

Thermal Imaging to Support Preservation

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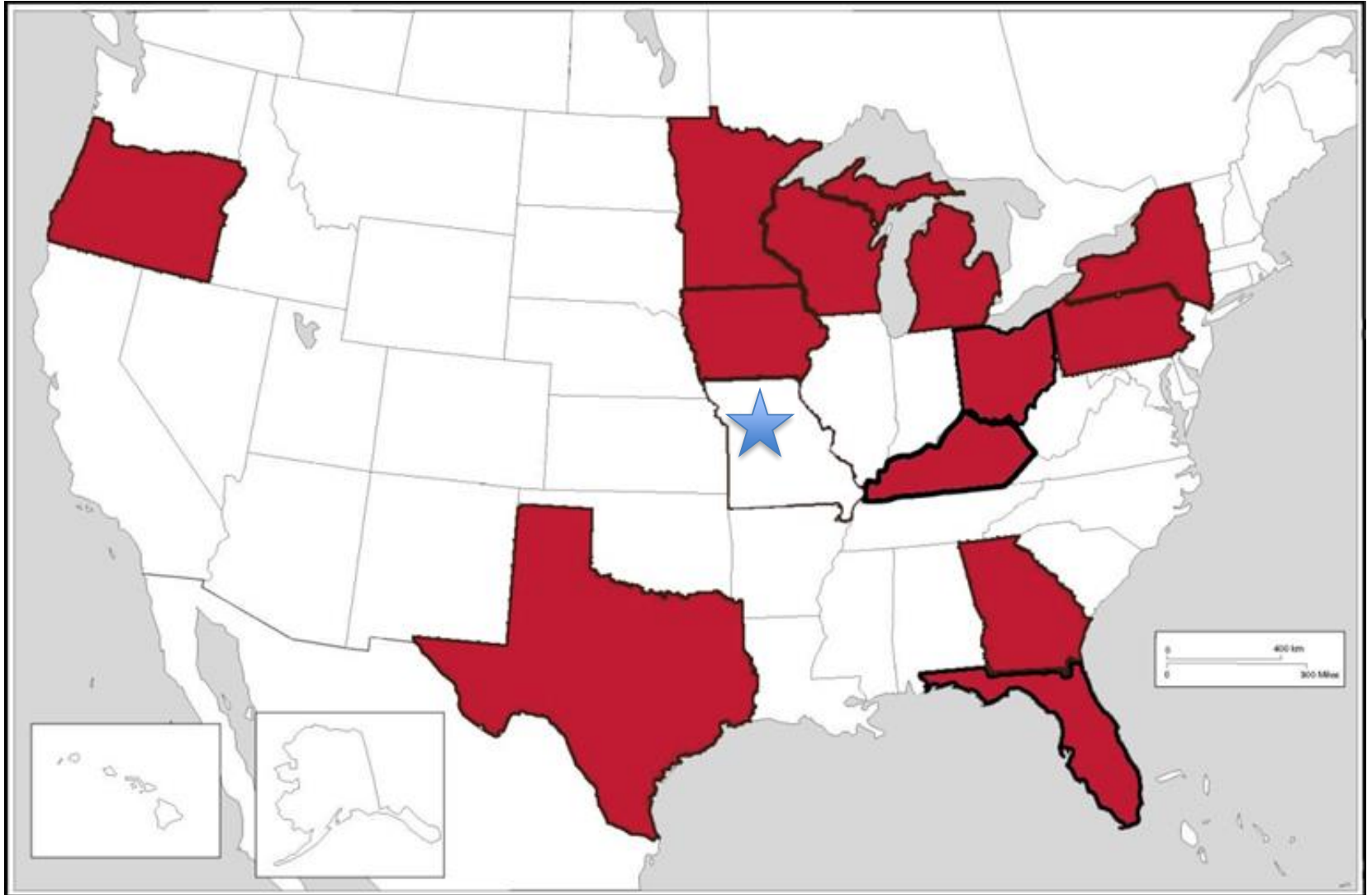
College of Engineering
University of Missouri

October 2016

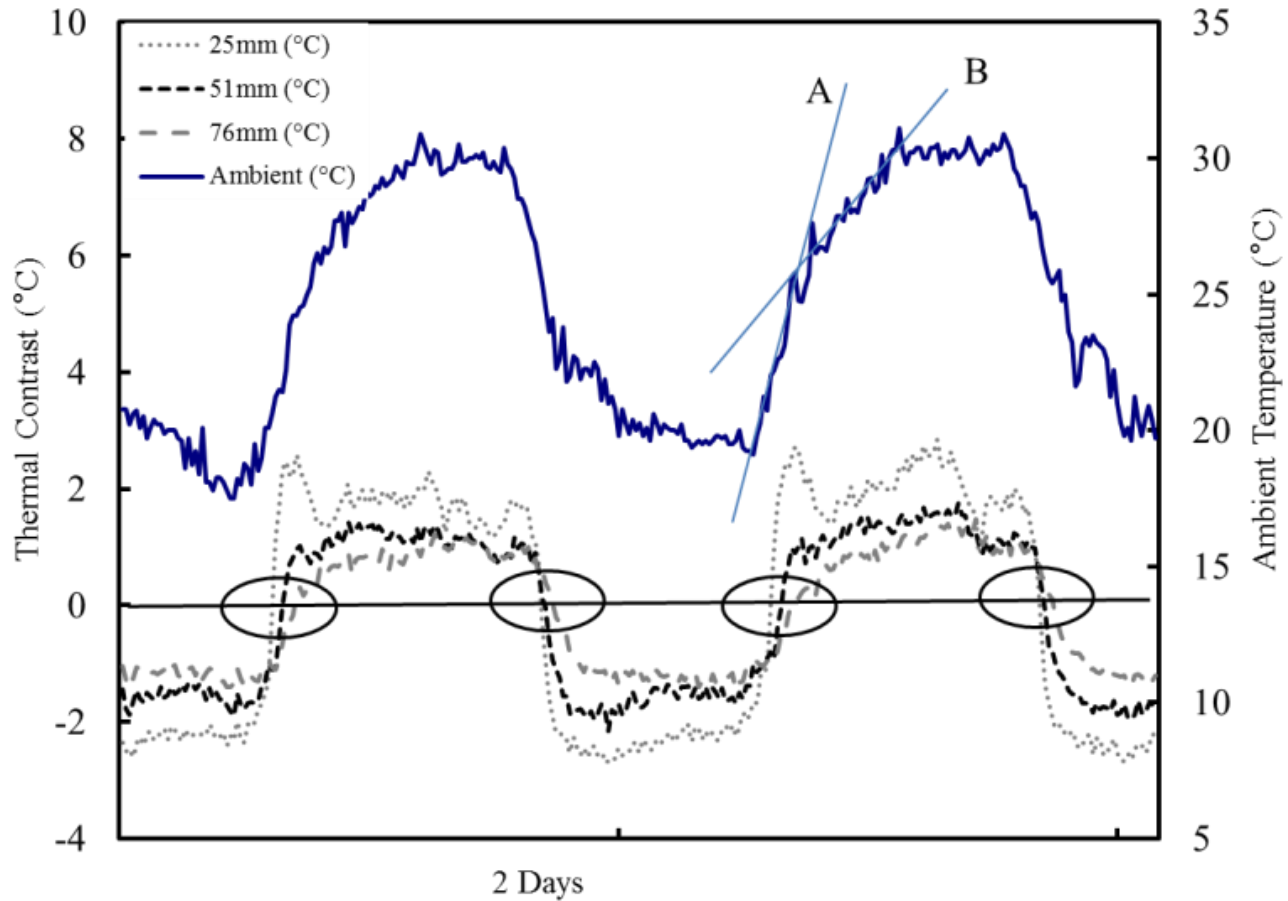
Goals and Objectives

- Goal: Broaden the use of IR technologies for the condition assessment of bridges
- Objectives:
 - Provide update on results of pooled fund
 - Introduce new IR technologies
 - Tools for IR inspection
 - IR Deck and Soffit Scanner (IR-DSS)
 - IR Ultra-Time Domain Imaging (IR-UTD)

