Innovation Panel #1:

Thermography

MoDOT

MoDOT Bridge & Maintenance Divisions

Mizzou
University of Missouri

Organizational Results

Development of Hand-held Thermographic Inspection Technologies: Pool – Funded Research to Support DOTs

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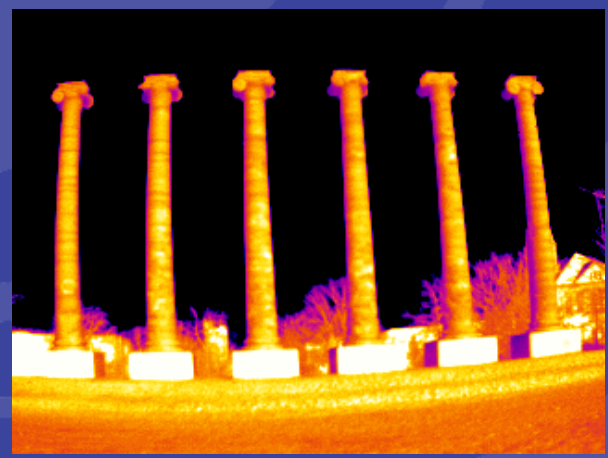


AGENDA

- Problem Identification
- Project timeline
- Funding and partnerships
- Project execution
- Keys to success

Problem Statement

- Spalled concrete can present a hazard to motorist
  - Overpass bridges with corrosion issues / low cover
    - Loose concrete can be knocked down as maintenance
  - Active corrosion develops damage continuously
    - Inspections are periodic
    - New areas develop on an on-going basis
- Bridge decks and concrete overlays
  - Developing delams/ potholes and ongoing deterioration / spalling
- Composite Quality Assurance


A1081 03-02-07
Sidewalk and deck edge
deterioration

Scope of Problem

- Lexus/Nexus search “Bridge Falling Concrete”, 1998 to present
  - MI
  - MA
  - OK (fatality, 52 yr old Texas woman, 2004
  - CO
  - FL
  - KY
  - AL
  - VA
  - IL
  - CO
  - MO
  - PA
  - OH
  - NY

- Bridge decks deterioration – well known and widespread problem affecting every state.

Falling concrete hits car on I-70

Darla McFarland
the Examiner

A Kansas City man narrowly escaped serious injury Wednesday when a 20-pound chunk of concrete dropped from the Noland Road bridge on to Interstate 70 and smashed through his windshield.

"i'm glad I was paying attention."

Jim Neal
driver who narrowly avoided being struck by a chunk of concrete that broke off an I-70 overpass and smashed through hi windshield

The piece of concrete, measuring about 12 by 6 inches, fell from the bridge about 12:30 p.m. The falling chunk bounced off the roof of an eastbound van and through the windshield of the car behind, police said.

The driver, Jim Neal, said he avoided the missile by throwing his body "almost completely into the passenger's seat." The rock came through his windshield straight toward his head. He was struck in the left arm which is now swollen and bruised but not broken, he said this morning.

The rock struck the interior where the seat belt connects to the door frame, breaking the belt, and came to rest in the back seat. Neal said he was returning to Kansas City from a sales call in Blue Springs when the accident occurred.

"I didn't have much time to think. I am glad I was paying attention and was able to watch the path (of the chunk.) If I had been talking on a cell phone or something, who knows what could have happened," Neal said.

