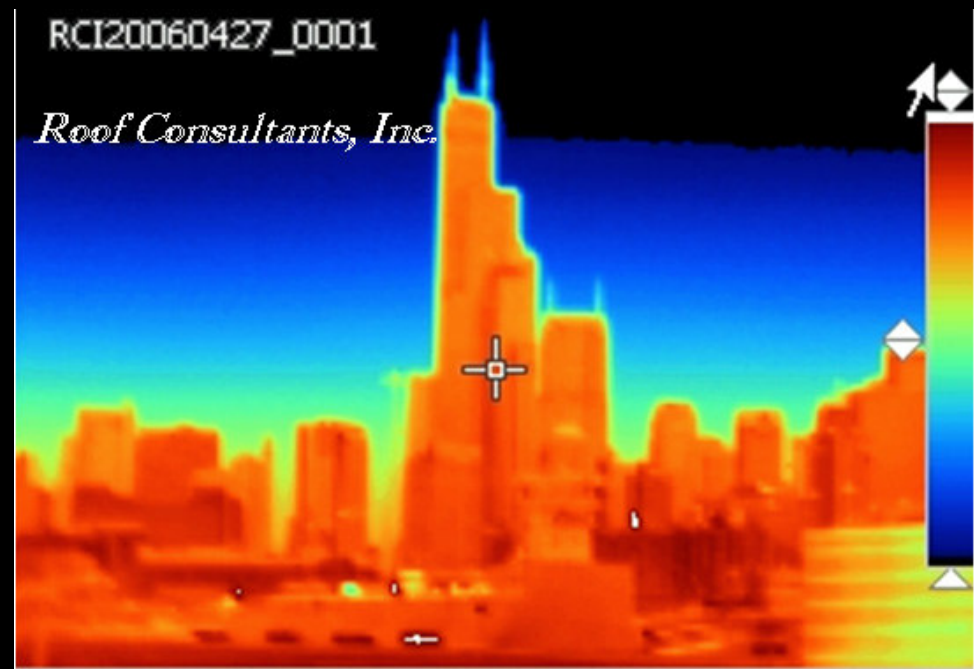


Infrared Thermography and The Building Envelope

Regardless of the building type involved, infrared thermography can provide remarkable nondestructive information about construction details and building performance.



INFRARED IMAGE OF CHICAGO AT NIGHT

Infrared Thermography and The Building Envelope

- Thermography is the use of an infrared imaging and measurement camera to "see" and "measure" thermal energy emitted from an object.
- Thermal, or infrared energy, is light that is not visible to the human eye. It's the part of the electromagnetic spectrum that we perceive as heat.
- Unlike visible light, in the infrared world everything with a temperature above absolute zero emits heat.

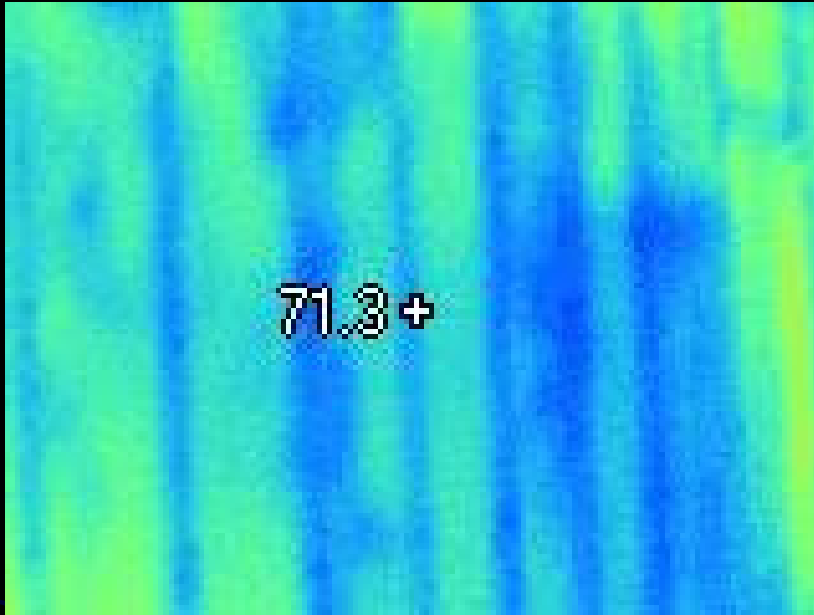


The higher the temperature the brighter the object becomes. Note the high amount of heat loss from the building foundation

Infrared Thermography and The Building Envelope

The Major Problems Found In Buildings Are:

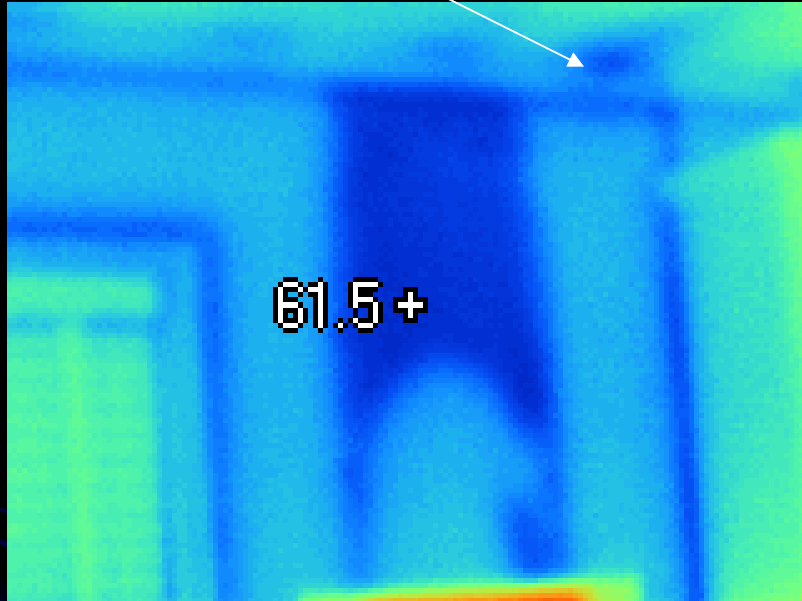
- Excessive energy use due to missing or damaged insulation and excessive air-leakage across the thermal perimeter
- Moisture damage due to leaks or condensation
- Ice damage to sloped roofs
- Poor HVAC distribution or performance
- Inadequate verification of construction details or structural performance
- Delamination of façade materials
- “Sick building syndrome” mold growth and other health related issues



When conditions are right, it is possible to locate missing, damaged or wet insulation, such as this area behind an interior wall

