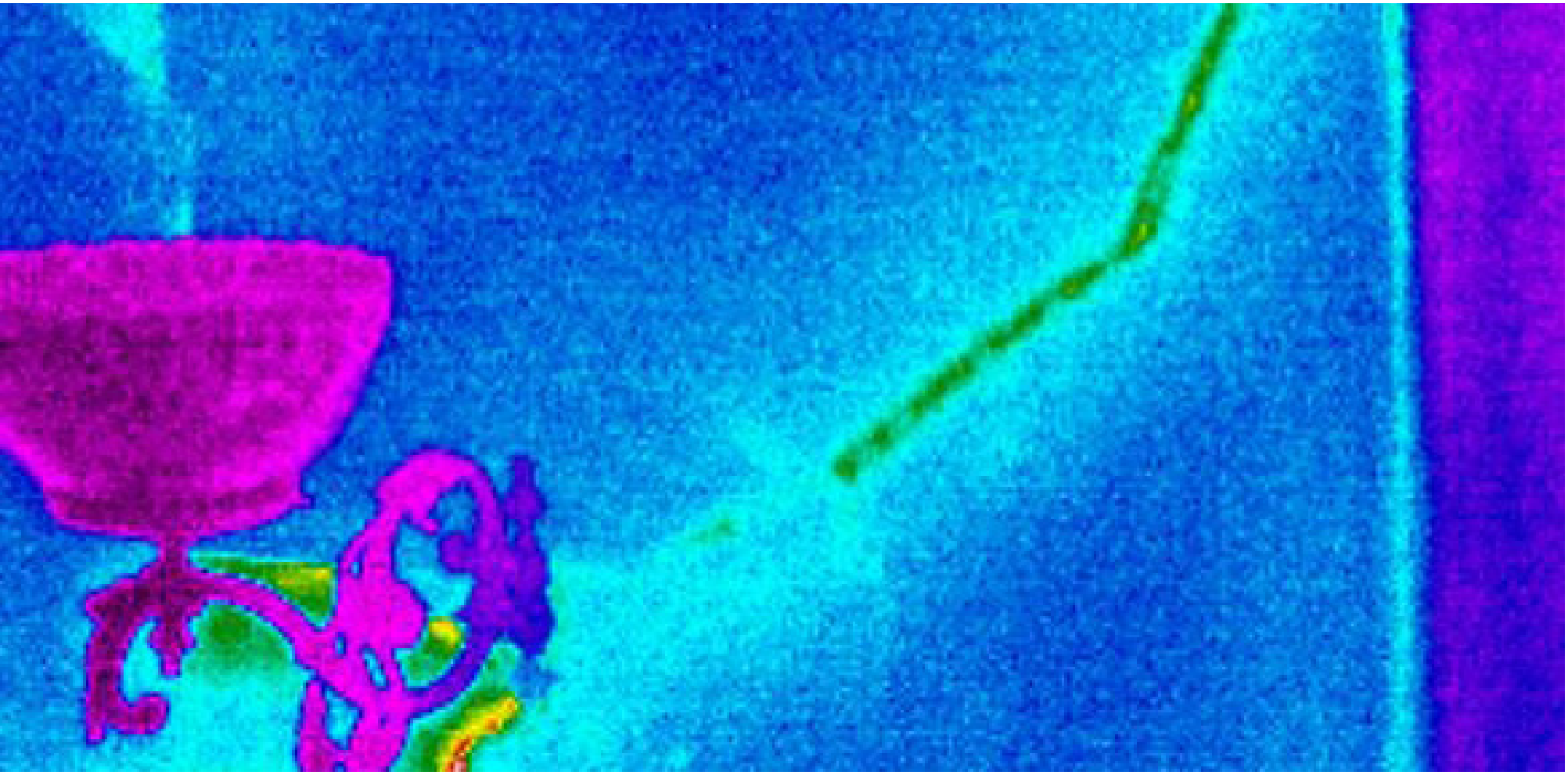
Beyond the Visible: Using Infrared Thermography to Assess Historic Structures



MEADORS CONSERVATION

Betty Prime, AIA, Architectural Conservator
Kalen McNabb, Architectural Conservator

[Heat]

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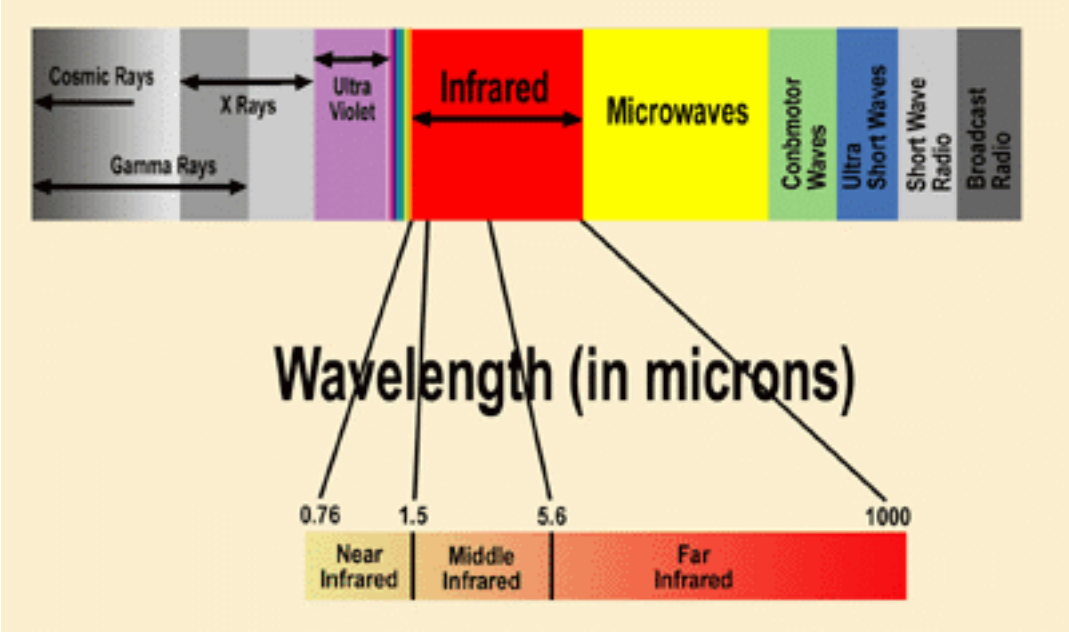
[Infrared Basics]

Infrared Thermography:

- Infrared thermography is equipment or method, which detects infrared energy emitted from object, converts it to temperature, and displays image of temperature distribution
- A graphical representation of heat



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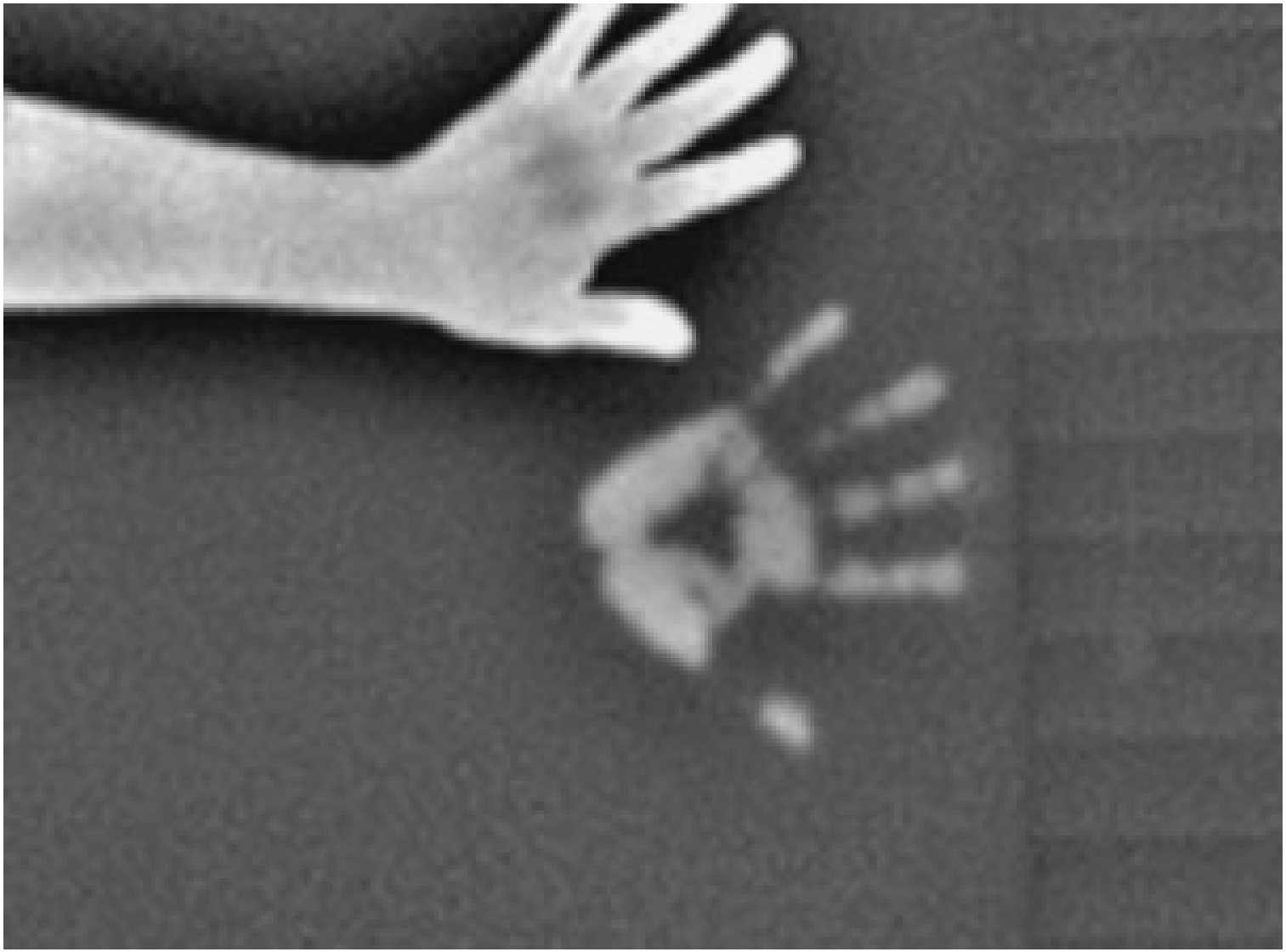
[Applied Heat]



