



Michigan Bridge Week

ALYNIX DECKER DRONE UPDATE

Dale Allen, PE - Michigan Department of Transportation

Ben Lindner CEO - Alynix, Inc.



Today's Agenda

- Team
- Problem
- Solution
- STENN³™
- Who is Working With Us
- The System
- Software Overview
- Differential IR Basics
- Cost Comparison
- MDOT Data
- Question

Scan your decks without closing
them to traffic for a fraction of
the cost

OUR TEAM



Ben Lindner
CEO

- Has led Alynix since 2019 after quick leadership progression within GBA
- 20+ years in diverse industries; 8 years in civil engineering

GBA  alynix 



Casey Kinsey
CTO

- 20+ year experience in software dev.
- Founded Lofty, a full-service software development firm, and trusted vendor to Alynix



Dr. Carl Merrigan,
Ph.D.
ML Scientist



David Harper
Data Scientist



Alan Fraley
Software Engineer



Dillon Wallace
Delivery Manager



Chris White
Systems Integrator



Richie Harper
Data Systems Specialist

ADVISORS



Dan Abitz
Retired CEO
GBA
Companies



Lori Kelleher
President & CHRO
Board Member
Black & Veatch
(Retired)



James Walsh
CEO
Intercool USA



Scott Moeder
VP of Bridge
Engineering
GBA

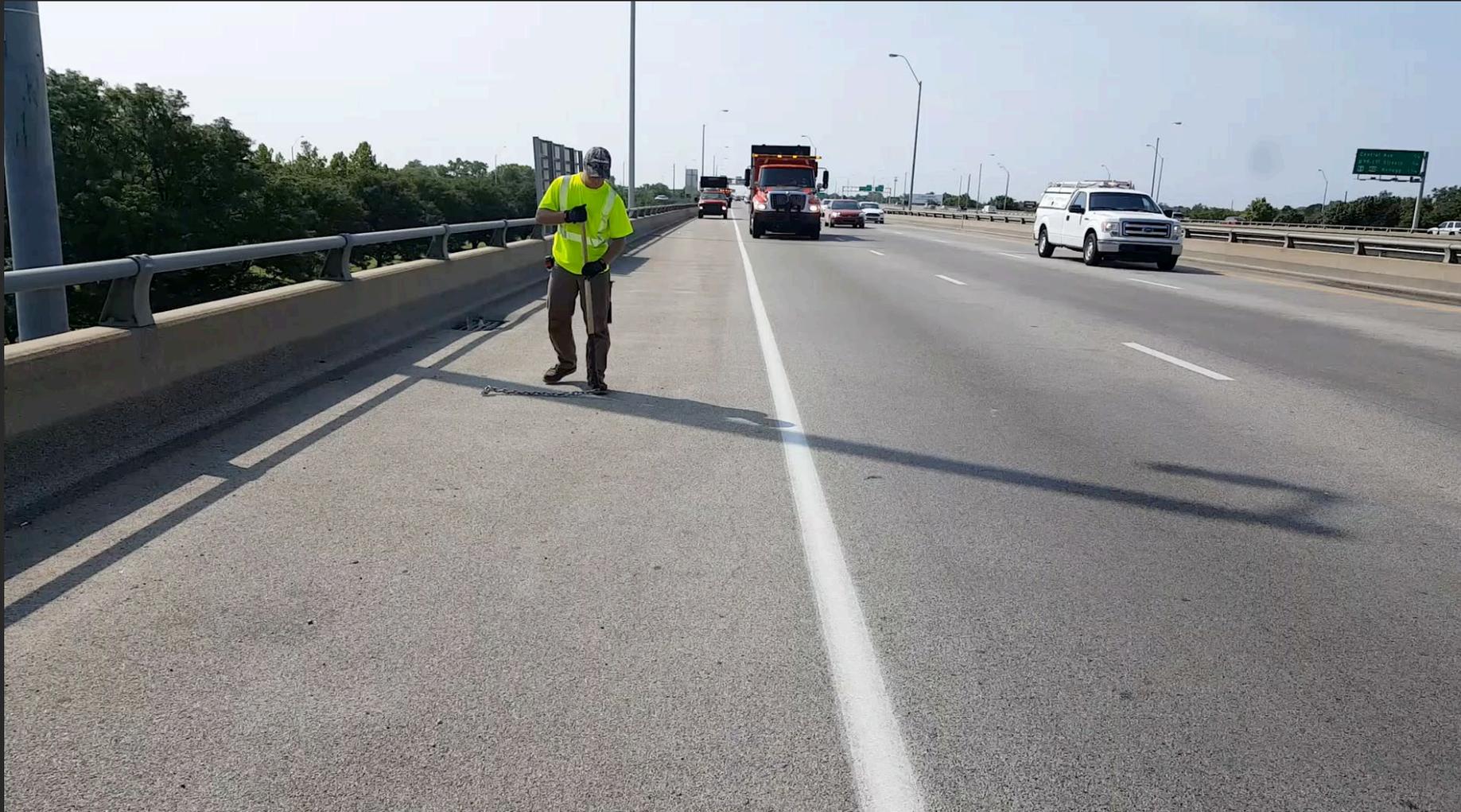


Marybeth Miceli
President
Miceli Infrastructure
Consultants

Problem



[Video Link](#)

