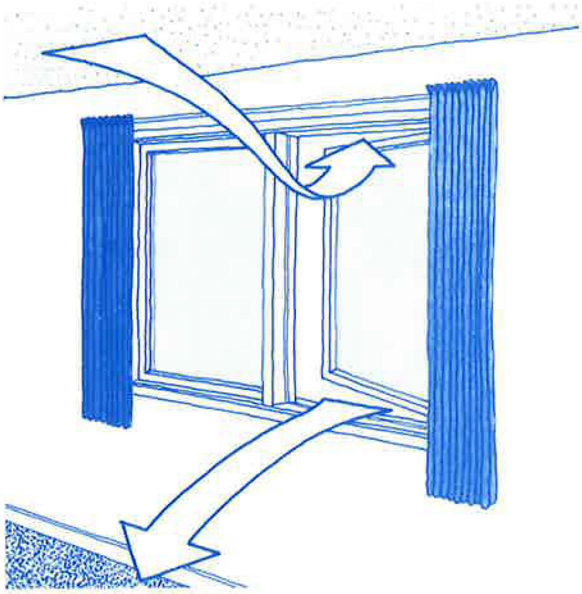

Figure 12. Opening a window helps reduce localized condensation.

5 The bathroom can be a troublesome area (Figure 11). If the bathroom door is closed during and after the use of a bath or shower, the excess humidity can be dispersed by:

(a) using a bathroom exhaust fan to the exterior.

(b) using the furnace circulating fan if there is a return air register in the bathroom.

(c) opening the bathroom window until the room is cleared.

If these suggestions are not effective, the bathroom door should be left open after completion of the bath or shower, and the circulating fan on the furnace run continuously until the excess humidity is reduced.

6 Leave radiator pans empty until humidity decreases.

7 Install storm windows and storm doors.

8 The free circulation of air is important. Leave drapes open as much as possible so the air can circulate freely over the windows or put on your furnace circulating fan.

9 If necessary you can open your window to reduce localized condensation (Figure 12).

10 Do not leave basement windows open during hot humid weather.

11 Caulk the perimeter of door and window frames to reduce local air infiltration which cools the surfaces and contributes to condensation.

PRACTICAL STEPS TO REDUCE CONCEALED CONDENSATION

1 Ensure that vents in the attic and unheated crawl spaces are open and free from obstruction. In cold regions it may be necessary to have crawl space vents that can be closed during the winter (Figure 13).

2 Seal all holes in the air barrier, i.e. attic hatches, over interior partitions, and around chimneys, plumbing stacks, and electrical wiring.

3 Increase the attic ventilation.

4 **Consult with local specialists.**

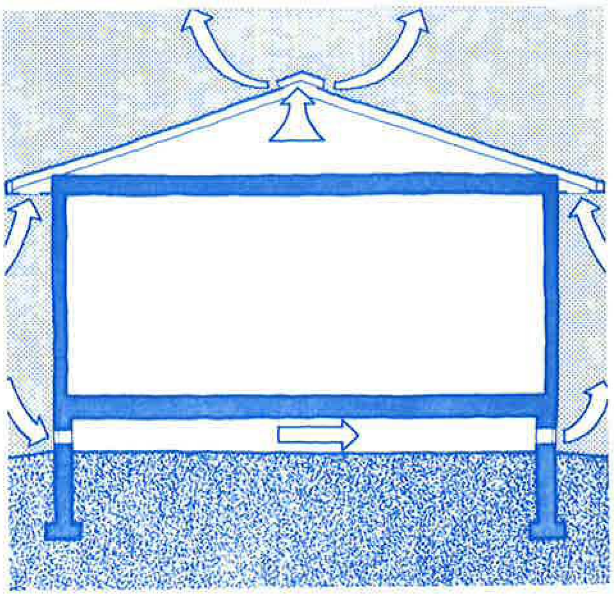

Figure 13. Attic and crawl space ventilation.

TO THE BUILDER

For New Construction

Buildings constructed under the National Housing Act must be provided with sufficient thermal insulation **to prevent moisture from condensing** on the interior surfaces of walls, ceilings, and floors during the winter and to ensure comfortable conditions for the occupants. The minimum resistance values of insulation required are available from any CMHC office.

Air leakage in buildings can occur at sills, headers and the area between the rough openings cut to accommodate doors and windows, around plumbing stacks and openings for electrical outlets. It also occurs at partition tops (where the vapour barrier does not extend over them), through windows, doors, chimneys, fireplaces and other miscellaneous openings.

Various materials can be used for vapour barriers but these must comply with the appropriate standards. Fortunately, older houses, which do not have one of the recognized types of material used as a vapour barrier, are not unduly affected by vapour diffusion because plaster or gypsum board ceiling and wall finishes still provide a reasonable resistance to vapour diffusion if they are covered with a good coating of oil-based paint. The critical factor in existing houses, as well as new ones, is moisture from **air leakage.**

Vapour barrier material, acceptable to CMHC and supplied in rolls, is identified along the full length of the roll with the manufacturer's name or logo and a CMHC Evaluation Report Number (Figure 15).

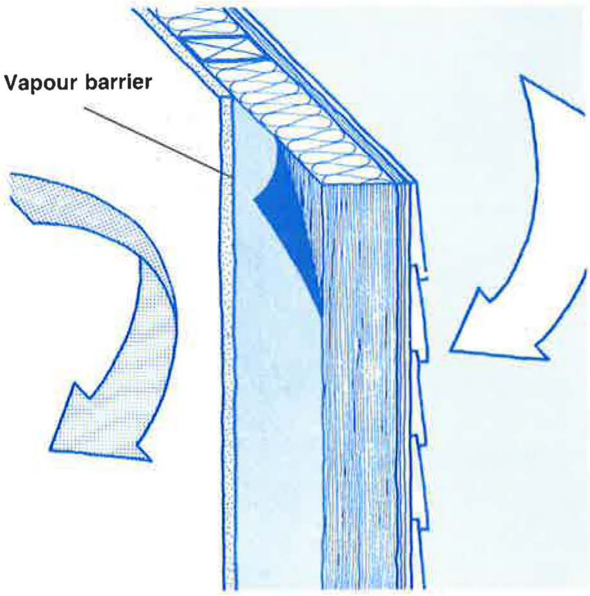

Figure 14. An effective vapour barrier must always be installed on the warm side of the insulation.

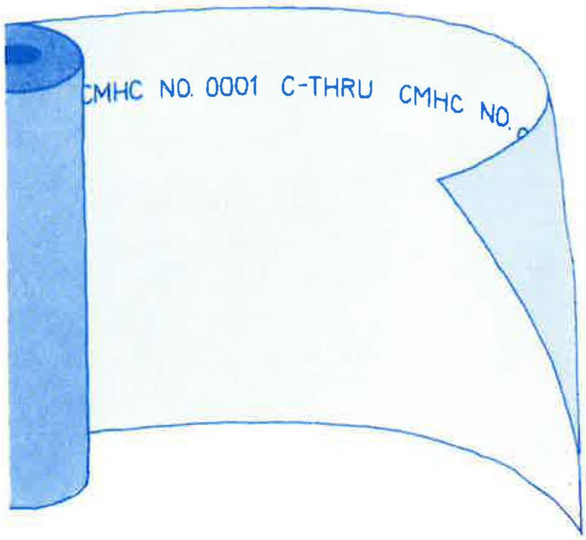

Figure 15. Use only acceptable vapour barrier.