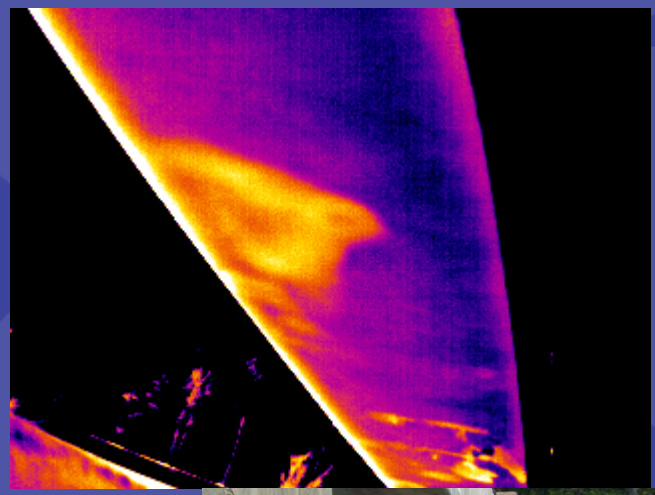
Police called Missouri Department of Transportation crews to inspect the scene. Paul Russ, MoDOT bridge maintenance engineer, said the breakage was due to regular wear.

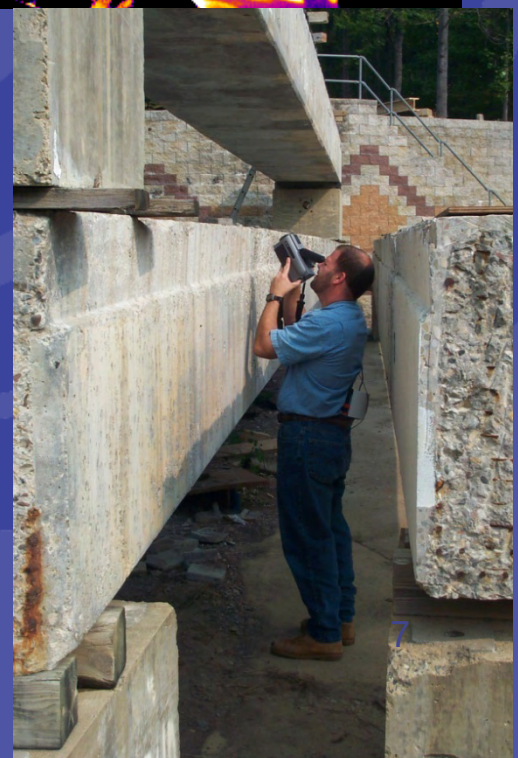
"We have deterioration of the bridges, especially with salting the roads. The salt works into the concrete and corrodes the steel causing it to expand. When that happens, the cement can fracture and crack off," Russ said.

Another crew will inspect the bridge today for any further sign of damage,

Approach

- Subsurface delaminations create a perturbation in heat transfer through the concrete
  - As a result, a the loose/delaminated concrete heats and cools at a different rate than surrounding concrete
  - Image using IR camera





Overall Goal of the Project

- Provide maintenance personnel, inspectors and engineers with an effective tool for monitoring concrete deterioration without disrupting traffic flow.

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Project Timeline

- Fall 2005: Discussions with MoDOT personnel on current issues and challenges
- Fall 2005: Discussion with other potential State partners
- Fall 2005: Initial discussions with University Transportation Center (UTC) at Rolla
- December 2005 – Submit initial unsolicited proposal to MoDOT
- March 2006 – Following meetings with MoDOT research team and maintenance personnel to discuss proposal, needs and funding
- April 2006 – Pooled fund proposal submitted to FHWA
- April 2006 – September, 2006 – Discussions with MoDOT and other potential State Partners
- October 2006: Full proposal (final) submitted to MoDOT Organizational Results
- February 2007: Contract Started with NY State and Texas as partners

