

Performing Infrared Roof Moisture Surveys

The roof above your head is one of the most complex and costly parts of your building. For many of us they are “OUT OF SIGHT, OUT OF MIND” –until they begin leaking. It’s a known fact that one third of all new roofs will be leaking at the end of their first year.¹ Within five years nearly 9 out of 10 roofs have problems stemming from poor installation, bad design, failed material and lack of annual maintenance and repairs

While the leaks themselves may be the owner’s largest headache, the water that is introduced into the roof system quickly stimulates other problems, usually more subtle than leaks but always more destructive. Listed are the worst offenders:

- When wet the roof system deteriorates prematurely. Blistering, ridging, delamination, quicker rusting of the metal deck all contribute to roofs being replaced every eight years on the average when they should be lasting 15-20 years.
- The water alone in a two inch thick piece of saturated roof insulation can weigh up to 650 pounds per square, which adds to the overloading of a roof’s structural system.
- To “fix” leaky roofs, many owners are installing new single ply membranes right over the old roof – wet insulation and all.. They are now operating under a time bomb, which ticks away as the damage continues unnoticed.
- The insulation once wet, not only loses much of its insulating value, but becomes an excellent thermal conductor, resulting in the use of extra energy for both heating and cooling.
- **Repairs, which all roofs will need at some point, cannot be made effectively when the wet insulation is left in place. The repair fails and the leak begins again – if it was ever stopped!**

INFRARED ROOF MOISTURE DETECTION

When water penetrates a roof membrane, it usually wets the insulation on its way to becoming the leak you see dripping in the building. The leak you see on your ceiling probably entered the membrane many yards away. Years’ ago, finding the point of entry was more often guesswork than anything was.

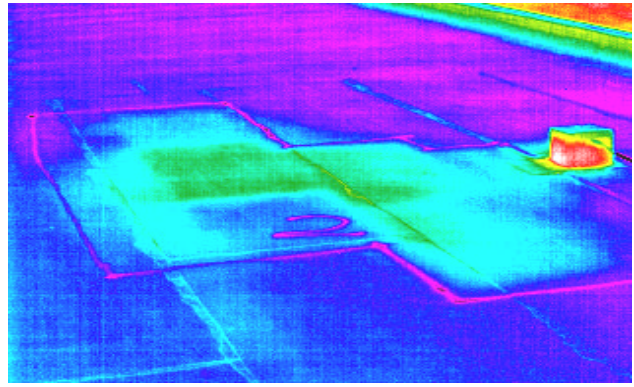
During the 1970s, the Army Corps of Engineers developed a method of detecting the wet insulation with an infrared thermal imaging camera. Once the wet insulation has been located using the thermographic equipment, a thorough visual inspection usually reveals the penetration point within the same bounds. The wet insulation is then removed, the membrane repaired, and the roof is again without leaks and free of the damaging moisture

Detecting wet insulation with an infrared camera is **THE KEY** to a predictive maintenance program that will keep your roof leak free, long past their “average life.”

HOW DO YOU “SEE” THE WET INSULATION

The infrared camera senses temperature differences as small as .25°F and electronically displays the thermal patterns as a video image. The temperature differences between the wet and dry insulation can easily be seen under the right conditions.

Absorbent insulations such as wood fiber, perlite and fiberglass, rapidly soak up water, and typically, never dry out. The wet insulation has different thermal characteristics and can be distinguished from the dry in one of two ways:



- On a summer day the sun loads the roof with solar radiation. After sundown, the whole roof begins to cool down, but not at the same rate. The wet insulation, having stored more of the sun's energy in its greater mass, will stay warm after the dry areas have cooled down. Identified by its temperature difference and a characteristic shape, the wet insulation shows up clearly as a heated image, as can be seen in the thermogram above.
- Wet insulation is not only a poor insulator, actually it is a good conductor of heat. During the winter in a cold climate a building loses heat to the outside through the wet insulation more rapidly than through the dry areas. Just as they do in a summer survey, these areas show up in the thermal image warmer than the cooler, dry areas.