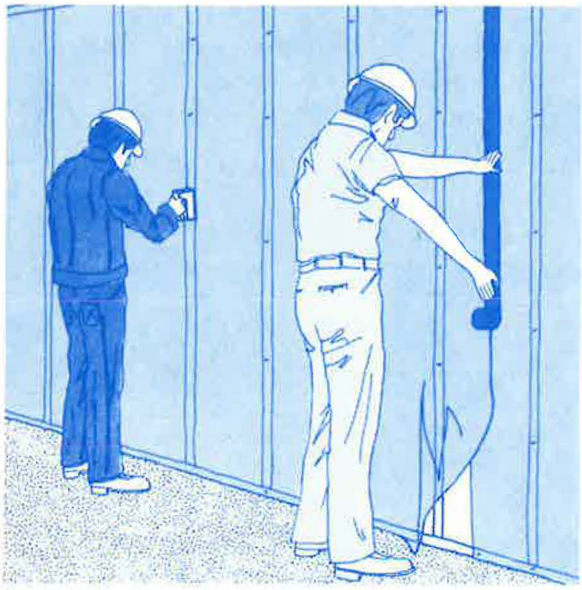

Figure 16. Good workmanship is essential.

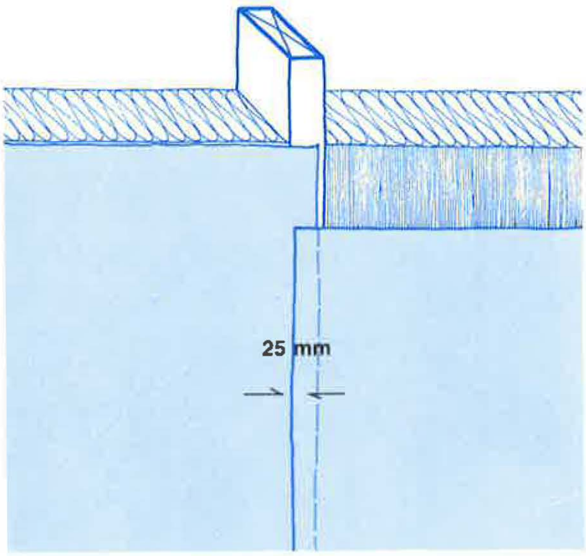

Figure 17. Lap a minimum of 25 mm.

The effectiveness of an air barrier depends almost entirely on how carefully it is installed. Materials such as foil, duplex paper, wax-coated paper, or polyethylene must be applied free of holes and with tight joints to ensure the continuity of the air barrier. **Where openings in the barrier are necessary, special care should be taken to seal the barrier to prevent air leakage.**

To ensure a good air seal, all joints in the air barrier (or the vapour barrier if this is also serving as the air barrier), should be lapped a minimum of 25 mm when located over a supporting member, or a minimum of 100 mm on both sides of the joint when not located over a supporting member, and sealed with tape or caulking (Figures 16 and 17).

For ease of installation as well as efficiency, many builders lap the barrier over two studs (one framing space) and this practice is recommended.

The barrier must be carefully installed so that it extends fully over the entire surface area and fits closely around electrical boxes, door and window frames, plumbing vent stacks and other openings in the walls or ceilings. Again, tape or caulking may be used to ensure a good seal in these areas.

Where an interior frame wall meets an exterior wall, the barrier should be between the two walls so as to form a continuous coverage of the exterior wall at the wall intersection (Figure 20).

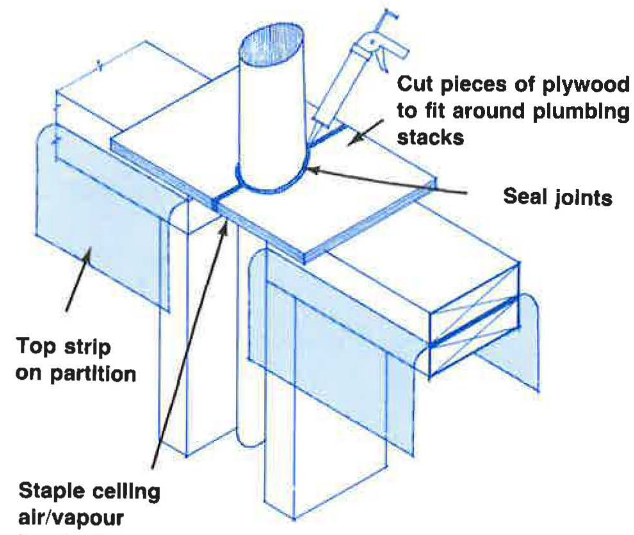

Figure 18. Care should be taken with these problem areas.

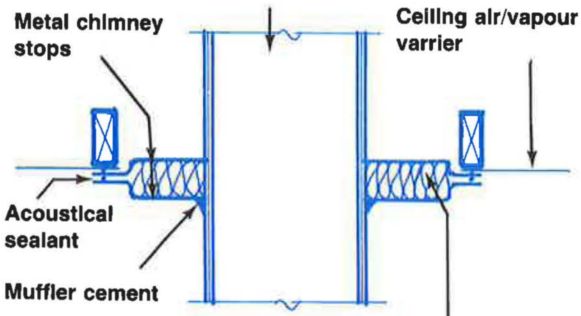

Figure 19. Sealing and insulating around a metal chimney.

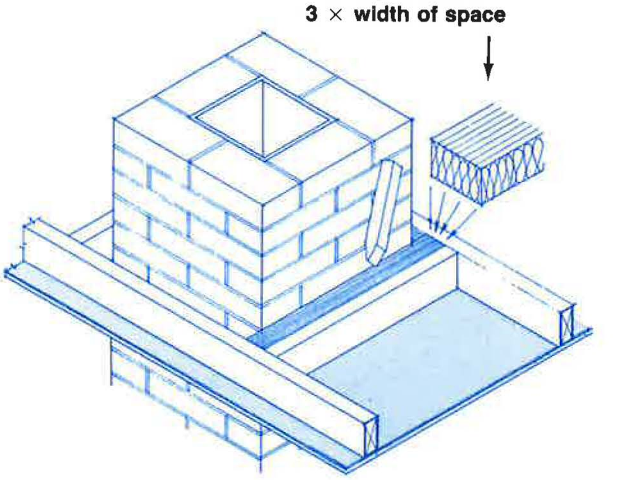

Figure 18 A. Maintaining continuity of the ceiling/air vapour barrier.