Pooled Fund States



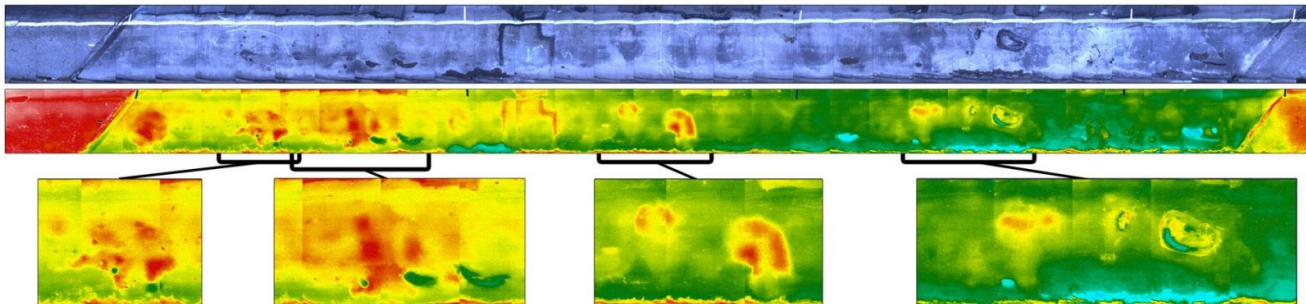
Limitations of IR

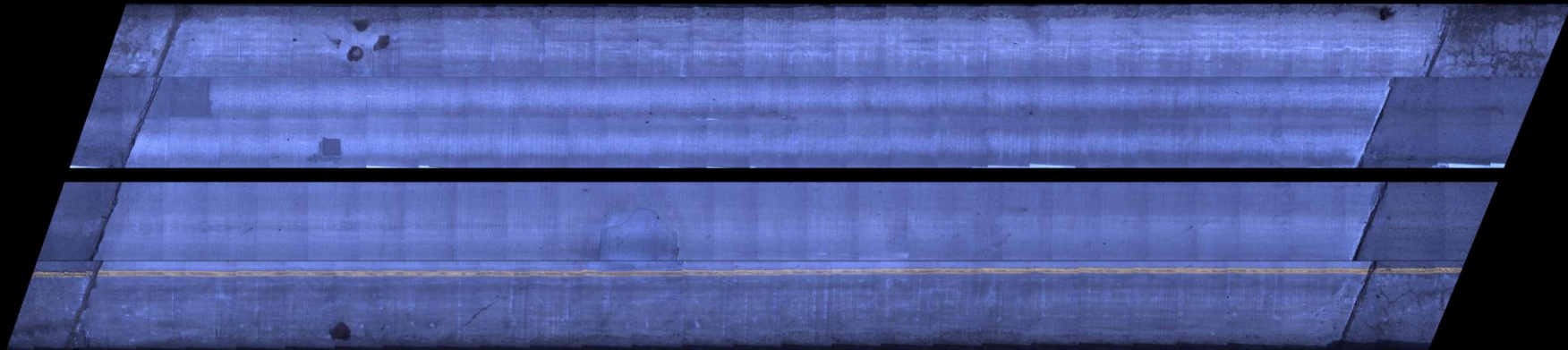


New Technology

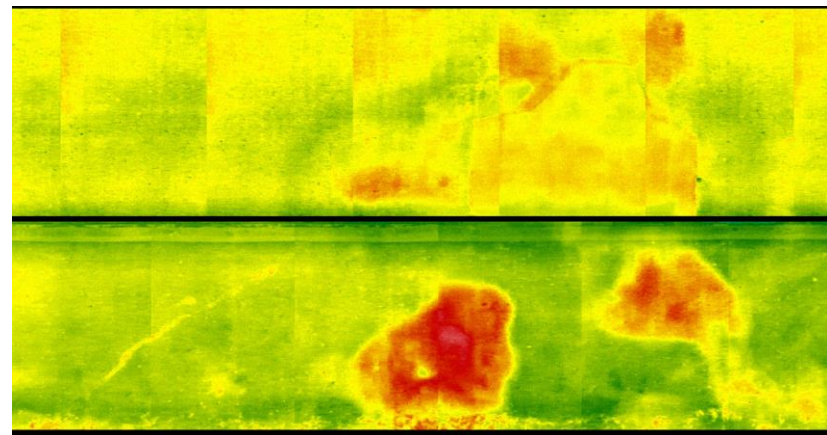
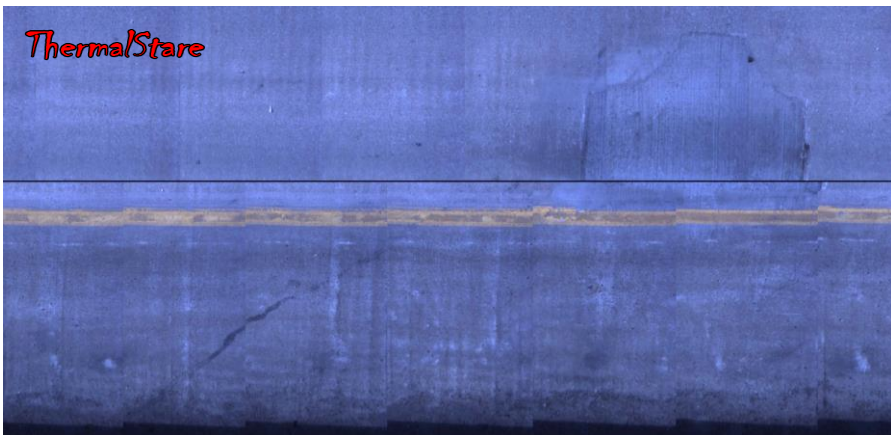
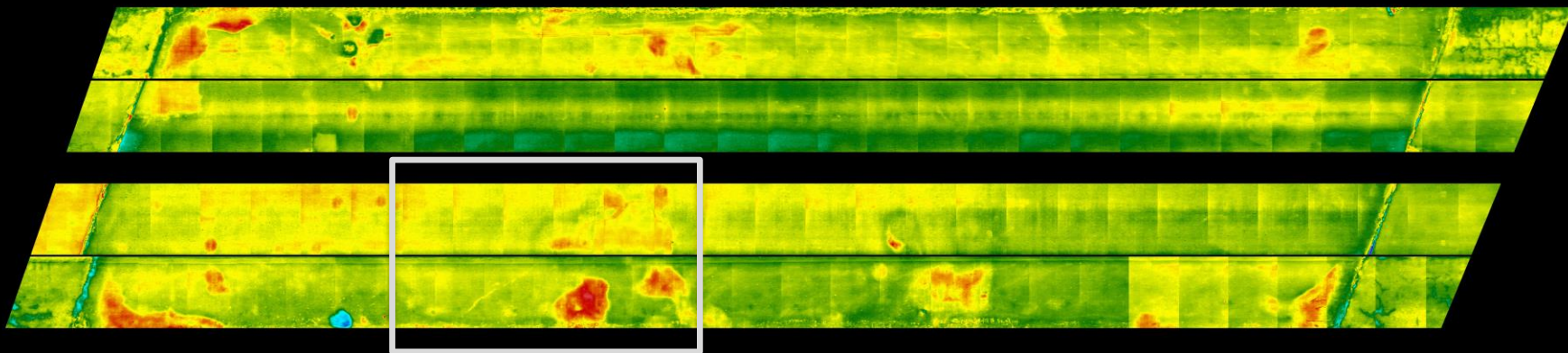
- IR-DSS
 - Mobile System
 - 5 MPH
- IR-UTD
 - IR-UTD is a new tool for condition assessment
 - IR images capture over time are processed to analyze thermal changes
 - Overcomes limitations of hand-held IR
 - Depth of damage
 - Weather dependence
 - Reproducibility
 - Quantitative

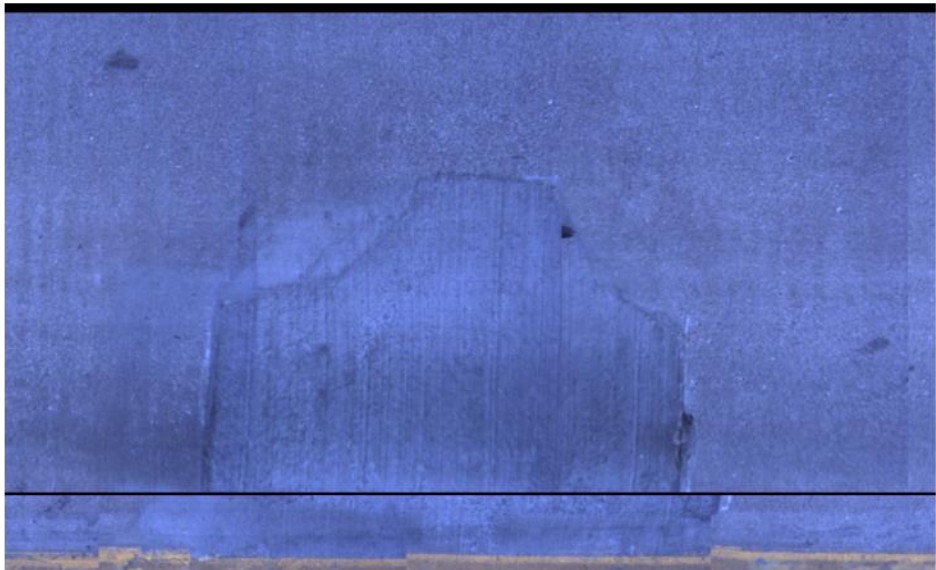
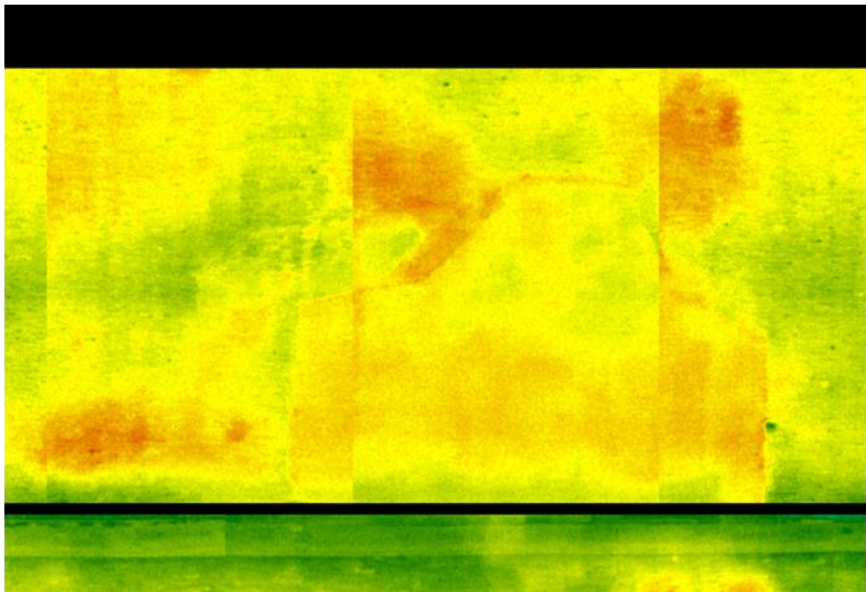
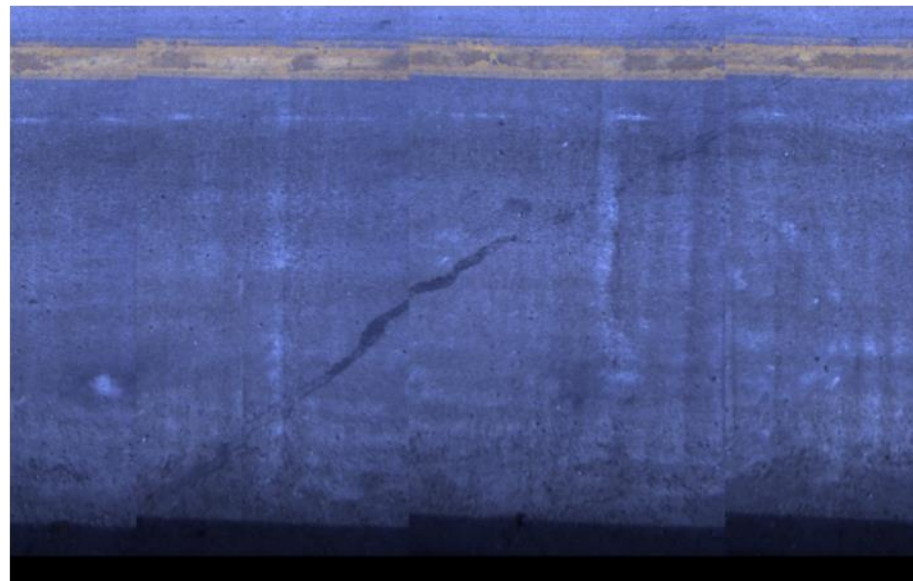
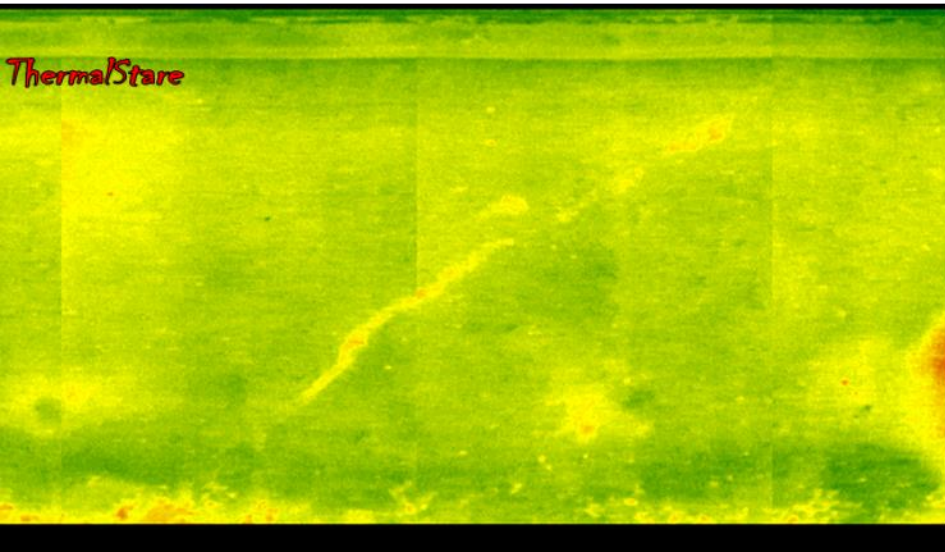
IR-DSS System