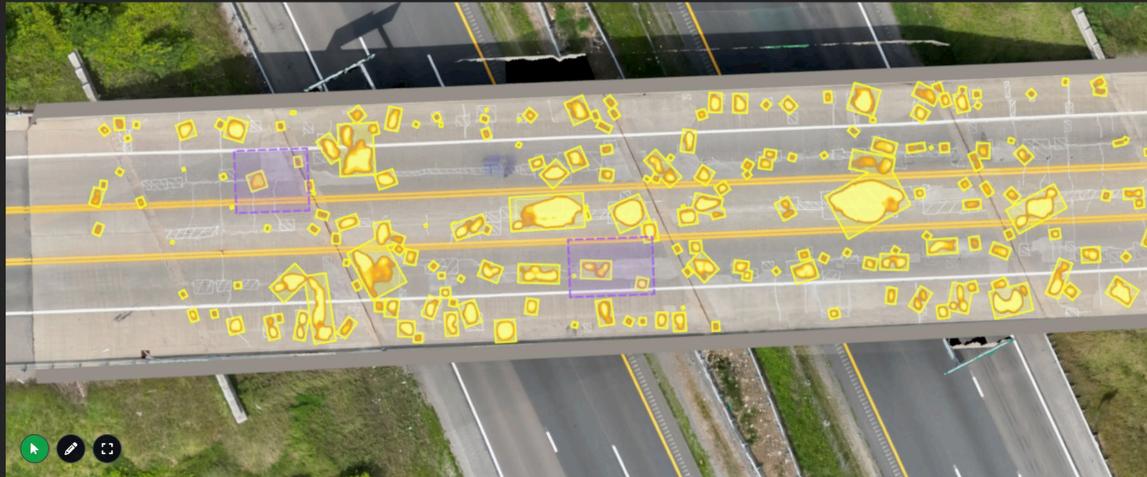


The new inspection standard: autonomous, affordable, and audit-ready.



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M52_I94



Export Data

DeckerAI

Minimum P-Value
0.50 0.60 0.70 0.80 0.90 1.00

Opacity
0.00 0.20 0.40 0.60 0.80 1.00

Thermal Background

Quantity Estimate

Cut Area Buffer (inches)
0 4 8 12 16 20

Deck Assessment

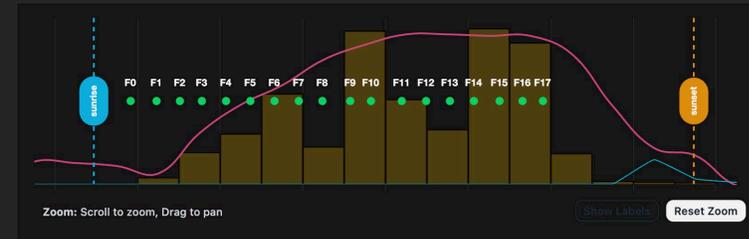
8.3%
1314 ft² / 15859 ft²
p ≥ 70%

DELAMINATION ESTIMATE

2659 ft²
16.8% of bridge
@4" buffer

QUANTITY ESTIMATE

Data Quality



Autonomous bridge inspection at scale: robots fly, STENN³ AI finds defects, engineers get answers.



DRONE-DRIVEN INFRARED BRIDGE DECK CORRIDOR SCANS

➤ FASTER	Days instead of months
➤ LOWER COSTS	No Traffic Control Automated Results
➤ SAFER	Keeps inspectors off active roadways, eliminates need for closures & traffic control
➤ ACTIONABLE DATA	Instant prioritization of issues for maintenance and improvements
➤ EASILY MANAGED	Fully Automated Workflow

A MAJOR MARKET DISRUPTION

EXISTING INSPECTION METHODS ARE SLOW, EXPENSIVE, LIMITED



Visual Inspection



Coring (Destructive)

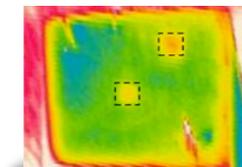
_____ Non-Destructive _____



Sounding



Impact Echo



IR Thermography



Ground Penetrating Radar (GPR)