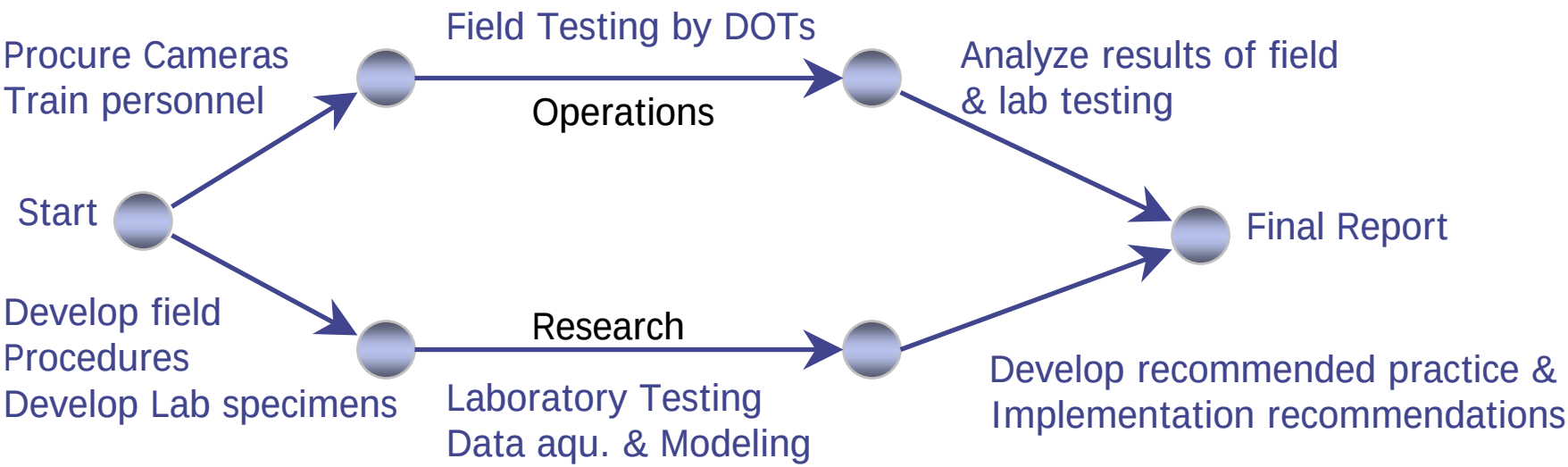
Partnerships and Funding

- MoDOT partnered with
  - NYSDOT
  - TXDOT
  - UTC-Rolla
- Budget on the order of ~ 300+ k, but the split made it manageable
  - About half the cost in hardware, each State will have a camera to use during and after the study
  - States provided ~$240 k, UTC provided ~$100 k, MU provided ~$30 k
- The potential benefits to both safety and improved maintenance practice justify the cost
  - Widely implementable tool addressing wide-spread problems

Links to MoDOT Tangible Results

- Uninterrupted Traffic Flow
- Smooth and unrestricted roads and bridges
  - Remote inspection capability allows inspection from roadside w/o disrupting traffic
- Safe Transportation System
  - Improve the ability to detect loose concrete over open traffic lanes between NBIS inspections
- Partner with others to deliver Transportation services
  - Partner with NYSDOT
- Innovative transportation solutions
  - Using state-of-the-art solutions
- Advocate for transportation issues
  - Provide leadership in a much needed area, with a practical solutions that benefits other States (no recommended practice exists)