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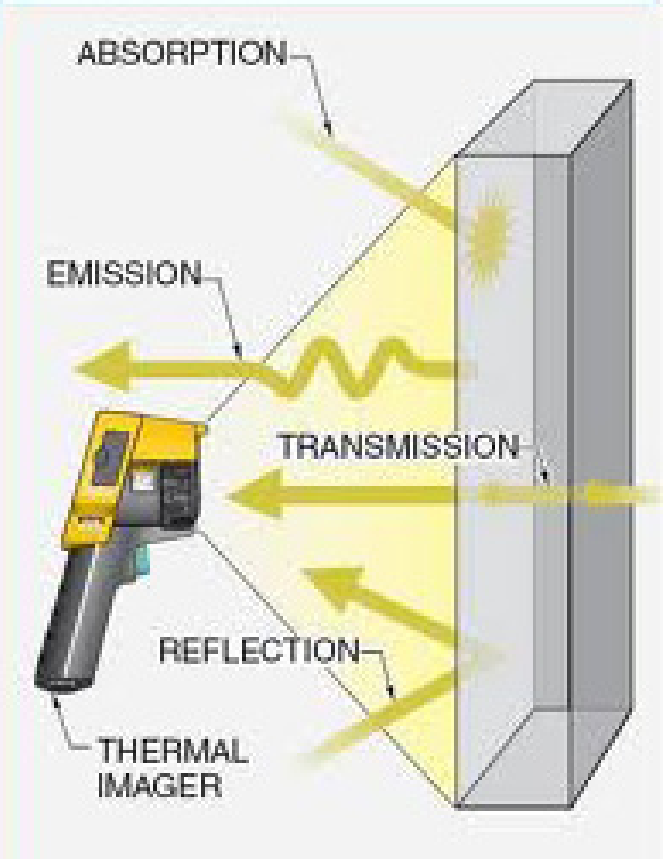
[Infrared Basics]

Emittance and Reflectance:

- Kirchoff's Law: Emitted Energy + Transmitted Energy + Reflected Energy = 1
- (E + T + R = 1)
- A good emitter is a good absorber of energy (Human skin)
- Heat is transmitted through an object to camera
- Reflectance- the amount of light reflected from an object. A mirror is a good reflector.
- Usually E + R =1



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[Infrared Basics- Emissivity]

Approximate Emissivity of Materials

Materials	Nominal	Polished	Oxidized
Aluminum		0.05	0.15
Brass		0.09	0.6
Cast Iron		0.21	0.7
Copper		0.02	0.6
Galvanized		0.02	0.6
Glass	0.94		
Stainless Steel		0.17	0.85
Steel		0.11	0.75
Rubber	0.86-0.95		
Wood	0.95		

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[Assessing Buildings with Infrared Thermography]

Factors to consider:

- Strong understanding of building science & building construction
- Surface Condition
- Material
- Focus/Angle of View
- Environmental Conditions (Temp & %RH)
- Wavelength

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[Infrared Applications: Moisture Intrusion]

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[Infrared Applications: Leaking Roof]

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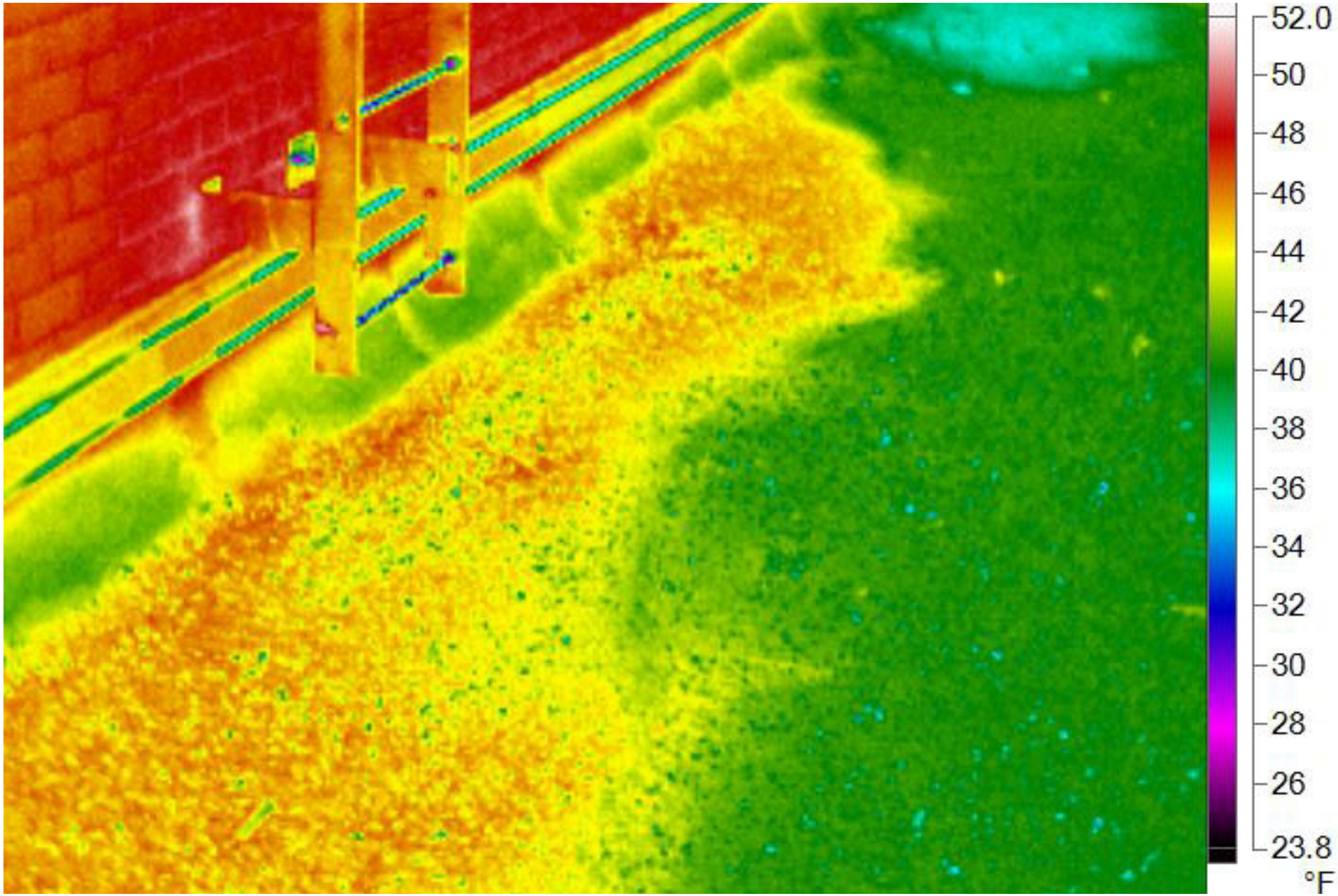
[Infrared Applications: Leaking Roof]



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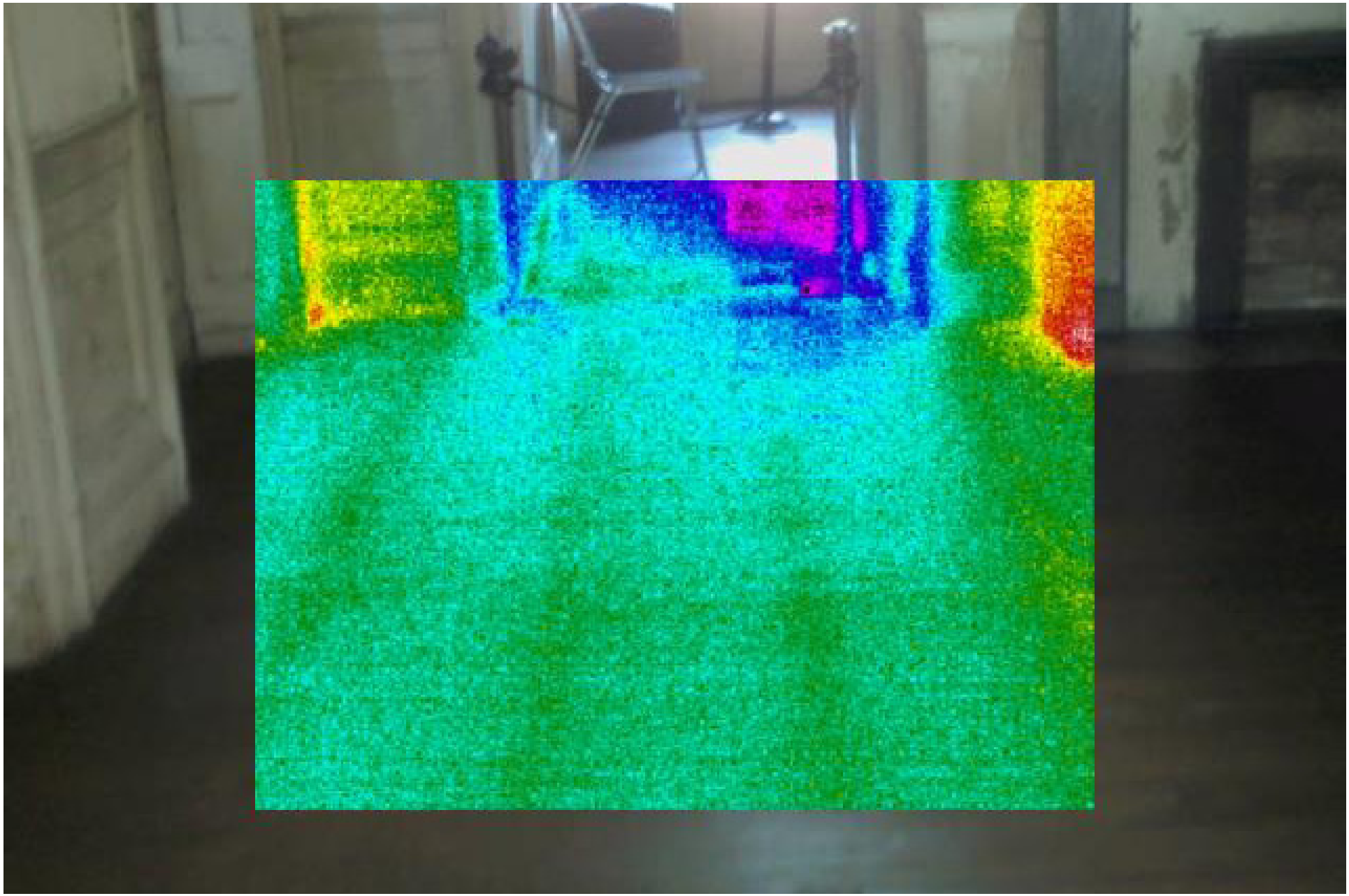
[Infrared Applications: Methods of Construction]



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[Infrared Applications: Methods of Construction]

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[Infrared Applications: Methods of Construction]

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[Infrared Applications: Methods of Construction]

