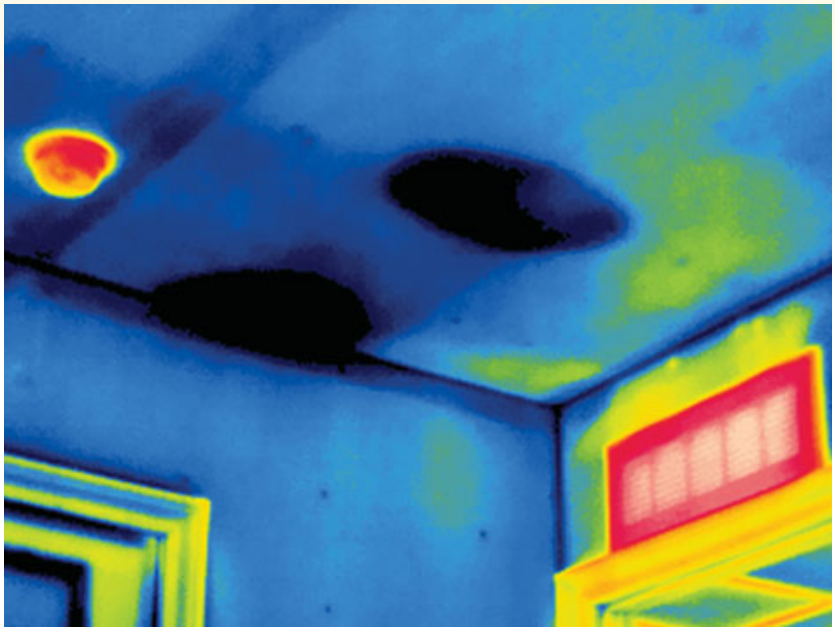
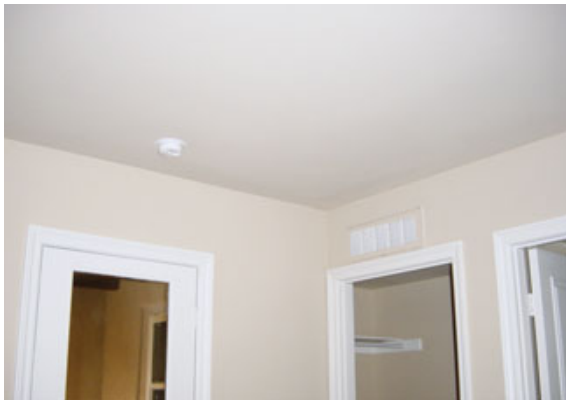
Solving Moisture Mysteries With an Infrared Camera

Water leaks aren't always where you think they are





During an energy survey of a new home, the author's IR camera recorded this image (top) showing spots in the ceiling that were not visible on the drywall (above), and which did not look like voids in the insulation. A hand-held moisture meter confirmed the presence of moisture (right); the culprit was a leaky roof flashing.

by Peter Hopkins

Because of the various state and federal tax incentives available for fixing energy leaks in buildings, the use of infrared cameras is definitely on the rise. But IR scanning can also be used for another, less-well-known purpose: finding the source of common moisture problems.

Using thermal imaging in this way — to investigate water leaks in buildings — is nothing new. The only reason the practice isn't more widespread is that IR cameras are thought to be very expensive. However, prices have been dropping over the past few years, thanks to new sensor technology and increased mass production, and now even entry-level IR cameras perform quite well when they're used for moisture mapping.

Of course, it isn't actually moisture that IR scanning "sees"; it's temperature. And differences in temperature — anomalies, as we inspectors call them — are clues that moisture might be present. Because of evaporative cooling, wet areas in a building assembly may be cooler than

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surrounding dry areas. Or, because water-soaked materials can hold heat longer than many other less-dense building materials, wet areas may at times be warmer than dry areas. Given these common anomalies, an IR camera can find moisture problems in a quick, nondestructive manner.

Get training. One problem with using an IR camera is that it's easy to get yourself in trouble by misinterpreting what you see on the screen. We recommend that you gain a thorough understanding of the technology and how it applies to the application you have in mind before making any investment. There are several infrared certification organizations and many application-specific training programs that can give you a head start. You should also research the cameras on the market so that you get the one that best suits your business needs. As with most things, cheapest is not best: I've met far too many contractors who bought the camera they could afford, only to have it became a paperweight because it couldn't do the job they needed it to do.