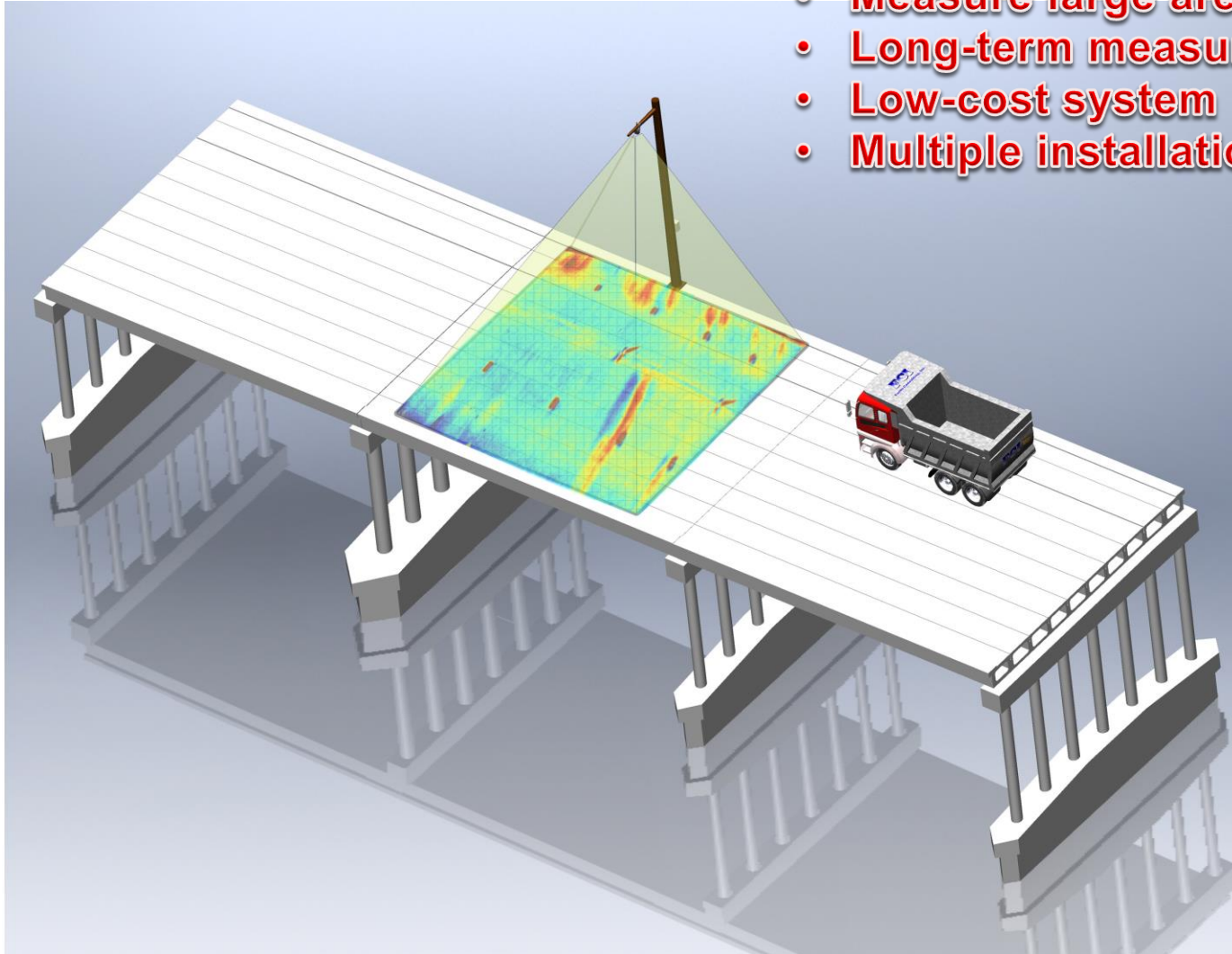
ThermalStare
www.thermalstare.com



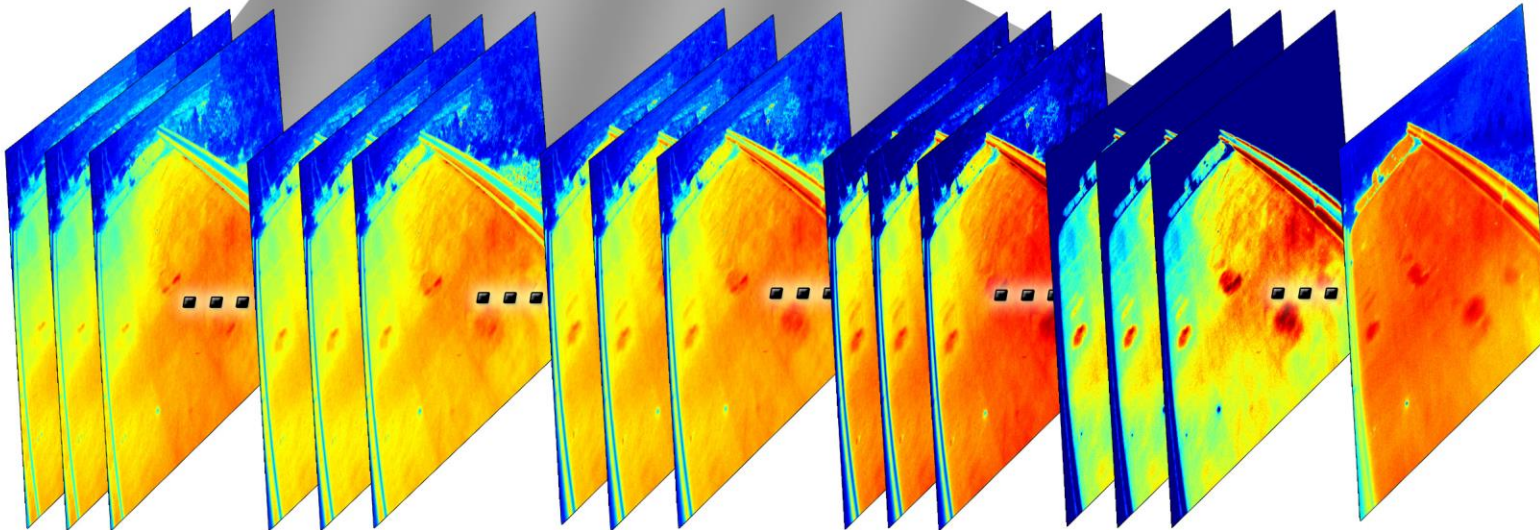
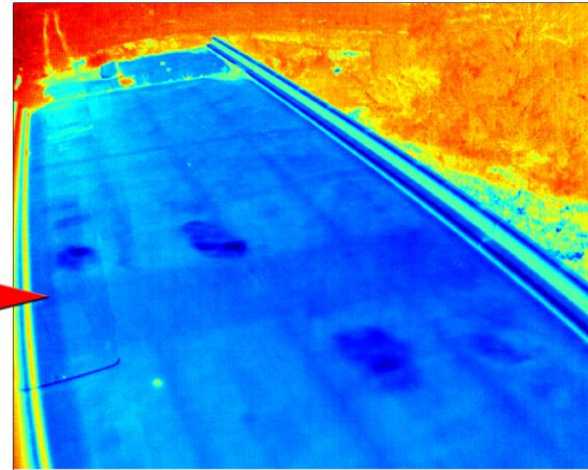
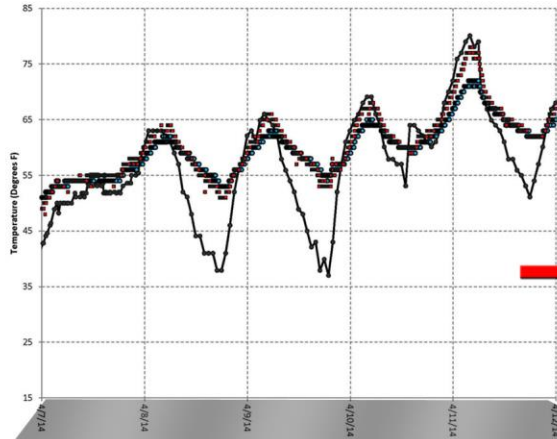


IR-UTD Concept

- Measure large area of deck
- Long-term measurements
- Low-cost system
- Multiple installation options



