Infrared Thermographic
Building Envelope Analysis

PERFORMED FOR:	**Viking Construction** **1387 Seaview Ave.** **Bridgeport, CT 06607**
LOCATION:	**Northeast School** **Stamford, CT**
CONDUCTED ON:	**April 24, 2019**
REQUESTED BY:	**Jo Ann Michaels**
PERFORMED BY:	**Jeff Demeter, Certified Thermographer**

Infra-red Analyzers, Inc.
65 Lyman Drive
Williston, VT 05495
(800) 879-1964

Table of Contents

May 8, 2019

Jo Ann Michaels
Viking Construction
1387 Seaview Ave.
Bridgeport, CT 06607

Dear Jo Ann,

This report summarizes the findings of the Infrared Building Envelope Analysis performed at the Northeast School, Stamford, CT, performed on April 24, 2019.

INFRARED THERMOGRAPHY

All objects emit heat (i.e. infrared radiation). This radiation is constantly being absorbed and re-emitted by ourselves and everything around us. "Infrared scanning" and "thermography" are the terms used to describe the process of making this thermal radiation visible and capable of interpretation.

Infrared Building Envelope Analysis locates and documents building heat loss and moisture damage problems. Infrared Thermography is the only non-destructive and complete system for locating and documenting causes of frozen pipes, ice dams, damaged or missing insulation, moisture damaged building materials, warm air exfiltration, cold air infiltration, and high heating costs. Infrared Building Envelope Surveys provide valuable information for trouble-shooting building envelope problems, evaluating energy retrofits, and developing practical and cost-effective energy solutions.

Our Infrared cameras can also be used in a variety of other Non-Destructive testing applications:

- Infrared Electrical/Mechanical Inspections pinpoint developing problems in power delivery systems. The infrared scanner can "see" hot spots where there are going to be failures before they happen. This Predictive Maintenance approach provides for time to repair these problem areas before they cause equipment damage, unscheduled outages, and expensive down time. Problem areas are pinpointed, prioritized and fully documented.

- Infrared Steam System Inspections pinpoint failing steam traps, malfunctioning heat exchangers and boiler problems. These surveys can save thousands of dollars by reducing energy usage.

- Infrared Roof Moisture Surveys pinpoint moisture damage within roofing systems to help you target problem areas and wet insulation for more cost-effective repairs or roof replacement. Our roof moisture surveys provide independent, objective information about the real condition of your roof system so you can make sound decisions and sift through conflicting opinions and advice.

INSTRUMENTATION

Infra-red Analyzers uses top-quality instruments when performing your Building Envelope Analysis. The portable, high-resolution FLIR T420 is one of the most sensitive and sophisticated scanners available. The T420 can resolve temperature differences < 0.05 degree Celsius, measure temperatures from -20 to 650°C, and offers thermal/visual/fused thermal image/Pi-P/MSX imaging options. In combination with the powerful FLIR Tools+ software, the T420 system enables highly detailed image/data processing in the Windows® environment.

The camera unit receives infrared radiation from the object being surveyed and converts it to an electrical signal that is instantaneously displayed on the color viewfinder. This high-resolution thermal image is then interpreted by Infra-red Analyzers' Certified Thermographers.

THERMOGRAM INTERPRETATION AND DOCUMENTATION

Hard copy documentation of the survey findings is provided through Thermograms and Control Photos. In the Thermograms, temperatures are indicated in various colors. The following is a chart illustrating the hierarchy of colors that the FLIR T420 uses to represent the relative temperature differences of the surface temperatures:

When viewing thermograms that were recorded on the warm side of the thermal envelope (inside the building), the colors that represent cooler temperatures (black, purple & blue) generally represent heat loss problems. When viewing images recorded on the cold side of the thermal envelope (outside of building) surface areas represented by warmer colors (white, red, yellow & green) represent areas of heat loss from the building. Typically heat loss occurs due to reduced insulation value in a wall system and/or air leakage into or out of the heated space.

When scanning from the outside in the cooler months, thermal imagers are limited in their radiometric (temperature measurement) functions. In order to maintain consistent qualitative information, occasionally the scale in the thermogram will be converted to a luminance reading rather than a temperature calibrated output. This allows the thermal imager to provide accurate high-quality thermal imagery at low temperatures. The luminance scale may also be employed at lower Delta T's (inside vs outside) to improve consistency in the thermographic imagery.