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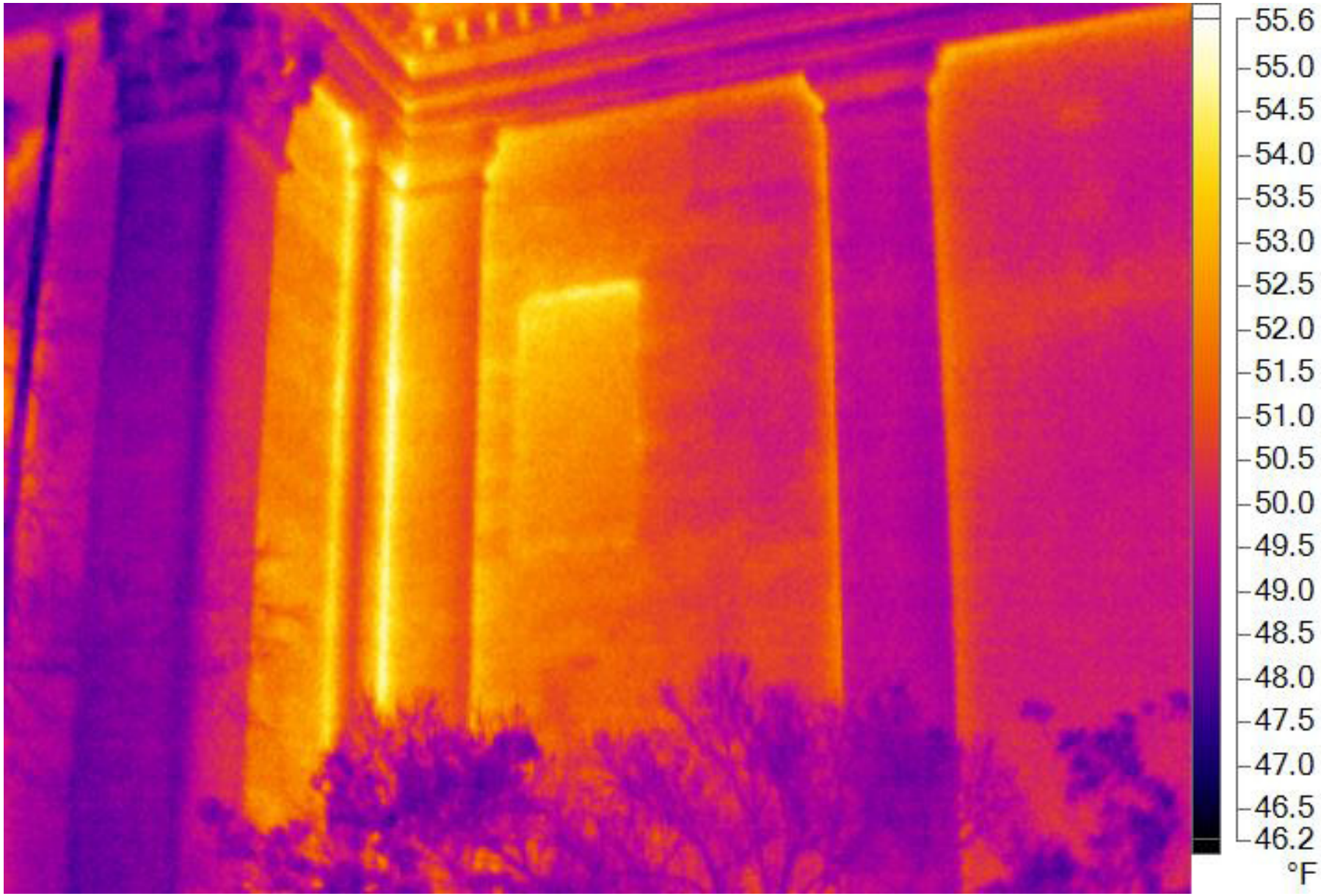
[Infrared Applications: Hidden Features]



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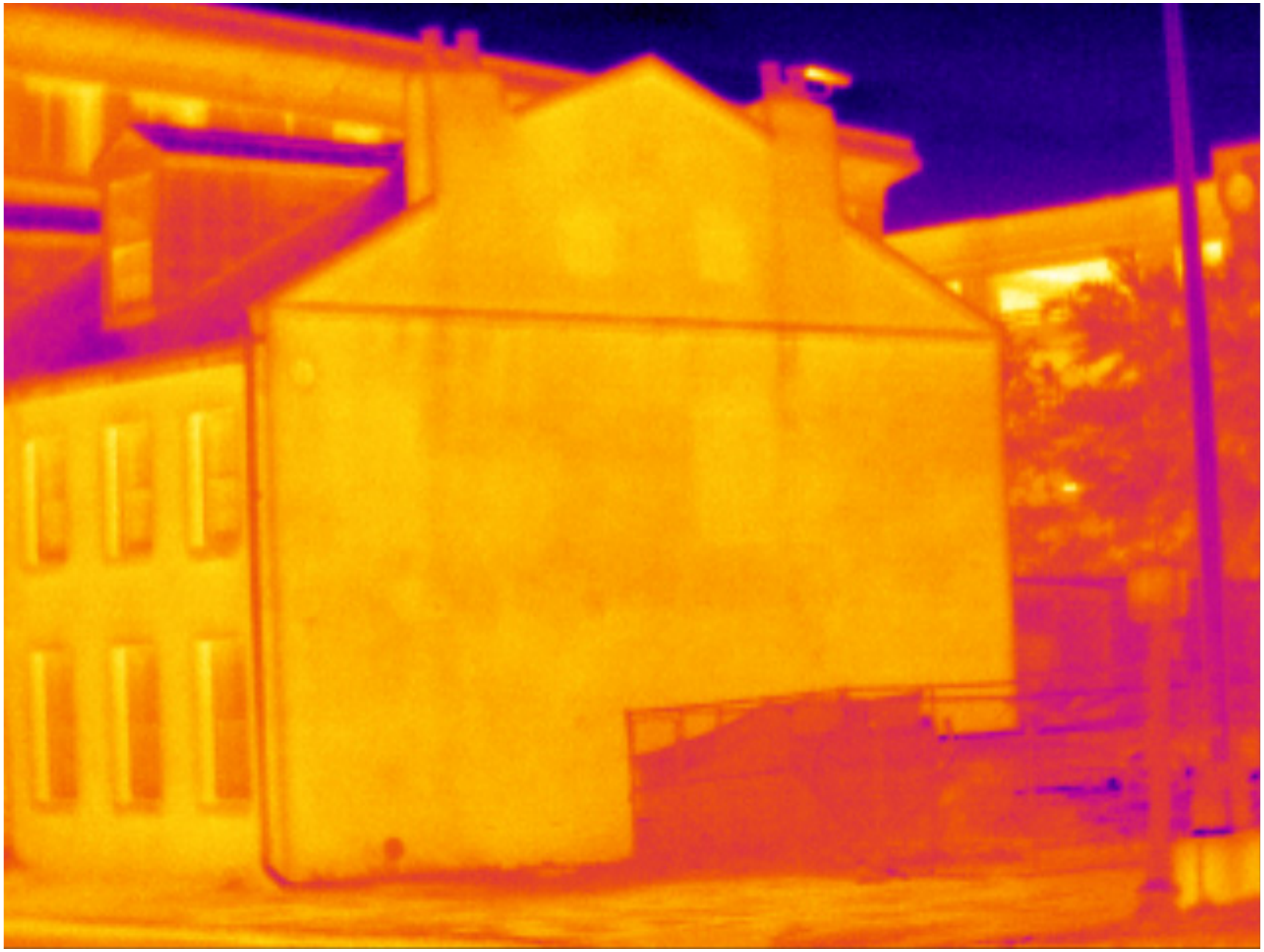
[Infrared Applications: Hidden Features]



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[Infrared Applications: Change Over Time]

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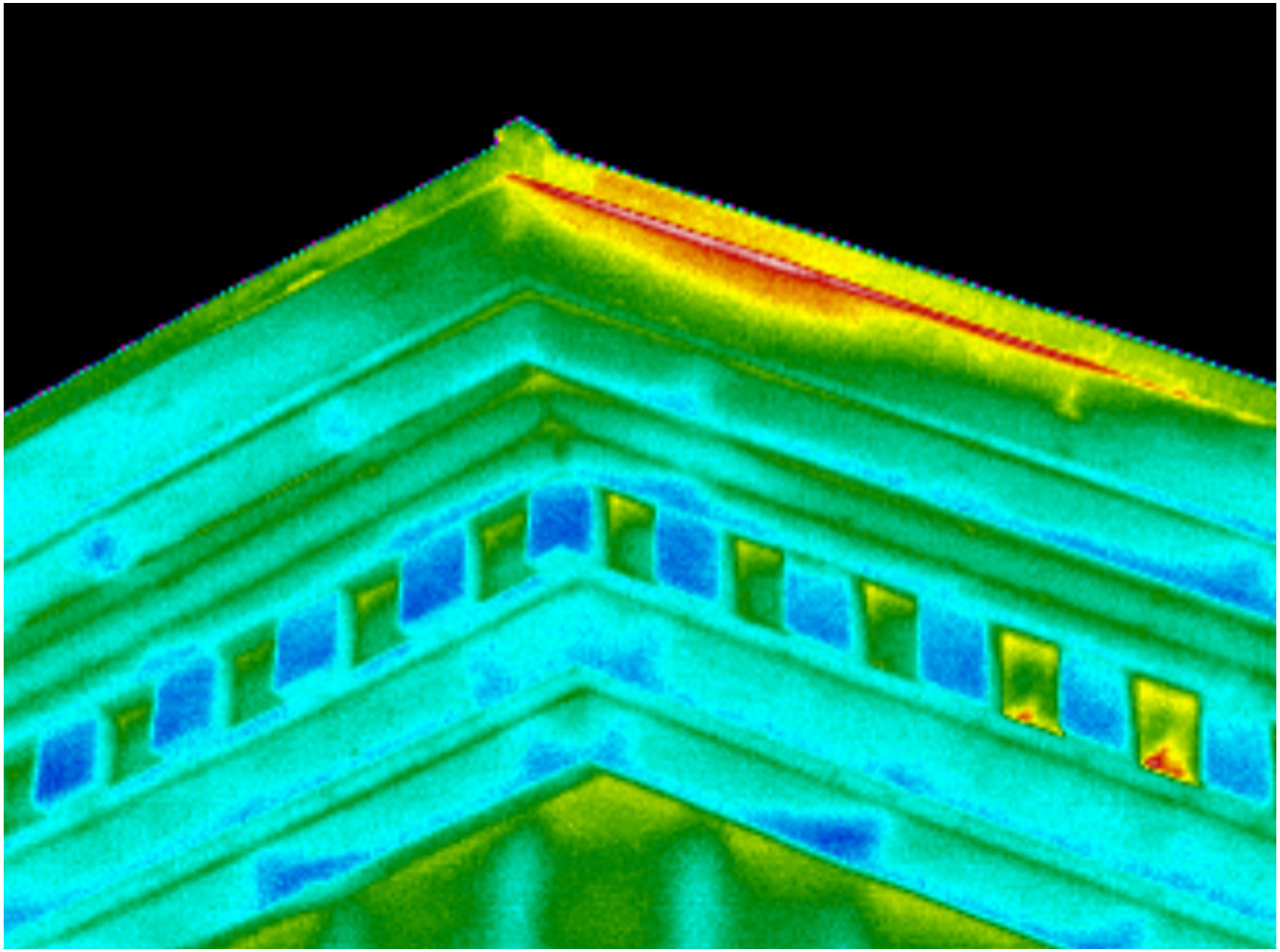
[Infrared Applications: Air Leakage]