IR-UTD Concept

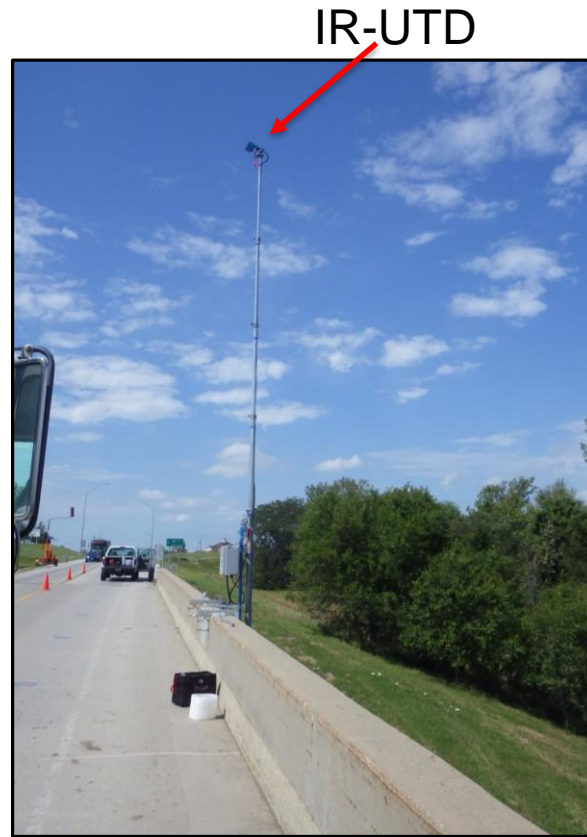


System Setup at Bridge

Non-intrusive system collects data without disrupting traffic



Existing light pole

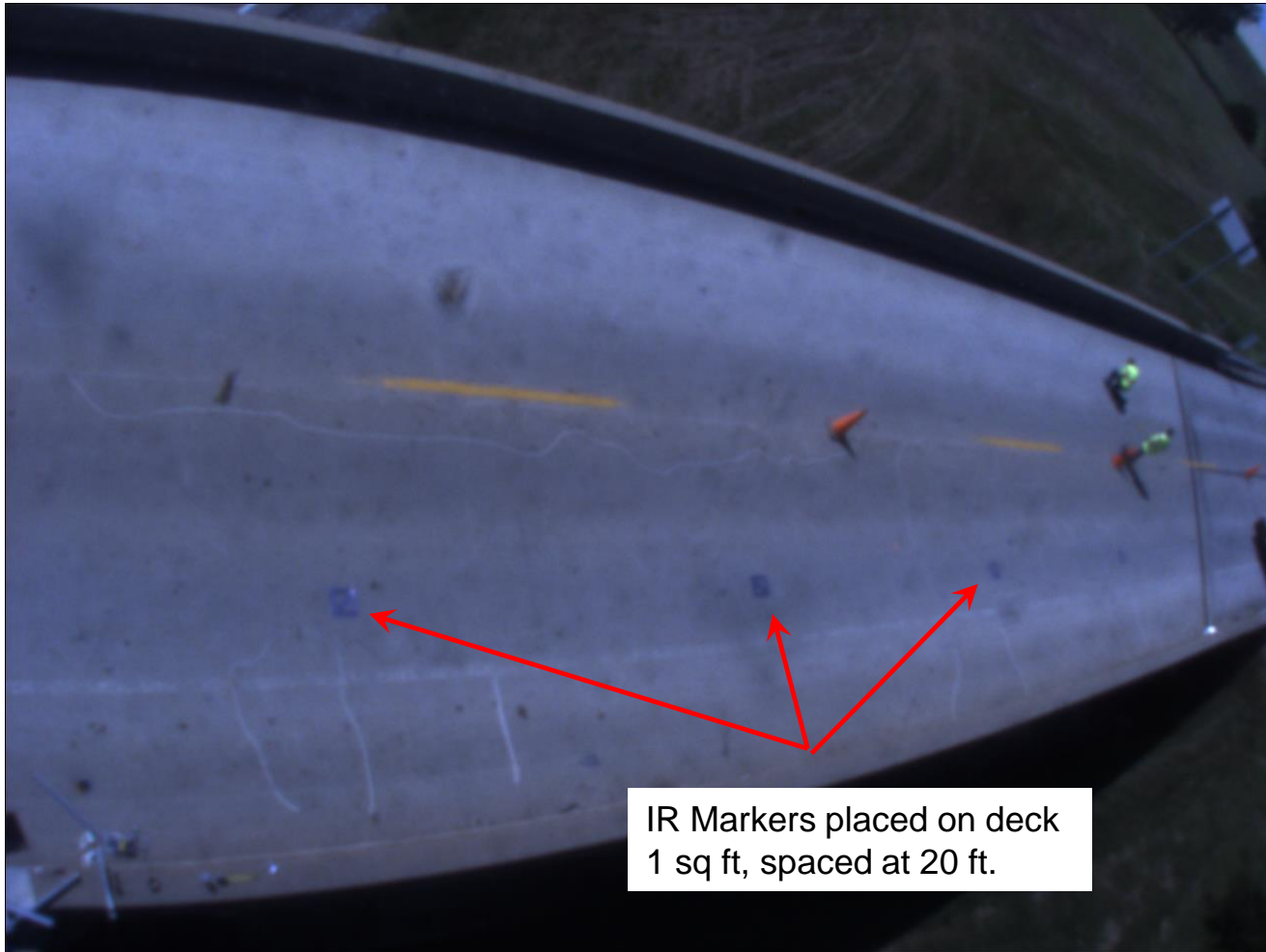


Pneumatic mast



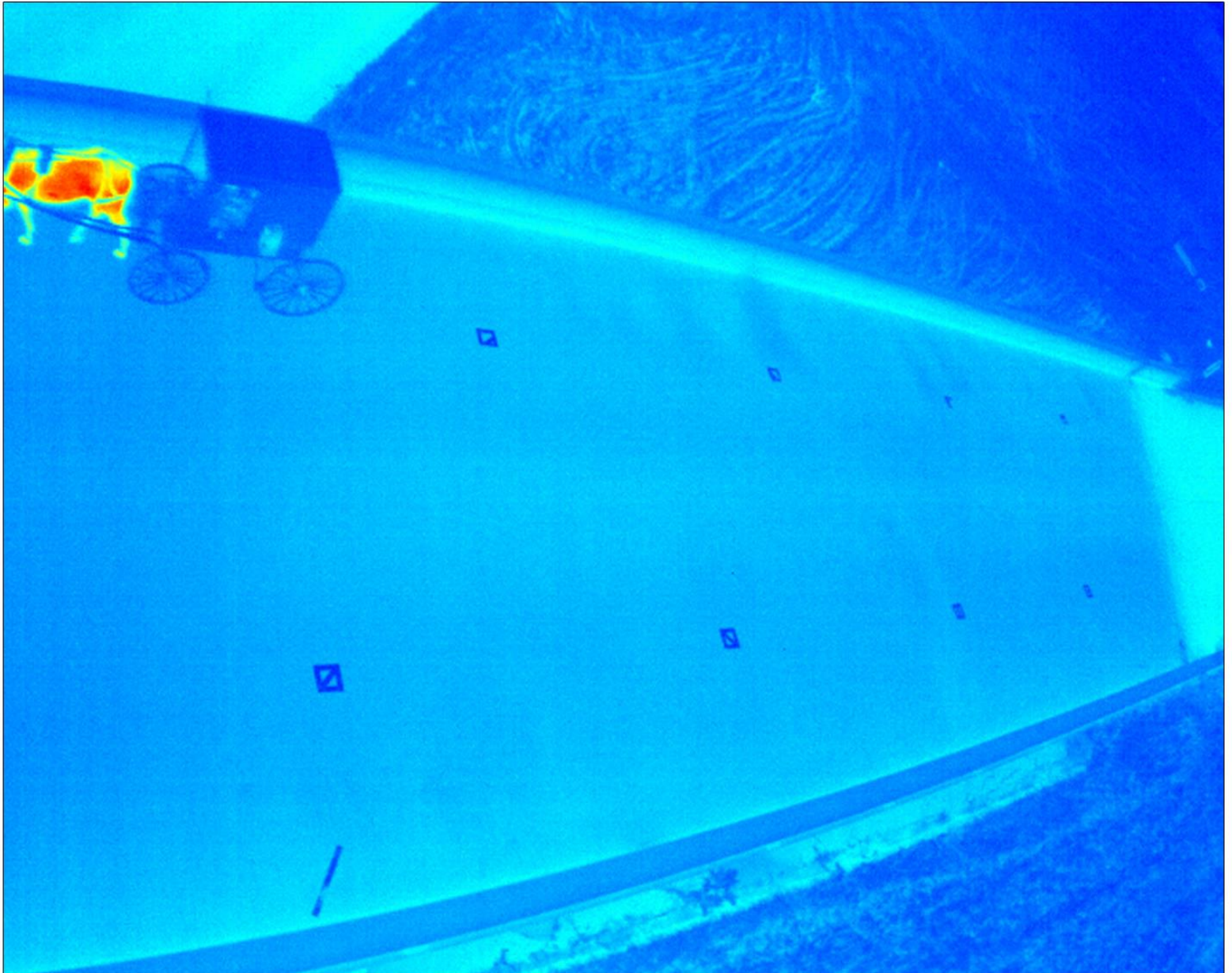
Sign Gantry

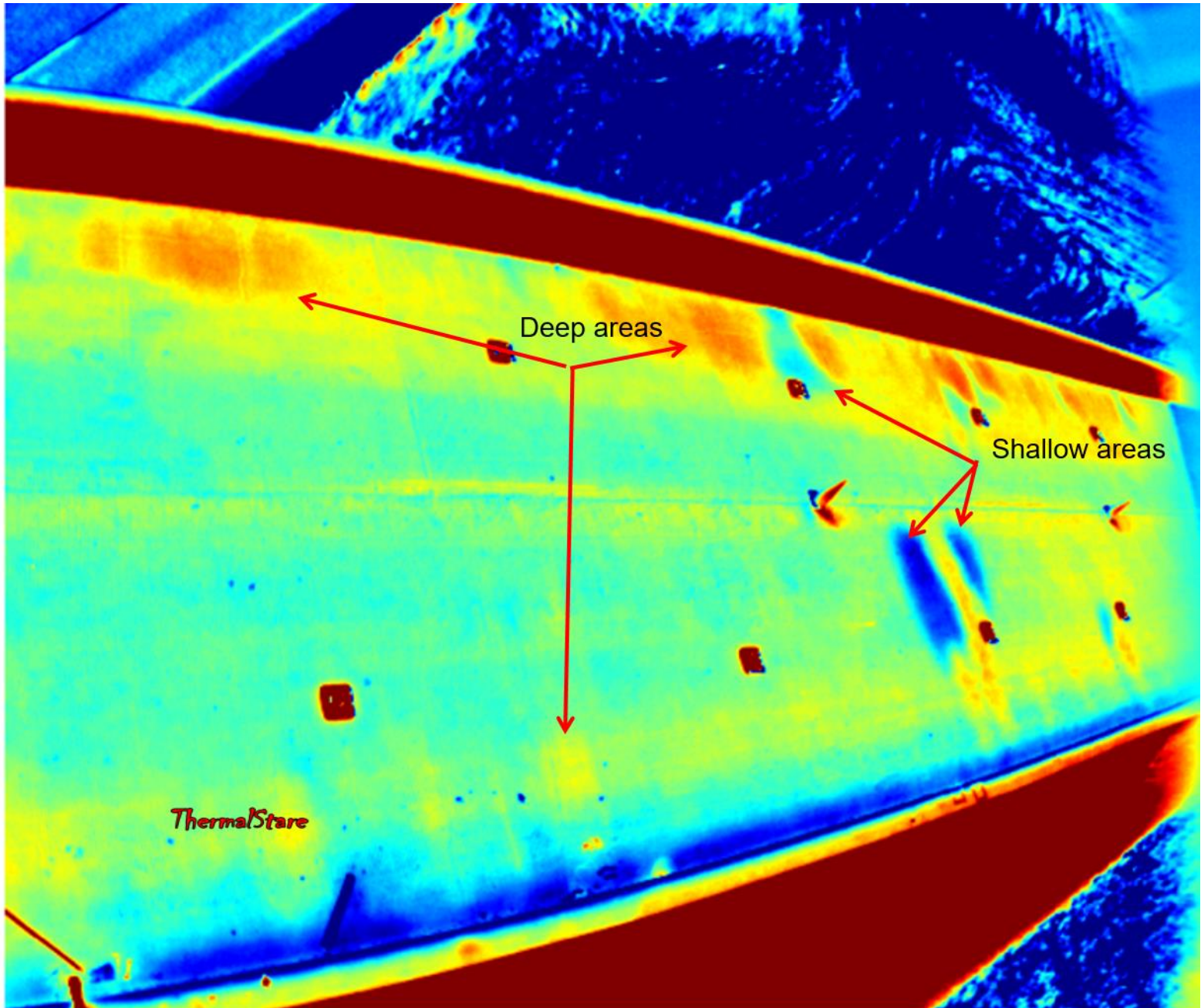
IR System View of the Deck – ~3200 sq ft of deck imaged