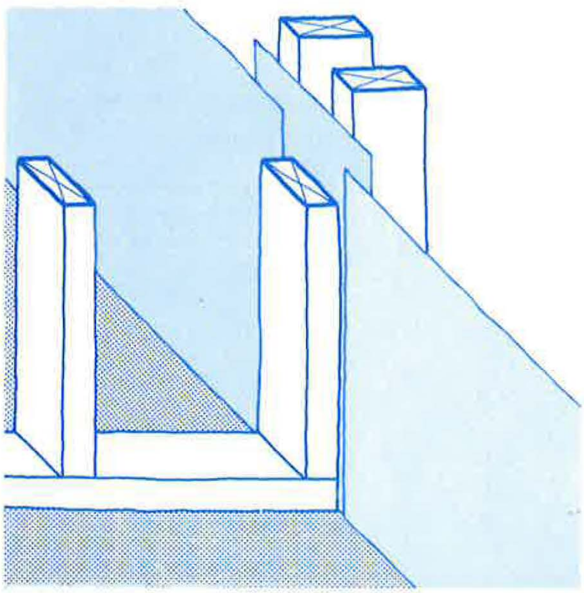

Figure 20. Ensure a continuous air/vapour barrier on exterior walls.

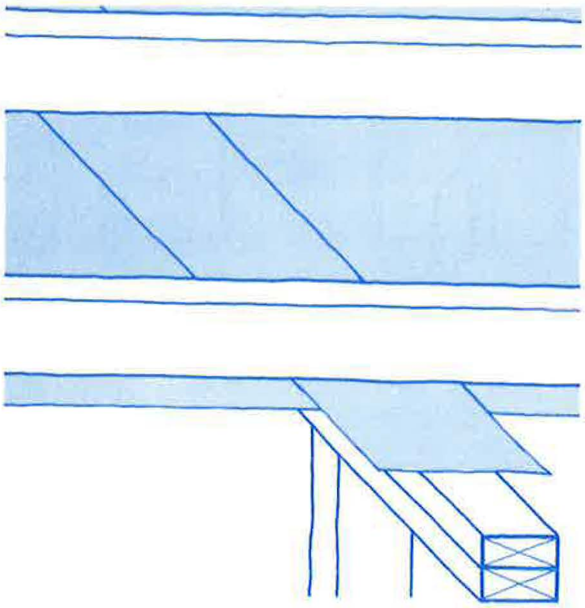

Figure 21. Continuity of an air barrier is essential to prevent air from leaking into the attic.

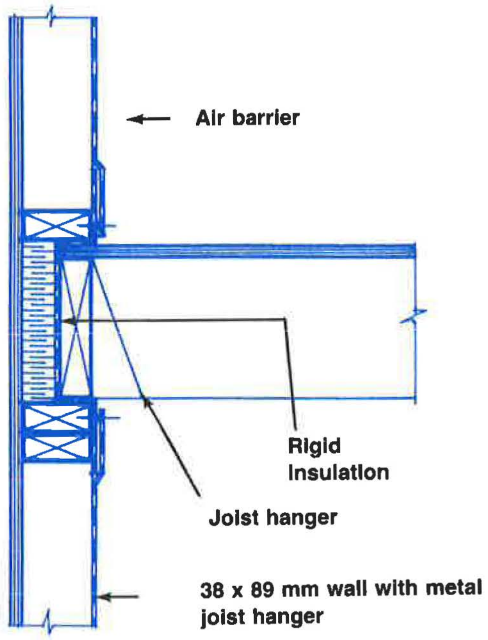

Figure 22B.

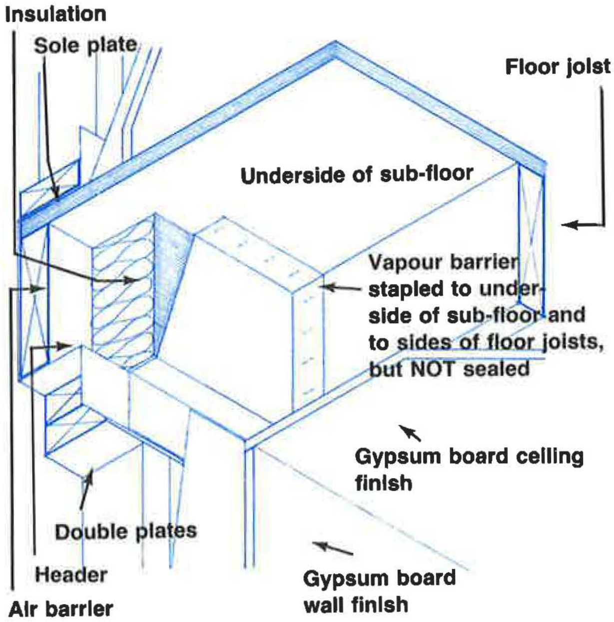

Figure 22A. Sealing around header joists — the continuity of the air barrier is maintained on the exterior side of perimeter joist.

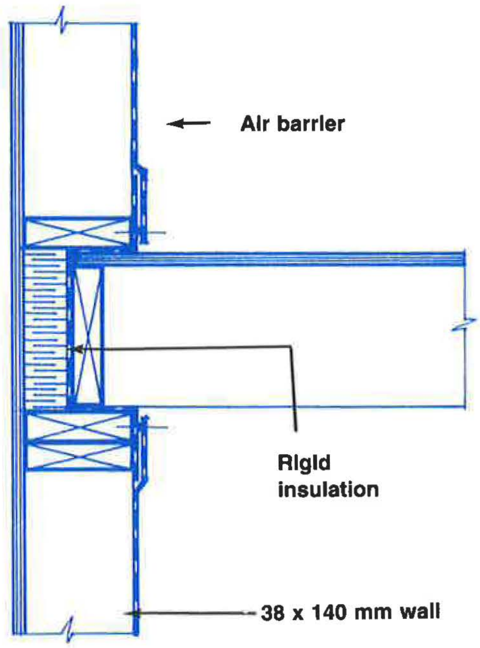

Figure 22C.

Where an interior frame wall meets a ceiling that is required to have vapour barrier protection, the barrier should extend over the top of the wall and so form a continuous coverage for the ceiling (Figure 21).

One method presently under trial in experimental housing is to seal around the header and floor joists, as shown in the illustration (Figure 22A). When using this system the insulation must be carefully installed at header and floor joist locations. Kraft/asphalt-backed insulation batts are ideal for this location, but friction-fit batts or rigid cellular insulation covered by a properly installed vapour barrier may also be used. The vapour barrier should be fitted tightly at the top and sides, but not sealed. The bottom should fit snugly but in a manner that would allow any winter condensate which might build up, to drain or dry up during the summer season.

A method for maintaining the air barrier while using rigid insulation on the exterior is illustrated in Figures 22B and 22C.

Because of their design, some electrical outlet boxes are difficult to make airtight. However, plastic electrical boxes (Figure 24) and plastic covers for metal electrical boxes, which can be made airtight, are available. These illustrations indicate generally acceptable procedures, but they should be checked with local hydro officials.

