TRACKING DOWN THE MOISTURE —

HOW INFRARED INVESTIG

When roofs leak, accusations fly as to whose fault it is. Suppose, however, that finger-pointing could be eliminated and the cost of repair reduced by easy identification of the source of the leak – all without destroying the building and displacing its occupants?

Infrared imaging is an effective means of monitoring and diagnosing the conditions of a building envelope. By utilizing this technology, one can save replacement and material costs by precisely locating the source and impact of moisture leak(s) on a project. The same modern technology that assists doctors, law enforcement officers, and firefighters can also help the building professional determine exactly where the moisture is entering the building and the extent of the problem. Using this knowledge, he or she can identify the problem area(s) and then devise a plan that will ensure a leak-proof system. No guesswork involved!

Infrared radiation is not a new concept. Its predecessor, thermal imaging, was discovered in the year 1800. Infrared energy is a part of the electromagnetic spectrum and behaves similarly to visible light. All materials on earth emit heat energy in the infrared portion of the spectrum. When an object becomes warmer, it emits more infrared radiation. Infrared cameras detect this energy and can "see" the surface temperature.

Infrared cameras measure the thermal capacitance, a physical property that evaluates a material's ability to store heat. The materials in a building have relatively low thermal capacitance, especially when compared with water. A lot of energy is needed to raise the temperature of water. Likewise, it must release this energy to cool.

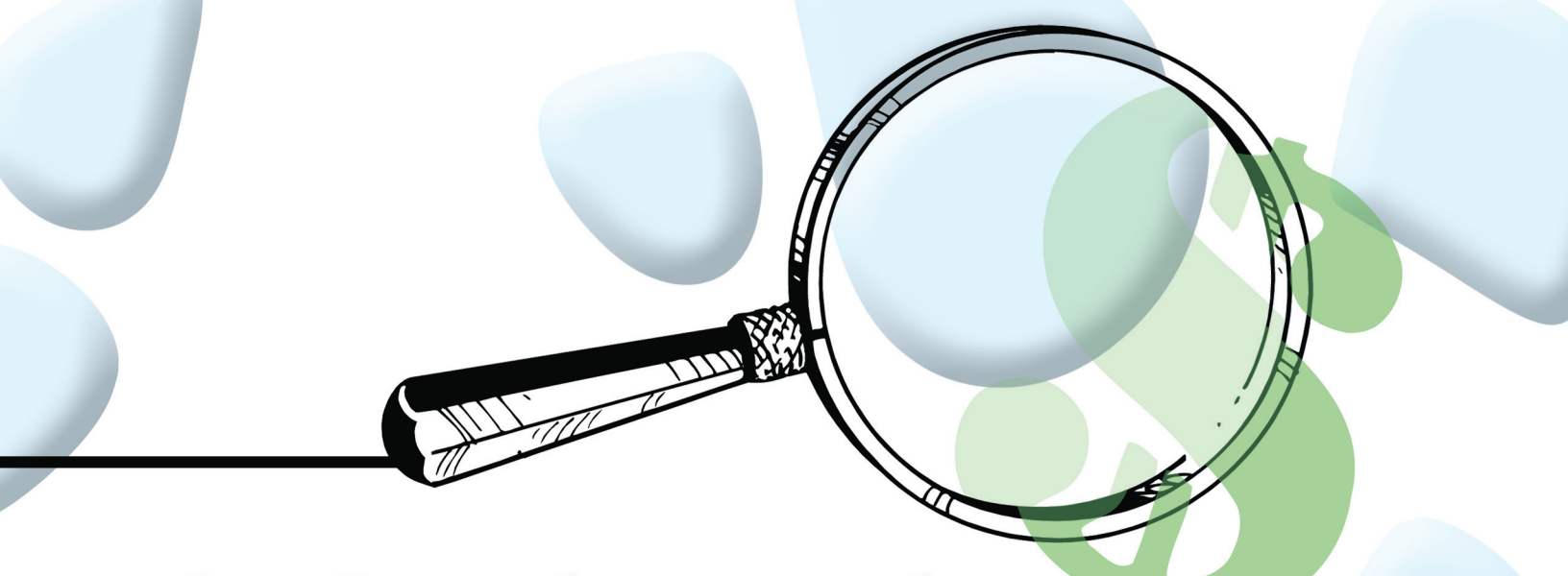
Photo 1: Previously undetected moisture is revealed through mushroom growth in a homeowner's window.

