

LEARNING OBJECTIVES

- Understand the **history** and **progression** of both thermography and drone technology
- **Compare** typical “boots on the ground” investigations with cool, new technology solutions using drones
- Identify how Owners can **pinpoint** problems with buildings, **prioritize** projects and free up operational costs by highlighting a case study from The University of Texas at Dallas
- Recognize the **benefits** including energy conservation, improved thermal comfort, air quality and noise control which greatly affect occupant health, comfort and well-being





Thea Junt, LEED AP BD+C
Associate Director for Energy Conservation & Sustainability
UT Dallas Facilities Management



Norma Lehman, RID, LEED AP BD+C, WELL AP
Director of Sustainability
The Beck Group



Grant Hagen
Virtual Design and Construction Manager
The Beck Group



Bill Conley, RWC
Managing Principal
Conley Group



PUSHING THE ENVELOPE



Net zero economy &
code requirements



INCREASED FOCUS ON HEALTH



Health, Wellbeing & Productivity in Offices by World Green Building Council

Influence behavior, health & productivity



OPERATIONAL EXCELLENCE



Prioritize deferred maintenance



UT DALLAS



- Founded in 1969
- 2016 Enrollment 26,797



UT DALLAS CASE STUDY : SOM 1



School of Management building completed in 2003



THE PROBLEM

- Leaks in the roof
- Significant water infiltration through windows
- Unhappy occupants
- Budget challenges



THE REAL FIX

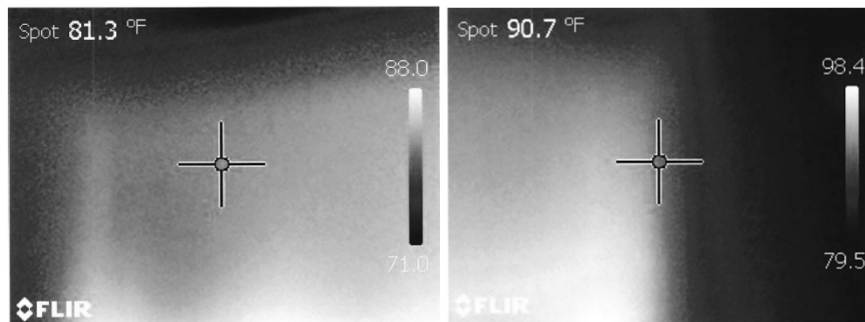
- Roof replacement
- Window replacement
 - Gasket, Caulk joints, silicon
- Building Envelope remediation
- Total cost for the “real” fix
 - Estimated \$4 million





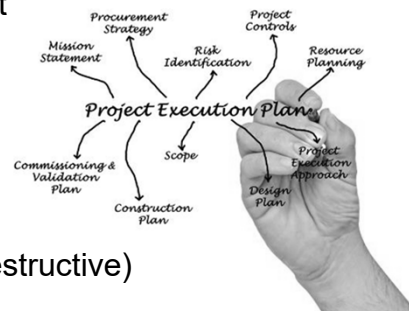
MONEY, MONEY, MONEY

- Requested \$4 million, received \$800,000
- How to determine the most important needs?
- How could we have gotten the \$4million needed?



METHODOLOGY

1. Review of Available Project Documents
2. Evaluation of Design Concept
3. Review Service History
4. Visual Observation
5. Access
6. Investigative Testing (Non-Destructive)
7. Analysis of Data Retrieved
8. Preparation of Report





METHODOLOGY

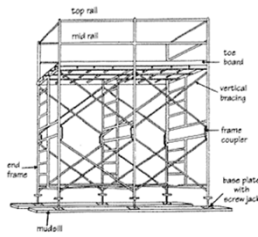
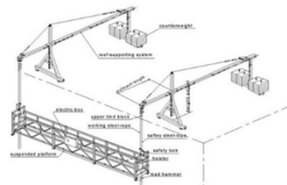
1. Review of Available Project Documents
2. Evaluation of Design Concept
3. Review Service History
4. Visual Observation
5. Access
6. Investigative Testing (Non-Destructive)
7. Analysis of Data Retrieved
8. Preparation of Report