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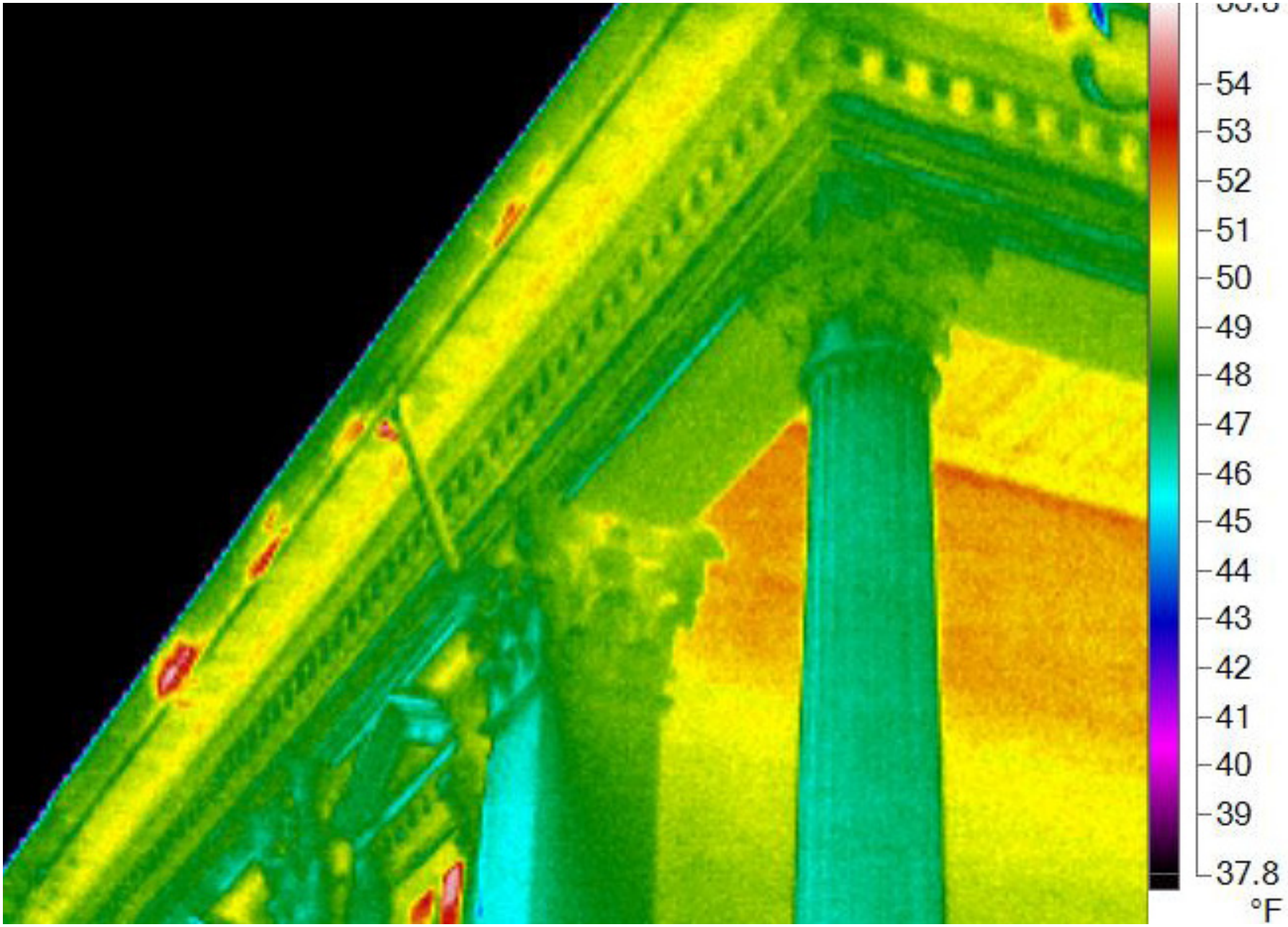
[Infrared Applications: Air Leakage/Deterioration]



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[Infrared Applications: Deterioration Confirmed]

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[Infrared Applications: Obscured Cracking]

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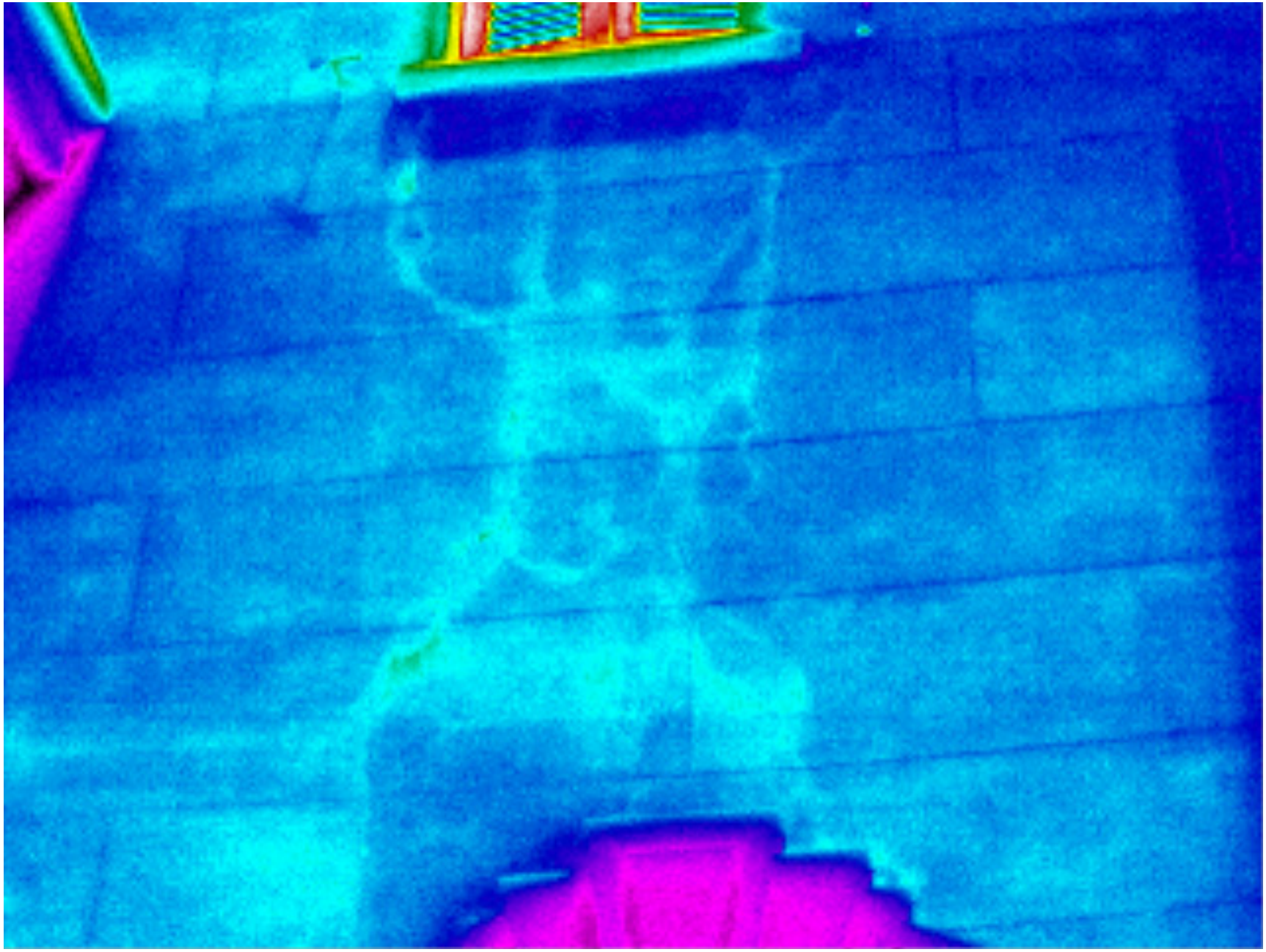
[Infrared Applications: Obscured Cracking]



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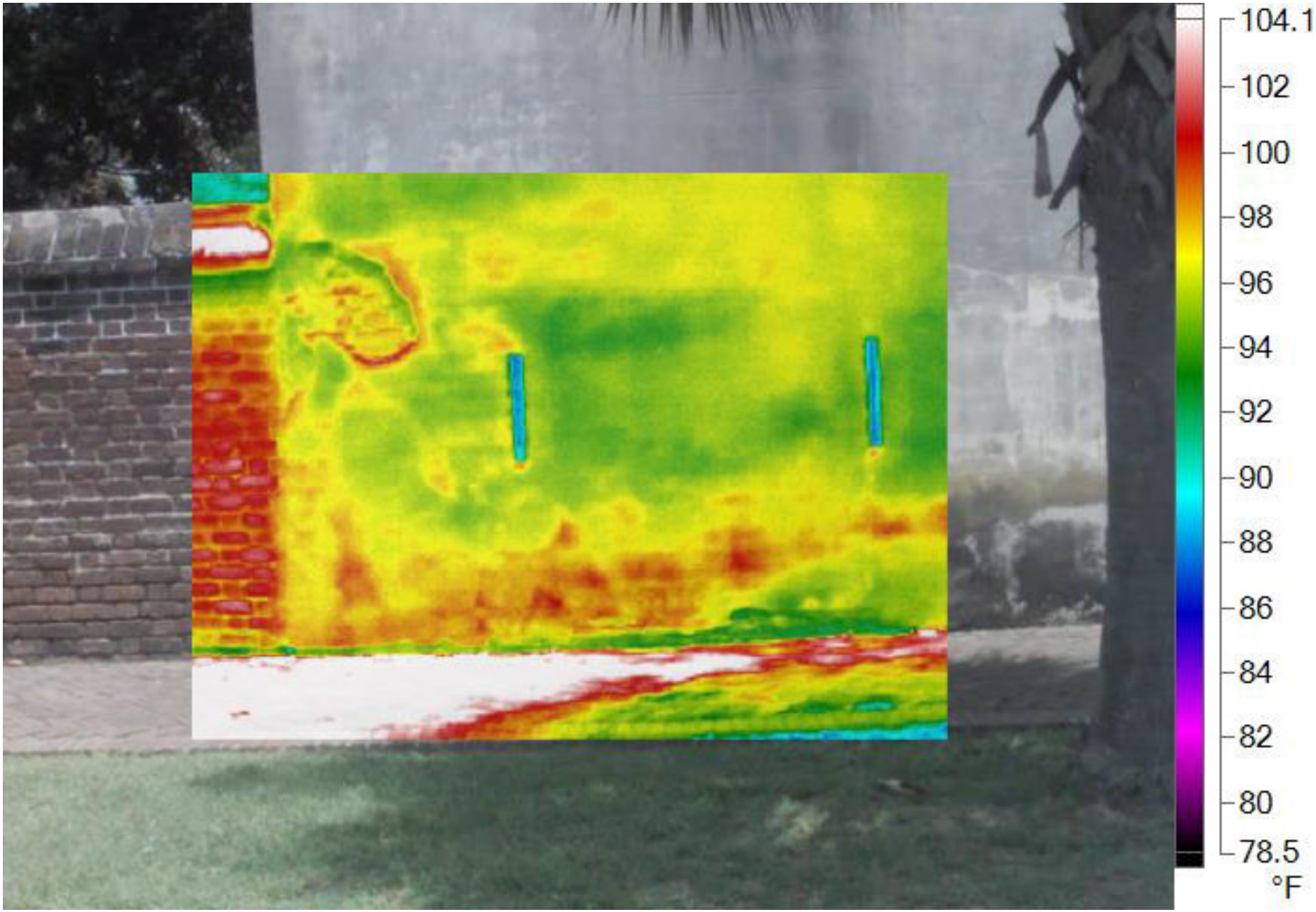
[Infrared Applications: Detached Exterior Stucco]