The next section of the report contains the 6 sets of thermograms and control photos that were generated during the inspection.

Key to Thermogram Explanations

Thermogram #: 1,2,3,4 etc

Facility: Building being surveyed.

Location of Target: Floor and/or room being surveyed.

Target Shown: Building elevation and/or specific area being surveyed.

Position/Location Taken From: Thermographer's location when recording the thermogram.

Camera Direction: Direction the camera was facing when the thermogram was taken.

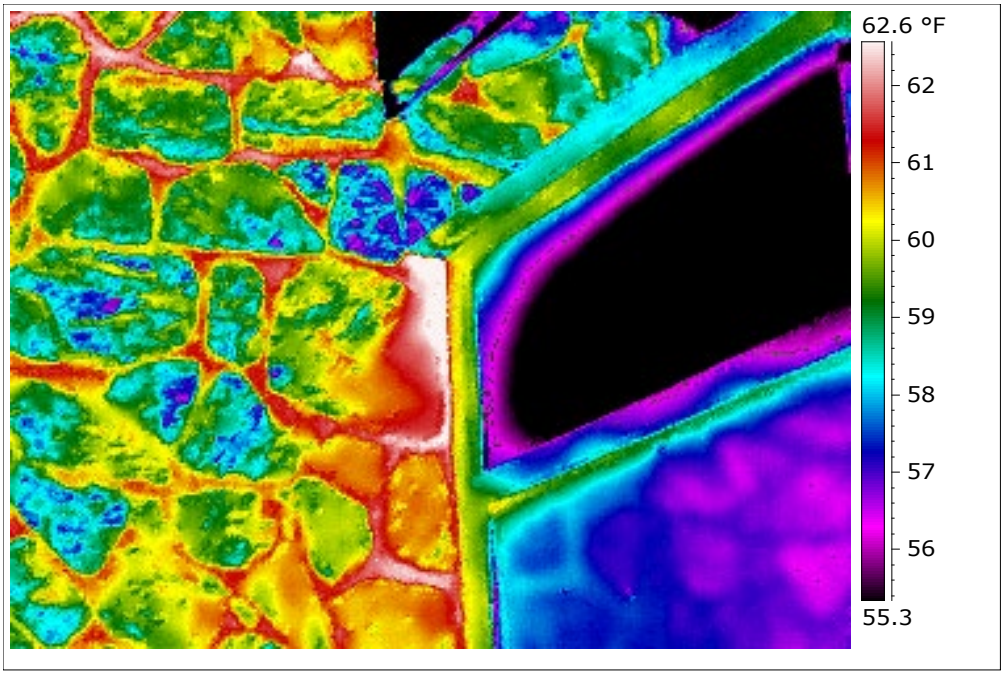
Building Component: The actual component being documented: wall, window, door etc.

Problem Category: Typically the types of problems documented will be Conduction Losses, Air Leakage Losses (infiltration/exfiltration), and Moisture Damage.

Recommendation: These are general guidelines for practical and cost-effective ways to correct the problem.