The Role of Infrared Thermography vs. Mold:

Moisture in building materials can destroy structural integrity and nurture mold and insect infestations. Mold is a growing concern for insurers, lenders, investors, and building owners because of the growing number of claims. In mold remediation, first one must identify the locations and remove all sources of moisture infiltration. Infrared cameras can image entire rooms and reveal moist conditions behind drywall, painted surfaces, and wallpaper that might otherwise be undetectable without destructive investigation.

Following California's lead, Congress has indicated plans to introduce legislation to require EPA to set national guidelines for what levels of toxic mold (*stachybotrys spp.*) constitute a "health risk."

Given that insurance companies intend to pursue subrogation in mold claims, the facility manager who fails to recognize and act upon a water penetration situation



ATION CAN SAVE MONEY

BY DOUGLAS C. TAIT

may well be held liable for damages.

Photo 1 is an example of undetected moisture entering a building structure. This shows mushrooms – not in a salad, but in a homeowner's window.

To a building owner or an insurance company involved in a property damage settlement, clear images of normally invisible diagnostic evidence can be invaluable for planning the restoration effort and rationalizing settlements. For catastrophic stormwater intrusion and plumbing failures, infrared thermography can trace the influx of moisture to find the ultimate source of the incursion with little or no physical disassembly of the premises and minimal disturbance of the inhabitants.

Photos 2 and *3* are examples of an infrared inspection after the apartment resident complained about mold and mildew appearing on the interior walls. The photo on the left shows an exterior wall that appears to be well constructed. The same photo on the right, using the infrared camera, shows the moisture infiltration, which could not be detected by the naked eye. Without removing the exterior siding, it was determined that the dryer vent installation was allowing the moisture to enter this building.

Photo 2 (left) shows apparently well-constructed exterior wall. Photo 3 (right), using an infrared camera, shows moisture infiltration not detected by the naked eye.

Take all this technology and display the results on paper and that's thermography – a heat diagram or visible thermal signature using infrared wavelengths. This imaging technique is a powerful and nondestructive means of monitoring and diagnosing the conditions of the building envelope in commercial and residential structures.

Infrared is an efficient, nondestructive method of locating building defects and moisture in both the interior and exterior of the structures. Current building moisture surveys performed using moisture-detecting equipment (such as a moisture meter) are slow and prohibit surveying of hard-to-reach locations. Areas inaccessible to the standard moisture meters can be surveyed with the infrared camera quickly, easily, and with little disruption to occupants.

It is not harmful to people; in fact, infrared is now being used in operating

Photo 4: The author at work using thermal imaging technology.

rooms to detect, define, and diagnose problems within our bodies. Infrared is also being used to find problems with animals.

In construction, it is used to detect moisture and building defects in exterior and interior structures, such as balconies, electrical installations, insulation, plumbing, stucco, windows, and roofing. Construction professionals find that infrared technology benefits them by:

- Reducing man-hours spent on pinpointing areas that need repair;
- Identifying leak areas before they become a major cause of property damage;
- Reducing total structure replacement; and
- Assisting in nondestructive investigation.

Finding Termites with Thermal Imaging:

State-of-the-art thermal imaging technology is also being used to locate termite infestation in buildings and homes. This technology gives the property owner visible proof of termite infestation and a record of how great the problem is. There is a significant and growing problem with damage to buildings due to subterranean termites. New invasions from foreign termites, such as the Formosan termite, are creating additional problems since its introduction in Houston in 1965. Estimated annual termite damage in the United States is greater than that caused by fire and storms and is present in up to 1% of total housing.