CHALLENGES

“Boots on the Ground” Challenges:

- Access
 - Ladder
 - Boom Lift
 - Scaffolding and Walkway Protection
 - Swing Stage





ANALYSIS

Methodology → Data Points

Traditional	High Tech
<ul style="list-style-type: none"> • Larger Area • Limited sample size • Time/cost restricted • Extrapolated • Accuracy impacted 	<ul style="list-style-type: none"> • Specific area • Infinite sample/data quantities • Time/cost managed • Accuracy assured

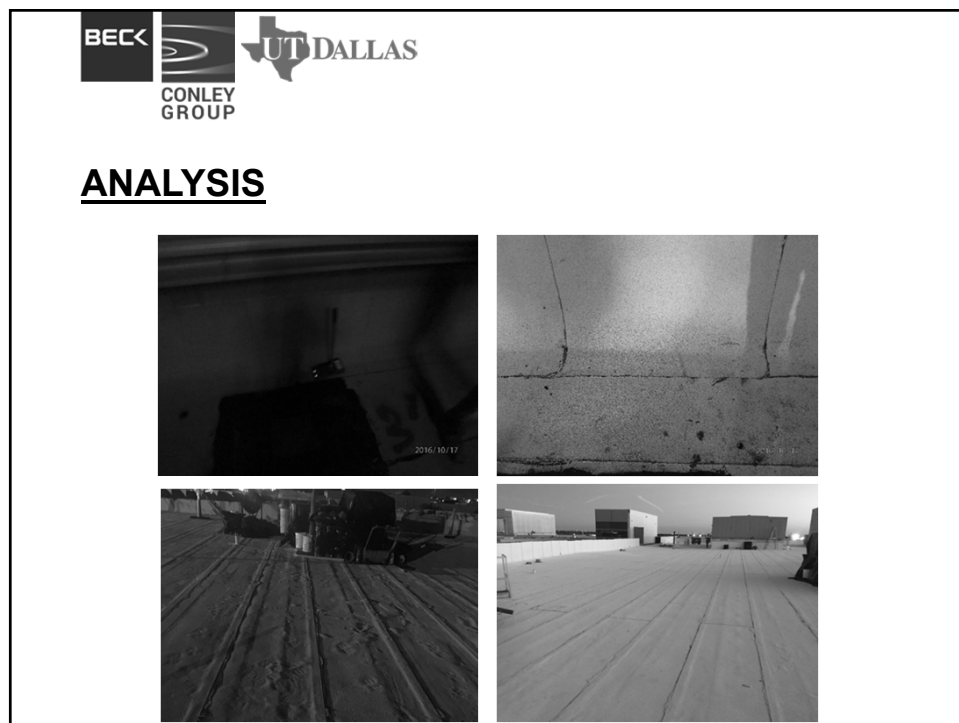
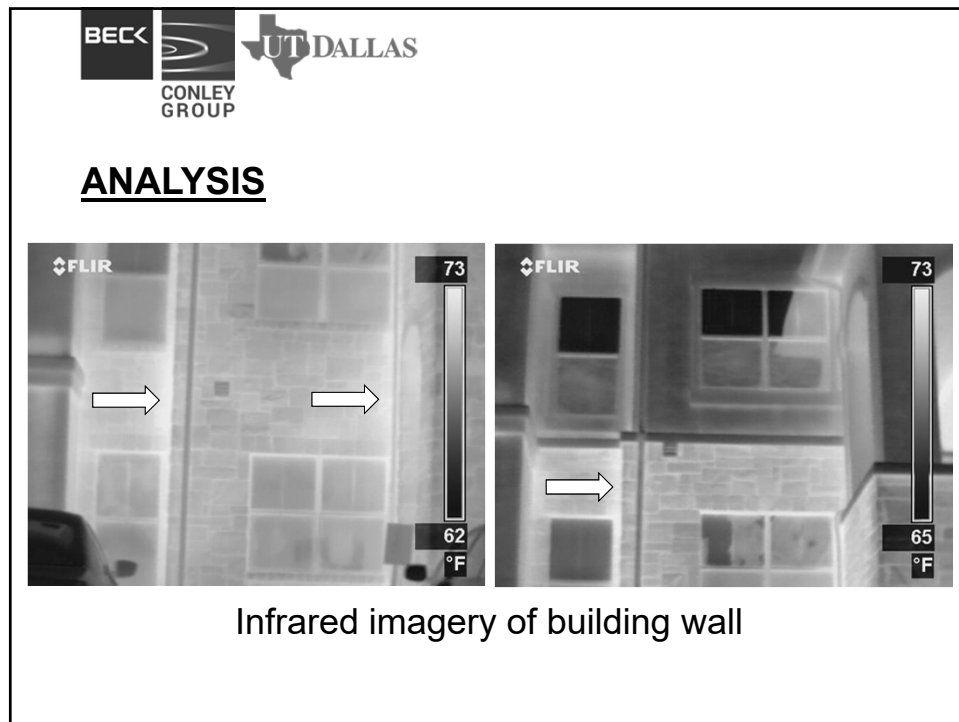
Data/Knowledge → Prioritized Investment