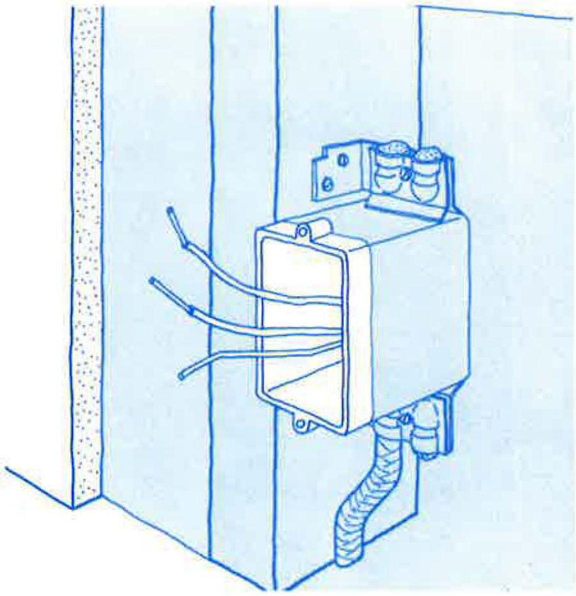

Figure 23. A metal electrical outlet box.

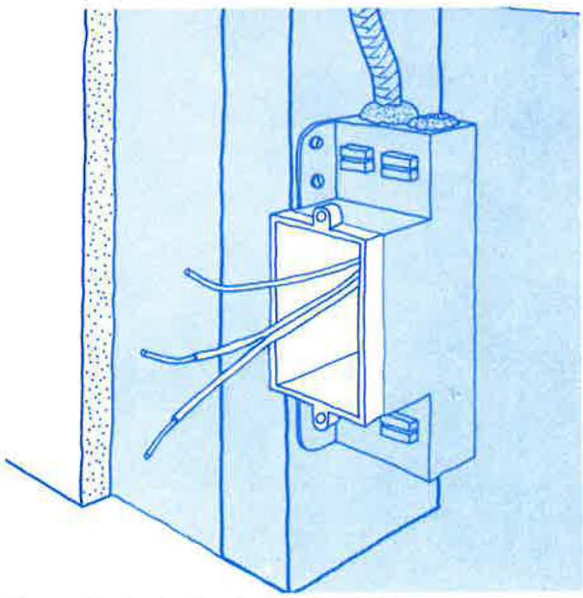

Figure 24. A plastic electrical outlet box.

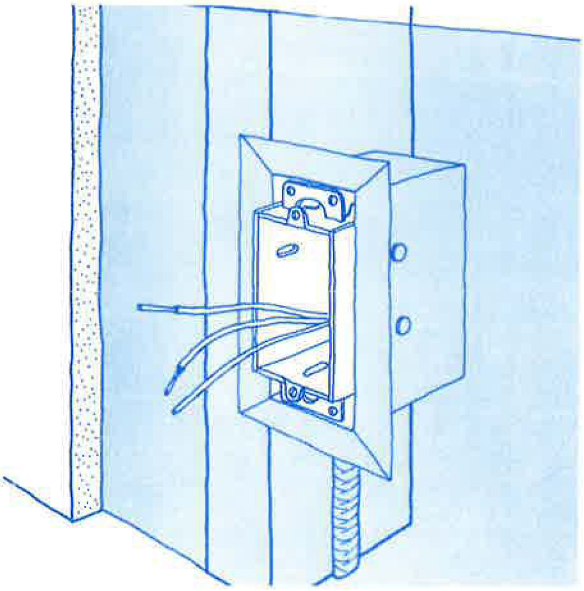

Figure 25. Use of a plastic box cover on a wall.

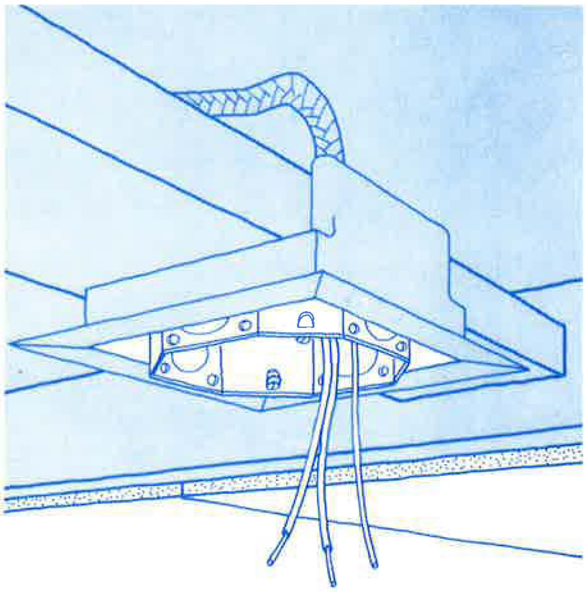

Figure 26. Use of a plastic box cover on a ceiling.

An inexpensive and acceptable way of sealing electrical outlet boxes is by enclosing them in precut pieces of polyethylene film.

The polyethylene film should be cut so that when in its final position (Figure 27E) it extends a minimum of 102 mm over the main sheet of polyethylene covering the wall. This will ensure a sufficient area for effective sealing with tape.

After positioning the outlet box on the wall (Figure 27B), the electrical wires should be secured in position and turned inward to avoid damage to the polyethylene. The latter should be carefully tucked into the outlet box awaiting the installation of the polyethylene on the wall (Figure 27C).

The main polyethylene sheet is installed so that it covers the outlet box (Figure 27D). At this time a cutout for the face of the box must be made. This should be carefully done with sharp scissors or a razor-type knife so that the hole will not be larger than required, and no damage done to the polyethylene film tucked into the box.

The last step is to release the tucked-in polyethylene from the box, spread it out over the surface of the main polyethylene sheet and then tape it together (Figure 27E).

The finished product should look like Figure 28. It should provide an excellent air/vapour barrier and satisfy the inspection authorities.

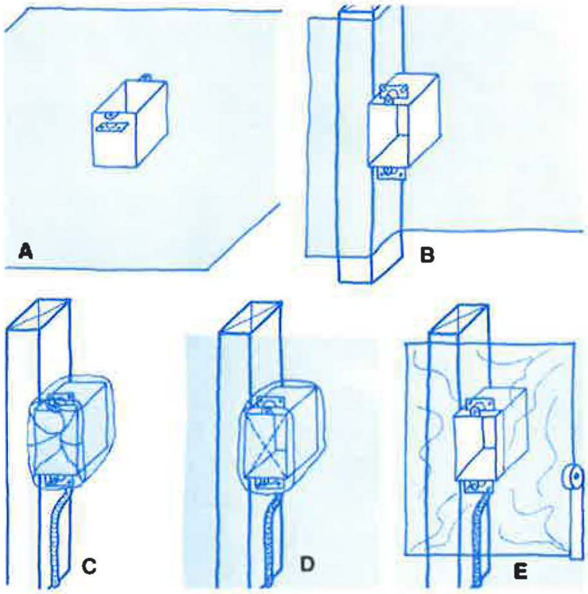

Figure 27. Installation sequence of polyethylene around an electrical outlet box.