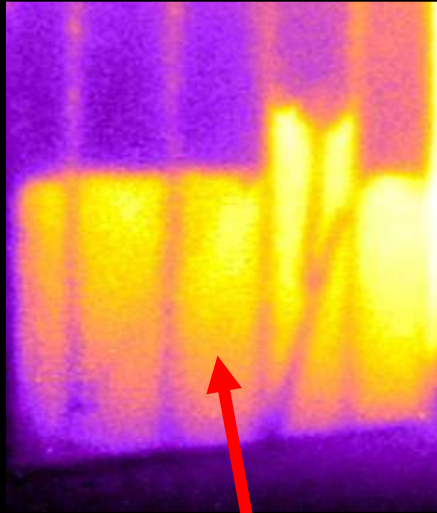
Missing Insulation

Cold Infiltration

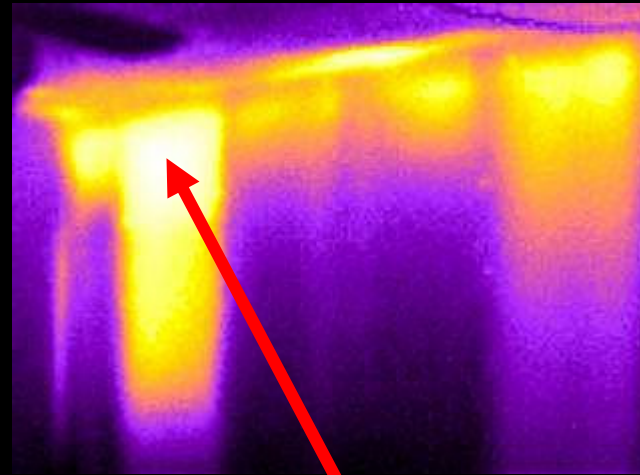


Missing insulation is easily found in this image. Note the cold air infiltrating into the ceiling

Wall Insulation

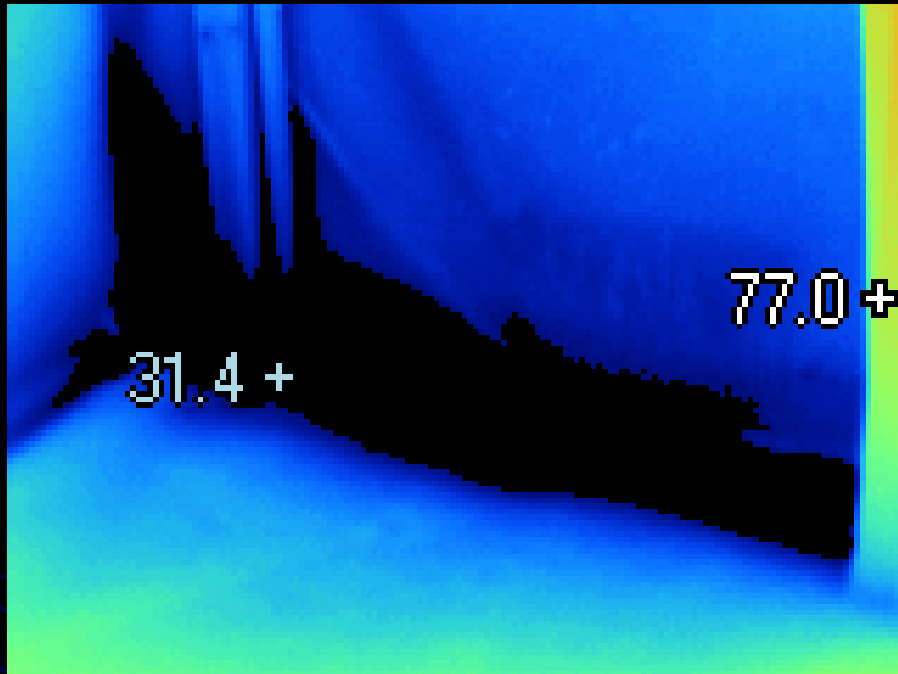


Exterior stucco wall was repaired/replaced. The insulation was removed and not replaced.



Interior view of exterior wall. Insulation is degraded possibly from previous roof leaks. Most severe at arrow tip.

Air Leakage Location



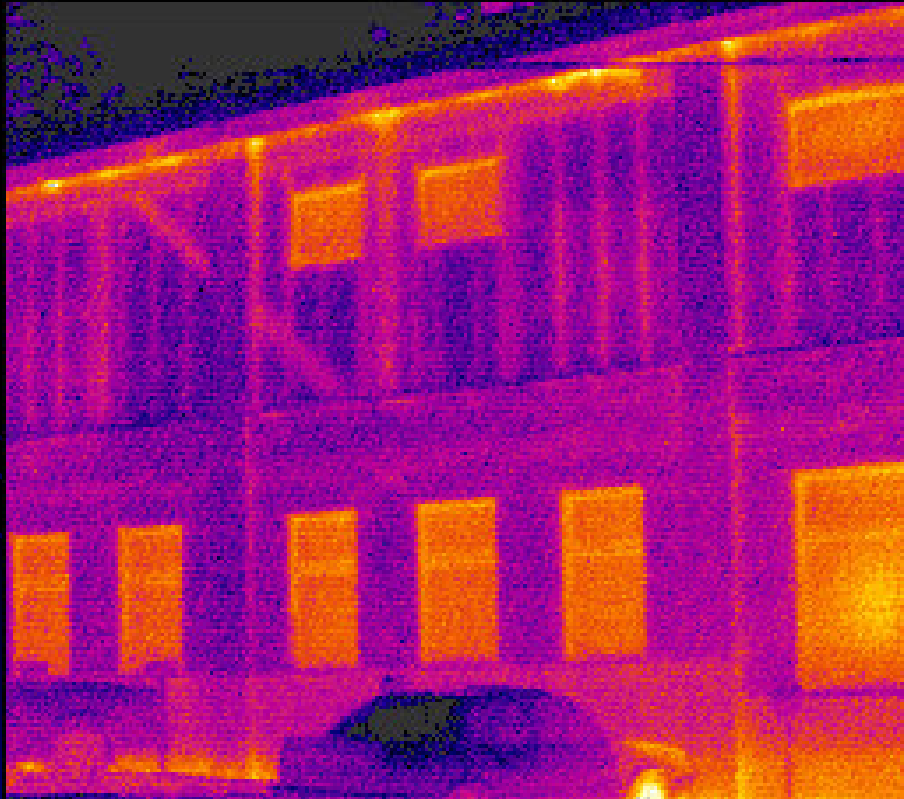
- Excessive air leakage can account for up to half of the energy consumed to conditioned buildings.

- The problems can be as straightforward as a failed door weather seal or as complex as an air pathway through a plumbing chase in an interior wall.

This image is of a sliding glass door. The corner at the adjacent wall was not insulated and there was poor weather seals on the door. This excessive cold caused condensation and subsequently mold to form in the corner. Note the temperature difference between the wall 77 f and the bottom of the door 31.4 f.