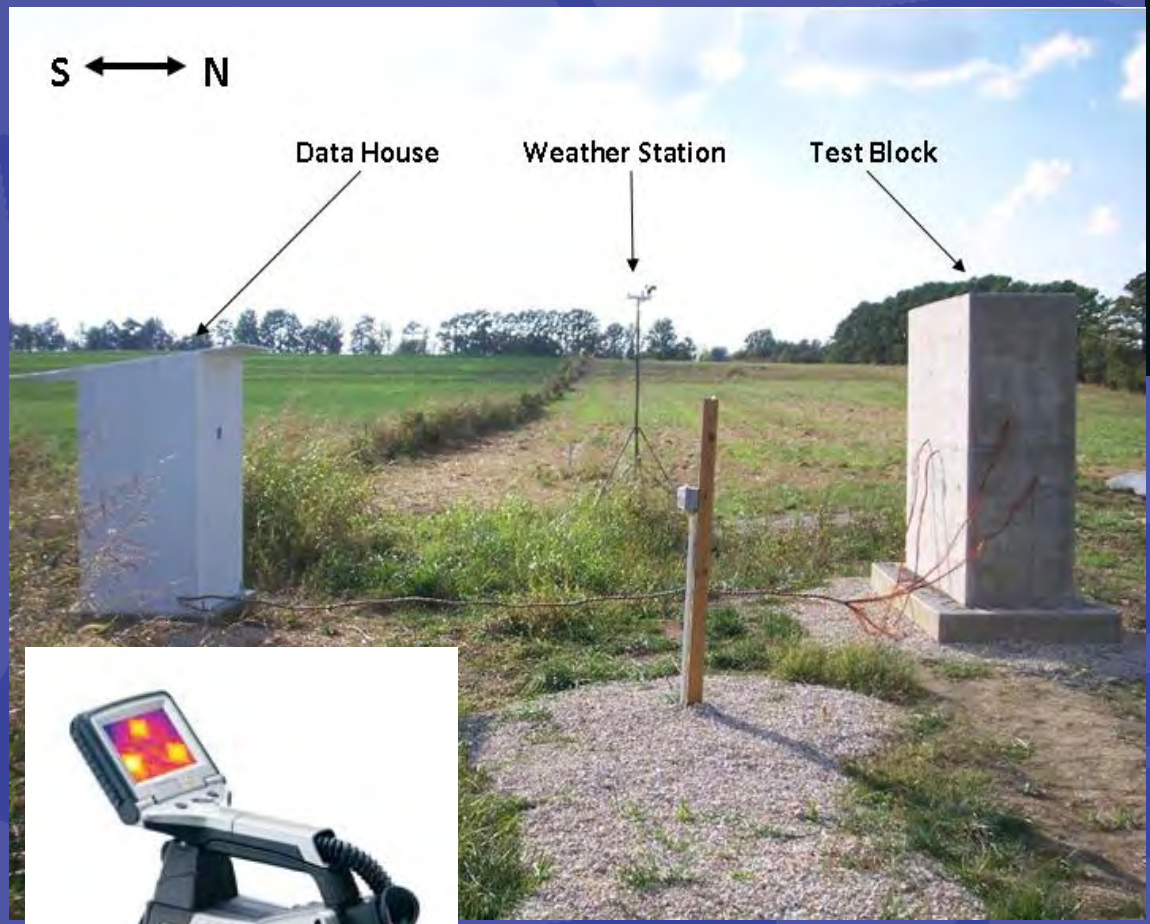
Path

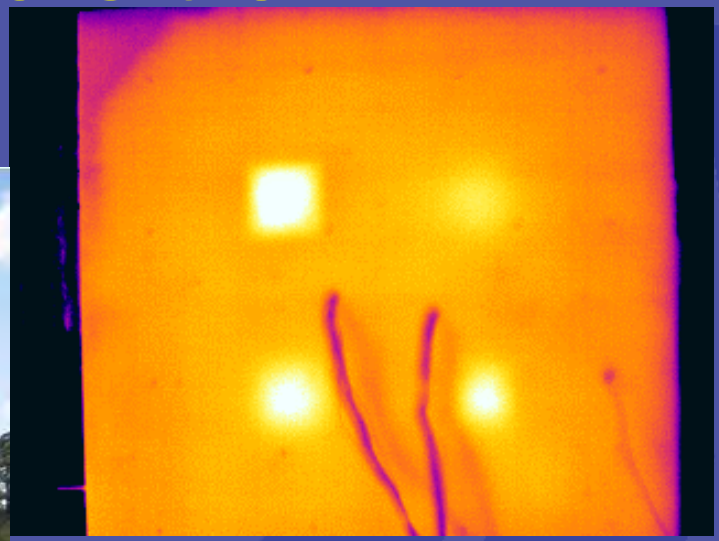

Procure Cameras
Train personnel
Field Testing by DOTs
Operations
Analyze results of field
& lab testing
Start
Final Report
Develop field
Procedures
Develop Lab specimens
Research
Laboratory Testing
Data aqu. & Modeling
Develop recommended practice &
Implementation recommendations