In this article I'll share a few moisture investigations our company has done and explain how using IR helped map the damaged materials and speed up a process that could have taken a lot longer.

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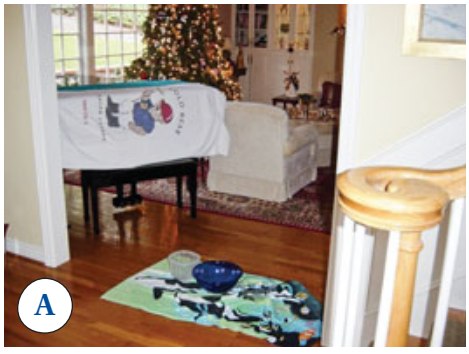
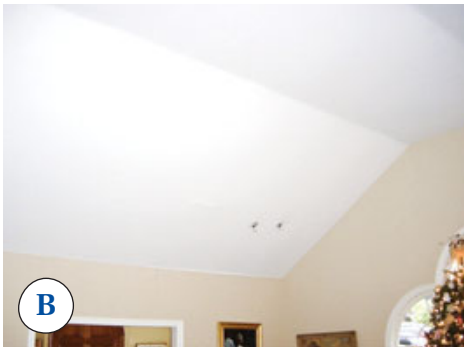
Bad Roof Design

In this case, the homeowner had already replaced the roof three times, seeking to cure an ongoing leak. The roofing contractor was now insisting that replacing an upper section of the roofing would fix the leak, but the owner wanted to try our services first. When we arrived, we found the usual assortment of buckets on the floor (A). After talking to the owner about the problem, we turned on our camera and went to work. Though you may not be able to see it in the photograph (B), there was a slight bulge in the drywall ceiling but no other signs of moisture. The moisture meter, however, read off the scale when placed on this spot (C), and an IR image (D) showed a concentration of moisture. (Note also the dark square areas to the right of the moisture spot; these indicate voids in the cathedral ceiling's insulation.)





The root of the problem turned out to be poor roof design (E). In heavy rains, water from an upper roof cascaded onto the lower steep-slope roof, where it was directed back against the building and in around the poorly executed counterflashing on the wall, eventually finding its way into the living room ceiling. Our recommendation was to install a new wide cricket flashing, taller counterflashing, and gutters on the upper roof to redirect the bulk of the water.

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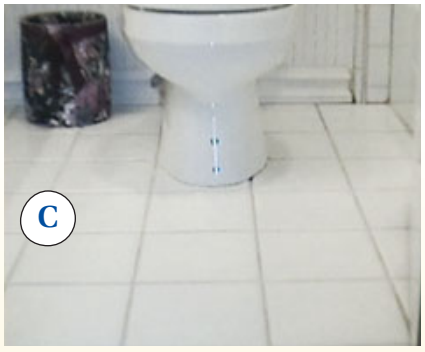
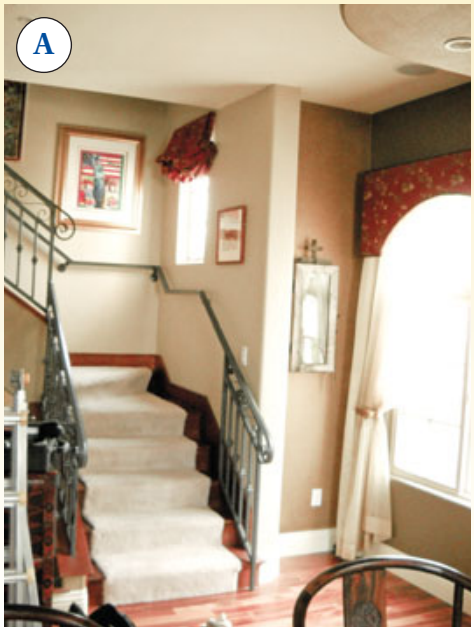
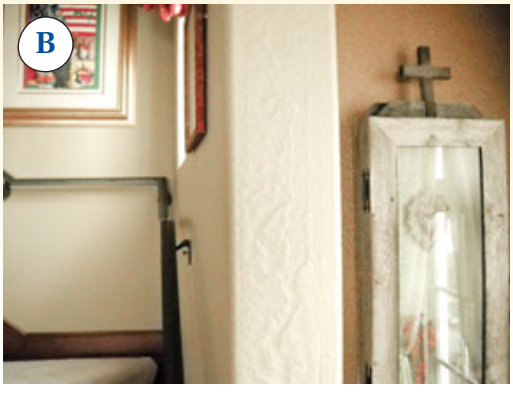
The Seven-Year Puzzle