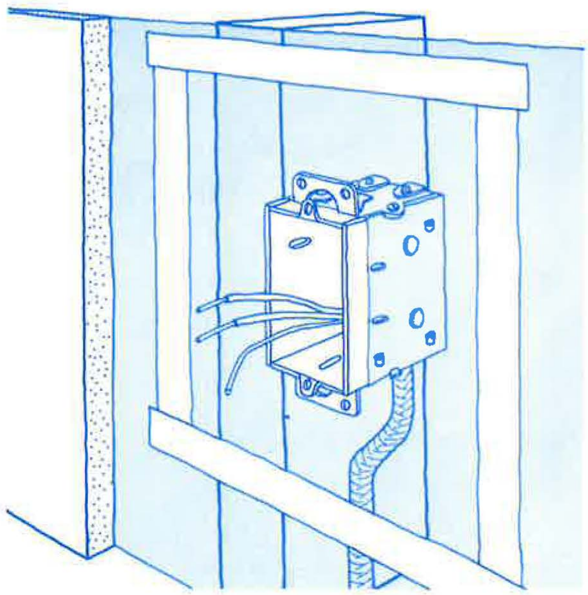

Figure 28. Completed installation of the air/vapour barrier around an electrical outlet box.

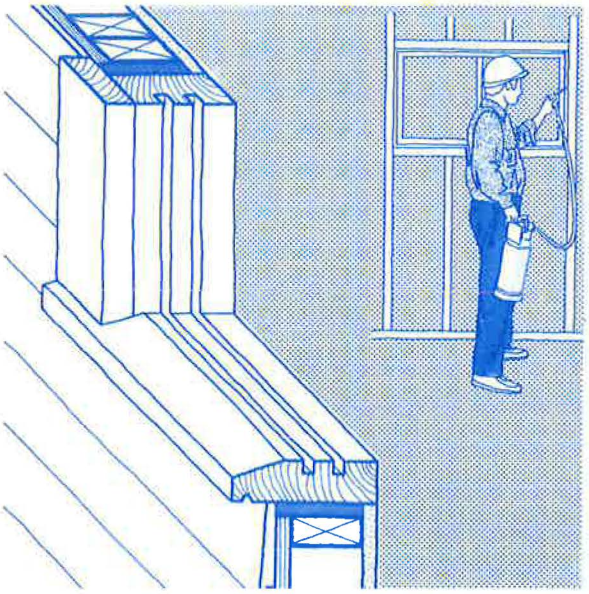

Figure 29. Prevent air leakage around window and door frames.

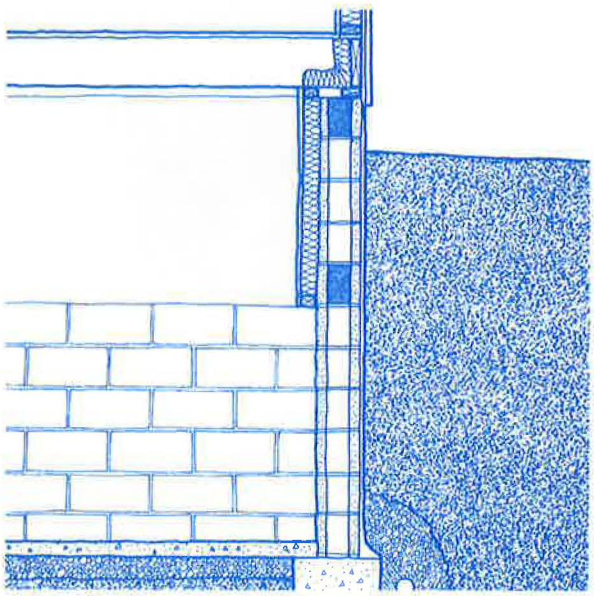

Figure 30. Blocked cores prevent air circulation in hollow unit masonry walls — see also Figure 31.

A recommended method of stopping air infiltration is the use of an expanding foam around sills and headers as well as between the rough openings of door and window frames and vertical wall corners. (Figure 29). As these spaces are usually narrow and difficult to insulate, the use of foam insulates and provides an air and vapour barrier between the components. Other insulation types are acceptable in this situation, but in all cases the sheet vapour barrier should be continued over the frame and fastened to it to also serve as an air barrier.

Hollow unit masonry walls should have their cores blocked at the top and bottom of the insulation to prevent air circulation within the block cores (Figures 30 and 32).

The joints between the sill plate and the top of the foundation should be sealed with a sealant or a gasket. Foam plastic gaskets are now available for this purpose. An alternative is to use an uncompressed strip of mineral wool at least 25 mm thick as illustrated in Figure 31.

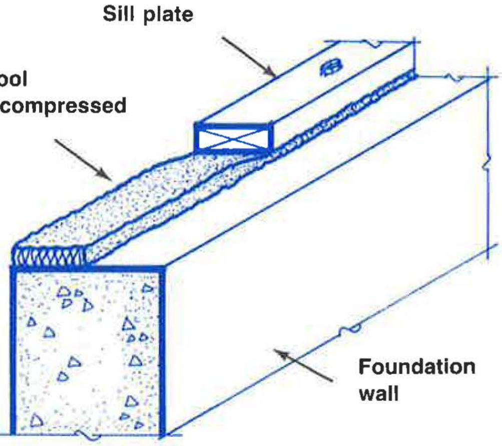

Figure 31. Sealing beneath the sill plate.

REMEMBER that in almost all cases the air and vapour barrier must be installed on the warm side of the insulating material and should be inspected for omissions or holes immediately before the interior cladding is installed (Figure 33). An inspection at this stage of construction will reduce the number of complaints and callbacks.

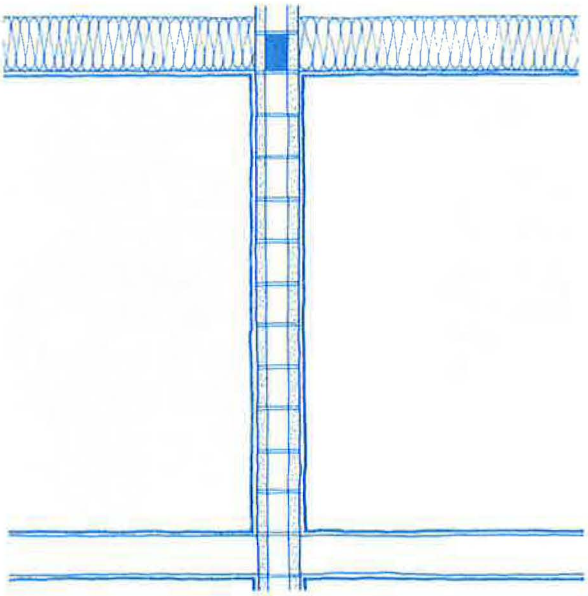

Figure 32. Prevent air circulation in hollow unit masonry walls.

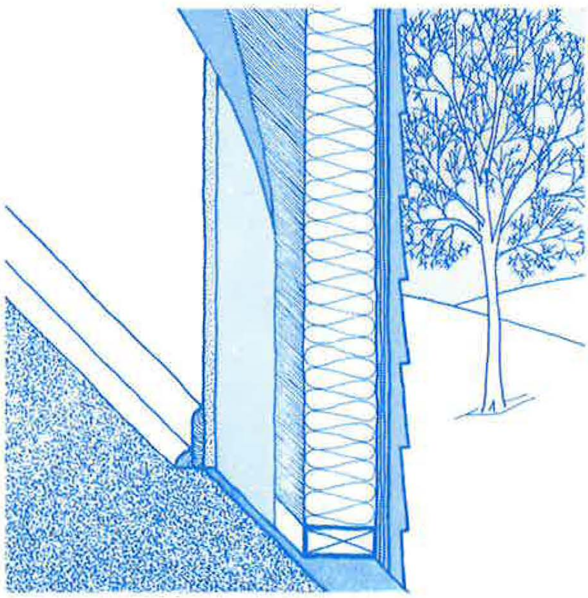

Figure 33. Location of the air and vapour barrier.