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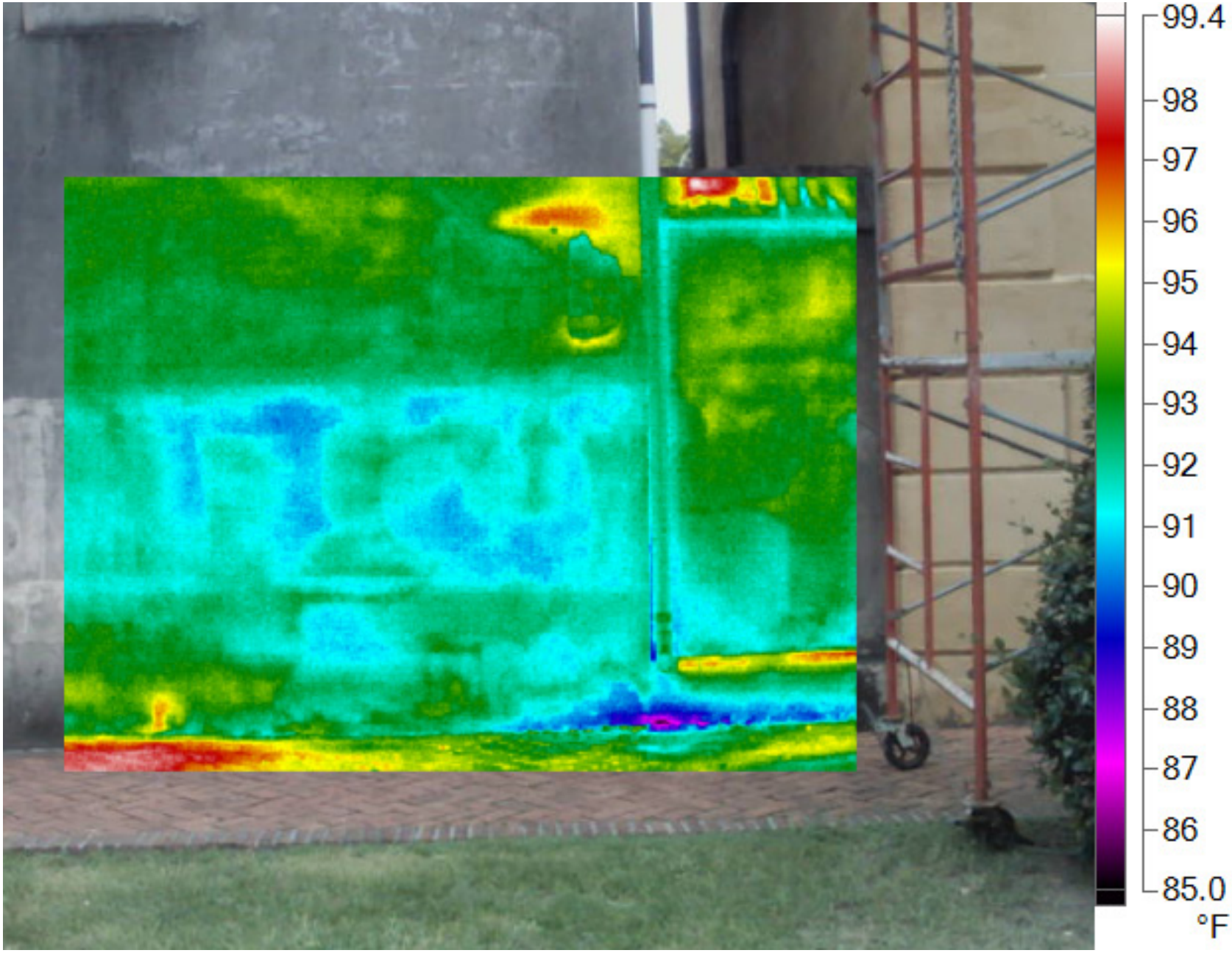
[Infrared Applications: Detached Exterior Stucco]



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[Case Study: Aiken-Rhett House Museum]

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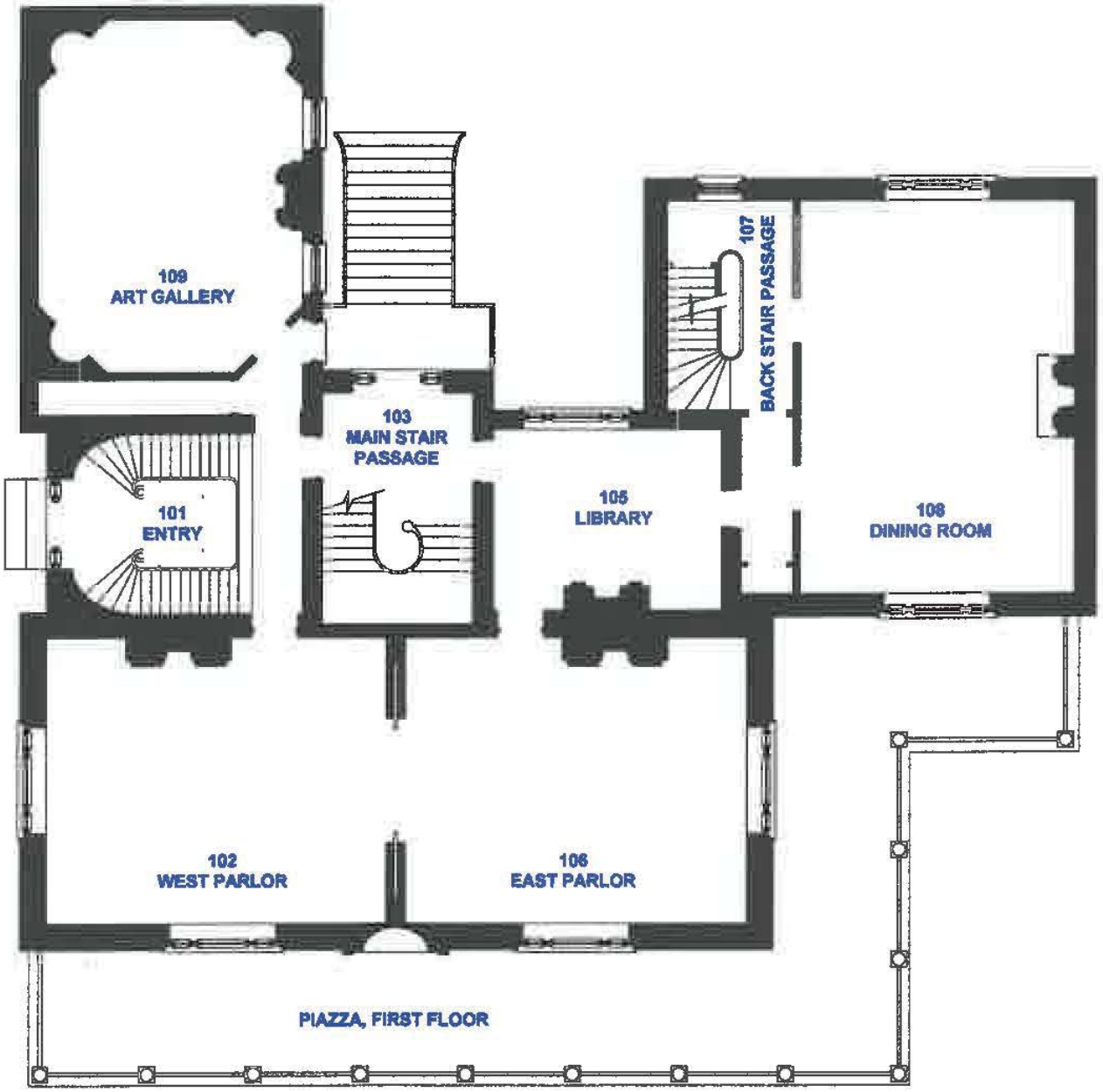
[Case Study: Aiken-Rhett House Museum]



First Floor

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[Case Study: Aiken-Rhett House Museum]

Preservation Philosophy :

"Intent is to preserve the resource as found, in combination with restored building exteriors"

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[Case Study: Aiken-Rhett House Museum]

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[Aiken-Rhett House Museum: Southwest Chamber]

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[Aiken-Rhett House Museum: Southeast Chamber]

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[Case Study: Aiken-Rhett House Museum]

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[Aiken-Rhett House Museum: Plaster Assessment]

Site Challenges:

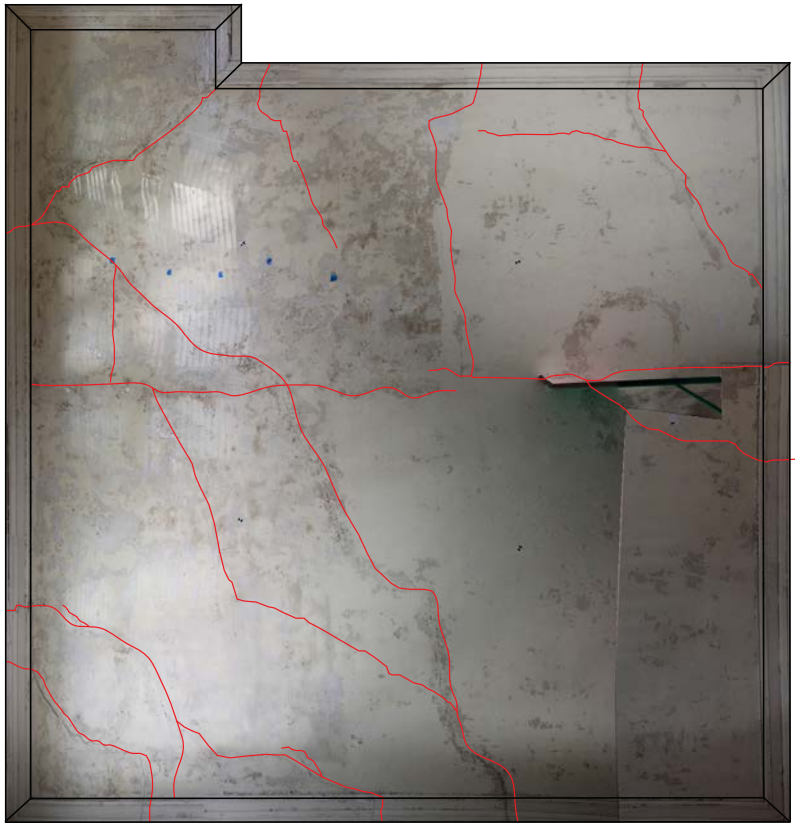
- Fragile wall coverings
- Vastness of the building, high ceilings, and limited accessibility
- Time & best allocation of financial resources

