Moisture Problems in the Maritimes

by David Scott

Over the past few years, a number of field visits have been made to investigate moisture damage to wood-frame housing in Atlantic Canada.

The number of cases investigated is too small to statistically predict moisture problems in the overall building population. It appears, however, that a small percentage of wood-frame housing suffers from localized moisture damage that can be attributed to poor detailing, workmanship, or maintenance. The three buildings described in this article are located in the Halifax, Nova Scotia, area and St. John's, Newfoundland. Each was constructed within the last ten years and is typical of local practice.

Saturated roof sheathing blackened by mold and beginning to sag.

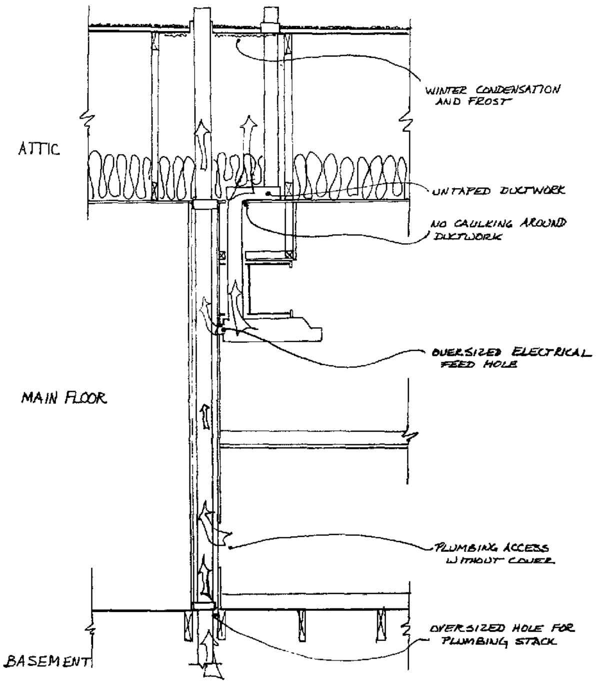
Case One

A split-entry, three-bedroom home, factory-built in the fall of 1982 near Halifax, was occupied by two adults and one child. The owners complained that the roof leaked in the vicinity of the bathroom each time a warm, rainy day followed cold weather.

An inspection of the roof in March 1984 showed that all asphalt shingles were in place and appropriately tabbed down. The flashings around the roof caps for bath and kitchen exhaust fans were well sealed. The attic hatch was weatherstripped and the fiberglass batts were installed uniformly. Yet the waferboard roof sheathing had turned black with mold, and was saturated in the area immediately above the bathroom and common plumbing wall with the kitchen (see photo).

No wetness or discoloration was evident in other areas of the attic. During this visit, the grill was removed from the bathroom fan, exposing gaps of up to ½ inch between the fan housing and adjacent drywall. Similar gaps were found between the top panel of the cabinet above the kitchen stove and the duct from the range hood. Because air leakage appeared to be the main source of attic moisture, these gaps were caulked. Instruments were installed to record indoor temperature and humidity.

The researchers made weekly visits to monitor the condition of the roof sheathing. One week after caulking around the exhaust-fan housing, they found that the roof sheathing was dry above the bathroom, with a reduction in moisture above the common plumbing wall.



Vertical section of the air-leakage paths.

Temperatures throughout the study period were maintained at 65° F., and the relative humidity varied between 50 and 64 percent. The high humidity can be attributed to the clothes dryer (unvented until late in the study) and low ventilation rates combined with a reasonably tight house.

By the second week, the roof sheathing was still wet above the plumbing wall, so the researchers looked for other air-leakage sources. The kitchen range hood and cabinet were removed, exposing a large gap between the drop ceiling and range-hood duct. When the duct was removed, additional air leaks were discovered at the plumbing stack and through several holes drilled in the top plate. These holes to the attic were connected with an uncovered plumbing-access hatch located behind the kitchen cabinet next to the stove. A further check in the attic revealed untaped exhaust ductwork.