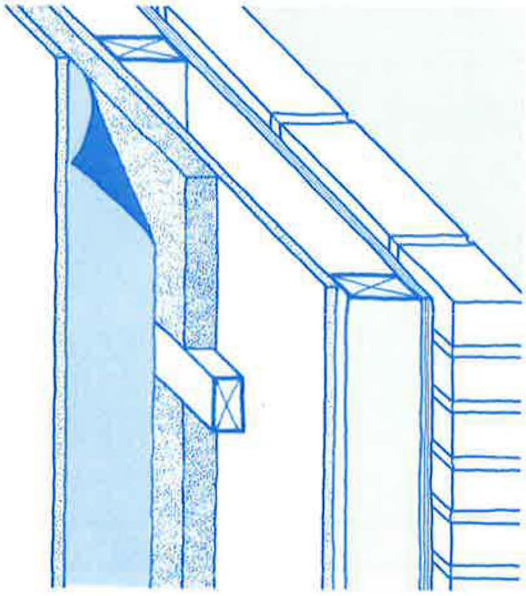

Figure 34. Adding insulation and a sheet vapour barrier to the inside of an existing house.

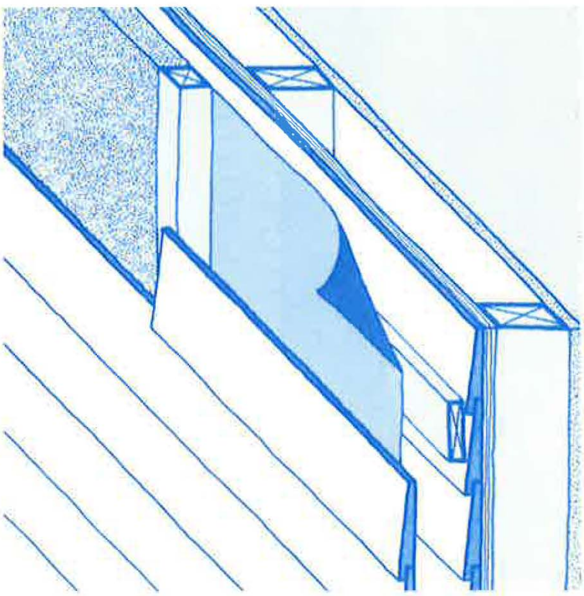

Figure 35. Adding insulation and a sheet air barrier to the outside (consult specialist).

For Existing Construction

It is difficult and expensive to add sheet vapour barriers to the walls of an existing house without major renovations to the interior or exterior (Figures 34 and 35). However, other alternatives are available. For example, to reduce vapour diffusion, the walls and ceilings can be covered with at least two coats of good quality oil-based paint after all holes and cracks in the plaster have been repaired. Since vapour diffusion is usually less of a problem than the potential moisture accumulation from air leakage, an effort should be made to plug the holes in the walls and ceilings to make the house as airtight as possible from the inside (Figure 36). Care must be taken to ensure there are no openings at intersecting walls or at the junction of the floor and wall as these areas are frequently overlooked.

Paint peeling on the exterior walls of older houses may result from moisture accumulation in the wood. Such moisture, trying to escape from the interior, penetrates the walls until it reaches the underside of the exterior paint. The moisture is driven through the wall assembly by the difference in vapour pressure between the inside and the outside of the house. Since paint restricts the movement of moisture, it accumulates behind the paint causing it to blister and peel off (Figure 37).

Paint may also peel as a result of wood expansion and contraction unrelated to moisture penetration or exposure to the weather. If remedial work to reduce moisture entry into the wall cavity from within does not solve the problem, you should look for other causes such as poor paint, faulty application of paint or moisture from exterior sources.

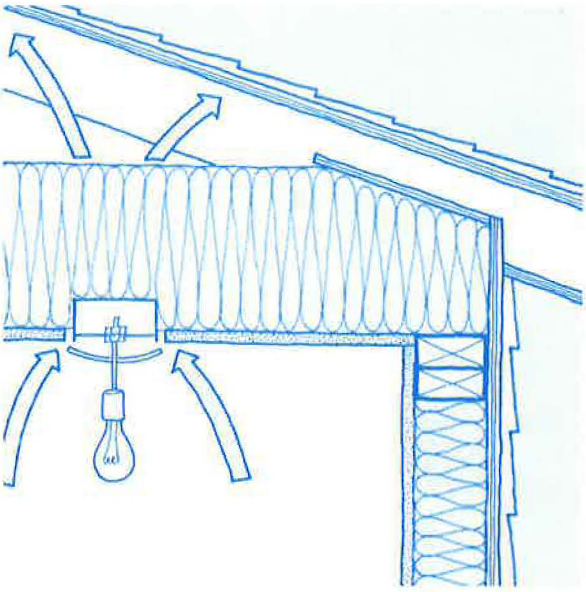

Figure 36. Seal all openings to reduce air leakage.

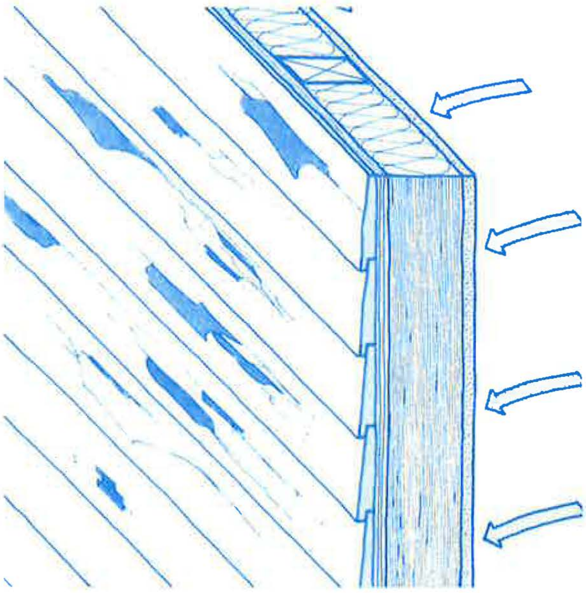

Figure 37. "Warning signals".

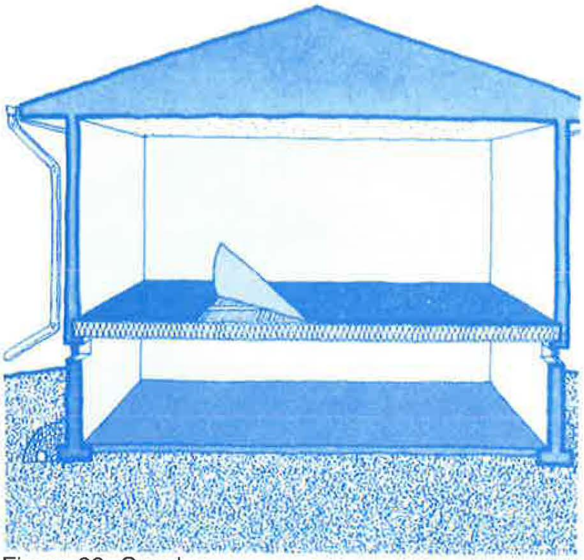
Figure 38. Crawl space.