Thermal imaging offers a new, high technology detection system that is quick, effective, and does not require any damage to the structure.

Thermal imaging detects heat patterns. When termites invade buildings, the normal heat patterns of walls, floors, and roofs are changed due to the termite mass. The infrared camera records this change in a heat pattern that indicates the exact location of the infestation.

There are three types of inspection methods:

- **Walk under or through**
- **Walk over (low-sloped roofing)**
- **Fly over**

Walk under or through — Used to inspect interior and exterior structures.

- **Advantages —** Quick, accurate, no roof access required, daytime inspection, no customer displacement.
- **Disadvantage —** May interfere with owners or operations.

Walk over (roofing) — Thermographer and assistant walk the roof using the infrared camera and moisture meter, looking for thermal differences.

- **Advantages —** Accurate moisture detection, can be verified, total roof and building inspection.
- **Disadvantages —** Time consuming, danger of falling off roof, problematic roof access.

Fly over — Used to inspect a large roof or a number of roofs.

- **Advantages —** Under the right conditions, several roofs can be inspected.
- **Disadvantages —** Restricted air space, wind conditions, verification requires walk over method. Other roof or building defects may not be identified. Cost.

Most infrared roof inspections are performed at night. The main reason for this is the top surface of the roofing material will cool while the moisture in the insulation, wood, and other substrates will retain heat that generates infrared radiation.

There are three types of report categories:

- **No documentation —** Area of moisture is marked. No written report or follow up.
- **Formal report —** Infrared and digital comparison images in a written report. Inspection verification by the use of a moisture meter.
- **Extensive report —** Detailed report, infrared inspected to ASTM E 2128-01a, Standard Guide for Evaluating Water Leakage of Building Walls Using Infrared Imaging. For roofing, infrared inspected to ASTM C1153-97, Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging. This may involve a structural engineer and a licensed roofing contractor to repair core locations.

Not all jobs are thermography candidates. Certain characteristics may result in poor inspections:

- Insulation with different R-values or different absorption characteristics;
- Different internal building temperatures;
- Large ballast or extra gravel left on the roof;

- Warm or cold air exhausting onto the structure;
- Internal sources of heat or cold such as lights, heaters, and steam pipes;
- Dirt, vegetation, and debris; and
- Water ponding or water spray.

The ideal conditions for infrared inspection are:

- Clear, sunny day;
- Clear night, no cloud cover (low-sloped roofs);
- Little or no wind;
- Dry surface; and
- Clean and clear of dirt and debris.

The report results are only as good as the person performing the work. Here are a few tips on how to select a thermographer:

- He or she is certified in thermography by a national training association;
- Must understand basic construction and roofing systems;
- Infrared imaging equipment must be calibrated yearly;
- Must carry liability insurance of $1,000,000.

REFERENCES

1. ASTM C-1153-97, Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging.
2. ASTM E-2128-01a, Standard Guide for Evaluating Water Leakage of Building Walls.
3. Infrared Training Center.
4. FLIR Systems.

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SPRI Test Procedure Earns ANSI Approval as National Standard

A new standard, designated ANSI/SPRI IA-1, 2005, "Standard Field Test Procedure for Determining the Mechanical Uplift Resistance of Insulation Adhesives over Various Substrates," has been approved by the American National Standards Institute (ANSI). This standard was developed by SPRI, the association representing sheet membrane and component suppliers to the roofing industry. It is intended to provide structural engineers and roofing design professionals with data on uplift load capability of an insulation adhesive combination that should be used when evaluating its suitability for a roof system installation.

This standard is intended primarily for situations when an existing roofing system is being replaced or recovered and the general condition of the substrate is in doubt. This procedure, however, is also applicable to new construction.

All SPRI standards can be downloaded free of charge at the SPRI website, **www.spri.org**.