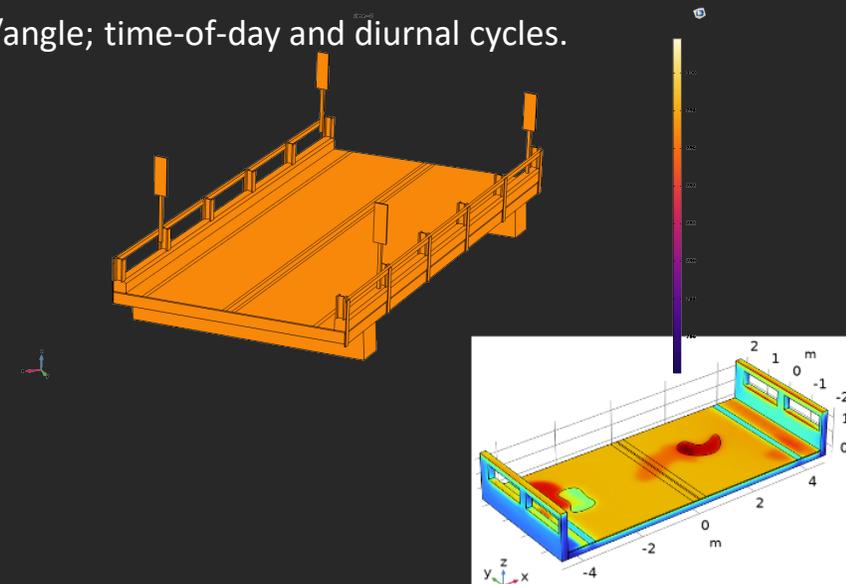


➤ HOW? AI for INFRARED STENN³™

- **Physics-guided features:** Thermal diffusion + diurnal heating models constrain the network.
- **Spatial-Temporal learning (the “ST” in STENN³):** Trains on time-stacks, not single frames—detects *change* and persistence, not noise.
- **Multimodal fusion:** Fuses IR, RGB, DEM/point-cloud geometry, and mission telemetry at training time.
- **Label quality & hard-negative mining:** Aggressive mining of thermally confusing regions (joints, patches, shadows) improves precision.
- **Uncertainty & calibration:** Calibrated probabilities

DeckForge™ — crafting detection on the bench

- **Digital twins of decks:** Parametric models (slab thickness, rebar spacing, cover, patch history) + defect priors (delam size/depth, moisture paths).
- **Physics-based thermal sims:** Transient heat-flow (PDE) with realistic boundary conditions (solar load, wind, humidity, emissivity, cloud transients).
- **Sensor & mission realism:** IR camera MTF/noise, vignetting, drift; flight altitude/speed/angle; time-of-day and diurnal cycles.



with uncertainty maps
with uncertainty
thresholds.

CONFIDENTIAL



➤ IN ACTION

Working with **12** State DOTs within 12 months of market launch

Statewide Deck Evaluation Contract Awarded with TxDOT October 2025

300+ bridge decks scanned across the U.S.

National Science Foundation selected our project pitch to provided non dilutional grant funding







Email

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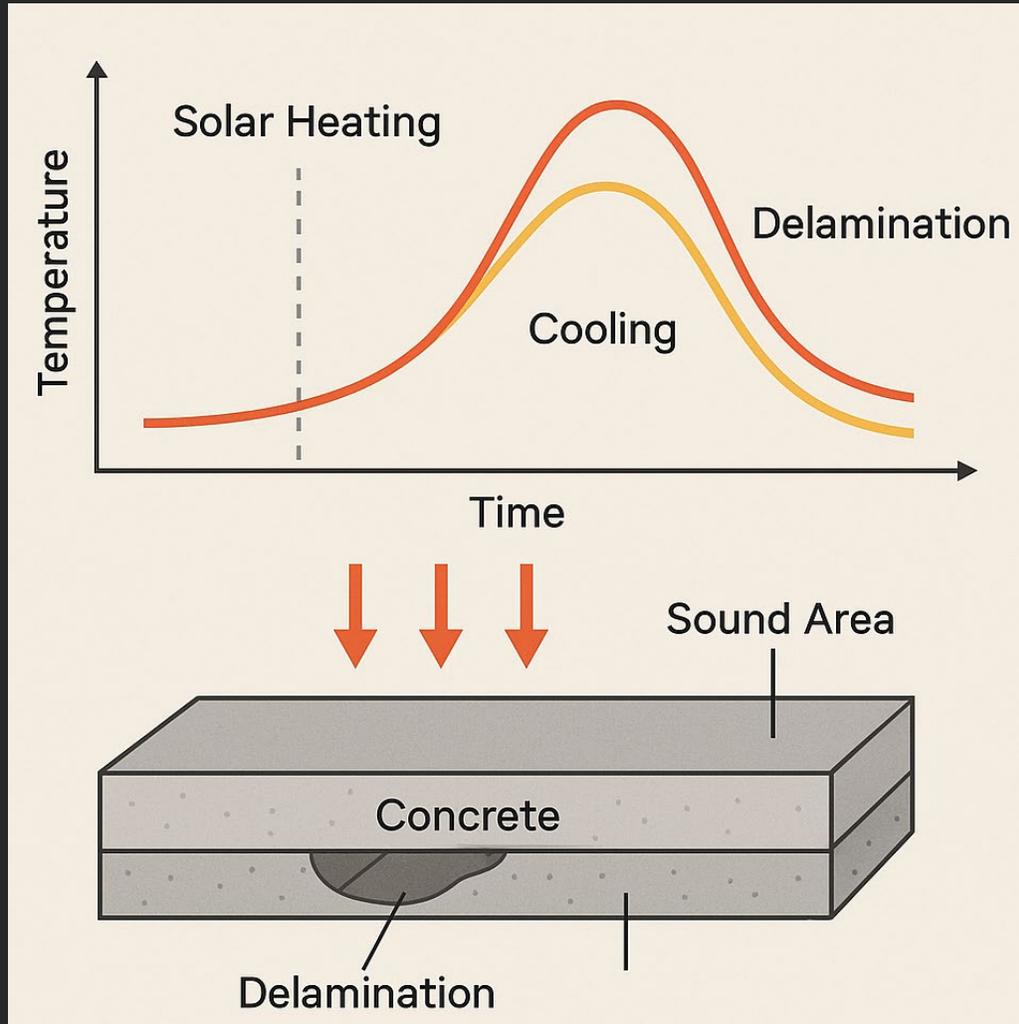
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➤ THERMAL PHYSICS