Several clear paths had now been discovered for moisture-laden air to leak from the kitchen into the attic (see diagram). After entering the attic, the moist air would rise until it hit the cold sheathing, where frost would form and melt to become "attic rain" during mild weather.

The builder sealed off the air-leakage paths and installed a hatch to the plumbing chase. The remaining wet sheathing dried within a week. The home owner was encouraged to eliminate indoor clothes drying and to use exhaust fans more often to reduce the relative humidity to a level of about 40 percent.

Case Two

Aluminum-siding installers were replacing the siding on a two-story duplex when they discovered water between the felt paper and the 3/8-inch plywood sheathing. The plywood in one of the second-floor bathrooms showed water stains and preliminary signs of rot in the stud spaces immediately adjacent to the tiled tub enclosure. The darkest pattern was immediately behind the soap dish. The same pattern occurred in the same spot on the adjacent unit.

The moisture content of the plywood was about 15 percent across most of the wall, increasing to 30 percent in the center of the dark patches behind the soap dish. The researchers cut away the sheathing behind the soap dish and removed the friction-fit insulation. They discovered that the polyethylene vapor barrier had been cut to install the soap dish and a substantial amount of mildew and moisture had accumulated between the poly and the gypsum drywall.

The wall vapor barrier stopped at the rim of the bathtub, leaving friction-fit fiberglass insulation exposed to the area under the tub. Since the home owners noted that the soap dish had been loose for some time, it is difficult to assess the relative moisture contributions from water leakage during showers, air leakage at the soap dish, and diffusion and air leakage through the open area below the tub. These factors did, however, combine to overcome the natural drying potential of the wall in the area immediately around the bathtub. The remainder of the sheathing in the two houses was sound.

These houses were built according to standard practice at the time. The plumber routinely roughs in the bathtub before the insulation is installed, which makes insulating below the tub difficult, and installing an air/vapor barrier there impossible. One approach is to install a barrier, such as a single sheet of plywood or waferboard, below the tub rim before the tub is installed. This reduces moisture buildup within the wall by limiting airflow and vapor diffusion into the wall cavity.

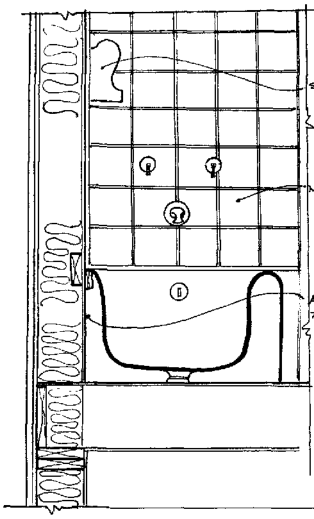
In addition, the movement of moisture through deteriorating ceramic-tile grout and at fixtures, such as soap dishes, set through the gypsum drywall is almost inevitable if the wall isn't carefully maintained. Surface-mounted fixtures at least allow the polyethylene and drywall to remain uncut, which will help to maintain air and vapor tightness.

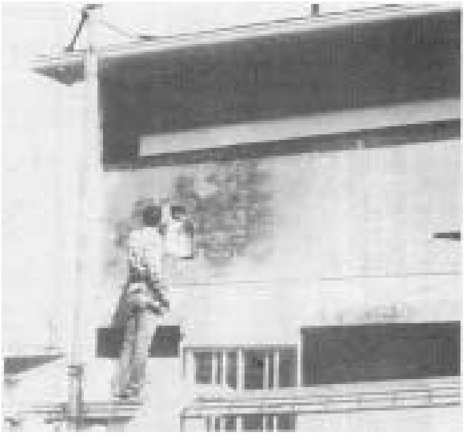
Case Three

A two-story duplex located in the St. John's, Newfoundland, area was investigated in March. The exterior wall system consisted of gypsum drywall, polyethylene, paper-clad (R-12) batts between 2x4 studs, 16 inches on center, and an exterior finish of 3/8-inch plywood with vertical and horizontal battens. Little is known of the inside temperature and moisture conditions.