Control Photo: Visible Light Image

Thermogram: Infrared Image



Thermogram # **1**

Thermogram #: 1

Facility/Building: Northeast School

Location of Target: Media Center – Northeast Entrance

Target Shown: Stone wall to metal & glass entrance transition

Position/Location of Thermographer: Outside – Ground Level

Camera Direction: Northwest

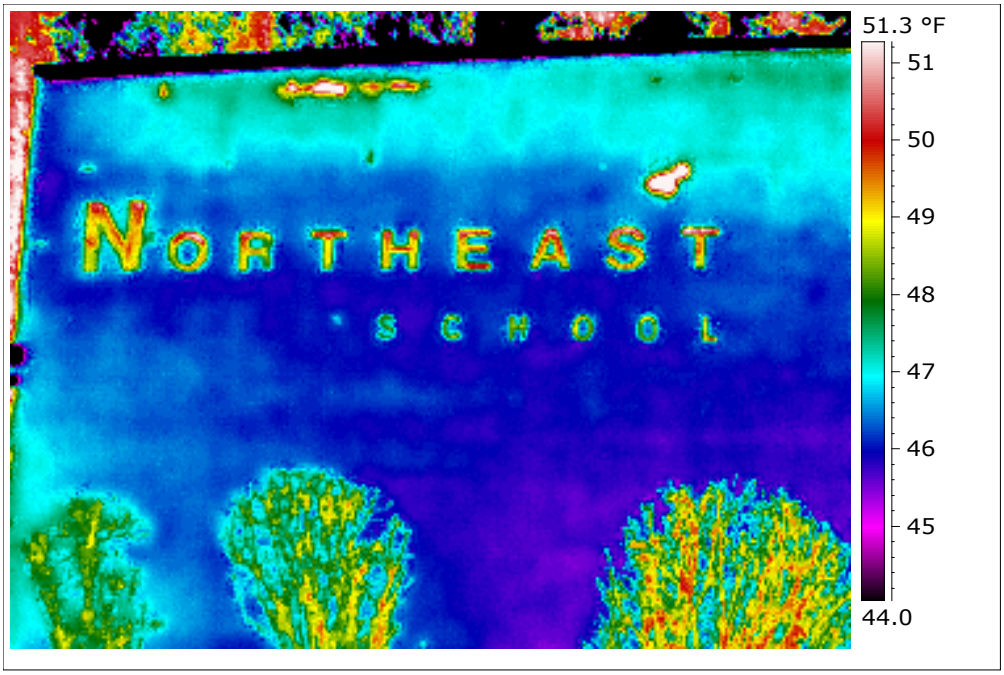
Building Component: Wall

Problem Category: Air Leakage – exfiltration & Conduction Loss

Recommendation: **WALL -** When viewed from the outside, warm air exfiltration at leaky building joints and penetrations will appear as warmer temperatures in the thermogram. If possible, these sources of warm air exfiltration should be sealed to reduce heating costs and improve occupant comfort. Air movement through narrow gaps can often be corrected with the careful application of high-quality, long-lasting caulking compounds. To seal large gaps it may be necessary to retrofit the leaky joints and penetrations with expanding foam insulation. Ideally, sites of air leakage should be physically investigated from both inside and out, and all gaps should be sealed.

WALL - Overall, the majority of the sidewall area exhibited very good performance with only minor areas of conduction loss. In many of the thermograms, the overall infrared patterns were quite consistent with only occasional and small thermal anomalies. However, there were periods of sunshine during the day preceding the testing and this can have an effect on the imagery. Therefore, in this Thermogram, the temperature increases noted could be at least partially caused by residual solar gain. When construction techniques are relatively uniform throughout a structure, and in situations where solar loading may be a factor, the west, south and east exposures may exhibit increases in temperature related to solar gain, while north elevations will typically be less affected.