ANALYSIS

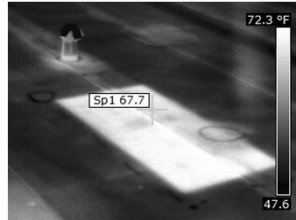
- Limitations
- Environmental Parameters
- Data Interpretation
 - Variations in Materials
 - Variations in Temperature
 - Variations in Material Emittance
 - Radiation from Nearby Source



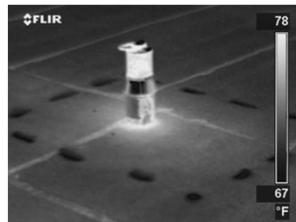




ANALYSIS



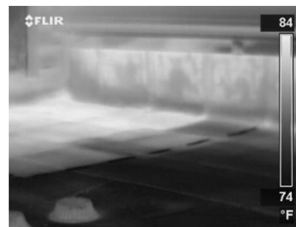
Wet Insulation



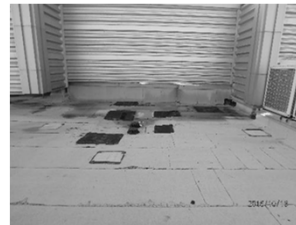
Trapped Moisture Under Membrane



ANALYSIS



Insulation



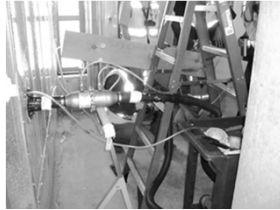
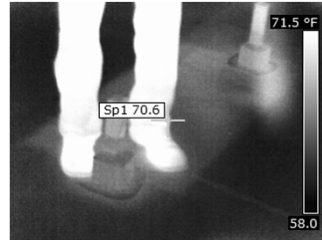
Traffic Damage



ANALYSIS



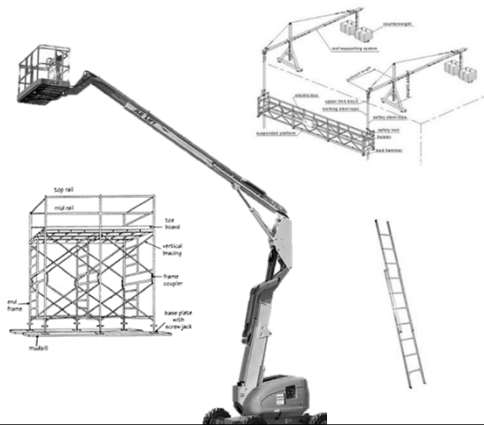
Always work with an escort on the roof and follow good, safe work practices, especially near the edge.