Basementless Buildings

To avoid condensation problems in basementless units built over a crawl space, the area must be kept dry. This can be achieved, in part, by ensuring that the lot is graded correctly for the water runoff to be away from the building, and by the use of gutters and downspouts to eliminate rain seepage. Where the level of the crawl space floor is below the exterior grade, foundation drainage tile at the footing level is required.

In addition, a ground cover consisting of not less than 50 mm of asphalt or 10 MPa portland cement concrete, or 2.2 kg/m^2 roll roofing or 0.10 mm polyethylene should be installed. Joints in sheet-type ground cover must be lapped not less than 100 mm and weighted down with stone or some other acceptable material. It is strongly recommended that measures be taken, such as the above, to restrict moisture from the ground below a crawl space, which can cause excessively high humidity levels in the building.

Ventilation of crawl spaces is also essential. This may be achieved naturally by outside air through not less than 0.1 m^2 of unobstructed vent areas for each 50 m^2 of floor area. The vents should be evenly distributed on opposite sides of the building for cross ventilation. Vents should be designed to prevent the entry of snow, rain and insects, and be capable of being closed. It is important that the vents be open in the summer for drying and closed for the heating season. Ventilation may also be by mechanical means but it is recommended such a system be designed and installed by knowledgeable persons.

Ventilation as a Solution

Roof Space Ventilation

Condensation results from the flow of warm, moist, indoor air through openings in the ceiling assembly, (i.e. holes in the air vapour barrier, interior partitions, and around plumbing and wiring penetrations), into the enclosed roof space. However, ventilation of the roof spaces helps to remove the moisture, although, if the air barrier contains holes allowing a substantial amount of air leakage to occur, the ventilation will be ineffective. In addition, the colder the temperature, the less effective will be the attic ventilation.

In new construction, every attic space above an insulated ceiling must be ventilated with openings to the exterior to provide an unobstructed vent area of not less than 1/300 of the insulated ceiling area.

Figure 39. Ventilation through the eaves.

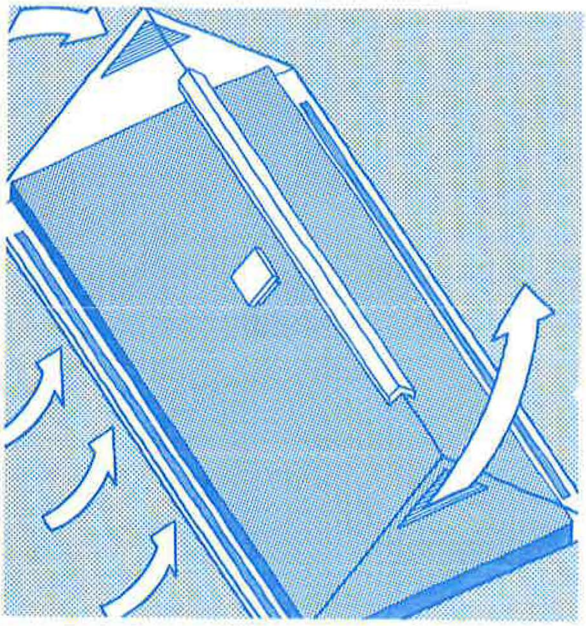

Figure 40. Attic ventilation.

Where insulation is placed below the roof sheathing and the roof slope is less than 2 in 12, or the roof incorporates no attic space, the unobstructed vent area must not be less than 1/150 of the insulated ceiling area, and uniformly distributed on all sides of the building. The vent types may be roof, soffit, eave, gable end or any combination of these, (Figure 40) and should be uniformly distributed on opposite sides of the building to facilitate an air flow. Ventilation to this scale should be satisfactory for most situations. Baffles, cardboard tubes or materials that will perform a similar function should be used so that the required vented space between the top of the exterior walls and the roof is not blocked by insulation (Figure 39).

If there is excessive air leakage, it should be apparent from the ice or moisture in the area where the air leakage is taking place or it may be indicated by darkening of the wood or visible signs of rot. The openings in the air barrier which are causing the air leakage should be sealed, preferably in the summer when the attic space is dry, although temporary repairs can be made in the winter.

Existing Roofs with Limited Air Space
Flat or shed roofs and cathedral-style ceilings may develop condensation problems more readily than other types of roofs. This is due to the limited volume of air in the roof assembly available to mix with the warm moist air leaking into the space. There is also a short flow path from a warm surface to a cold outdoor temperature surface. These styles of roof are more likely to have condensation problems than are those with large volumes of air, such as attics.

When retrofitting, there are restrictions as to what can reasonably be done to improve the situation, and there are no simple answers. As it is difficult to check the interior of these spaces it is **recommended that a specialist familiar with the retrofitting of this type of structure be consulted.** Depending on the condition of the structure the specialist may recommend that if the roof space is vented and more insulation is added, the amount of ventilation should also be increased. If, later on, condensation is found in the roof space, the vents should be sealed off and the assembly made as airtight as possible. By closing the vents the roof membrane is used as an air barrier. In other words, if the air cannot get out of the roof assembly, the warm moist replacement air is not going to leak in.

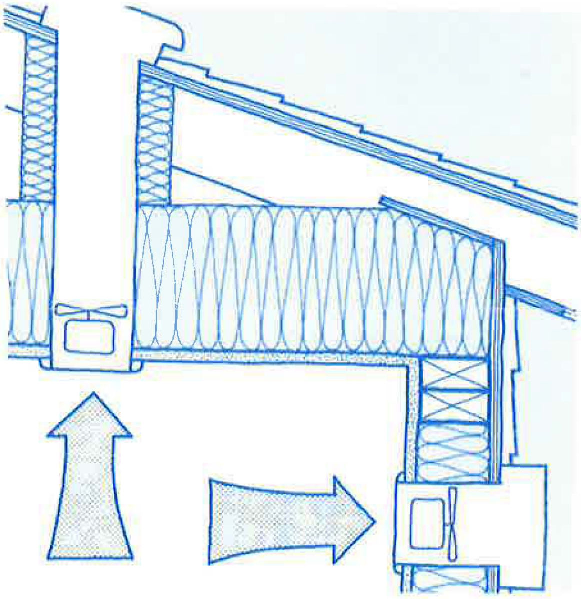

Figure 41. Different solutions for mechanical ventilation.

When considering increasing the insulation of a flat roof or cathedral ceiling that does not have condensation problems, the following options are available:

1. If there are no holes in the air barrier, increased insulation within the roof cavity should not result in a condensation problem. When adding insulation, however, ensure that ventilation openings are not blocked.

2. If there are holes in the air barrier and they cannot be effectively sealed, do not insulate. Additional insulation may result in condensation.