New Construction

PHOTO COURTESY OF SNELL INFRARED

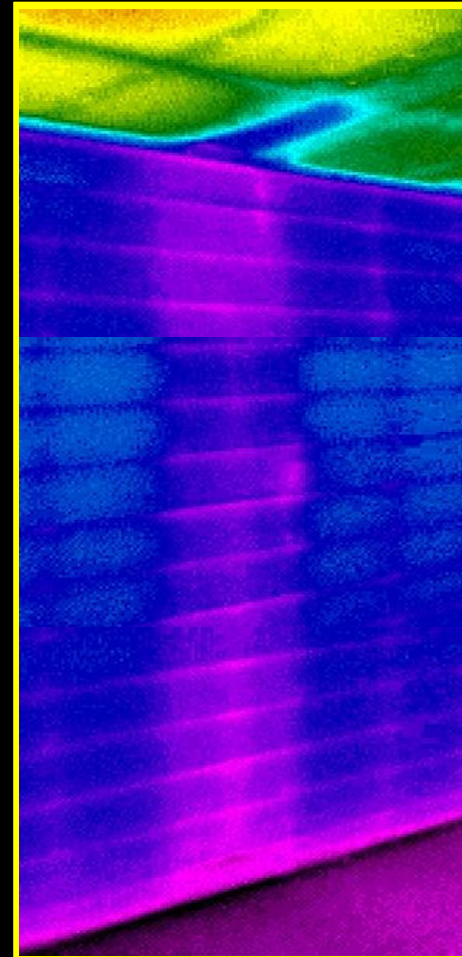


All the framing and insulation is clearly visible in this commercial building.

Normal pressure differences on the top floor result in air leaking past the envelope through various pathways.

Moisture Intrusion or Condensation

- As building designs and techniques produce tighter thermal envelopes, moisture has created more and more problems.
- The water can intrude through a small crack and is then trapped between the relatively impermeable building materials.
- Good building techniques typically must deal with both air sealing and moisture retarders to keep moisture from accumulating inside the wall sections.



Leak from roof
and down the wall

PHOTO COURTESY OF STOCKTON
INFRARED

Condensation and Mold

This mold was caused by condensation on the sheathing.

There was a utility room with a hatch to access the attic. In the room was a washer and dryer, wash tub, furnace and humidifier.



Condensation and Mold



Cold outside air and humid indoor air have caused condensation in this baby's room.



This condensation has caused active mold growth.

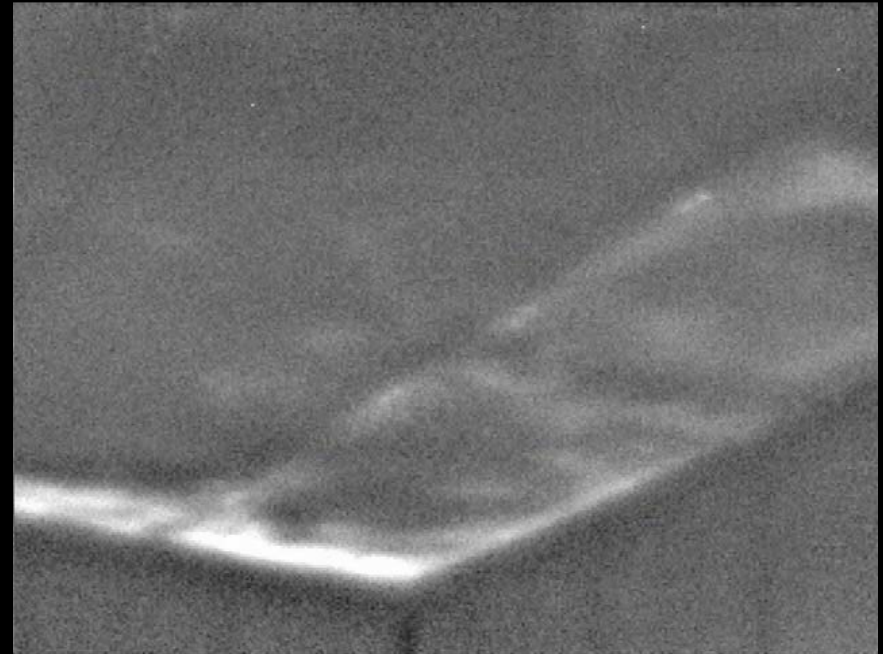


View shows a lack of insulation over this dining area

Condensation Thought to Be a Roof Leak.

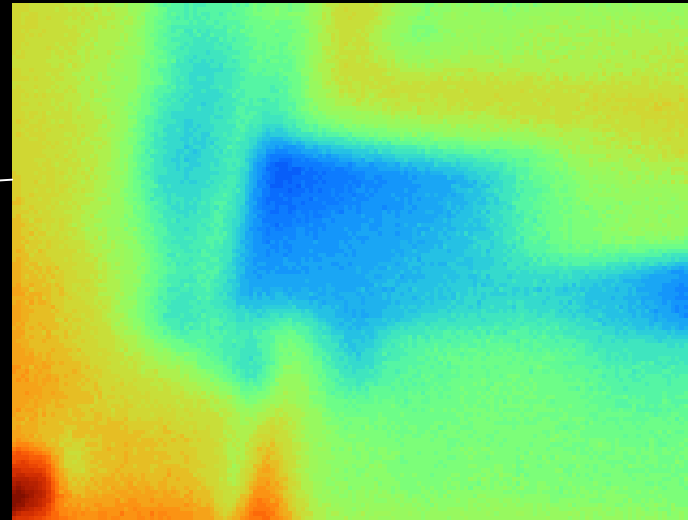


Ceiling and drywall damage



Condensation where insulation was disrupted

Detection and Cause of a Roof Leak



Leaks were caused by penetrations of the siding that were not sealed. Gas pipe and water spigot.

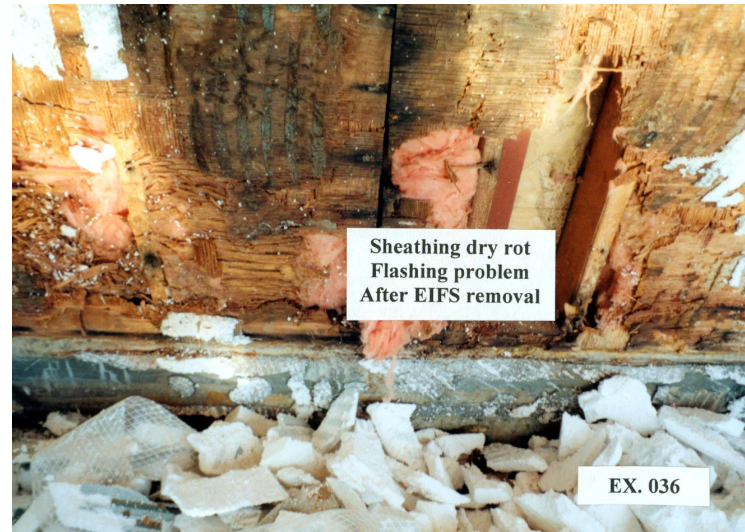
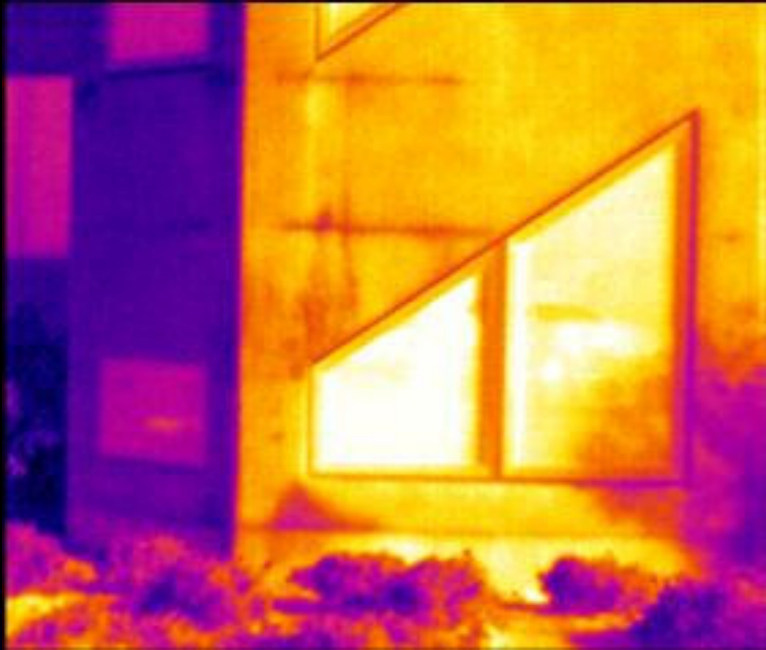
RCi