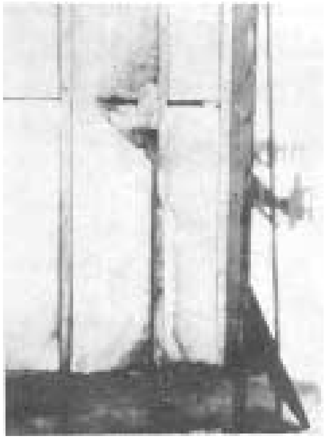
The plywood cladding on the southeast corner was removed, revealing a wet stain on the panel starting at the height of an electrical box and extending down to the plate (see photo).

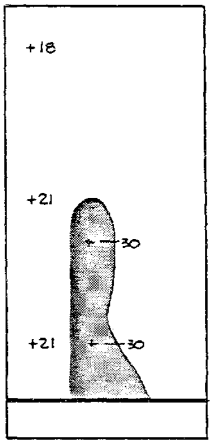
Moisture-laden air apparently had leaked out through holes around and through the electrical boxes and condensed on the back of the siding. Here, water formed and ran down in a fan-shaped pattern to saturate the sill plate and header. The moisture content of the sheathing and studs varied considerably in relation to the proximity to the electrical outlet (see

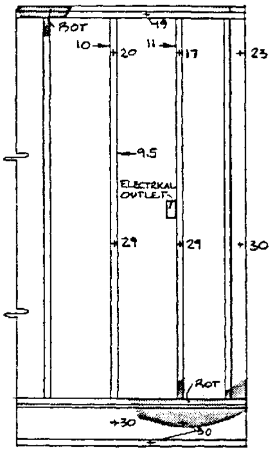




Above left: the right way to enclose a bathtub. Right: what can happen when it isn't done right.







Note blackened area around the electrical box. The numbers represent the moisture-content percentage of the plywood (middle) and framing (right) at that spot.

diagram).

Substantial rot was found in the sill plates and headers behind the lower right- and upper left-hand corners of the panel. Both locations are below an electrical outlet (subject to air leakage) and an unflashed horizontal joint in the cladding (subject to rain leakage). The fiberglass insulation was dry, except where it was wadded in around the electrical box.

Conclusions

Moisture damage in the houses studied was limited to small, specific areas and appeared to result from one or more of three factors.

1. Inadequate specifications. Residential working drawings rarely convey critical details regarding air and vapor control, and leave the detailing to standard trade procedures.

2. Poor workmanship. The quality of the workmanship determines whether a detail is suitable for its intended use. Furthermore, poorly built details often are concealed by the construction process.

3. Lack of maintenance. To avoid the types of problems described in this article, the home owner should identify and attend to minor problems before serious deterioration begins.■

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For the U.S....

What can U.S. builders conclude from this study? First, bear in mind that the Canadian Maritime Provinces, where the study took place, are cold and damp—providing many opportunities for condensation to form and few opportunities for wet building materials to dry out.

In Halifax, where cases one and two were studied, the climate is as cold as that of Concord, N.H. (about 7,000 degree-days), but faces year-round relative humidity of 75 to 85 percent—more like Florida. In St. John's, the climate is colder (8,700 degree-days) and wetter still.

Given the demands of this climate, it's a wonder that so few houses suffer major moisture problems. In each of these cases, the researchers identified a fairly clear route through which moist air flowed into the attic or wall cavity. These air leaks—rather than vapor diffusion—appear to be the major source of problems. After all, each of these houses had a poly vapor barrier in place. The vapor barriers stopped most diffusion but, because they were full of holes and discontinuities, they didn't stop air leakage.

In case one, blocking off the leakage paths cured the problem. In new construction in less severe climates, blocking off air leaks from moist areas (kitchens, baths, crawl spaces) to cold areas (attics, wall cavities) should go a long way toward avoiding similar problems. ■

—Ed.