6 Months
12 Months
6 Months

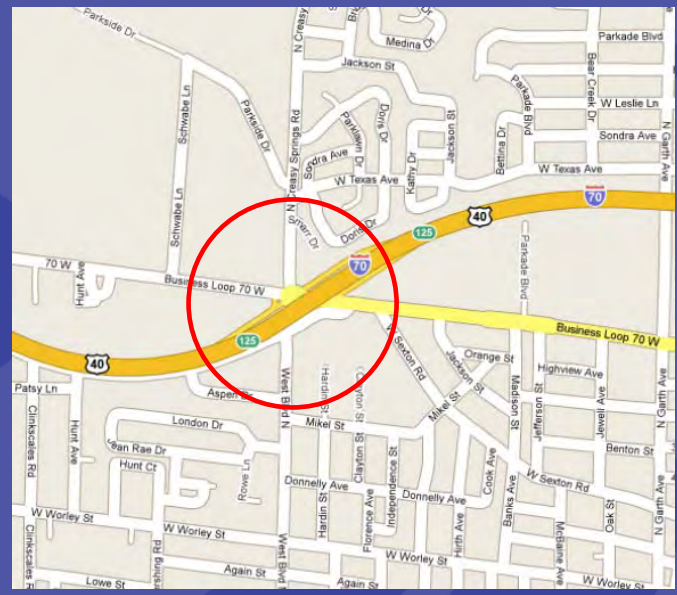
12

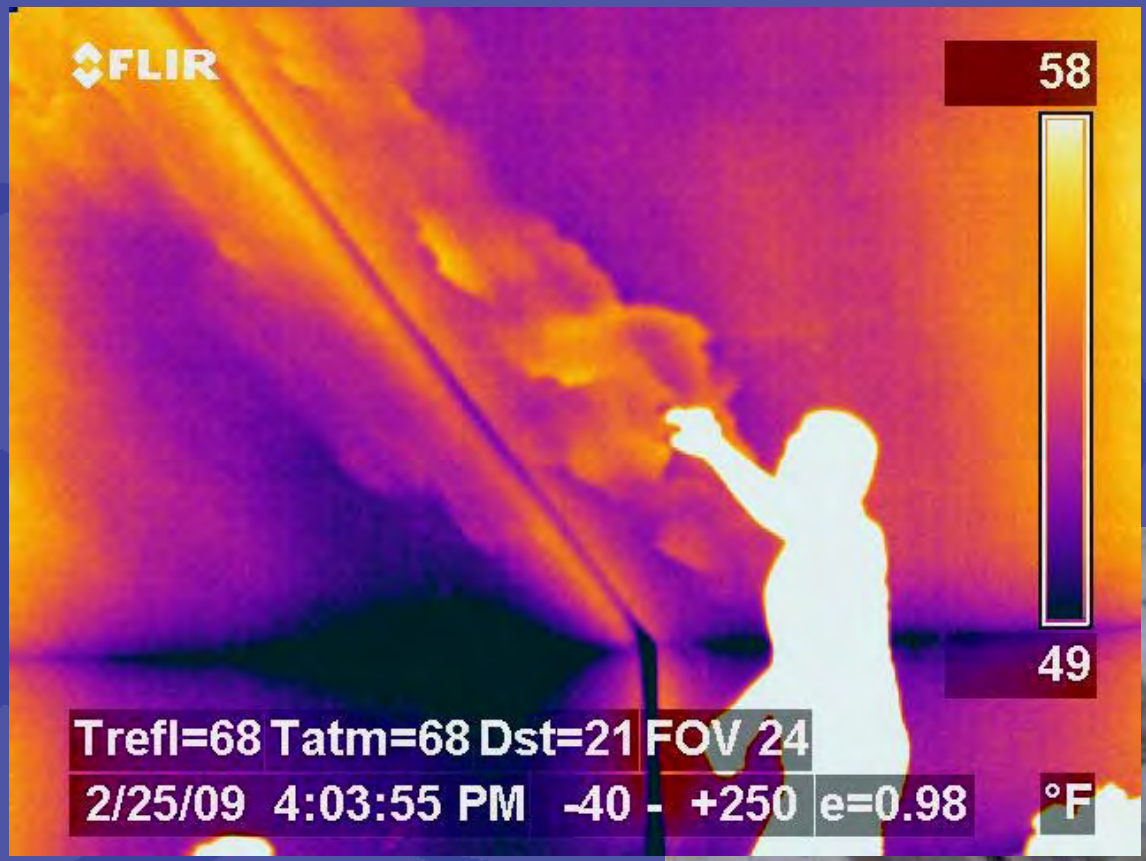
Test Block Data Acquisition





Field Testing

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Keys to Success

- Communication
- Start with the problem
  - Funding is not available to fix all imperfect aspects of a transportation system
  - Prioritization is constantly occurring and changing
- Understanding of roles and responsibilities
  - DOT's are generally not interested in innovative research, they are interested in innovative solutions
    - Research is the concern of the researcher, DOT's seek implementable solutions
    - Team approach
  - Understand the value of the bridge owner's...
    - Knowledge, Experience, Judgment
    - Understanding of the complexity of the issues
      - Funding, resources, overall programmatic goals
  - .... to the success of your research
- Flexibility to changing circumstances
  - Capitalize on parallel developments
  - Maintain focus on the problem

How OR became involved

- Approached by Glenn Washer with concept