EIFS



POOR DETAIL WORK HAS ALLOWED WATER TO ENTER THIS WALL SYSTEM

EIFS AND MOLD



The growing popularity to use EIFS on structures has been accompanied by numerous cases of moisture related structural damage. Although some of the cases are due to leaks around windows and doors, others are caused by poor installation of drainage systems.

Vinyl Siding



Suspect wall

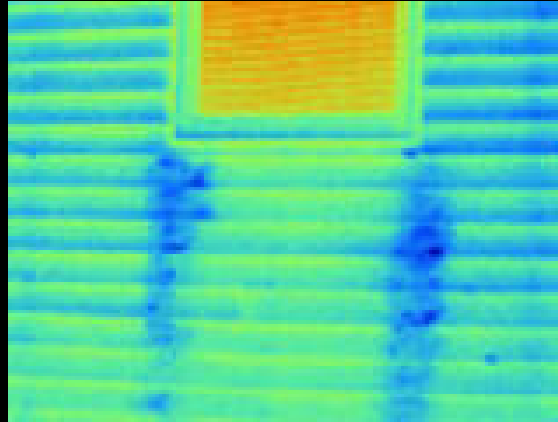


Image consistent with water damage



Fungal contamination and rot

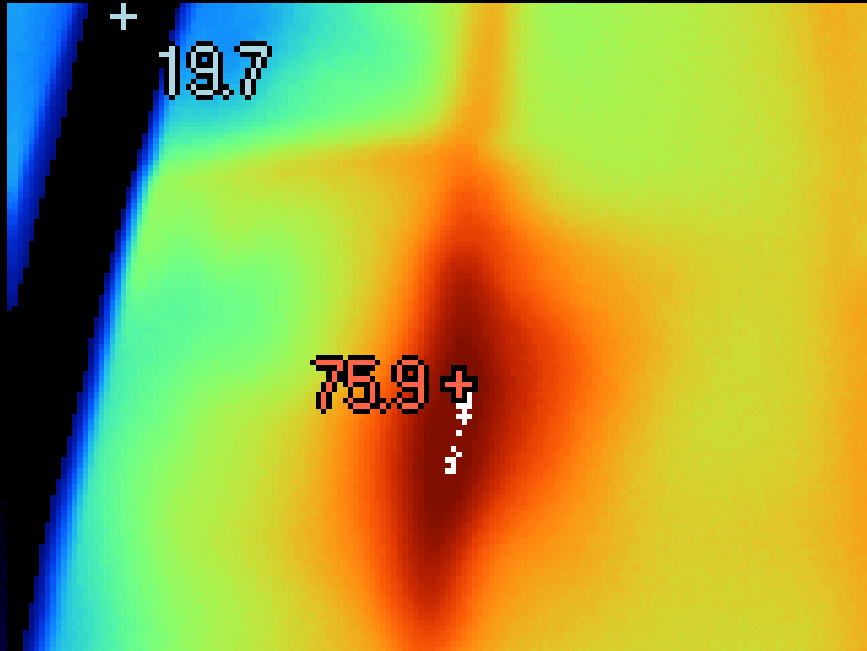
Subsurface Heat Sources



Thermography easily identifies locations and deficiencies in subsurface piping.

Here the exact location of a leak allowed the technician to concentrate his destructive work to a small area instead of destroying large sections to find the broken pipe.

Broken Heat Pipes

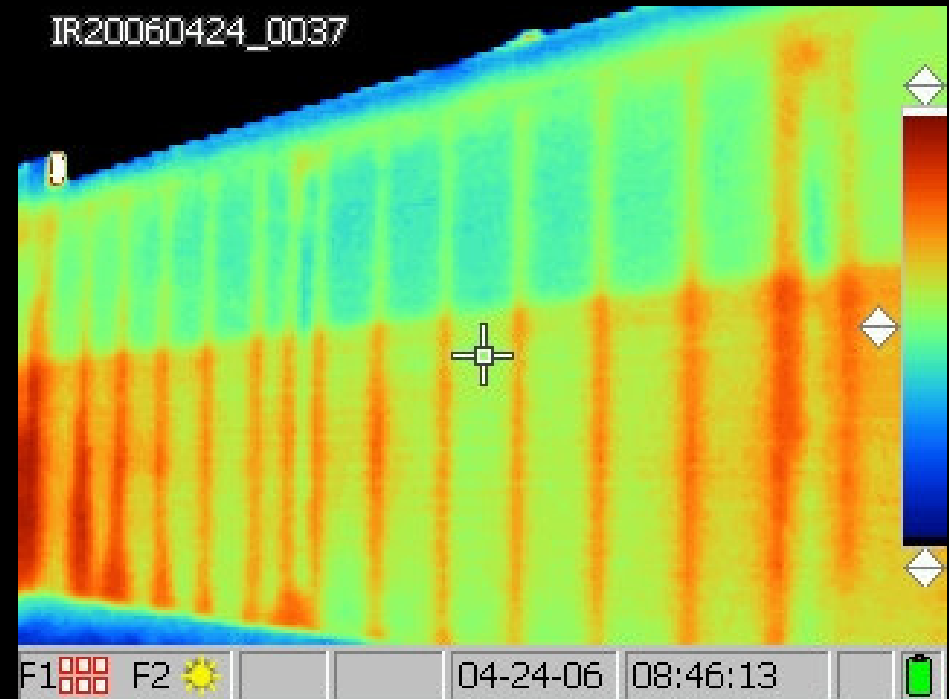


Cold air from this patio door caused the pipes to freeze and burst. Severe damage was done to this unit and the unit below.