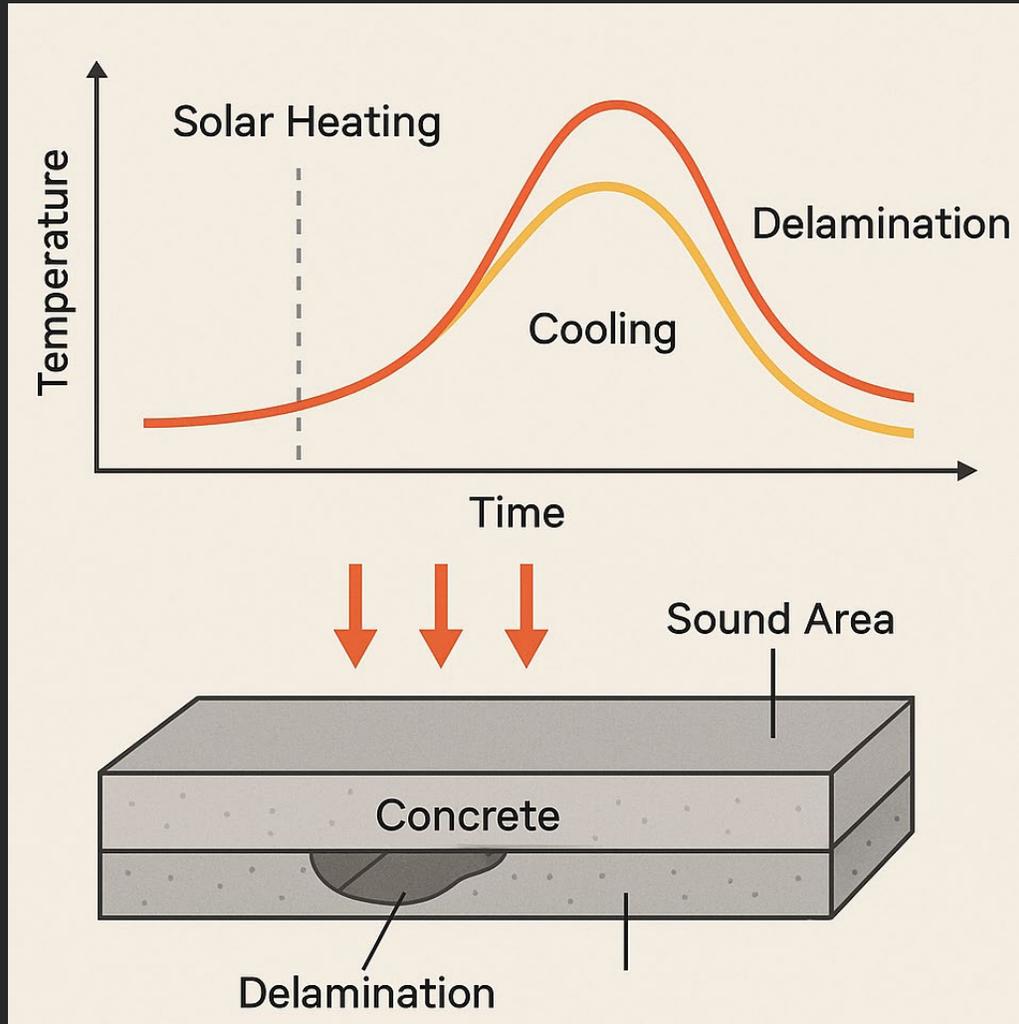
- Heat capacity and thermal inertia of concrete vs. air-filled delaminations
- How solar loading or active heating creates surface temperature contrasts over time