TRADITIONAL CAPTURE SUMMARY

	Traditional Capture
Labor Costs	\$100-150 / hour
Equipment Costs	\$1,500.00 per wk
Training Required	Certification
Avg time to complete one building inspection	8-10 MH
Camera Quality	320 x 240
Site Restrictions/ Limitations	Building Access
Height Restrictions	Walking or Scaffolds
Field of Vision	Boom and camera zoom
Convenience of reinvestigation	No

Photo Credit: DJI





DRONE COMPARISON TO TRADITIONAL

	Traditional Capture	Aerial Capture
Labor Costs	\$100-150 / hour	\$100-150 / hour
Equipment Costs	\$1,500.00 per wk.	\$100-150 / hour
Training Required	Certification	Certification
Ave time to complete one building inspection	8-10 MH	.5-1 MH
Camera Quality	320 x 240	640 x 480
Site Restrictions/ Limitations	Building Access	None
Height Restrictions	Walking or Scaffolds	400'
Field of Vision	Boom and camera zoom	None
Convenience of reinvestigation	No	Yes

Photo Credit: DJI



DRONE FLIGHT BASICS



Photo Credit: DJI



FLIR TECHNOLOGY

ZENMUSE XT

640

RESOLUTION

30Hz

Fast Speed

Powered by **FLIR**



DRONE FLIGHT BASICS

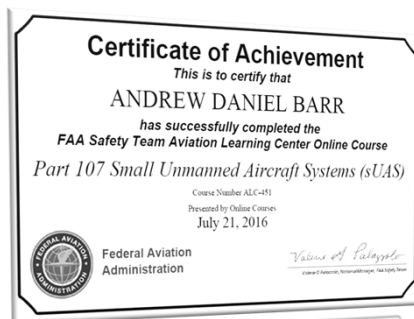


How Does it all work?

- Communication Frequencies
 - 5.8 GHz – Flight Control
 - 2.4 GHz – Broadcasted WiFi from external transmitter attached to controller
- The Internal computer draws on all information including GPS, Gyroscope, and the Compass to steady, balance, and fly.

BECK

RULES & REGULATIONS



- Establishes a remote pilot in command position
- Must pass initial aeronautical knowledge test or an initial training course if hold a pilot certificate
- Must be vetted by TSA
- Required for Commercial Operations
- Comply with registration requirements

BECK

WAIVERS - FLIGHT AREA LIMITATIONS

Waiver/Airspace Authorization

You must select at least one regulation subject to waiver or airspace authorization.

Regulation subject to airspace authorization

☐ 107.41 Operation in certain airspace

Regulations subject to waiver

☐ 107.25 Operations from a moving vehicle or aircraft

☐ 107.29 Daylight operation

☐ 107.31 Visual line of sight aircraft operation

☐ 107.33 Visual observer

☐ 107.35 Operation of multiple sUAS

☐ 107.37(a) Yielding the right of way

☐ 107.41 Operation in certain airspace

☐ 107.51(a) Operating limitations: ground speed

☐ 107.51(b) Operating limitations: altitude

☐ 107.51(c) Operating limitations: minimum visibility

☐ 107.51(d) Operating limitations: minimum distance from clouds

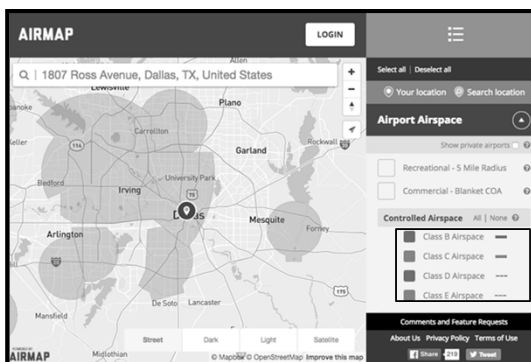
* Local start date: mm/dd/yyyy **Launch Date Picker**
Date cannot exceed two years from today's date.
Date Picker keyboard shortcuts

* Local start time: nn:nn AM

* Local end date: mm/dd/yyyy **Launch Date Picker**
Date Picker keyboard shortcuts

* Local end time: nn:nn PM

* Local time zone: --:--



BECK

WAIVERS – NIGHT OPERATIONS

Waiver/Airspace Authorization

You must select at least one regulation subject to waiver or airspace authorization.