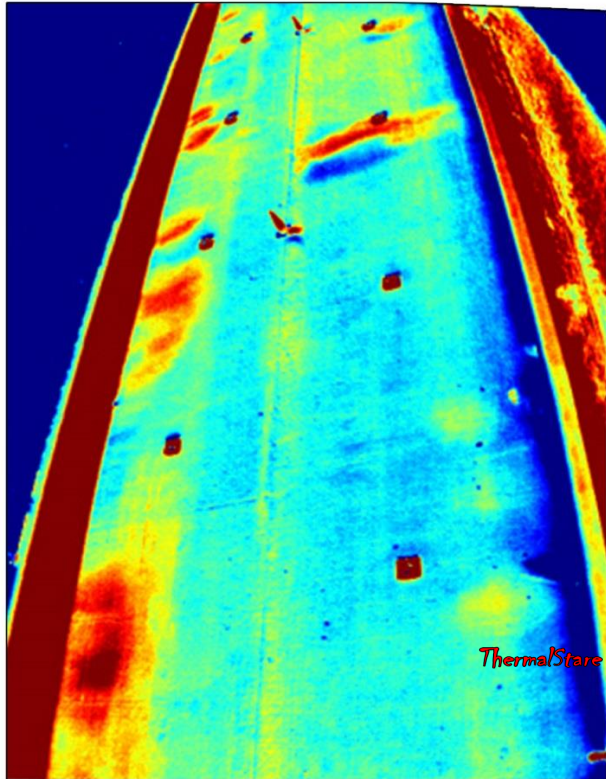
IR Markers placed on deck
1 sq ft, spaced at 20 ft.

Open to Traffic





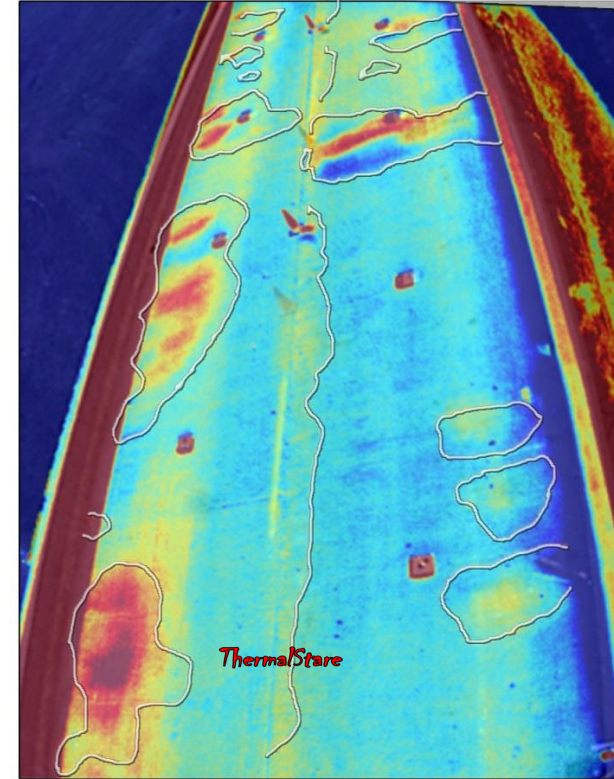
~3000 sq. ft. of Bridge Deck - IR-UTD images, sounding and overlay