Blind Study to Evaluate the Efficacy of Infrared Technology to Assess Historic Plaster:

Part 1 (Traditional Tactile Evaluation)

Part 2 (Infrared Thermography)

[Aiken-Rhett House Museum: Interior Plaster Study



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[Aiken-Rhett House Museum: Tactile Assessment

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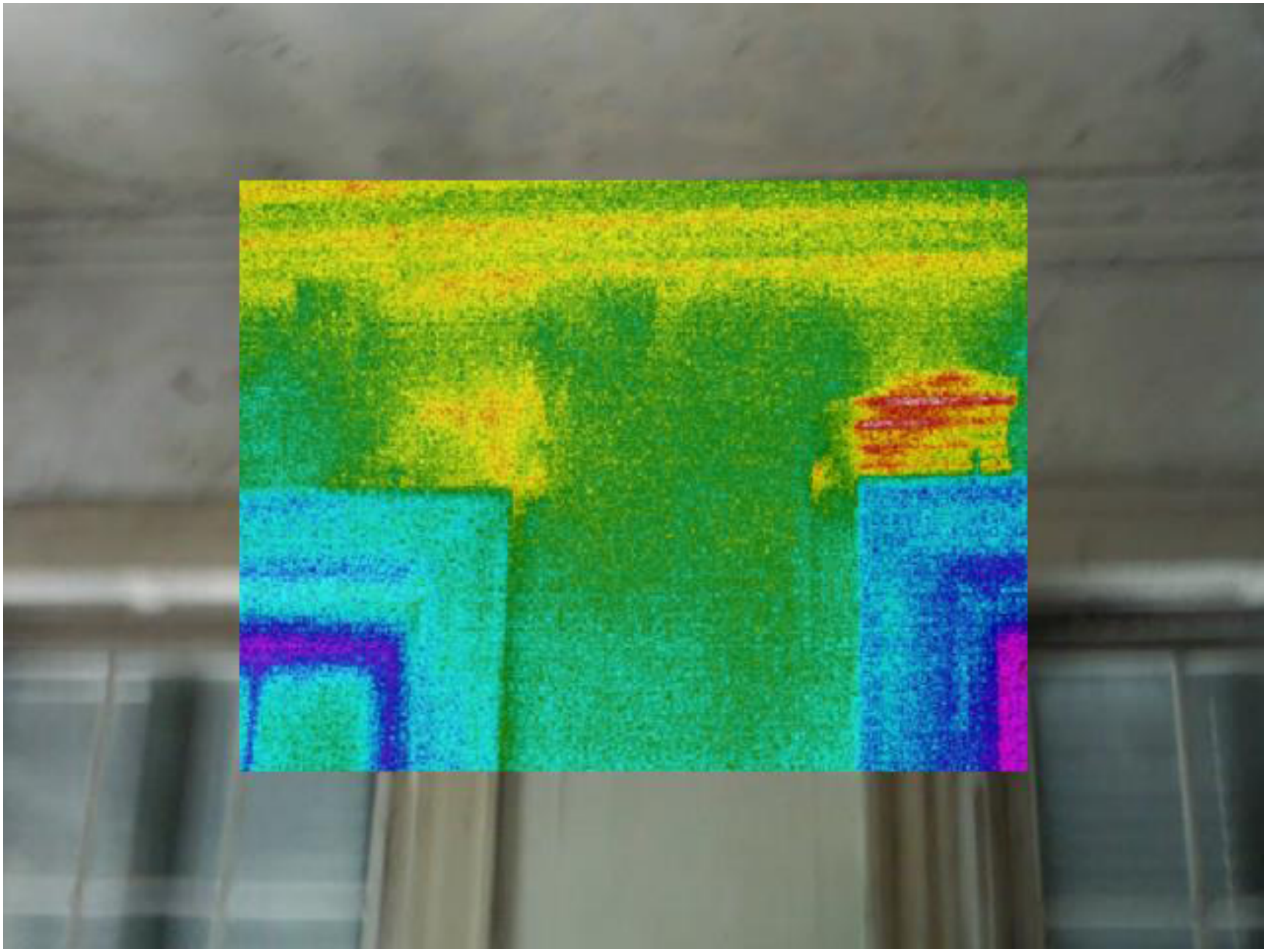
[Aiken-Rhett House Museum: Tactile Assessment

Not solid But not hollow.
...does not connect.
turn Back 180 sound.
1ft
2ft
1ft
2ft
1ft
1ft
1ft
2ft
1ft
1ft
1

[Aiken-Rhett House Museum: Passive Thermography]



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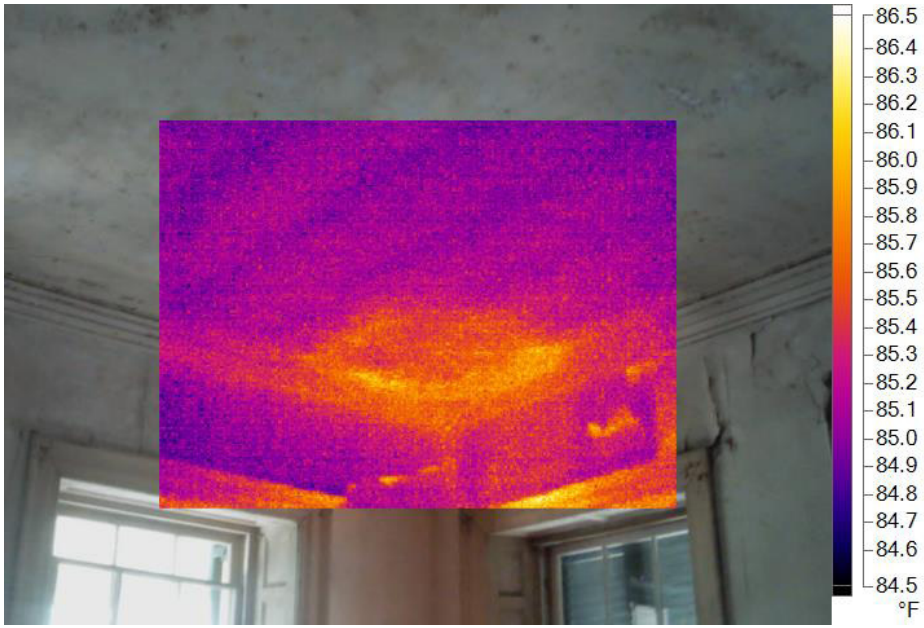
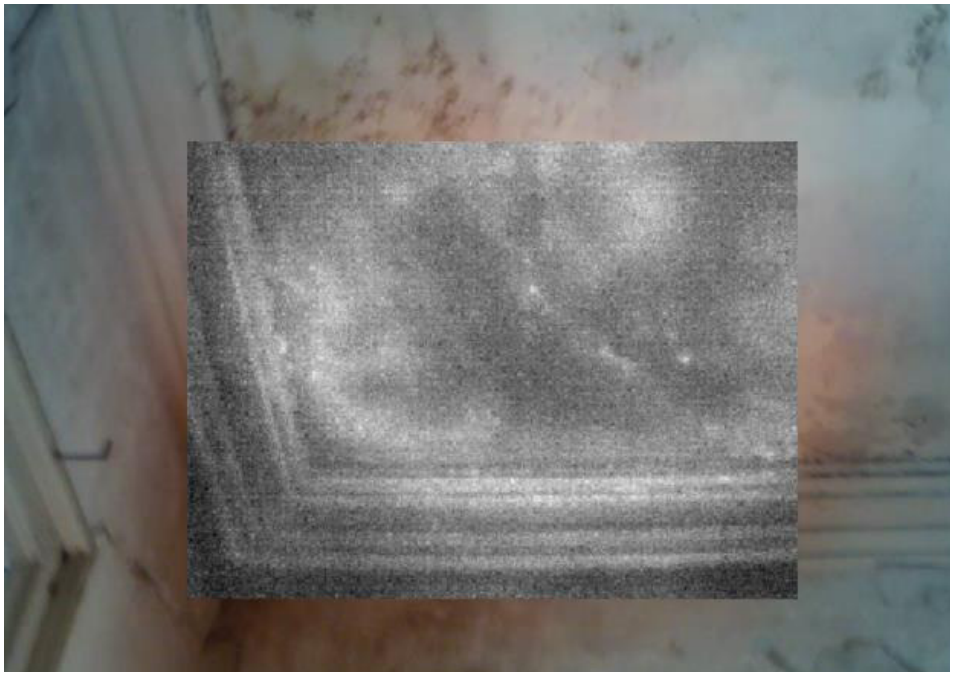
[Aiken-Rhett House Museum: Active Thermography]