➤ TIME-SERIES CONCEPT

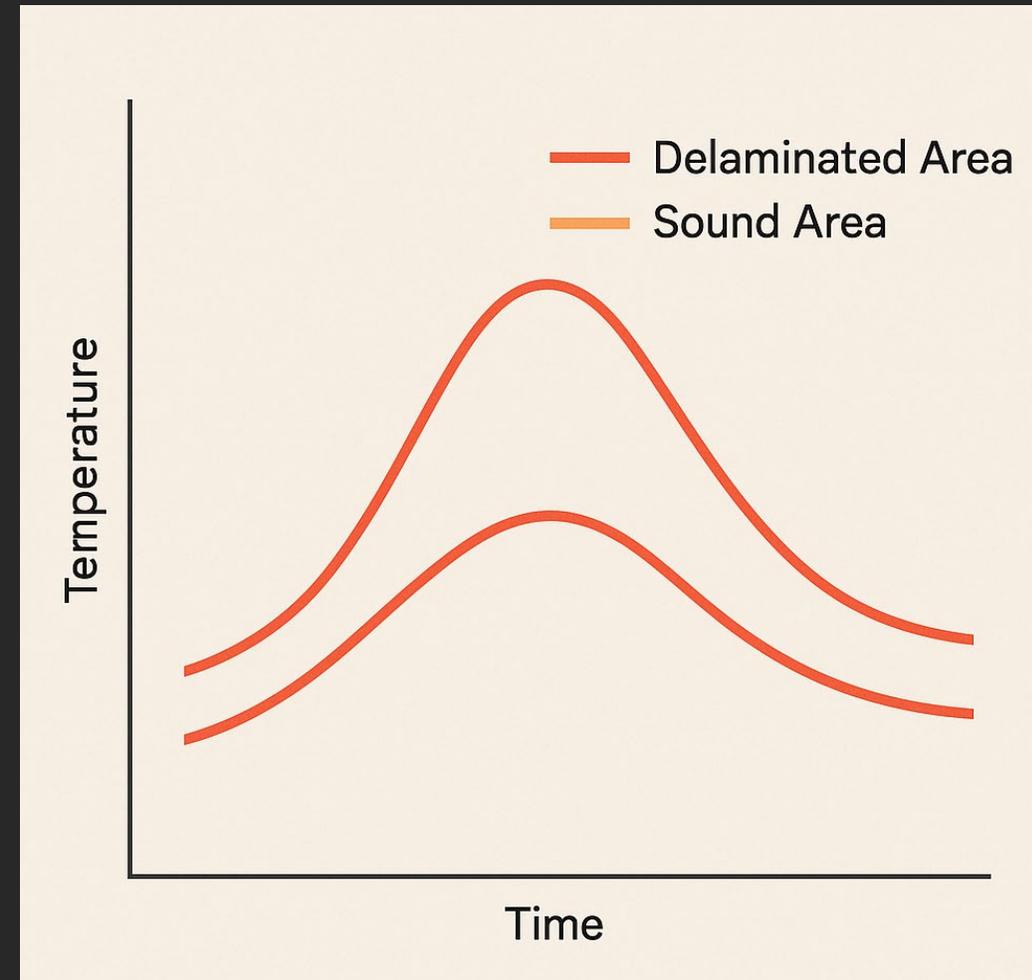
- Capturing a sequence of thermal images at regular intervals to observe rate of heating/cooling.
- Typical acquisition intervals (e.g., every 30 min to 1 hour) and why.





➤ DELAMINATION SIGNATURE

- Delaminated zones heat and cool faster → show as hot (daytime) or cold (evening) “spots” relative to sound areas.