Regulation subject to airspace authorization

☐ 107.41 Operation in certain airspace

Regulations subject to waiver

☒ 107.29 Daylight operation

☐ 107.31 Visual line of sight aircraft operation

☐ 107.33 Visual observer

☐ 107.35 Operation of multiple sUAS

☐ 107.37(a) Yielding the right of way

☐ 107.39 Operation over people

☐ 107.41 Operation in certain airspace

☐ 107.51(a) Operating limitations: ground speed

☐ 107.51(b) Operating limitations: altitude

☐ 107.51(c) Operating limitations: minimum visibility

☐ 107.51(d) Operating limitations: minimum distance from clouds

* Local start date: **Launch Date Picker**
Date cannot exceed two years from today's date.
Date Picker keyboard shortcuts

* Local start time: **Launch Date Picker**
Date Picker keyboard shortcuts

* Local end date: **Launch Date Picker**
Date Picker keyboard shortcuts

* Local end time: **Launch Date Picker**
Date Picker keyboard shortcuts

* Local time zone: **Launch Date Picker**
Date Picker keyboard shortcuts

§ 107.29 Daylight operation

- a. No person may operate a small unmanned aircraft system during night.
- b. No person may operate a small unmanned aircraft system during periods of civil twilight unless the small unmanned aircraft has anti-collision lighting visible for at least 3 statute miles. The person in command may reduce the intensity of the anti-collision lighting if she determines that, because of operating conditions, it is in the interest of safety to do so.
- c. For purposes of subsection (b), civil twilight refers to the following:
1. Except for Alaska, 30 minutes before official sunrise and 30 minutes after official sunset.
 2. Except for Alaska, 30 minutes before official sunset and ends 30 minutes after official sunrise.
 3. In Alaska, the period of time between the end of civil twilight and the beginning of civil twilight.

Guidelines for the

1. Provide a method for the person in command to determine the location of the small unmanned aircraft system during darkness.
2. Provide a method for the person in command to determine the location of the small unmanned aircraft system on the ground, and ground-based personnel, and to determine the location of the small unmanned aircraft system.
3. Provide a method by which the person in command can determine the location of the small unmanned aircraft system.
4. Provide a method to the person in command to determine the location of the small unmanned aircraft system.

BECK

WAIVERS - OVER PEOPLE

Waiver/Airspace Authorization

You must select at least one regulation subject to waiver or airspace authorization.

Regulation subject to airspace authorization

☐ 107.41 Operation in certain airspace

Regulations subject to waiver

☐ 107.25 Operations from a moving vehicle or aircraft

☐ 107.29 Daylight operation

☐ 107.31 Visual line of sight aircraft operation

☐ 107.33 Visual observer

☐ 107.35 Operation of multiple sUAS

☐ 107.37(a) Yielding the right of way

☒ 107.39 Operation over people

☐ 107.41 Operation in certain airspace

☐ 107.51(a) Operating limitations: ground speed

☐ 107.51(b) Operating limitations: altitude

☐ 107.51(c) Operating limitations: minimum visibility

☐ 107.51(d) Operating limitations: minimum distance from clouds

* Local start date: **Launch Date Picker**
Date cannot exceed two years from today's date.
Date Picker keyboard shortcuts

* Local start time: **Launch Date Picker**
Date Picker keyboard shortcuts

* Local end date: **Launch Date Picker**
Date Picker keyboard shortcuts

* Local end time: **Launch Date Picker**
Date Picker keyboard shortcuts

* Local time zone: **Launch Date Picker**
Date Picker keyboard shortcuts

§ 107.39 Operation over people


§ 107.39 Operation over people

No person may operate a small unmanned aircraft system over a human being unless that human being is:


- a. Directly participating in an authorized activity;
- b. Located under a cover that provides reasonable protection from the small unmanned aircraft.