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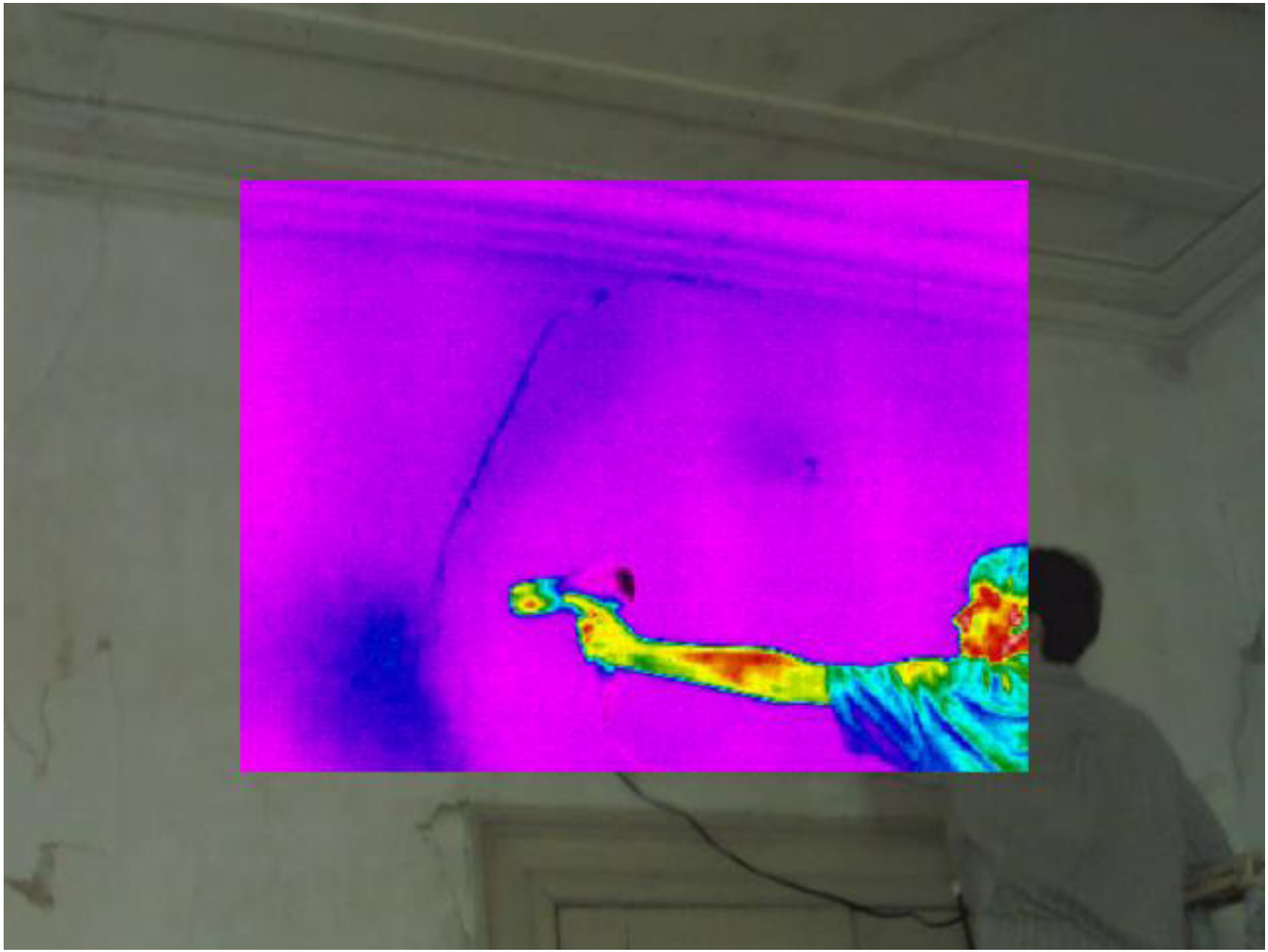
[Aiken-Rhett House Museum: Active Thermography]



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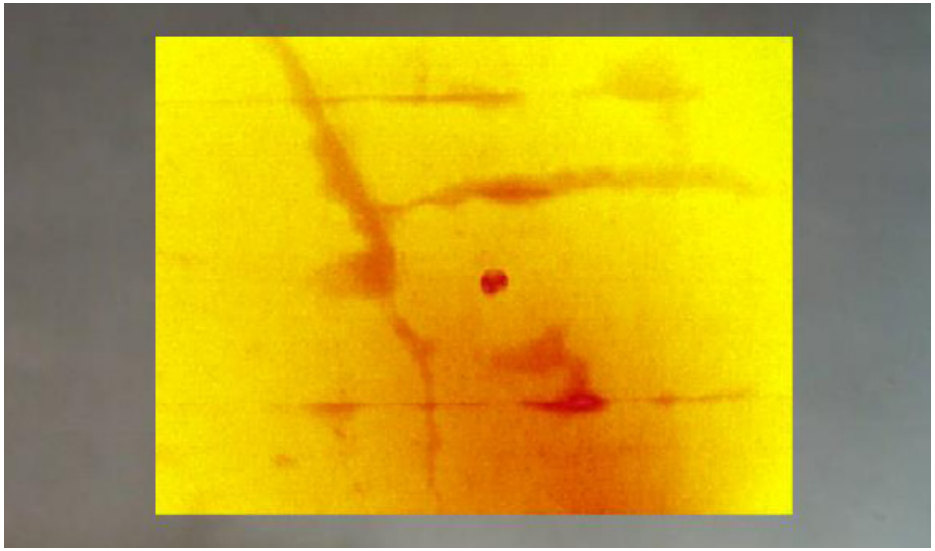
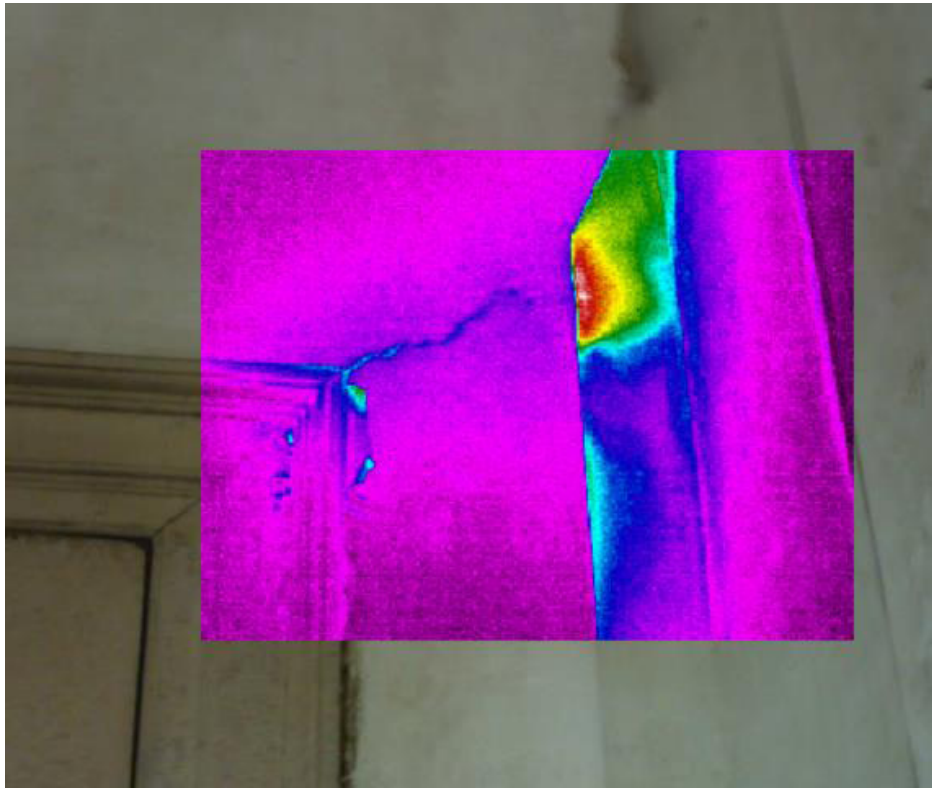
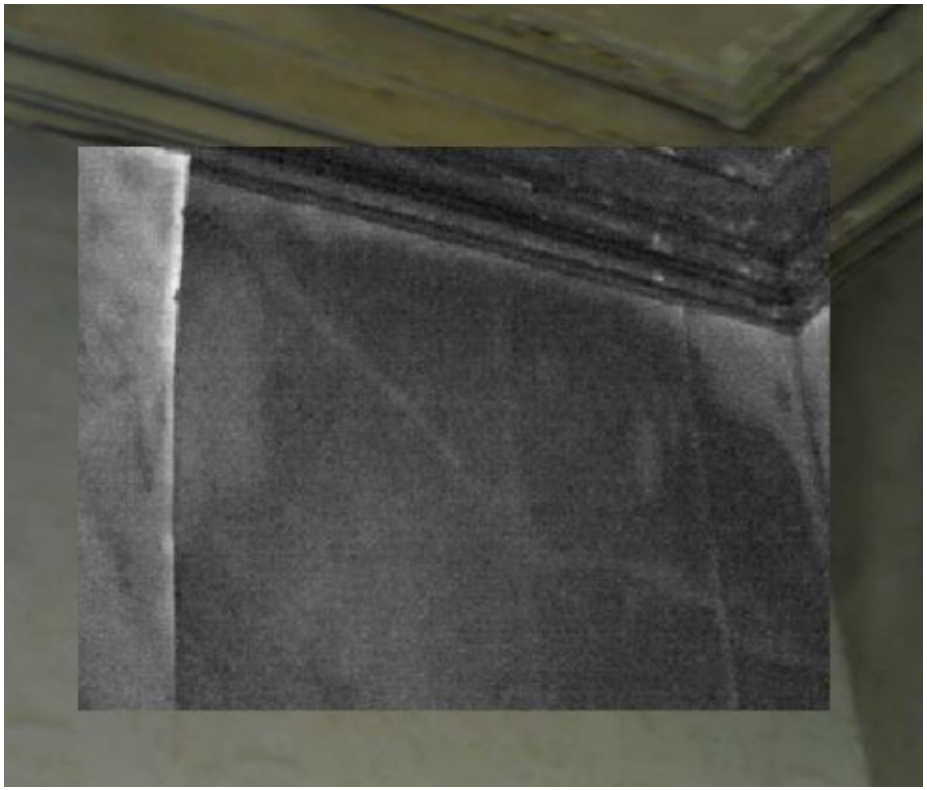
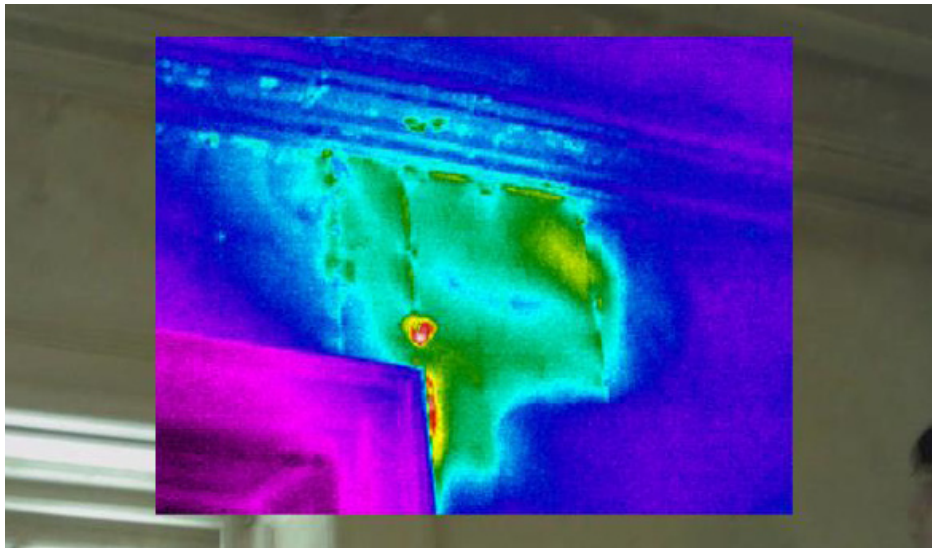
[Aiken-Rhett House Museum: SE Infrared Assessment