CMU



Painted Concrete Block Wall



Grouted Cells Filled At Regular Intervals

CMU



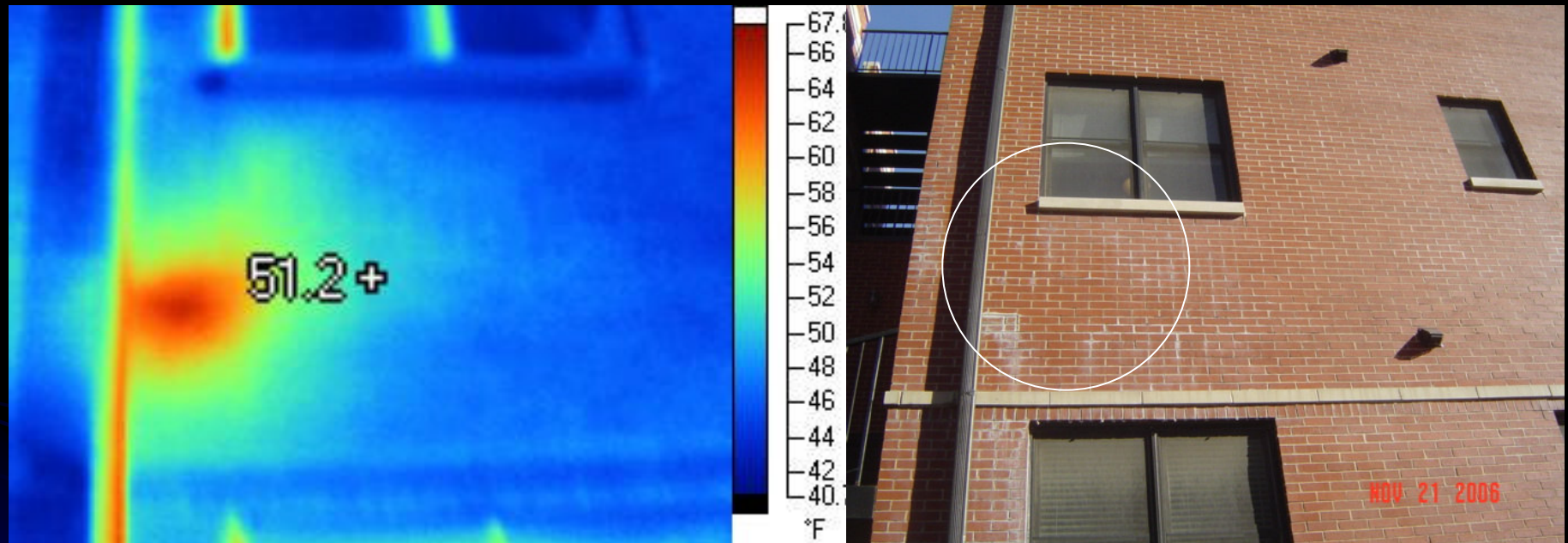
Precast Concrete



Popular Precast Concrete Wall

Photo shows distinct lines of the cables in the precast masonry wall

Brick and Block



This interesting image detected a heat source in a repaired brick wall. The source of the heat was a vent pipe for a clothes dryer bricked in and blocked in the wall.

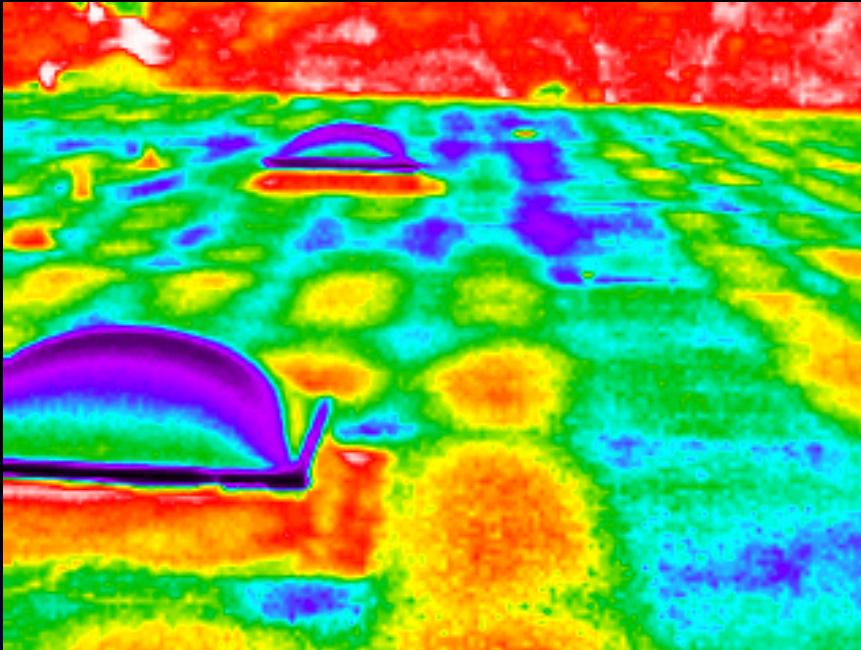
Roofing

Infrared imaging can save building owners hundreds of thousands of dollars on avoidable roof replacement costs.

Studies prove that over 50% of all roofs removed and replaced can be effectively repaired at a fraction of the cost of removal and replacement.

Problems exist with the quality of an infrared survey and thus a trained thermographer and a roofing professional must be utilized in interpreting the results of a thermographic survey.

Roofing



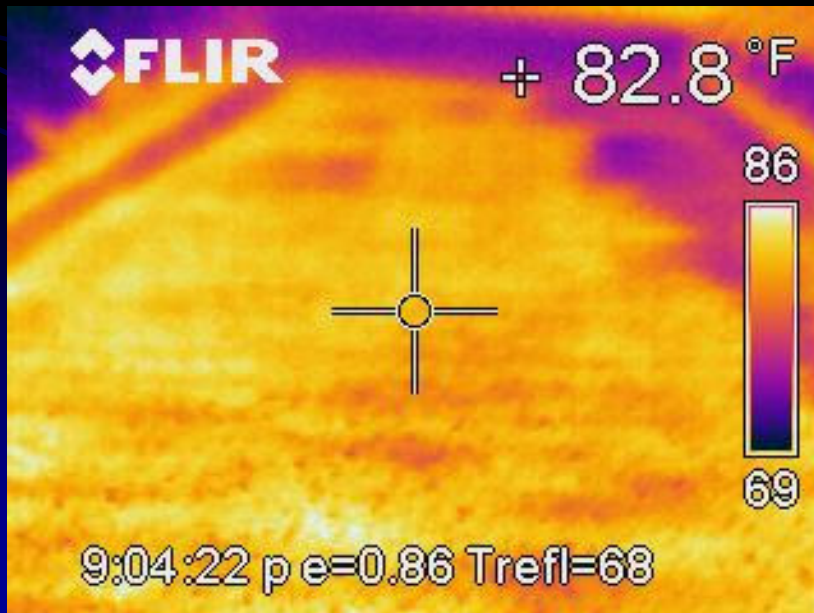
From the looks of this image it appears that the roof being surveyed has a significant amount of wet insulation; red and yellow outlined areas.

Yet in reality, there was no wet insulation throughout the entire roof.