Control Photo: Visible Light Image



Thermogram: Infrared Image

Thermogram # **2**

Thermogram #: 2

Facility/Building: Northeast School

Location of Target: Media Center – East Wall

Target Shown: South portion

Position/Location of Thermographer: Outside – Ground Level

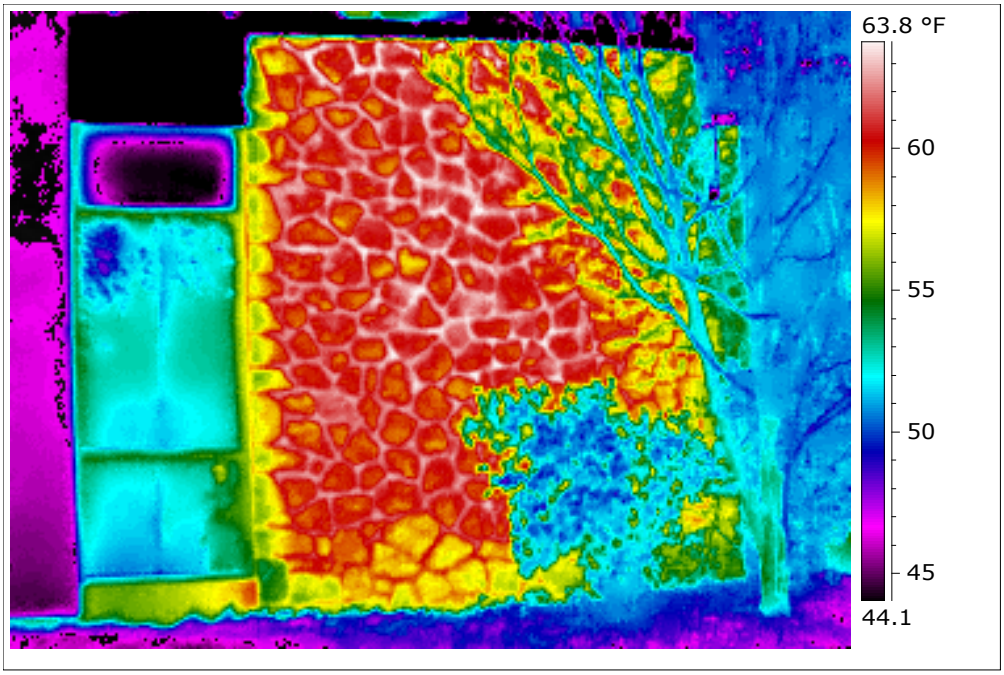
Camera Direction: West

Building Component: Wall

Problem Category: Air Leakage – exfiltration & Conduction Loss

Recommendation: **WALL -** This thermogram illustrates areas of the EIFS that have elevated temperatures, typical of moisture damage in the insulation. However, there are other factors beside moisture damage that can create warm thermal anomalies in these systems. For instance, gaps between insulation boards can allow heat to escape from the building even though the insulation is dry. Also, variations in the application of the insulation and finish can create subtle, but recognizable, temperature differences. Typically, areas with the warmest temperatures are the most likely locations of moisture damage. Areas showing smaller temperature increases (represented by blue, cyan and green) while not as likely to contain significant moisture damage, still should be physically investigated if a thorough analysis is to be performed.

Control Photo: Visible Light Image



Thermogram: Infrared Image

Thermogram # **3**

Thermogram #: 3

Facility/Building: Northeast School

Location of Target: Media Center – East Wall

Target Shown: North portion

Position/Location of Thermographer: Outside – Ground Level

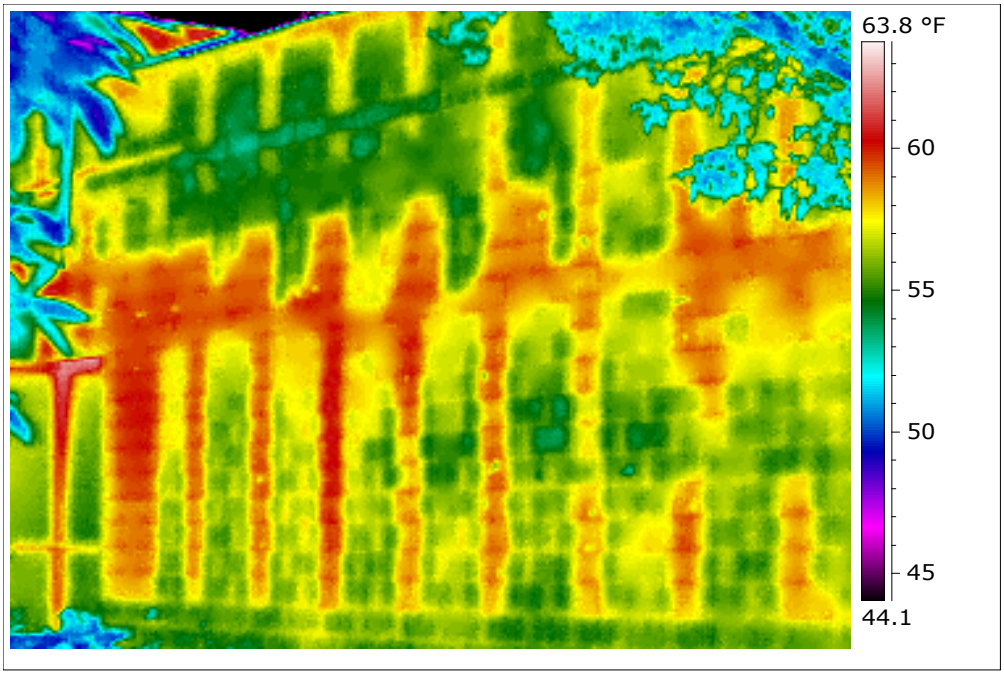
Camera Direction: West

Building Component: Wall

Problem Category: Conduction Loss

Recommendation: **WALL -** Overall, the majority of the sidewall area exhibited very good performance with only minor areas of conduction loss. In many of the thermograms, the overall infrared patterns were quite consistent with only occasional and small thermal anomalies. However, there were periods of sunshine during the day preceding the testing and this can have an effect on the imagery. Therefore, in this Thermogram, the temperature increases noted could be at least partially caused by residual solar gain. When construction techniques are relatively uniform throughout a structure, and in situations where solar loading may be a factor, the west, south and east exposures may exhibit increases in temperature related to solar gain, while north elevations will typically be less affected.