Guidelines for the A

1. Applicant must provide a method for the person in command to determine the location of the small unmanned aircraft system during darkness.
2. The data provided must include the location of the small unmanned aircraft system, the location of the person in command, and the location of the small unmanned aircraft system.
3. Applicant shall include any operational limitations or conditions that must be followed in order to safely operate the small unmanned aircraft system over human beings.
4. Applicant must describe any unique qualifications of the pilot in command, or person manipulating the controls, including any knowledge, experience, or skills necessary to safely operate over human beings.



**BECK
CONLEY
GROUP**



UT DALLAS

AERIAL REPORT / COMPLIANCE

Aerial Inspections and Thermal Imaging

Frequency During each visit or throughout the day for thermal photo needs

Deliverables


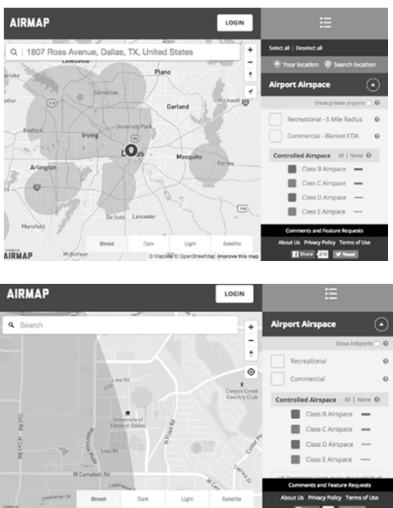
- Photos
 - Normal JPG files
 - 8x8 JPG files (Thermal Photo specific files)
 - TIFF Files (Thermal Photo specific files)
- Video
 - 4K Video


Flight Notes The flight path to capture the required perspectives for the photos and video will be at the discretion of the pilot to capture the needs of the project

Areas of Interest The aerial unit will be kept at a safe distance from the building facade and roof to ensure safety of the building and the unit