Processed IR



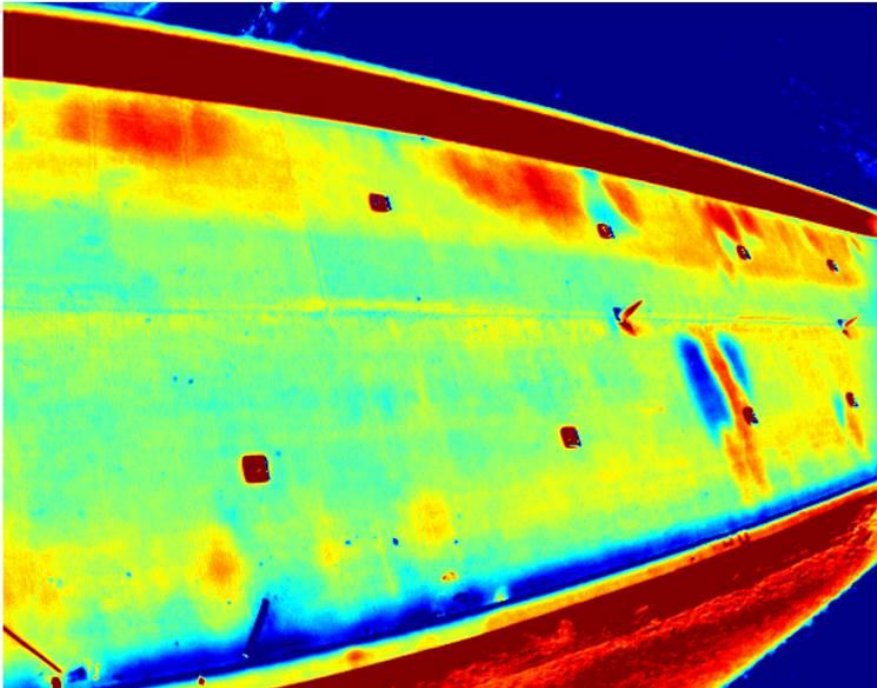
Visual with Sounding Areas Marked



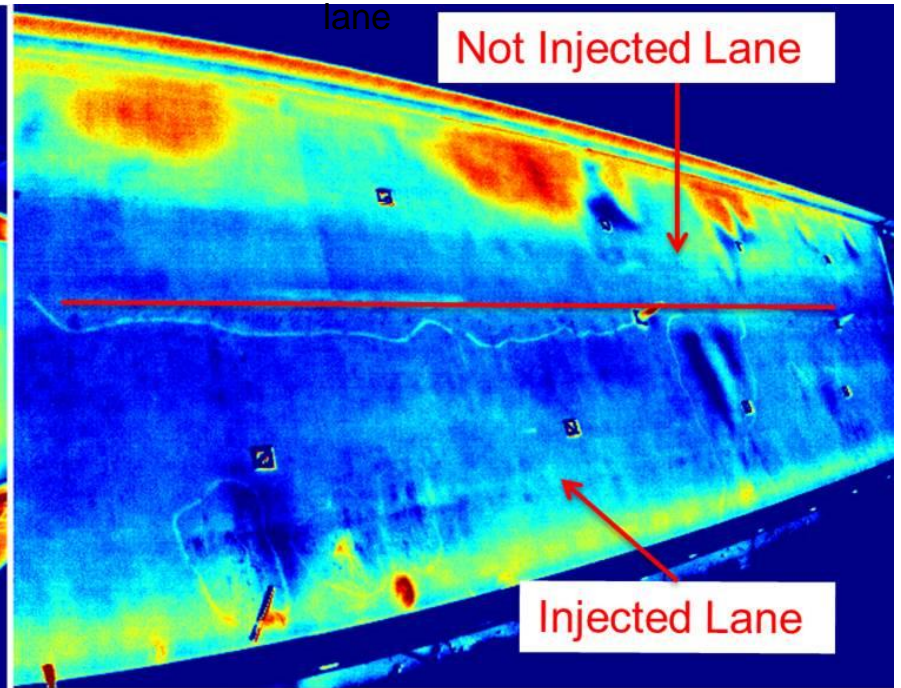
Overlay IR / Visual

Epoxy Injection

Before Injection



After Injection of one
lane



KC Bridge Deck



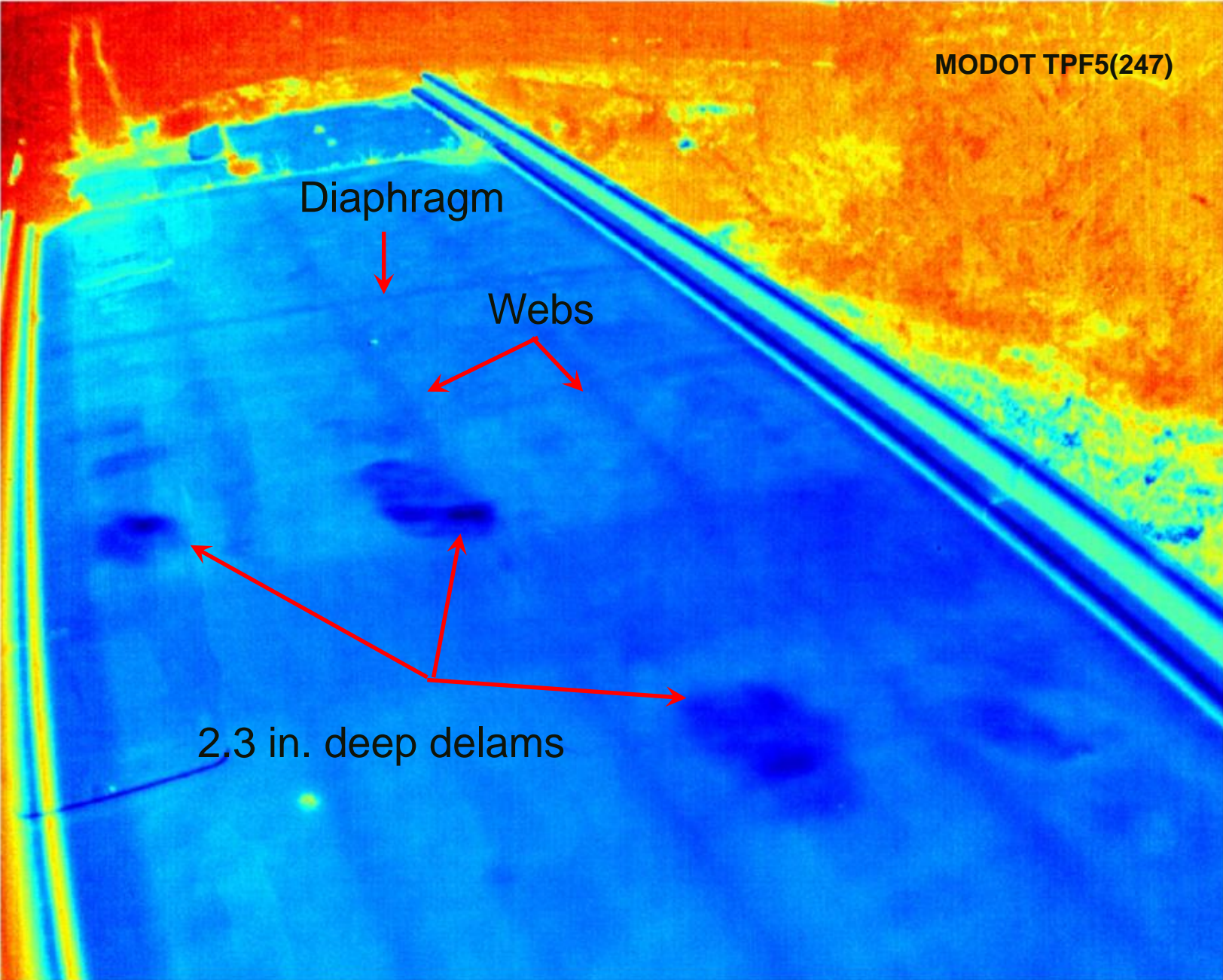
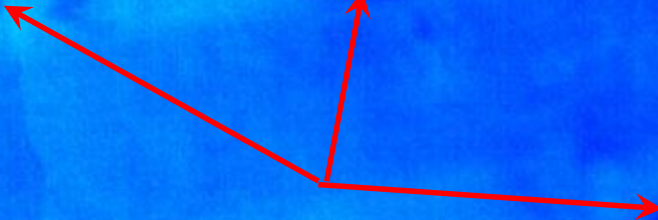
Diaphragm



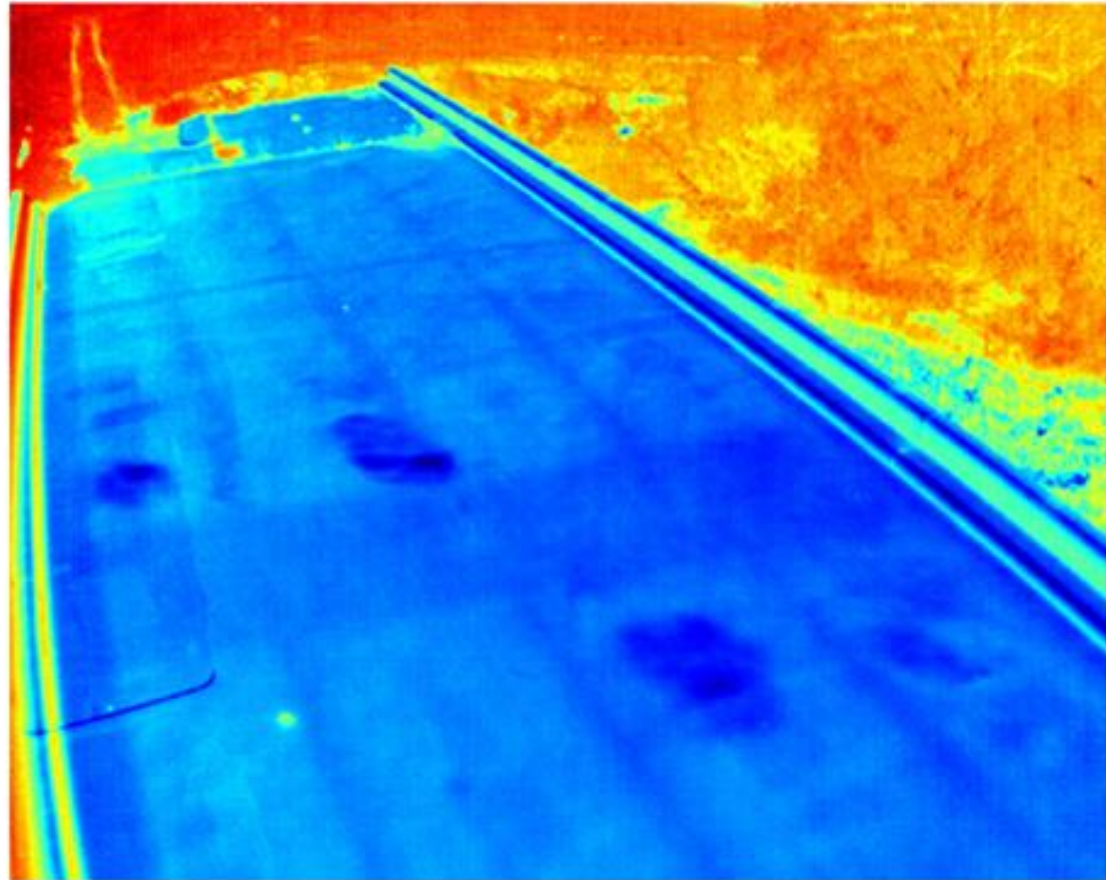
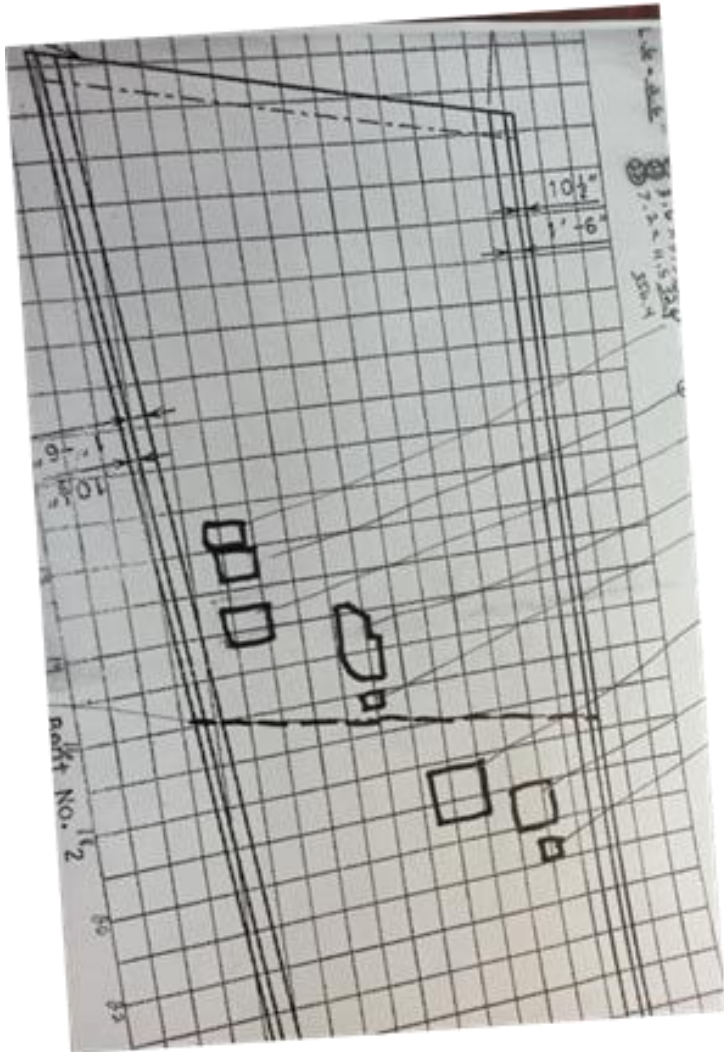
Webs



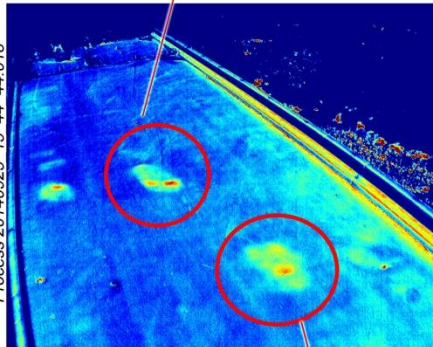
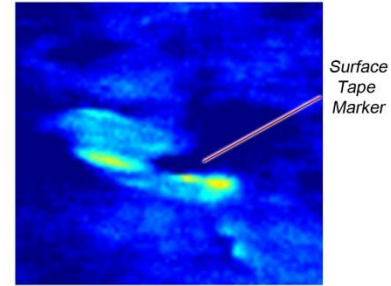
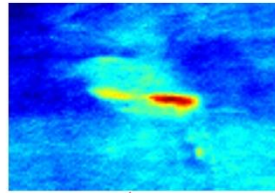
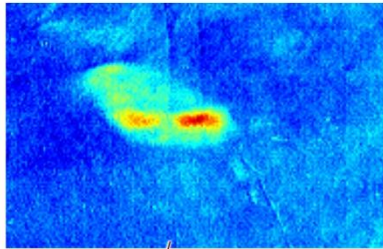
2.3 in. deep delams



Comparison to MoDOT chain drag

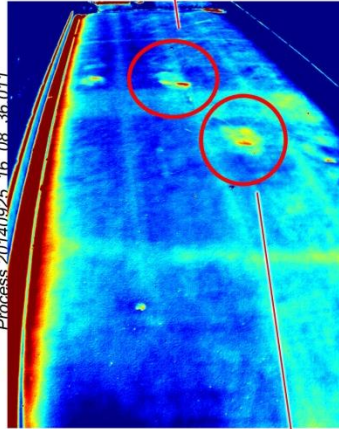


Repeatability



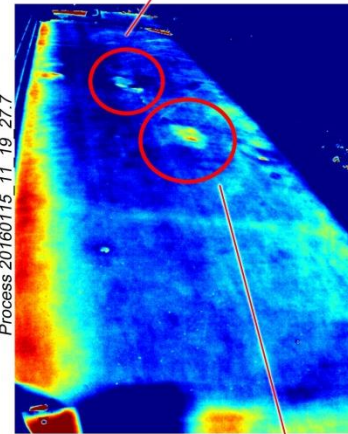
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June 5, 2014
12:30 pm to 6:30 pm