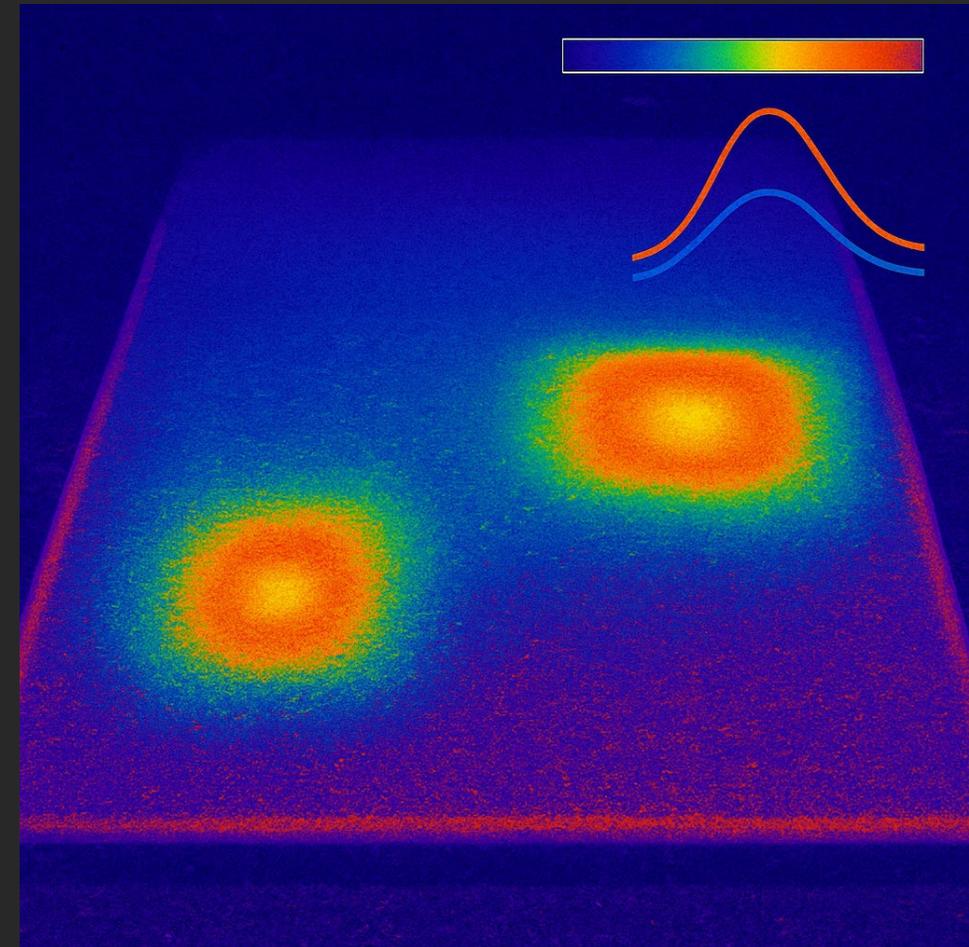
➤ THERMAL RESPONSE FUNDAMENTALS

Heat Path Length:

- **Shallower** delaminations have **shorter** conduction paths, so surface temperatures change **faster**.
- **Deeper** delaminations delay the peak temperature response—heat takes longer to travel to the surface.

Air Gap Thickness (Severity):

- **Thicker** gaps act as stronger thermal insulators → **higher** temperature contrast but may also **delay** the moment of maximum contrast.
- **Thin** separations produce subtler contrasts that **peak sooner** but with **lower** amplitude.