- Discussed benefits to MoDOT and other DOTs
- Became a pooled fund project on January, 12, 2007
- Agreed to be lead state
- Negotiated workplan, deliverables and timeline

Interest to MoDOT

- Project geared towards implementation
- MoDOT staff will have opportunity to use camera in field
- Technology is already available
- Project costs split between MoDOT, NYDOT, TXDOT, UTC, University of Missouri

Pooled Fund

- Website Link
- http://www.pooledfund.org/
- About TPF
- Browse
- Search
- Sign Up to Be Notified

How will the research be used

- Locate defects in bridge decks
  - Saturated areas
  - Shallow fracture planes
- Under deck cracking on panels
- Delaminations on concrete beams over traffic
- Locate Sonotubes in voided slabs

Benefits to MoDOT

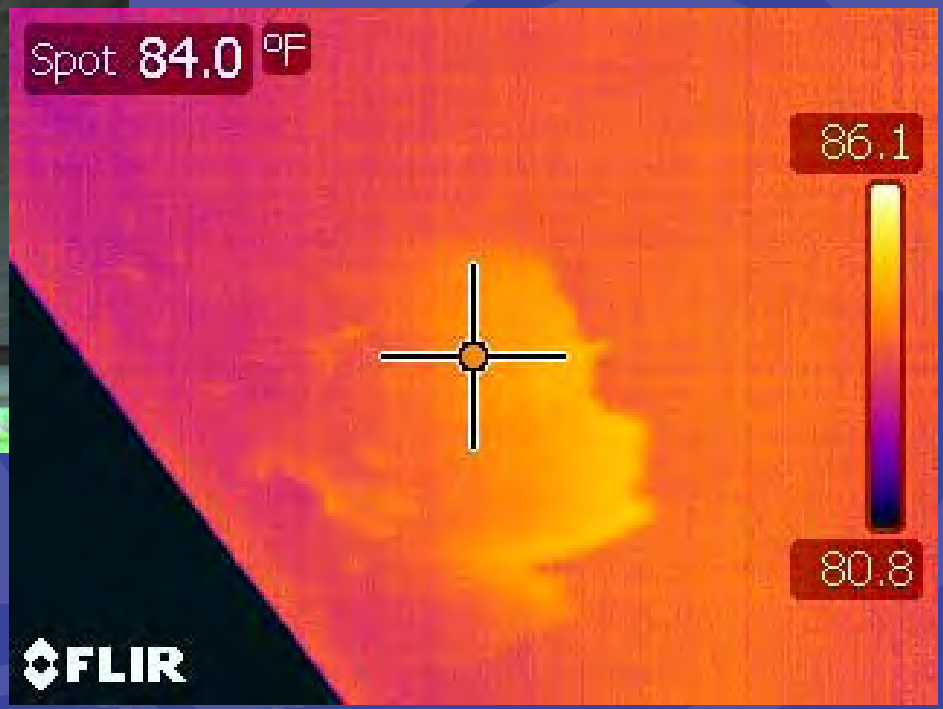
- Can detect concrete damage without closing lanes of traffic
  - Save time and resources
- Non-destructive testing technique
  - No damage to deck
- May be able to detect damage earlier
  - Get entire delaminated area located prior to patching