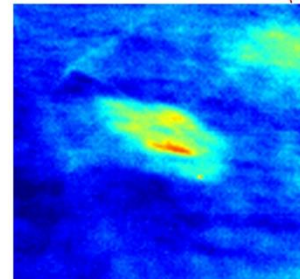
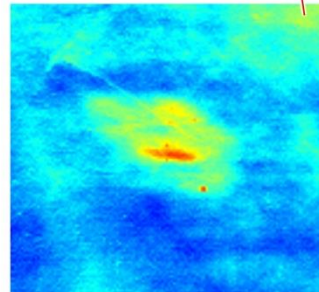
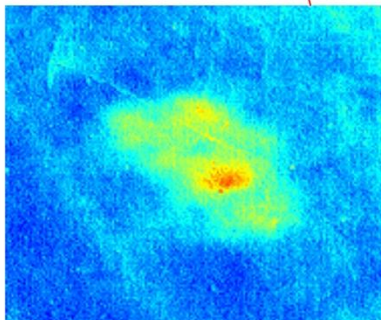
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August 20, 2014
7:30 am to 6:30 pm



Process 20160115_11_19_27.7

September 3, 2015
8:30 am to 8:00 pm



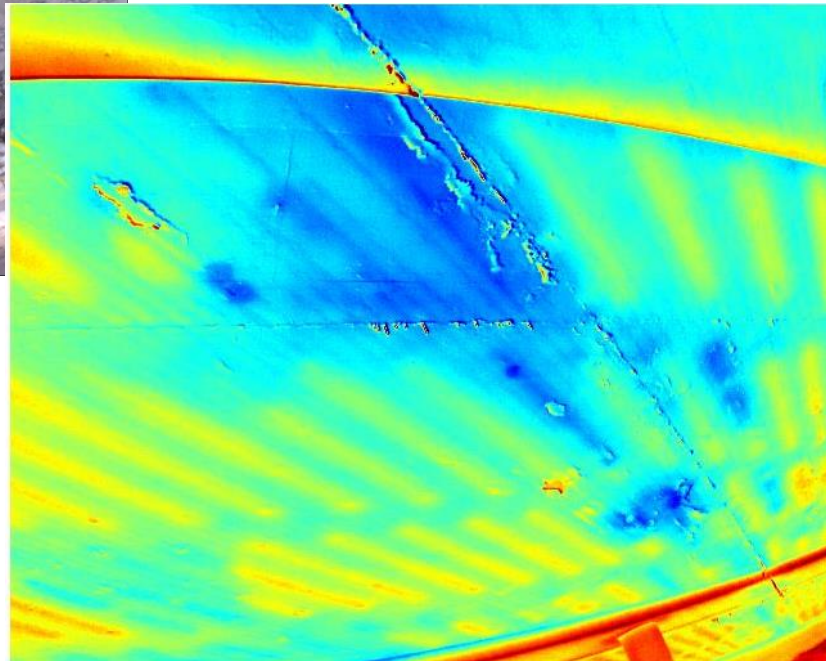
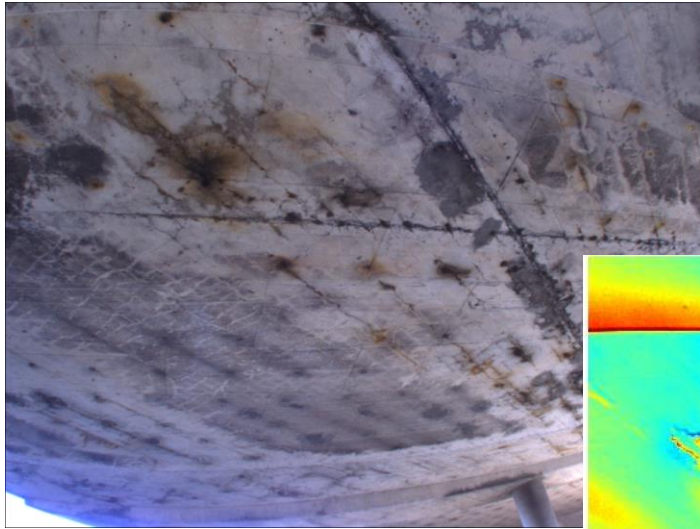
Voided Slab Bridges

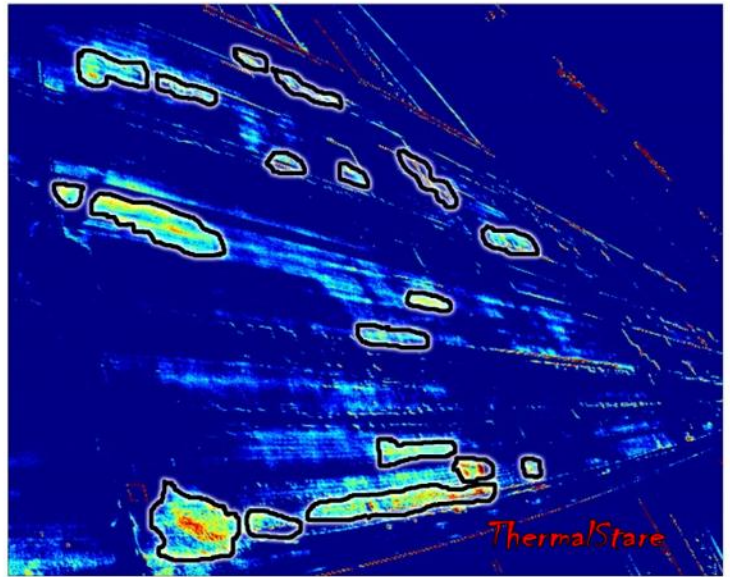
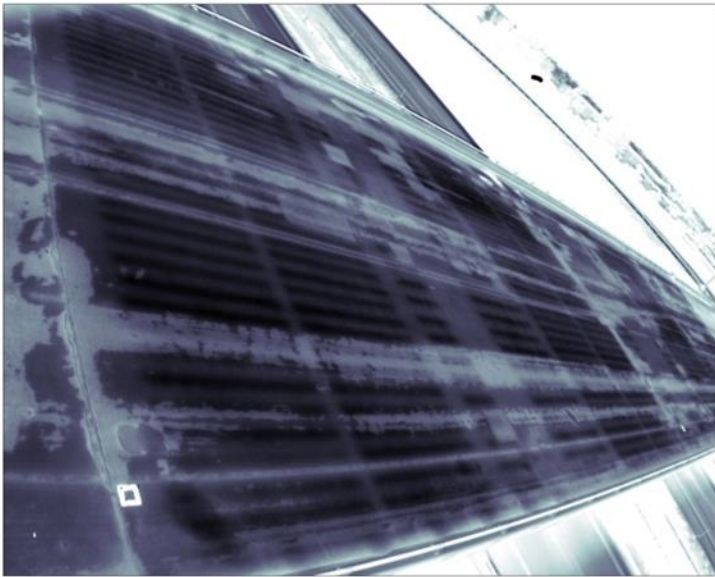
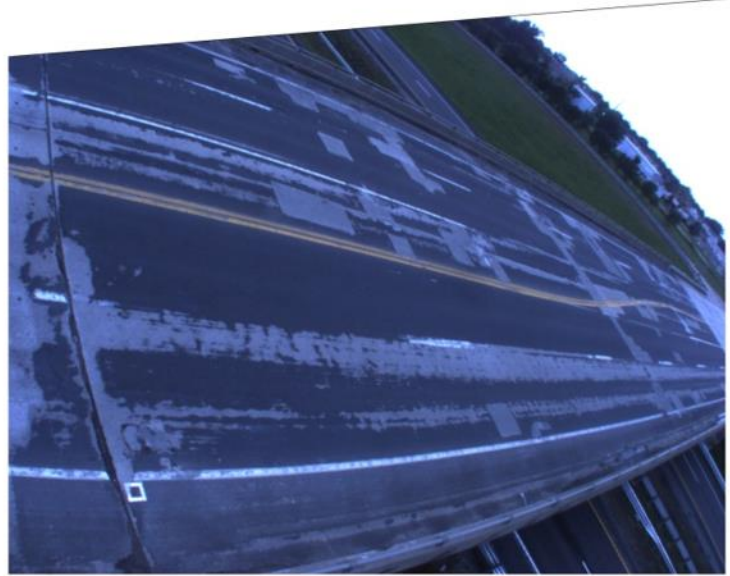
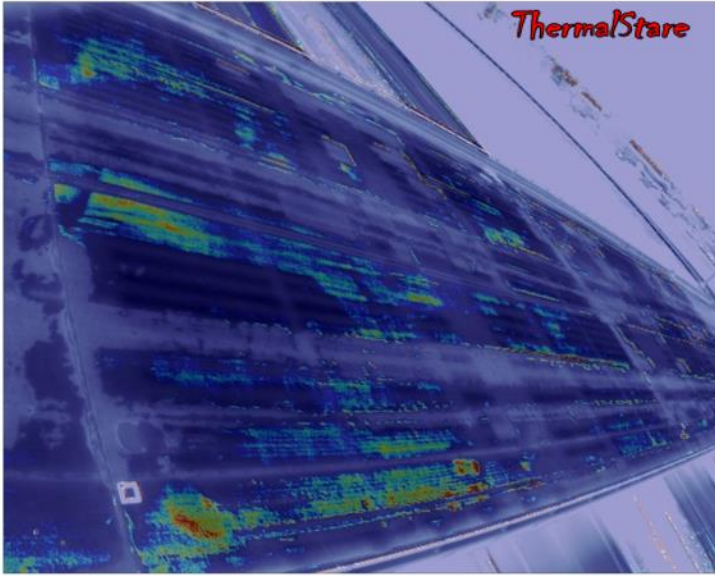