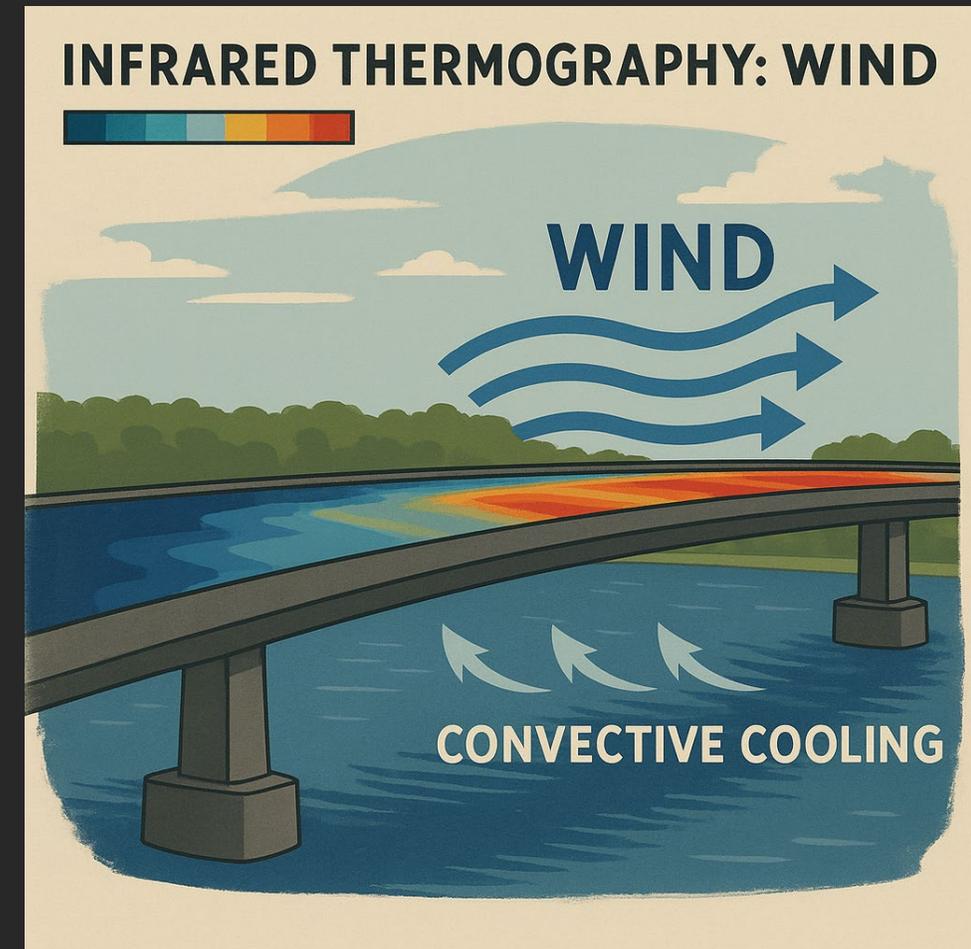
➤ WIND SPEED EFFECTS

Enhanced Convective Cooling:

- **Higher wind speeds** increase heat loss from the surface via convection, flattening the heating curve.
- **Delaminated areas**, which rely on trapped air for pronounced contrast, may show **reduced ΔT** and a **shifted peak later** in the acquisition period.

Practical Implication:

- On **windy days**, add flights after the hottest flight (2-3 additional)





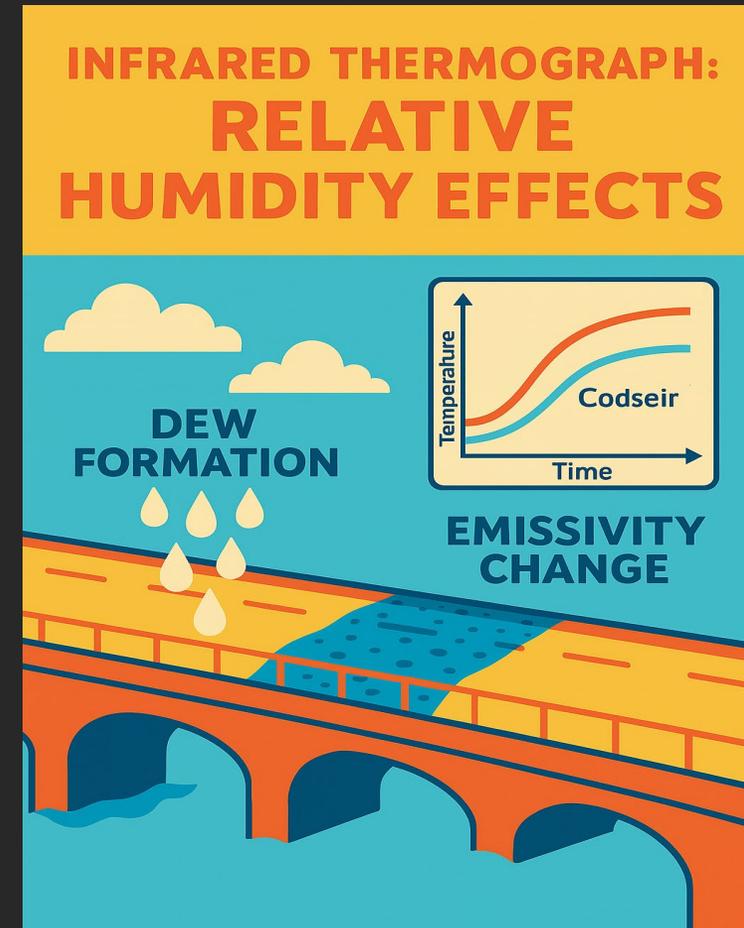
➤ RELATIVE HUMIDITY EFFECTS

Moisture Content & Emissivity:

- **High humidity** can increase surface moisture, **changing emissivity** and **dampening thermal contrast**.
- **Evaporative cooling** from moisture can delay surface heating, **pushing the peak** further into the solar loading period.

Practical Implication:

- In **humid** conditions, add flights after the hottest flight (2-3 additional)
- Collection within 24 hours of significant precipitation or when moisture is visible on deck will not lead to an inaccurate result