What are the first steps

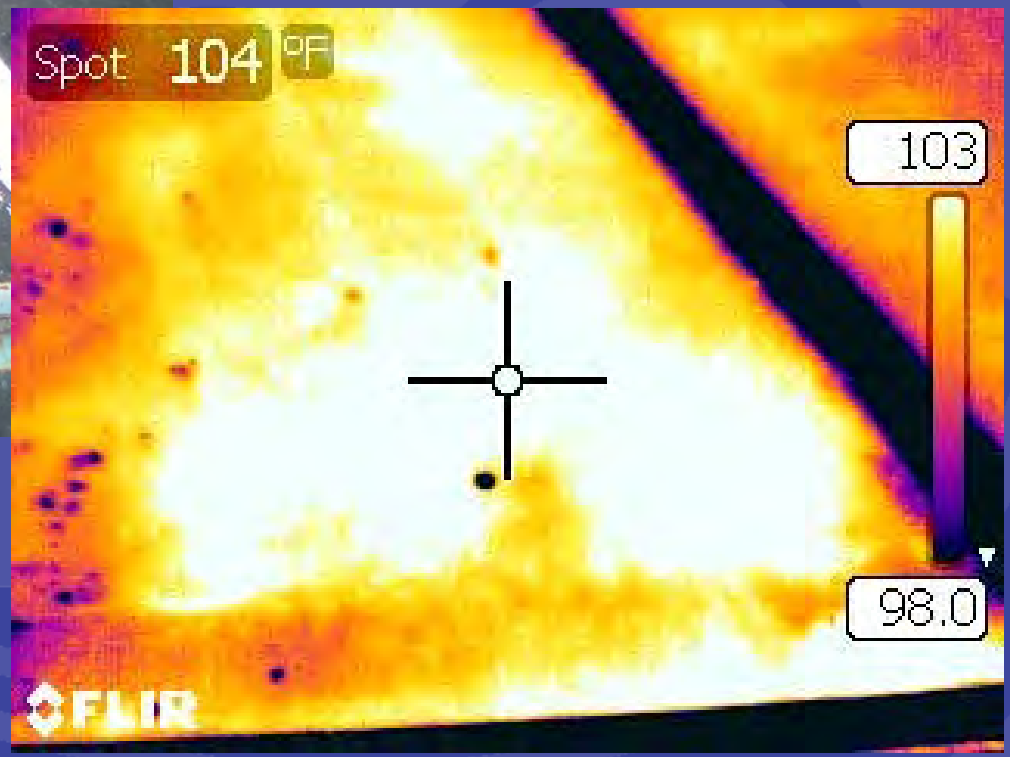
- Get inspectors comfortable with operation of the camera
- Use the technology along with traditional inspection techniques to verify accuracy

What are the drawbacks

- Requires practice to operate camera properly and effectively
  - Level and span adjustments
  - Focusing
- Temperature and weather sensitive
  - Must have “good day” to have confidence in results



Able to detect concrete delaminations from shoulder, no traffic control required



Have often been able to detect delaminations outside of the “sounding range”

Questions?