CONDITIONS FOR A ROOF MOISTURE SURVEY:

Certain weather conditions enhance the thermal patterns you are searching for during a survey. Other conditions make it difficult,

1. A sunny day, either clear or slightly overcast, will deliver enough energy to adequately heat up the roof. This summer loading is essential to a summer survey, and will help during a winter survey.
2. Winds more than 5-10 m.p.h. will simply erase the thermal patterns on the roof.
3. The roof surface must be dry. Ponded water, rain, snow and ice cover the thermal patterns.
4. A summer survey requires not only a sunny day, but also a clear night sky. The thermal patterns you are searching for are revealed only when the roof begins to cool down. If overcast conditions or low clouds move in during the evening, the roof will cool off very slowly, if at all.

Each type of insulation has a characteristic pattern depending on how it absorbs water. Because they wet easily, insulations such as wood fiber and fiberglass show extremely clear patterns. Foam non-absorbent insulation absorbs water much slower and from the edges inward causing a "window pane" pattern. Their "window pane" pattern may be difficult to see until the insulation is several years old. Before the survey begins you, need to know the type of insulation.

Uninsulated roofs, roofs with lightweight concrete insulations, inverted roof membrane assemblies, and most large ballasted single ply roofs are difficult to survey. Infrared roof moisture surveys are generally not recommended for these types of roofs because the roof moisture does not express itself in a distinguishable pattern.

Not all "hot spots" on a roof are areas of wet insulation. Gravel piles, extra bitumen, exhausted air, shading, and equipment mounted below the deck are just a few of the factors that must be considered.

PERFORMING THE SURVEY:

A roof moisture survey involves three separate operations: the visual inspection, the infrared survey, and the follow up work. Each operation is vital to the result of maintaining the roof in a leak free condition.

A visual inspection of the roof, done anytime before the infrared survey, details the nature and locations of any existing leaks, the repair history, and an inventory of the condition of the roof.

The infrared survey is done at night, beginning about 1-3 hours after sunset, depending upon the weather and roof conditions. With ideal conditions, patterns may remain visible until very late at night. How much roof can be surveyed in one evening? Depending on the complexity of the system and the number of problem areas, you should be able to cover between 40,000 and 150,000 square feet.

During the survey, the thermographer's assistant outlines the areas of wet insulation directly on the roof. Generally, the assistant also verifies each suspect area, using a capacitance meter. While verification is not essential, it does speed up the survey by insuring that correlations of thermal patterns with areas of moisture are indeed accurate. Follow-up consists of another visual inspection in which correlations are made between areas of wet insulation and points of entry through the membrane; these are usually related to penetrations or defective flashings. Notes and photographs documenting the problems are then made. Report writing can be done in the office taking hard copy photographs from data acquired.

THE KEY TO A ROOF MAINTENANCE PROGRAM:

The information from the survey is passed out to the roof contractor, architect, engineer, consultant or building owner. This is the key to both formulating a successful maintenance strategy and making repairs that keep the roof leak free. Most roofs benefit from being resurveyed annually in order to check on repairs and locate problems in their stages of development.

New roofs should be surveyed upon acceptance from the contractor to document their baseline condition. Again, just before expiration of any warranty or bond, another survey will help to establish the true condition of the roof. Any roof that is scheduled for replacement should be surveyed; many are, in fact, easily salvaged at tremendous savings.

Aerial surveys of large roofs or multiple roof complexes and facilities are of immense value in prioritizing follow-up roof level surveys. Inspection efforts can be focused on those roofs where the benefits will be greatest.

The bottom line is that none of us has to be at the mercy of leaking roofs any longer. The tremendous toll taken by our old "out of sight, out of mind" attitudes about roofs are made bearable, even eliminated in many cases, by these simple, proven techniques of infrared moisture detection. Infrared equipment, in the hands of a trained person, is **the key** to a roof maintenance program that will save you countless headaches and a big bundle of money.

¹ **Manual of Built-Up Roofing Systems** (AIA), McGraw-Hill, 1970