Roofing

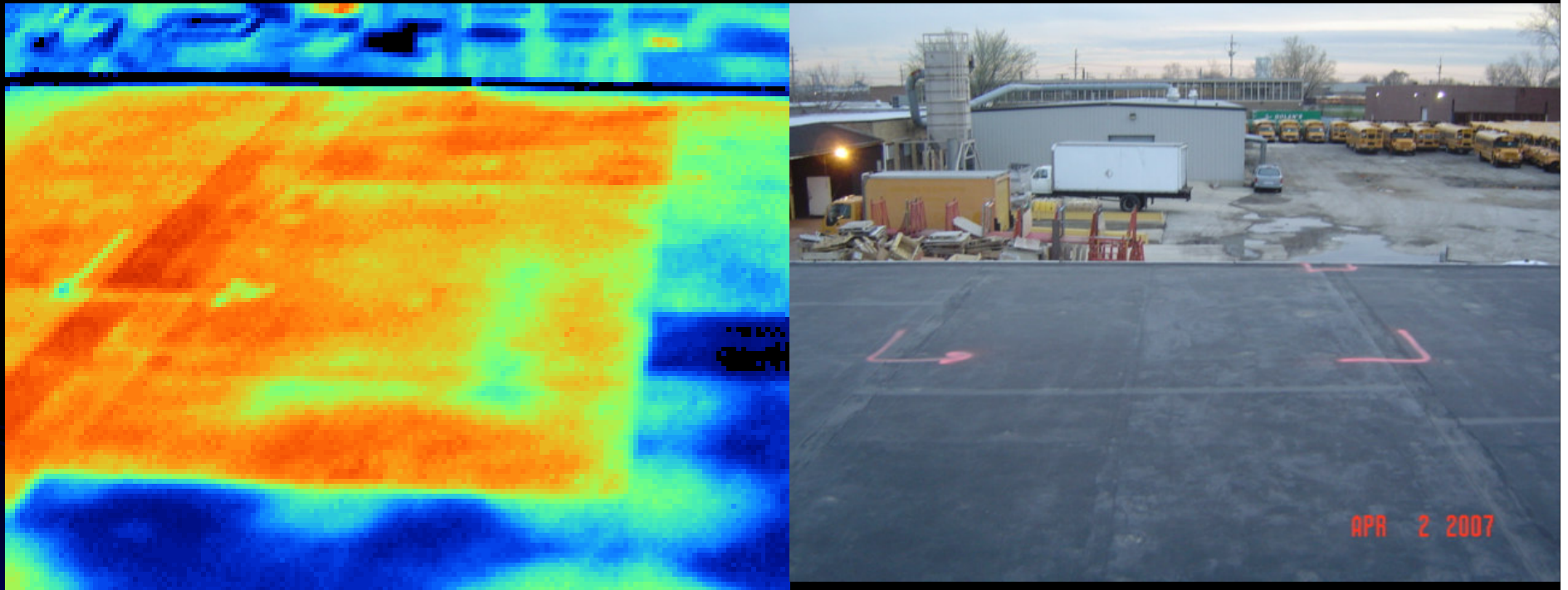


This roof didn't leak



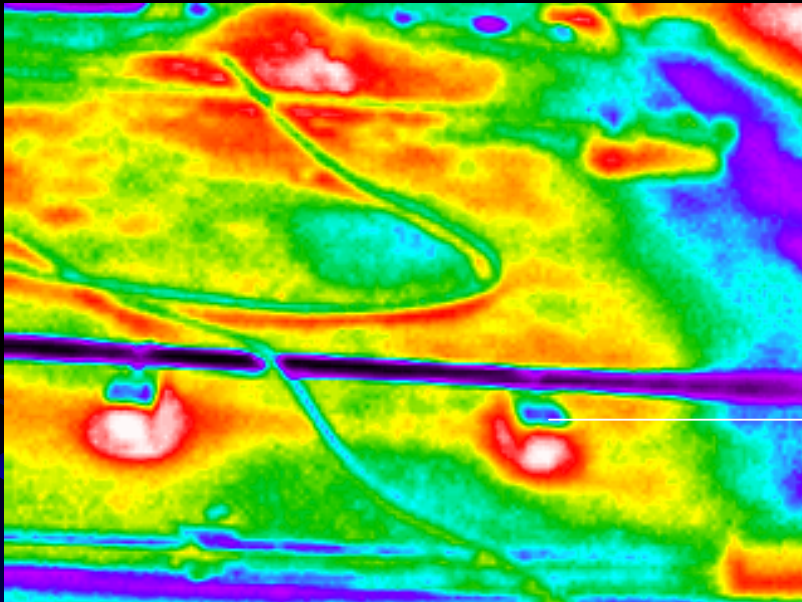
The roof scan discovered the roof was saturated and didn't leak because of a 2 ply vapor barrier.

Roofing



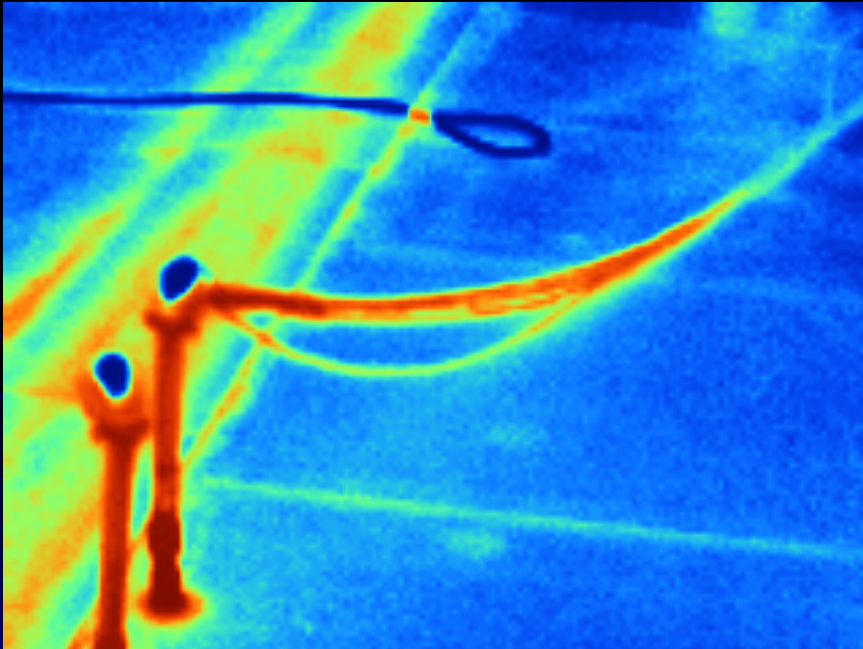
The extent of wet insulation is clearly evident in this image. This is fiberboard insulation under an EPDM membrane.