Operator See Below

Grant Hagen - VDC Manager



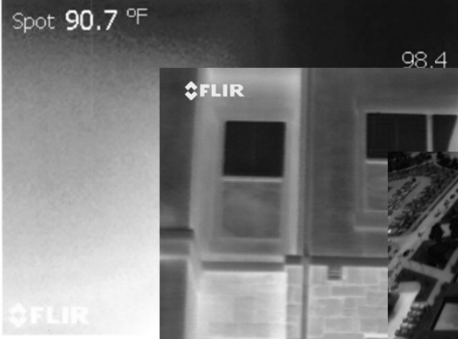
**BECK
CONLEY
GROUP**




UT DALLAS

EVOLUTION OF THERMAL IMAGERY


Spot 90.7 °F



98.4



73





THERMAL RESULTS / POST ANALYSIS

INSTRUMENTS

LIBRARY

FLIR

DJI_0171.jpg

NOTE

MEASUREMENTS

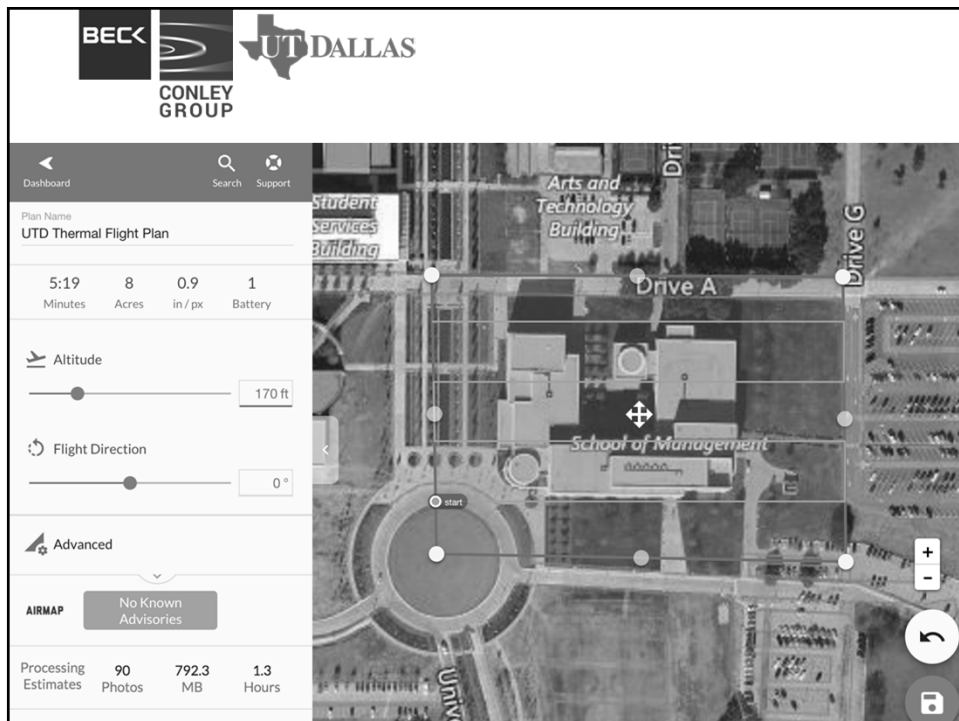
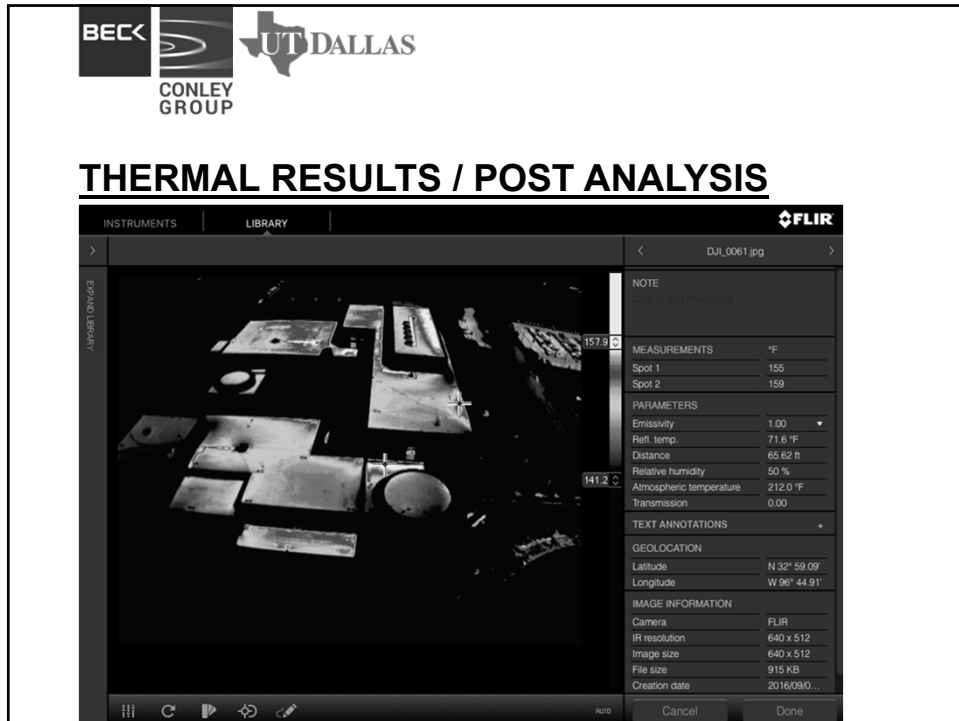
PARAMETERS