Photo

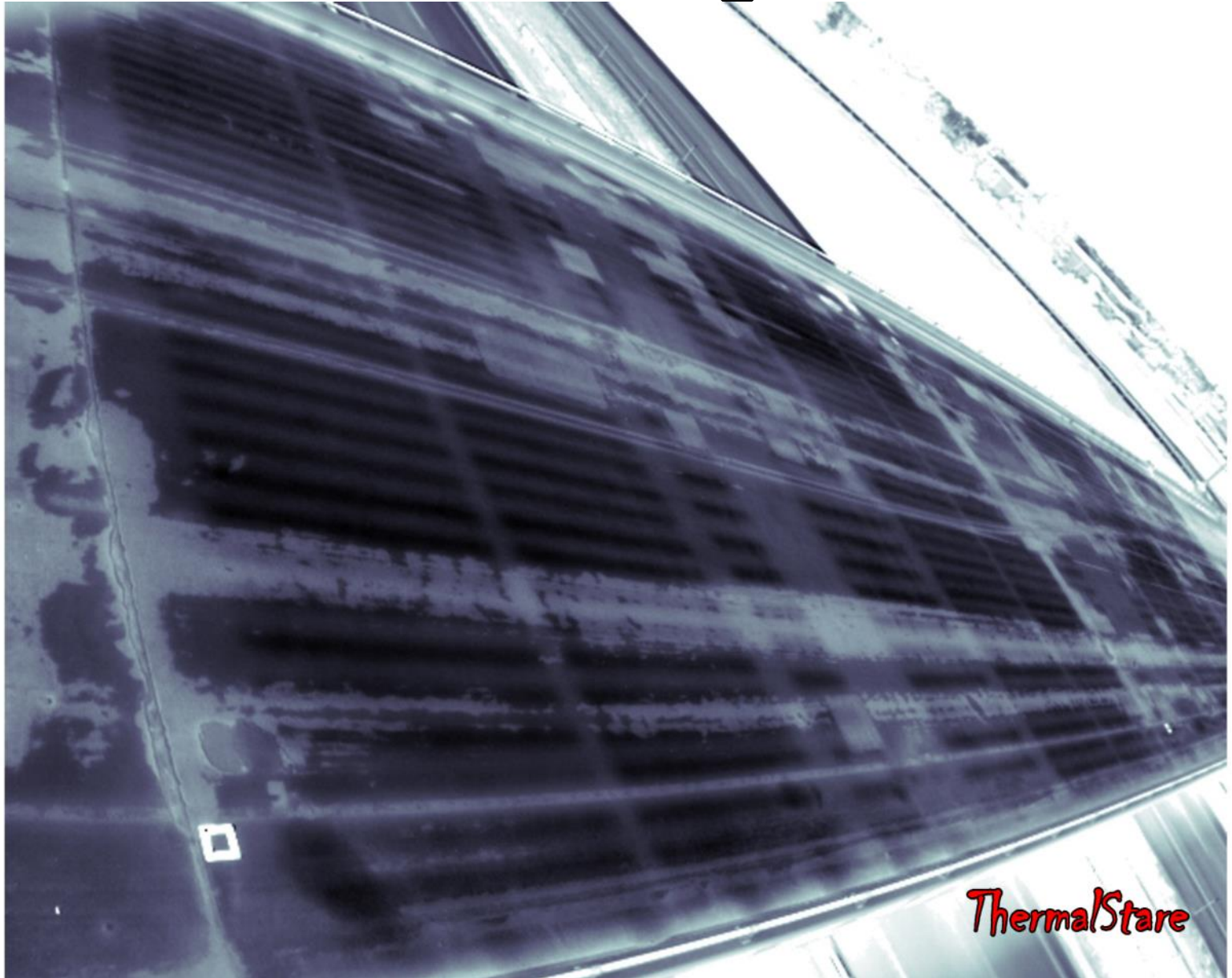


Saturated Concrete

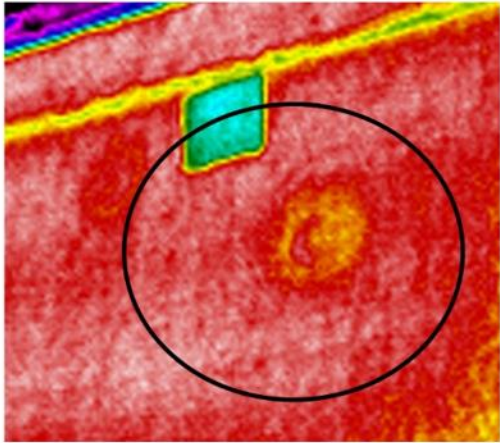




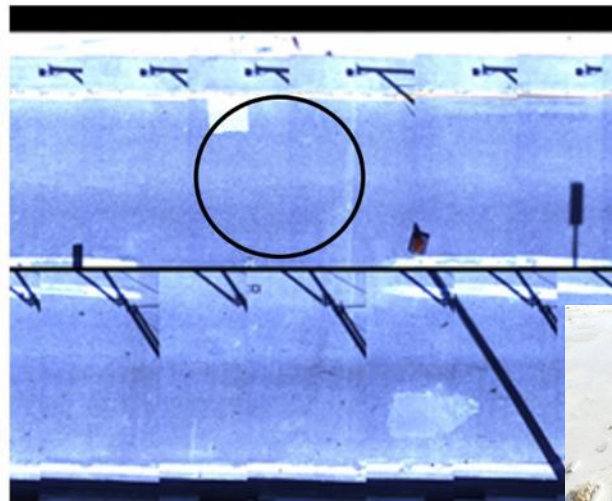
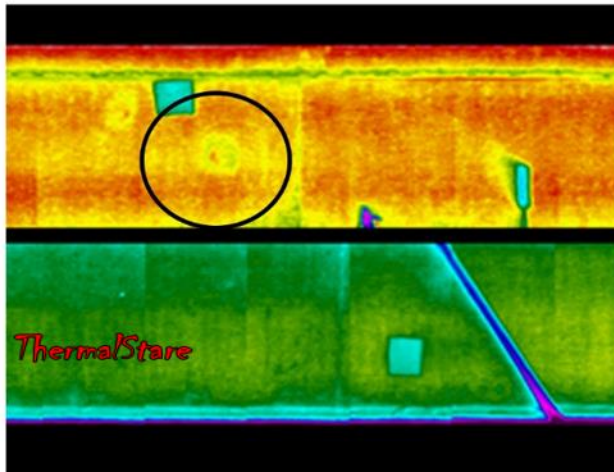
Structural Configuration



IR-UTD vs IR-DSS



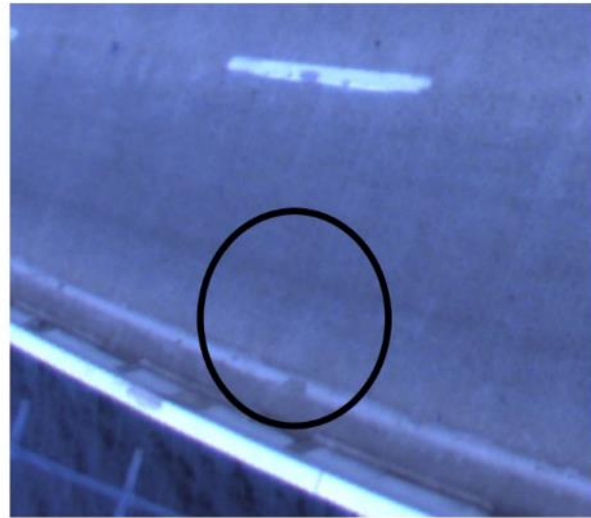
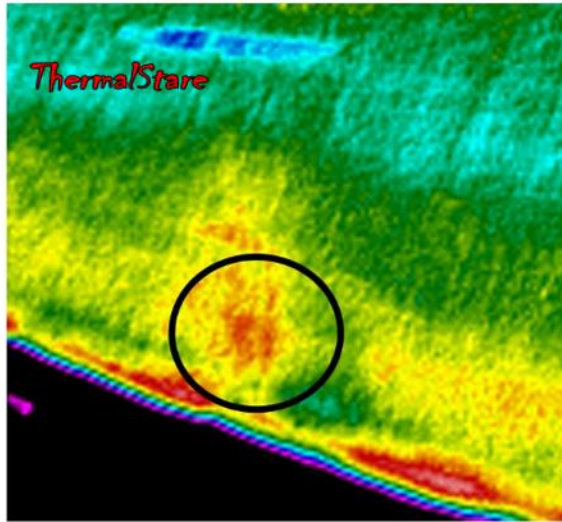
IR-UTD



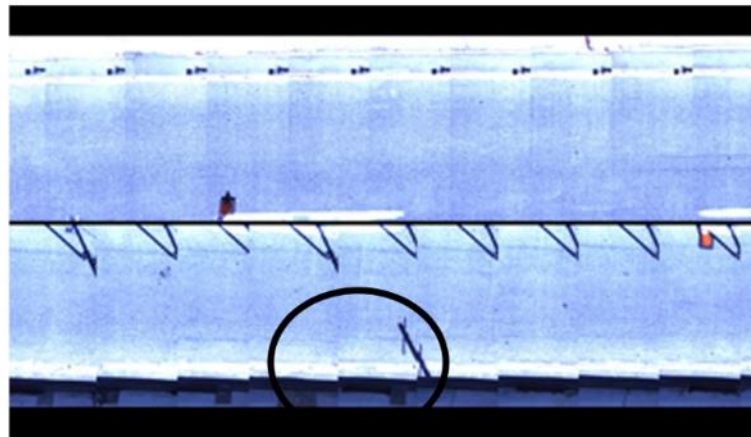
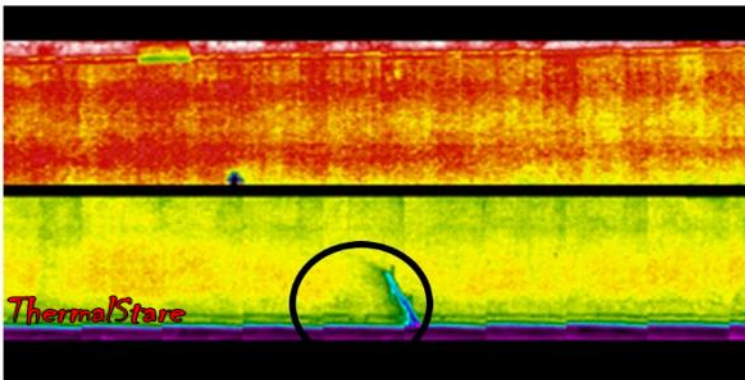
IR-DSS



IR-UTD vs IR-DSS



IR-UTD



IR-DSS

Conclusions and Discussion

- IR-DSS – High resolution, conventional vehicle mounted IR
 - Observe preservation needs, results
- IR-UTD
 - New tool for condition assessment
 - Transient thermography
 - Quantitative, Reproducible
 - Determines depth
 - No traffic control
 - Deck, soffits, substructures
- Commercializing research results

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Questions / Comments
/Discussion?