Control Photo: Visible Light Image



Thermogram: Infrared Image

Thermogram # **4**

Thermogram #: 4

Facility/Building: Northeast School

Location of Target: Media Center – Southeast Wall

Target Shown: Most of the wall from glass walkway

Position/Location of Thermographer: Outside – Ground Level

Camera Direction: Northwest

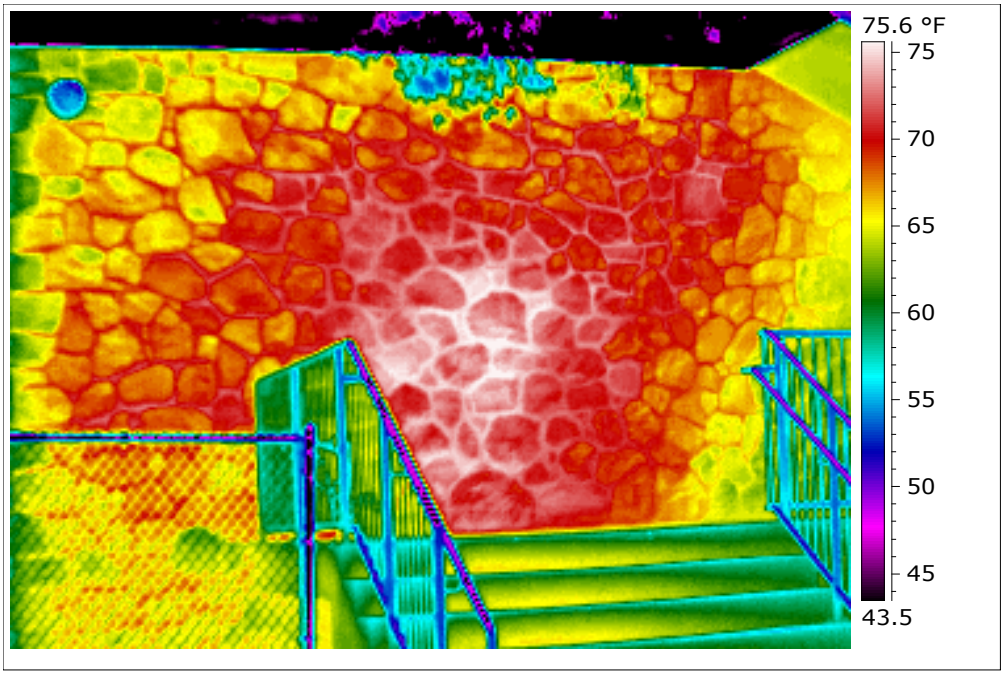
Building Component: Wall

Problem Category: Conduction Loss

Recommendation: **WALL -** There are significant conduction losses through the masonry wall in this area. If possible, the construction of this wall should be physically investigated to determine if the wall is insulated, and if the insulation has been properly installed. Although there are significant heat losses here, retrofitting masonry walls often involves substantial expense. There may not be a practical, cost-effective way to reduce these conduction losses. It may be prudent to perform a comprehensive cost-benefit analysis to determine the return on investment (ROI) and advisability of any retrofits designed to reduce these conduction losses.

Control Photo: Visible Light Image

Thermogram: Infrared Image



Thermogram # **5**

Thermogram #: 5

Facility/Building: Northeast School

Location of Target: Front of School - Northeast Entrance (Upper)