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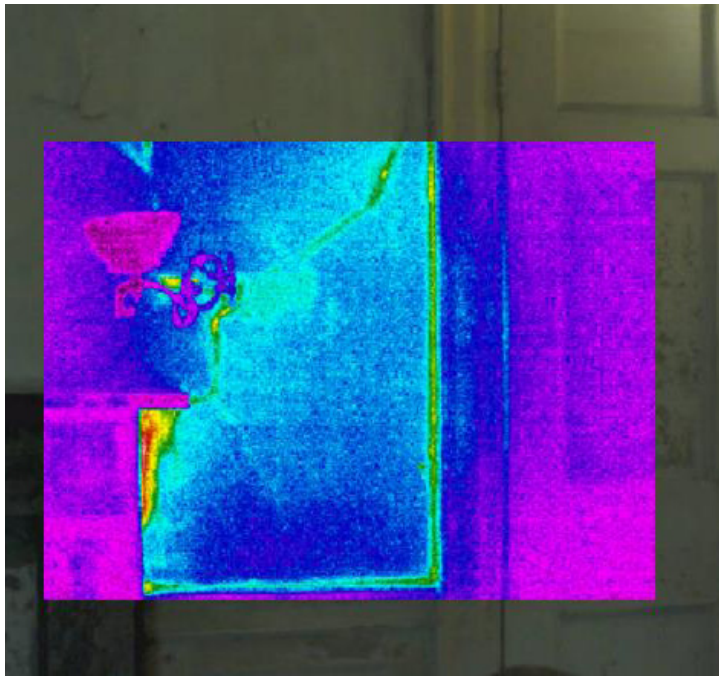
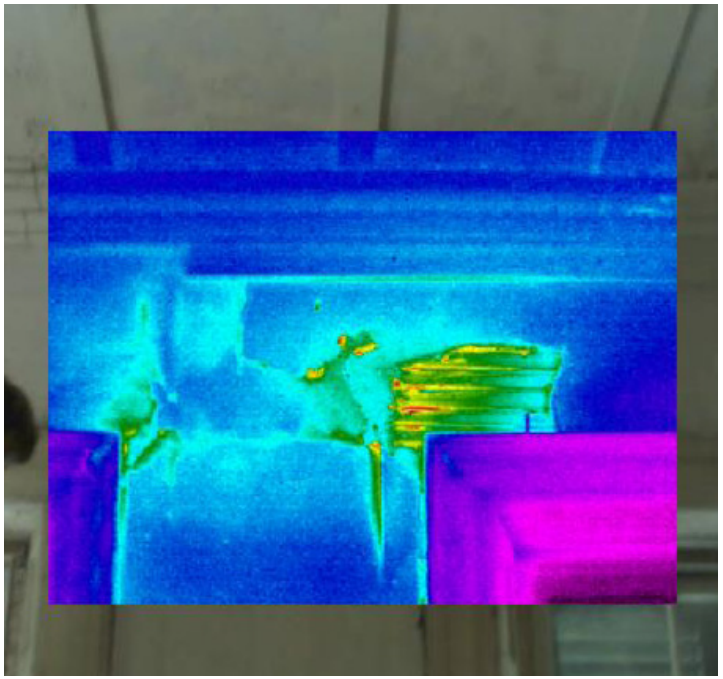
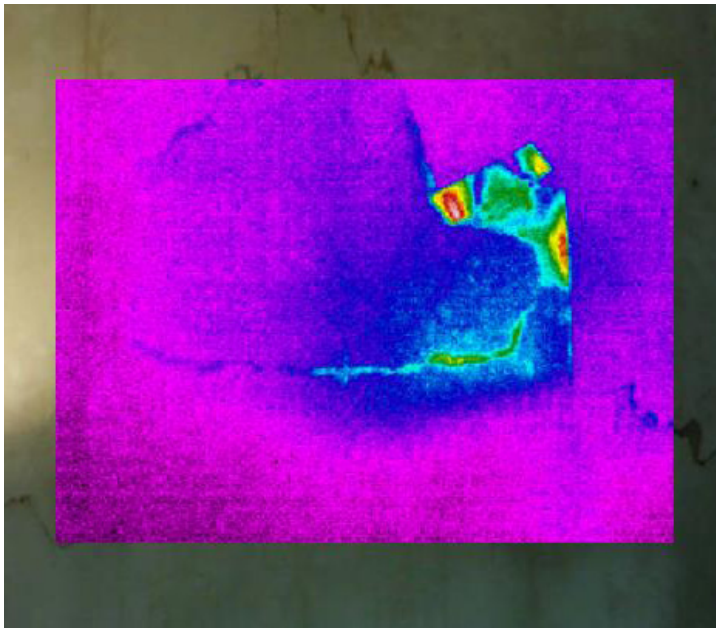
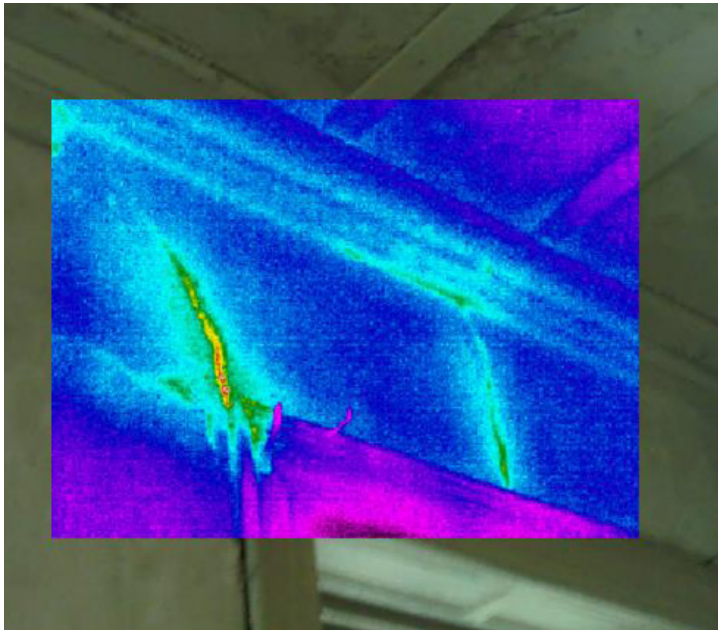
[Aiken-Rhett House Museum: SW Infrared Assessment









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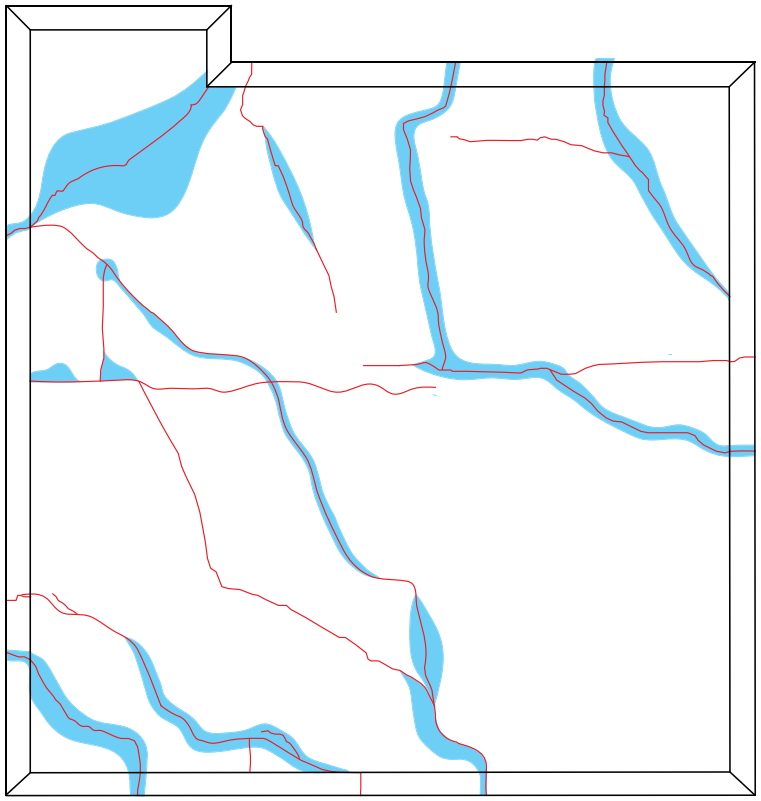
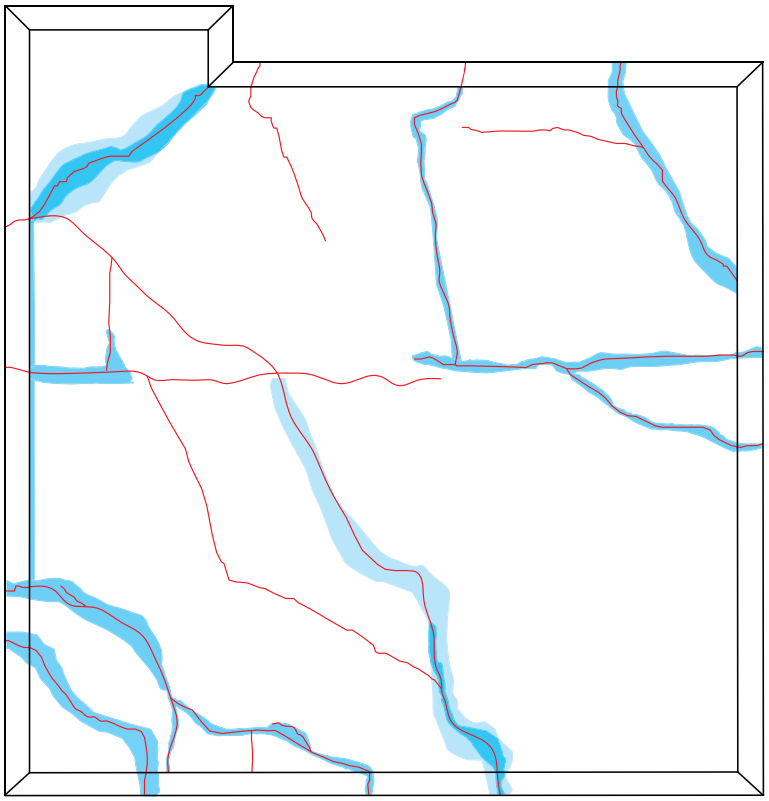
[Aiken-Rhett House Museum: Tactile vs Infrared]

Southwest Chamber- Ceiling

Tactile Assessment



Infrared Assessment



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[Aiken-Rhett House Museum: Plaster Assessment]

Conclusions of Blind Study:

- IR Technogy is a good tool for evaluating the overall condition of historic plaster
- IR Technology is non-destructive and more rapid than traditional methods of evaluation
- Most beneficial when used in conjunction with confirmatory tactile evaluation
- Interpretation is key

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[Limitations]

Not Always So Easy :

- Weather conditions can affect readings
- Building orientation can affect readings
- No standards for assessing historic structures via infrared
- May need to apply heat (active thermography)
- Data must be interpreted/Training necessary
- Can not assess reflective material (low emissivity)
- Absolute temperature measurements difficult
- One tool out of many

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[Live Demonstration]

[Questions??]

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