Roofing



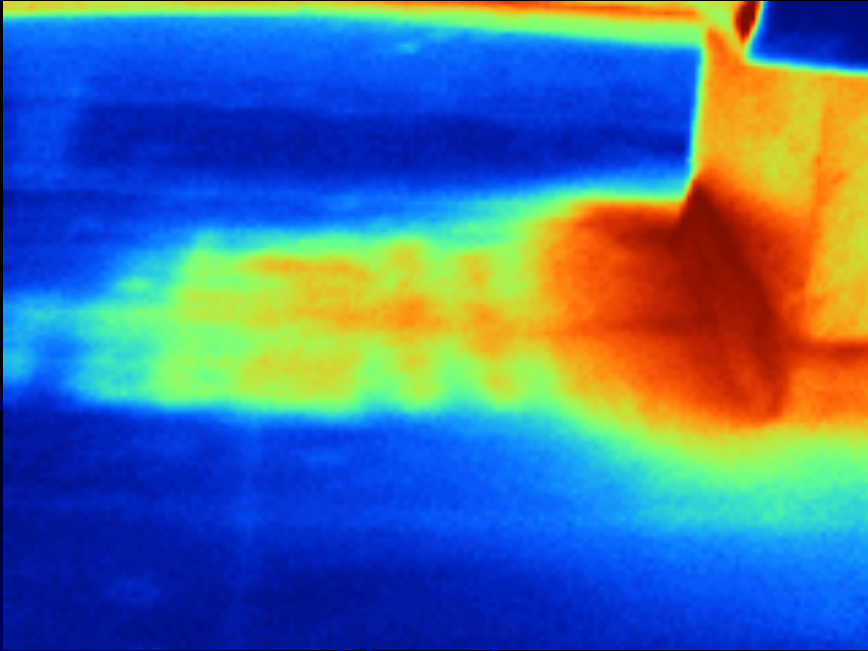
Roof leaks caused by improper
pipe supports

Roofing



Leaking Control Joint

Roofing



Roof Curb Leak

Roofing

Some Roofs Are Difficult To Survey



Ballasted EPDM



Coated Modified Bitumen

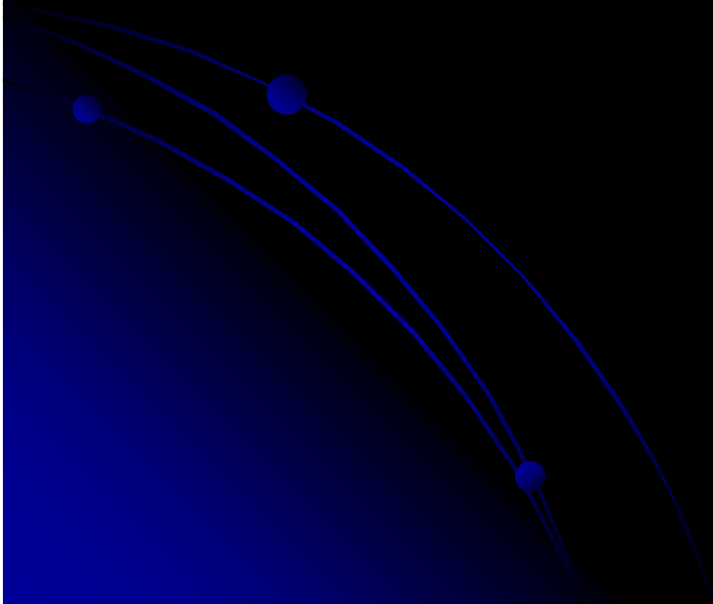
Interior Roofing Inspection



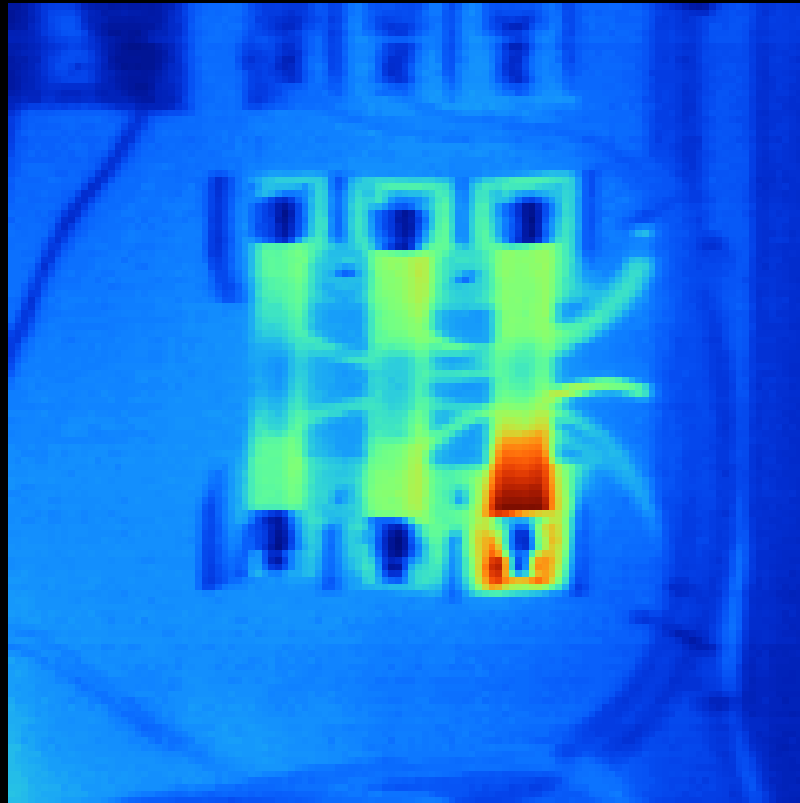
Metal Roofs



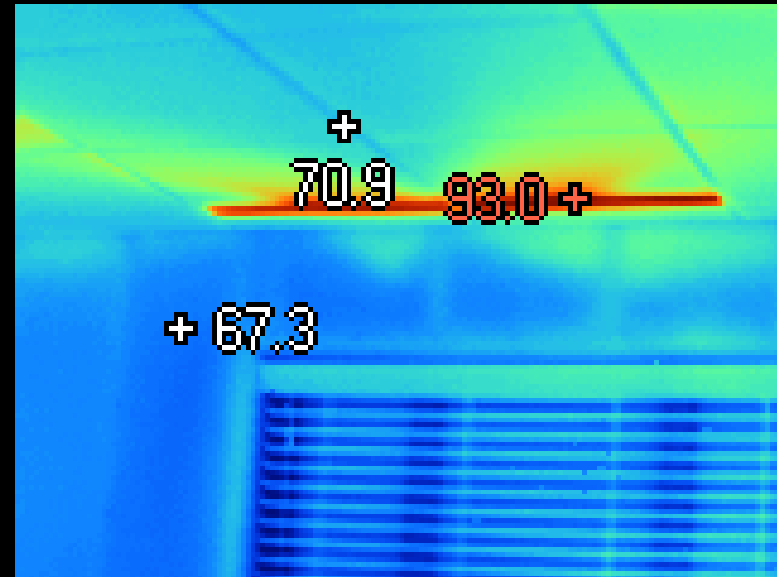
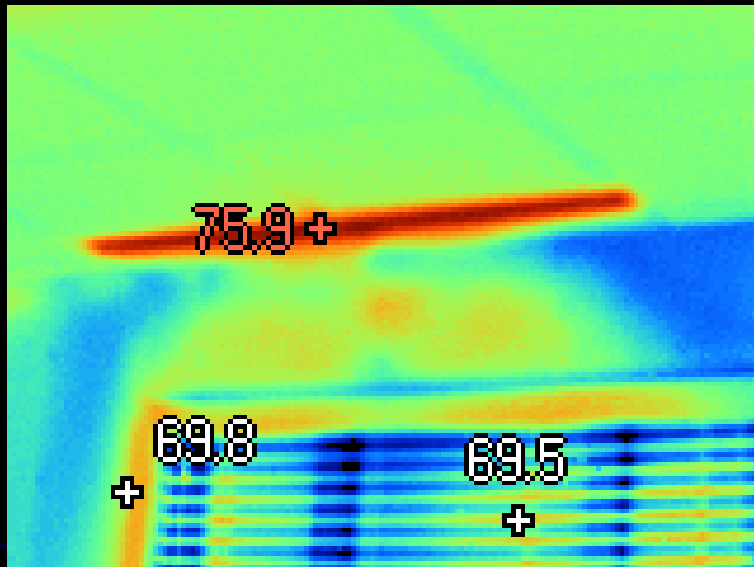
Other Applications



Electrical



H.V.A.C.