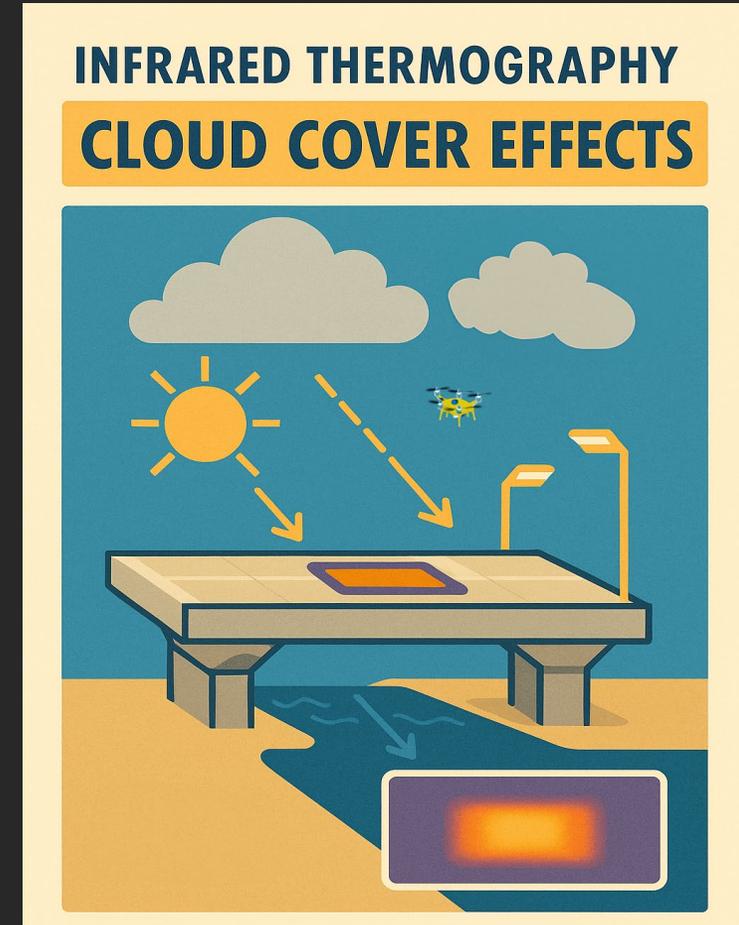
➤ CLOUD COVER EFFECTS

Solar Loading Variability:

- **Intermittent clouds** cause fluctuating irradiance, creating **noise** in the temperature–time curves.
- **Thick cloud cover** reduces net solar input, leading to **lower peak temperatures** and **less pronounced** delamination signals.

Practical Implication:

- For **partly cloudy** days, monitor how often the bridge is in and out of sun if the bridge is out of sun for more than 4 hours add flights
- On **overcast** days, no problem looking for more than 10-degree temp swing





➤ KEY TAKEAWAYS

1

More Flights
are Better than Less
(to an extent)

2

Closer Together
Better than Far Apart
(every 30 min better than 1 hr.)

3

Cold Flight
Before Thermal Loading,
Before Sunrise

4

Warming Flights
In Between

5

Hot Flight
30 mins after hottest
part of the day

Diminishing results after the “Hot Flight”

Flight over Non-Participants and Moving Traffic

✓ Accepted

Tracking #: OOP000000166

Created: 7.1.2024

Operations Over People Declaration of Compliance

Category 2, Category 3

Make:

Aerial Vehicle Safety Solutions (AVSS)

On February 13, 2019, the FAA issued a notice of proposed rulemaking (NPRM) titled Operation of Small Unmanned Aircraft Systems over People, which proposed to modify these regulations to permit routine operations of small unmanned aircraft over people and at night under certain conditions.

➤ Cost Comparison



Baseline Assumption

An average bridge deck size of **17,000 sq ft** is used as our basis for comparison.

MPT averages \$10,000 per bridge deck of average sq ft.

Rolling closure MPT averages \$4000 per bridge deck of average sq ft.

Chain Drag with Full or Partial Lane Closures

Inspection Speed: ~6,000 sq ft per day (about 3 days per bridge)

Labor & Equipment Cost: ~\$2,000/day

Maintenance and Protection of Traffic (MPT):

\$8,000–\$12,000 total (flaggers, signs, lane closures)

Total Cost Estimate:

\$6,000 (labor/equipment over 3 days)

\$10,000 (avg. MPT)

Total: \$16,000 per bridge

Cost per square foot: ~\$0.94

Vehicle-Mounted GPR and/or IRT with Rolling Closures

Inspection Speed: ~17,000 sq ft per day (1 bridge/day)

Labor & Equipment Cost: ~\$3,500/day

MPT (rolling closures): ~\$3,000–\$5,000 (escorts, traffic control)

Total Cost Estimate:

\$3,500 (labor/equipment)

\$4,000 (avg. MPT)

Total: \$7,500 per bridge

Cost per square foot: ~\$0.44

UAS with Infrared Thermography

Inspection Speed: 3 bridges per day (~51,000 sq ft/day)

Monthly System Lease: \$6,000 → \$300/day (based on 20 working days/month)

Labor Cost: ~\$1,200/day for a two-person crew

MPT: None required

Total Daily Operating Cost:

\$300 (system) + \$1,200 (labor) = \$1,500/day

Per bridge: \$500

Cost per square foot: ~\$0.03

Method	Total Cost/Bridge	Cost per Sq Ft	MPT Required	Workers on Bridge?
Chain Drag	\$16,000	\$0.94	Yes	Yes
GPR/IRT Vehicle	\$7,500	\$0.44	Yes (rolling)	Yes
UAS with Infrared Thermography	\$500	\$0.03	No	No

Questions?