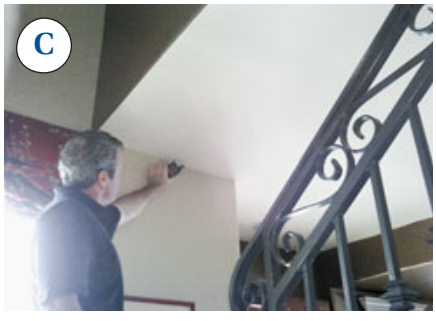
For seven years, the homeowner had tried various repairs to fix a leak that showed up in his library ceiling (A). The bathroom above seemed the obvious source, even though it was never used. One contractor had opened up the drywall around the tub and replaced all the plumbing, but that didn't stop the leak. Another contractor replaced the angle stops on the fixtures, but — again — to no avail. The owner began to suspect the bathroom window and called me in to set up my spray apparatus and do some water testing. But first, we pulled out the camera.

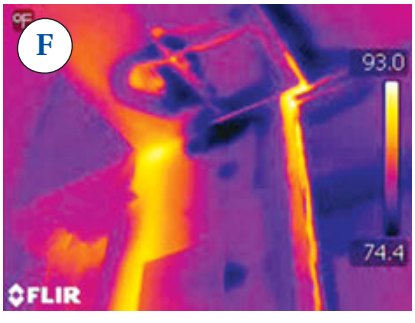


The dark spot in the infrared scan of the ceiling (B) helped to pinpoint the source of the water. Upstairs, we found that this coincided with the location of the toilet (C). As you can see in the thermal image (D), there's a darker area on right side of the toilet. A moisture meter confirmed that the floor around the toilet was soaked (E, F). We made some measurements downstairs and found that the wet spot in the office was 55 inches from the outside wall — the same distance as the right-hand toilet bolt. In questioning the owner about use of the bathroom, we learned that in fact the house cleaner flushed this toilet as part of her weekly cleaning — a seven-year mystery solved.









Not the Roof but the Tub

A general contractor called, saying he believed he had a roof leak in a house he had built and asking me to take a look. I found a patch of blistered paint on the return wall of the home's main staircase (A, B). Moisture readings confirmed that the wallboard in the area was damp (C). A bathroom upstairs might have been the likely culprit, but the builder had already repaired leaky supply pipes a few months earlier, so now he suspected the roof. However, the initial IR scan (D) showed a pattern of water under the bathtub, so we figured we'd start there.

We turned on the hot water and let it run, then set the camera on time-lapse mode and began scanning. In a couple of minutes, the water began to show up as a bright yellow streak coming down the corner of the wall (E). (You can also see the hot-water supply pipe running up through the wall to the left.) Then gradually, as the wall was saturated, the hot water filled in beneath the tub (F, G), which turned out to be the source of the leak.

As this case illustrates, the moisture stain is often in a different location than the leak, because water will always follow the path of least resistance. The great advantage of the infrared image is that it shows the path, right back to the source.

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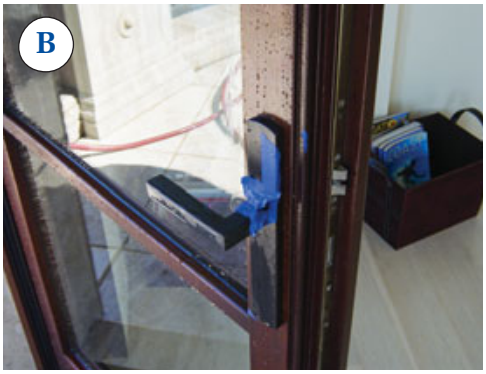
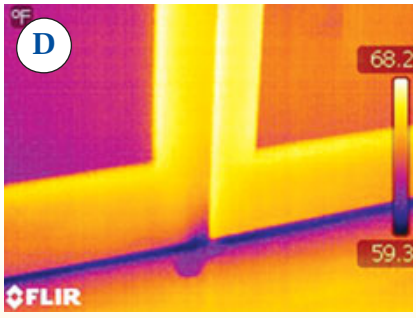