TEXT ANNOTATIONS

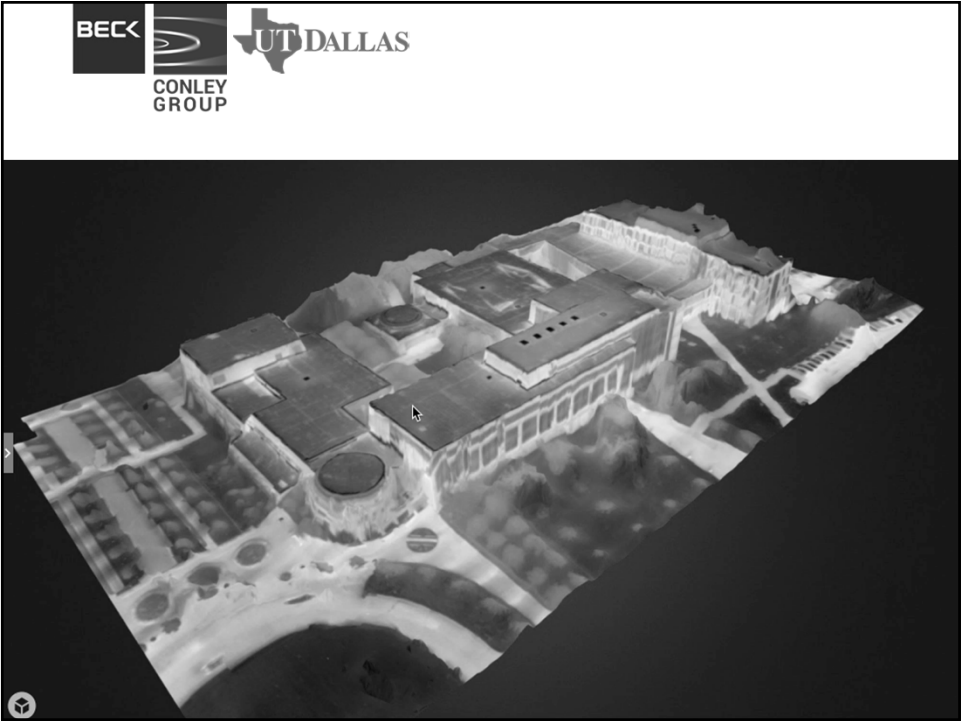
GEOLOCATION

IMAGE INFORMATION

17





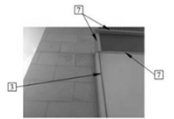




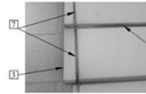
REMEDATION



1. ELEVATION @ SOUTHEAST CORNER 0318



2. WINDOW WALL TO MASONRY JOINT 0318



3. WALL PANEL TO MASONRY JOINT 0318



4. WINDOW MULLION 0318

TYPICAL DETAIL NOTES

- [1] Exterior wet glaze glass panel to mullions using specified sealant system on properly prepared substrate.
- [2] Interior wet glaze glass panel to mullions using specified sealant system on properly prepared substrate - all interior work shall be performed at non-business hours between 7:30 pm to 6:30 am CST unless prior authorization is given by the UT Dallas Facilities Director. Weekly meetings shall be held to provide client with 3 week look ahead schedule.
- [3] Sealant joint treatment at interface of window wall or storefront glazing system to stone or masonry system.
- [4] Expanding foam system applied to all interstitial spaces in the exterior vertical surface portion of the building envelope.
- [5] Sealant system replacement at all control joints, expansion joints and construction joints in the masonry, storefront and window wall systems including joints within these systems and joints at the interface or intersection with any other system.
- [6] Replace interior and exterior window gaskets/seals at damaged gaskets. Include replacement of 5% of the window wall system for the most common size window unit.
- [7] Sealant joint installation using specified sealant system at all extruded mullion to mullion intersections or any location where mullions are within 1 inch of adjacent or adjoining mullions.
- [8] Clean all masonry surfaces using specified cleaning process and apply specified breathable, cosmetic, non-organic masonry sealant system to properly prepared masonry substrate.
- [9] All vertical surfaces shall be water tested following completion of the specified scope of work witnessed by the Engineer. Contractor shall provide the Engineer access to work areas for all water testing processes.
- [10] Any surface which does not successfully pass diagnostic low pressure (50psi) water testing shall be re-treated with the specified sealant materials until the area does not leak.

Typical Details



PHASE 1 COMPLETE