3. Insulation may be added to the underside of the ceiling, or to the surface of the roof (inverted membrane roof), however, **a specialist should be consulted.**

   For new construction, emphasis must be put on maintaining a continuous air and vapour barrier on the roof/ceiling assembly that is free from holes. Venting and air space requirements must meet the appropriate codes and standards.

Mechanical Ventilation
Mechanical ventilation of the habitable space, by fans, to remove excessive moisture, should always be to the outside of the building — NEVER to an attic or unused space within a building. Vent ducts passing through an attic area should be sealed and insulated (Figure 41).

Laundry, bathroom and kitchen fans should be ducted to the exterior by the shortest route, usually through the exterior wall and be insulated. All duct work passing through an air barrier should be sealed to prevent air leakage. If horizontal duct work is used within the roof space it should have a positive slope to the exterior to allow for the drainage of any moisture condensing in the duct.

Electrically Heated Houses

While it is recommended that the air barrier be made as airtight as possible for all types of housing, a change of air from outside the building is not only required to reduce relative humidity, and to provide make-up air for fuel combustion, but is also essential for the health of the occupants.

As electrically heated houses do not require a chimney, or combustion air, as do houses with gas or oil furnaces, there is less change of air, and thus the possibility of higher indoor humidity. This may be overcome by the **controlled intake of outside air** whereby outside air is ducted to the cold air plenum of an electric forced air furnace (Figure 42). With baseboard electric heaters it may be necessary to install a manually operated mechanical ventilation system to provide the change of air.

In electrically heated houses in areas with high humidity levels such as the Maritimes, or in houses where the occupants create unnecessarily high levels of moisture, rotting of the wood in the walls or ceilings has occurred. This relatively recent problem is currently under investigation.

Part of the solution to the problem, as mentioned throughout this publication, is the need to vent electrically heated buildings to assist the process of drying the interior of the walls and to stop moisture from penetrating and remaining within the walls.

A method that has been found to be successful for some two-storey houses is to have a non-dampered vertical vent extending from a second-storey bathroom directly to the exterior through the roof.

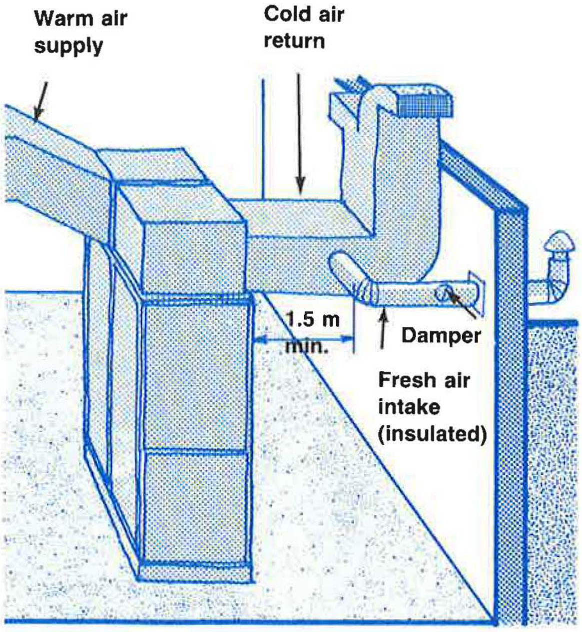

Figure 42. "Controlled intake of outside air" to a forced air furnace.

For single-storey houses, a vent or "dummy chimney" extending vertically from the basement through the roof to the exterior has proved satisfactory. Some authorities recommend that this type of vent be equipped with a humidistat-controlled damper installed at the location shown in Figure 43. If outside winter temperatures are sufficiently low, there could be a frost build-up which might block the top portion of the vent. Should this occur, the humidistat should be disconnected and the bottom damper removed. The vent would then operate on gravity air flow.

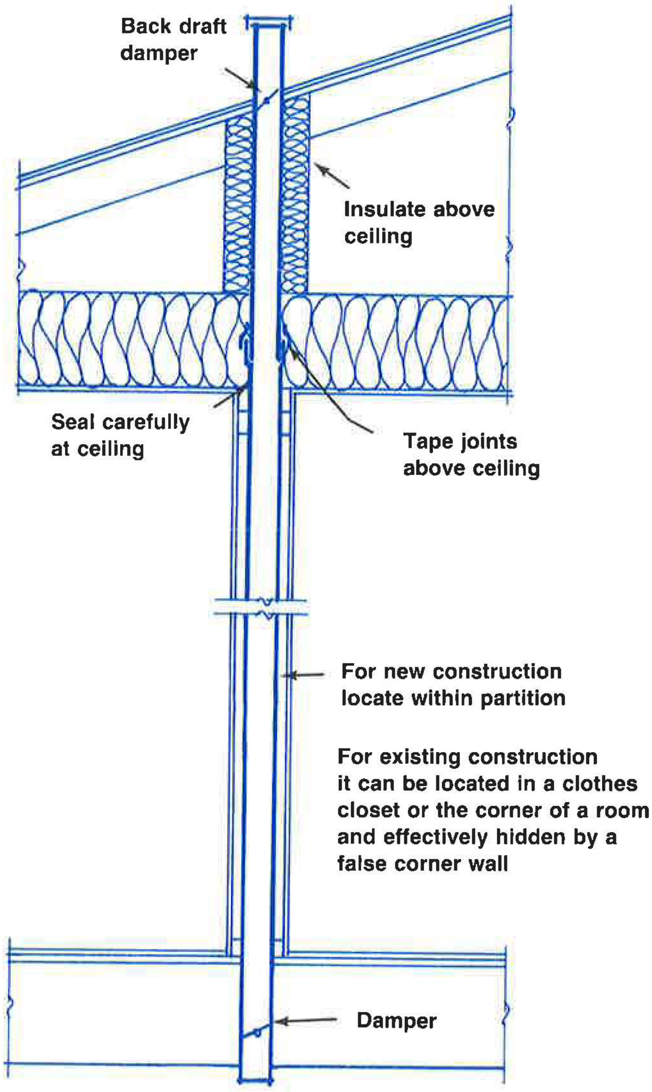

Figure 43. Dummy chimney.

In both cases the vent should extend a minimum distance of 600 mm above the roof and be insulated in the attic/roof space.

An alternative to the above systems is to install an exhaust fan in the basement and run the ducting horizontally to the exterior. The fan should operate quietly, and be wired to run on a continual basis. Based on the fan rating, the electrical authorities should be able to quote the exact cost of operating the fan on a 24-hour-a-day basis.

Some heat loss will be incurred by using these systems; however the cost will be minimal compared to the damage caused by the rotting of the structural members and by heat loss through the wet insulation. An air-to-air heat exchanger installed on the vent systems would reduce the heat loss. However, their cost may not yet justify their widespread use.

CAUTION: People who have used urea formaldehyde foam insulation to insulate homes, should follow the principles and practices outlined in NRC Building Practice Note No. 23 — "Urea Formaldehyde Foam Insulation: Problem Identification and Remedial Measures for Wood-Frame Construction", to increase ventilation. This is essential to reduce the infiltration of formaldehyde gas. This publication is available free from:

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