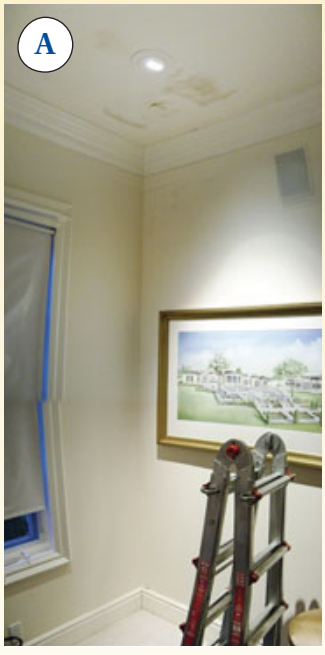


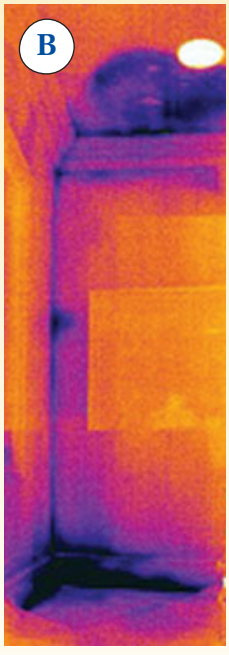
Leaky Glass Door

Sometimes IR scanning is a nice complement to an investigation that probably could have been solved without it, as in the case here.

This home, located in Newport Coast, Calif., was eight months old when we were called in. Like many coastal homes, it had a wall of glass facing west, which bore the brunt of the storms coming off the ocean. The owner had complained that water was always coming in at the floor along the double glass doors. The builder had tried several times to fix the problem, replacing all the weatherstripping and recaulking every possible entry point, but nothing had worked. They heard about our infrared and water-testing services and called us to determine the cause.

After getting up to speed on what had been done, we used a hose to perform a water test (A), which would help us figure out where the water was getting in. We taped off obvious points of entry, like the keyhole (B), to rule those out. Before long, water was coming in under the door, as both the visual and infrared photos show (C, D). When we opened the door, the IR scanner quickly picked up something that might not have been obvious — the water was flowing out from inside the bottom corner of the door (E). The problem wasn't the caulking or weatherstripping, but simply a small gap between the door handle and the faceplate, which allowed water to enter and run down through the three-point locking mechanism. Note the rust spot on the hardware (F) where the water came in. We recommended adding a rubber washer between the handle and the plate — an inexpensive fix, considering how much money had been invested in trying to solve the problem.





Flat Roof Leak

We were called into this large custom home in Rancho Santa Fe, Calif., by a water-remediation company that was already at work on another portion of the home when a rainstorm blew in and caused some new leaks. Before making any expensive repairs, the remediation crew wanted to make sure they knew what they were facing.

As you can see from the visual image (A), there was some moisture damage on the ceiling, but it seemed to be limited to that one location. But in the thermal image (B), it's obvious from the darker areas that the water had in fact traveled all the way to the floor. When we went up on the roof, we found that ponding was occurring because an overflow drain at the parapet wall was improperly installed (C). This was a leak waiting to happen.

IR From the Air

Our company also does aerial scanning of large commercial roofs. For roofs up to 100,000 square feet, walk-on inspections with capacitance meters are cost-effective. But for larger roofs, a fly-over survey becomes a viable solution, because it's much more efficient. Roof inspections are typically done at night, when the dry areas of the roof cool off quickly but wet areas continue to radiate heat due to higher thermal mass.

The white lines in this scan of a large low-slope roof (A) indicate moisture trapped along the edges of the rigid insulation panels. The other light-colored irregularly shaped areas show places where the insulation is wet. In the image of a flat roof (B), the light-colored area at the top indicates moisture in the roof substrate.