Target Shown: Wall area by stair landing

Position/Location of Thermographer: Outside – Ground Level

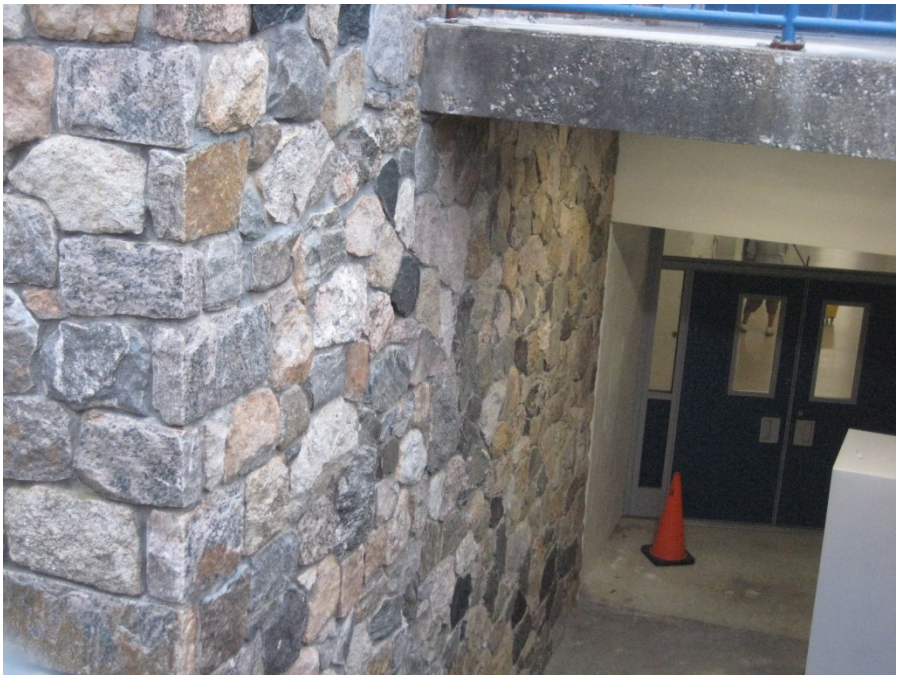
Camera Direction: Southeast

Building Component: Wall

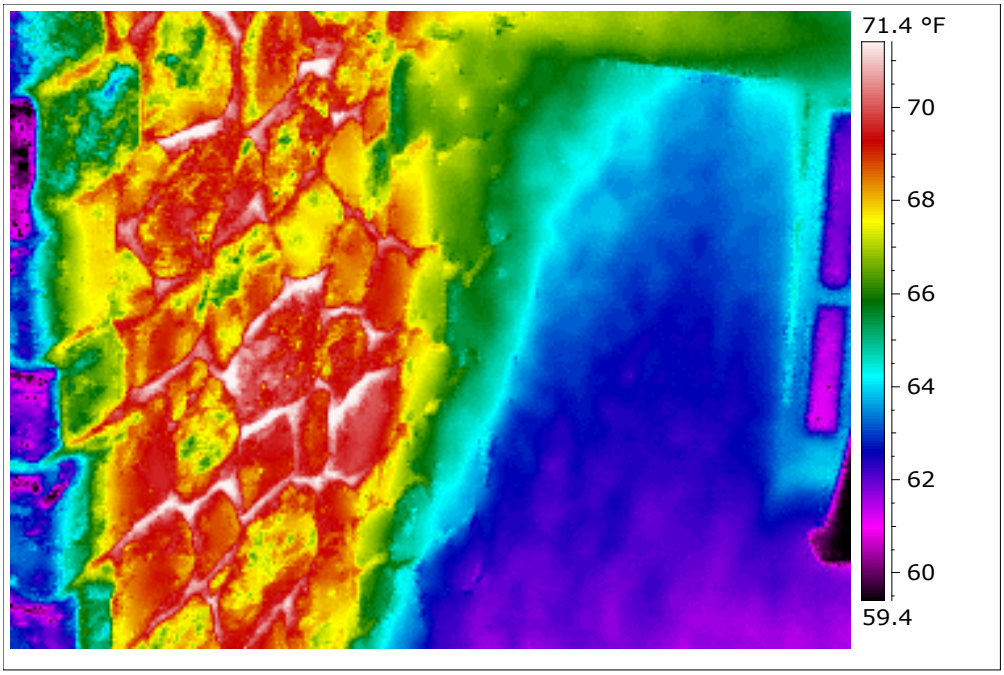
Problem Category: Conduction Loss

Recommendation: **WALL -** Overall, the majority of the sidewall area exhibited very good performance with only minor areas of conduction loss. In many of the thermograms, the overall infrared patterns were quite consistent with only occasional and small thermal anomalies. However, there were periods of sunshine during the day preceding the testing and this can have an effect on the imagery. Therefore, in this Thermogram, the temperature increases noted could be at least partially caused by residual solar gain. When construction techniques are relatively uniform throughout a structure, and in situations where solar loading may be a factor, the west, south and east exposures may exhibit increases in temperature related to solar gain, while north elevations will typically be less affected.