The air flow in the image on the left is good.

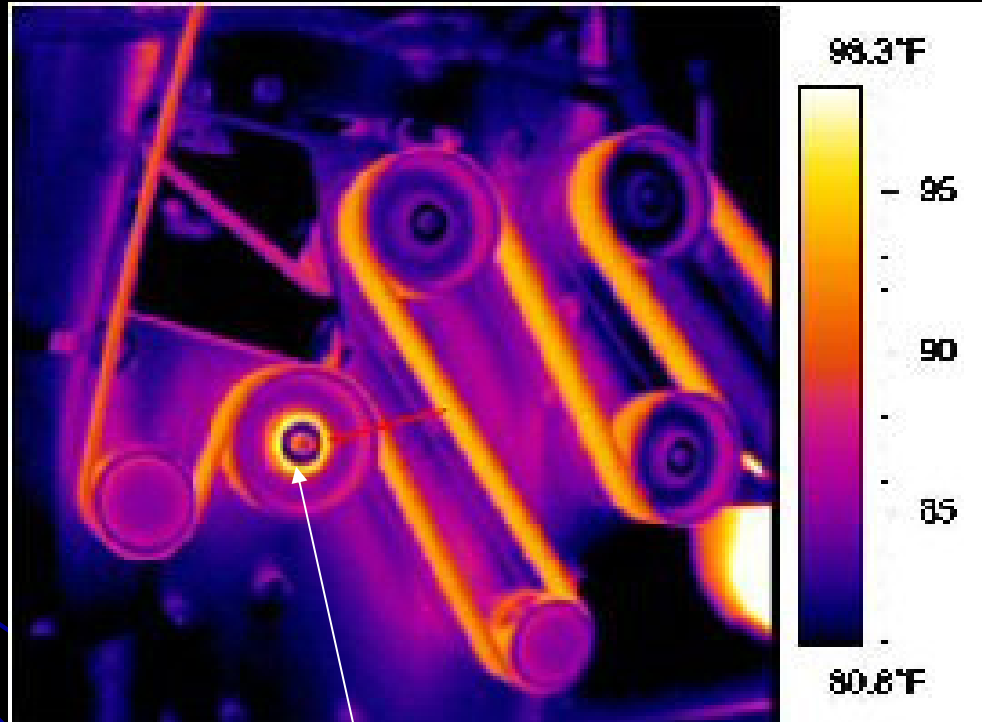
There is very little air movement in the image at the right.

System Performance

Courtesy of Stockton Infrared

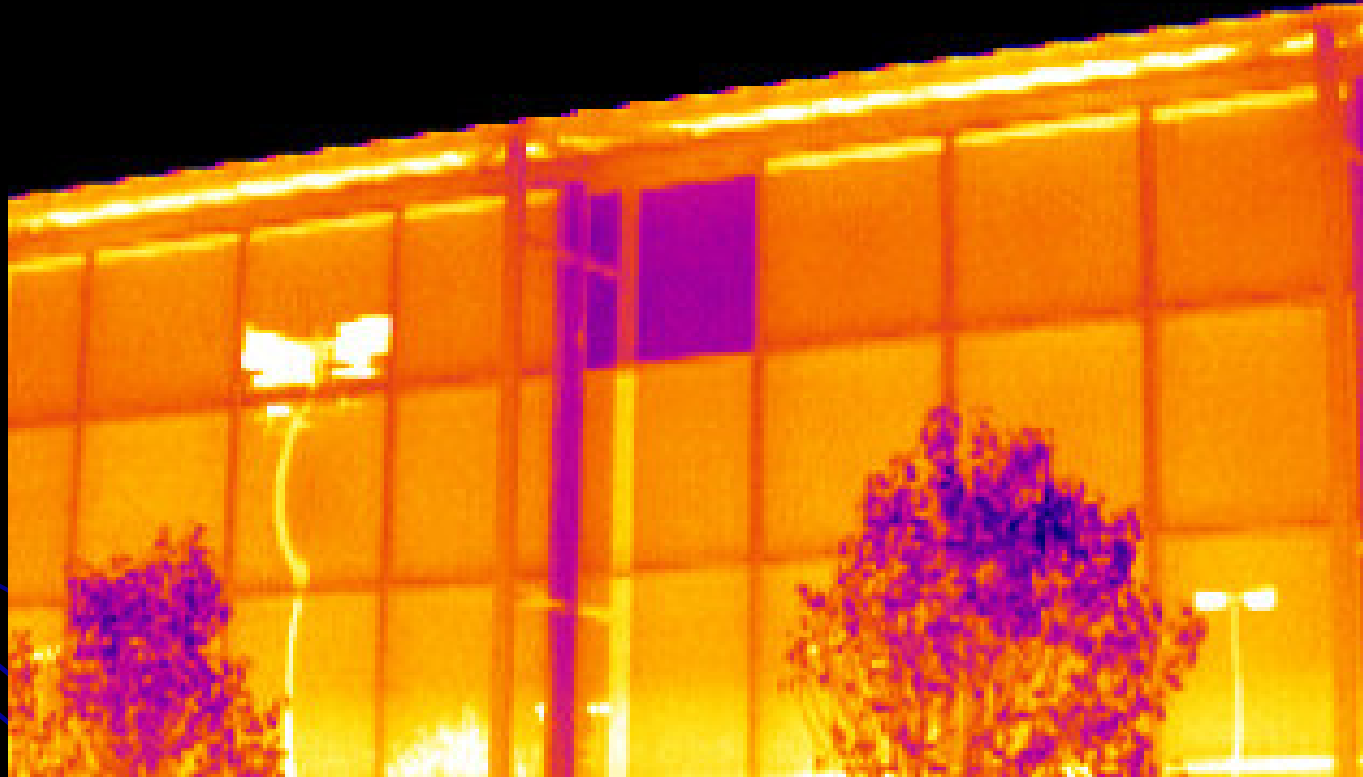


Mechanical



A worn bearing could shut this equipment down

Window Walls



Double Pane Sample VS: Single Pane Glass

thank you



IR20051017_0080

0051017_0016

10-17-05 19:50:46

04-07-05 23

10-11-05 19:05:21

51017_0029

10-17-05 19:50:46

10-17-05 21:39:40

_0021

F2 10-17-05 0051017_0017

10-17-05 10:10:39

10-17-05 10:10:39

F1 F2

10-17-05 15:13:48