Control Photo: Visible Light Image



Thermogram: Infrared Image



Thermogram # **6**

Thermogram #: 6

Facility/Building: Northeast School

Location of Target: Front of School - Northeast Entrance (Lower)

Target Shown: Wall area by stair landing

Position/Location of Thermographer: Outside – Ground Level

Camera Direction: South

Building Component: Wall

Problem Category: Conduction Loss

Recommendation: **WALL -** Overall, the majority of the sidewall area exhibited very good performance with only minor areas of conduction loss. In many of the thermograms, the overall infrared patterns were quite consistent with only occasional and small thermal anomalies. However, there were periods of sunshine during the day preceding the testing and this can have an effect on the imagery. Therefore, in this Thermogram, the temperature increases noted could be at least partially caused by residual solar gain. When construction techniques are relatively uniform throughout a structure, and in situations where solar loading may be a factor, the west, south and east exposures may exhibit increases in temperature related to solar gain, while north elevations will typically be less affected.

SUMMARY

The testing at the Northeast School uncovered some significant areas of heat loss, and they are documented in this report. Typically, when addressing heat loss issues the air leakage problems are assigned higher priorities. While most buildings have both conduction and air leakage losses, addressing the air leakage problems is usually the simplest and most cost-effective way to improve the thermal performance of the building envelope. Air movement through the building envelope can often be reduced or eliminated using simple, inexpensive and easily applied materials. While conduction losses through the solid materials in the structure may also be significant, it is typically more expensive and disruptive to reduce the conduction losses through walls, windows and doors. It may be prudent to perform a complete cost/benefit analysis before undertaking retrofits designed to reduce any conduction losses.

The issues documented during the testing are listed below in approximate priority order, i.e the recommendations at the beginning of the summary appear to constitute the most practical and cost-effective actions, while those at the end will probably require greater expense and result in a longer return on investment (ROI).

WALL - In Thermograms #4, there is significant conduction losses through the masonry wall in this area. If possible, the construction of this wall should be physically investigated to determine if the wall is insulated, and if the insulation has been properly installed. Although there are significant heat losses here, retrofitting masonry walls often involves substantial expense. There may not be a practical, cost-effective way to reduce these conduction losses. It may be prudent to perform a comprehensive cost-benefit analysis to determine the return on investment (ROI) and advisability of any retrofits designed to reduce these conduction losses.

WALL – Thermogram #2 illustrates areas of the EIFS that have elevated temperatures, typical of moisture damage in the insulation. However, there are other factors beside moisture damage that can create warm thermal anomalies in these systems. For instance, gaps between insulation boards can allow heat to escape from the building even though the insulation is dry. Also,

variations in the application of the insulation and finish can create subtle, but recognizable, temperature differences. Typically, areas with the warmest temperatures are the most likely locations of moisture damage. Areas showing smaller temperature increases (represented by blue, cyan and green) while not as likely to contain significant moisture damage, still should be physically investigated if a thorough analysis is to be performed.

WALL - When viewed from the outside, warm air exfiltration at leaky building joints and penetrations will appear as warmer temperatures in Thermogram #1. If possible, these sources of warm air exfiltration should be sealed to reduce heating costs and improve occupant comfort. Air movement through narrow gaps can often be corrected with the careful application of high-quality, long-lasting caulking compounds. To seal large gaps it may be necessary to retrofit the leaky joints and penetrations with expanding foam insulation. Ideally, sites of air leakage should be physically investigated from both inside and out, and all gaps should be sealed.

WALL - Overall, the majority of the sidewall area exhibited very good performance with only minor areas of conduction loss. In Thermograms #1, 3, 5 & 6, the overall infrared patterns were quite consistent with only occasional and small thermal anomalies. However, there were periods of sunshine during the day preceding the testing and this can have an effect on the imagery. Therefore, in this Thermogram, the temperature increases noted could be at least partially caused by residual solar gain. When construction techniques are relatively uniform throughout a structure, and in situations where solar loading may be a factor, the west, south and east exposures may exhibit increases in temperature related to solar gain, while north elevations will typically be less affected.

Jo Ann, thank you for using our Infrared Services. Please call me if you have any questions regarding this report, or if I can help in any way.

Sincerely,

J.P. Phillips
Director of Operations