SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

SHRP2 R06C Technology to Enhance Quality Control on Asphalt Pavements: Paver Mounted Thermal Profiler

Hosted by:
FHWA/AASHTO
January 31, 2018

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

R06C Technologies to Enhance QC on Asphalt Pavements

Moderator:

- Kate Kurgan; AASHTO

Presenters:

- Stephen Cooper, FHWA
- Harold Von Quintus, P.E., ARA
- Bill Stone, P.E., Missouri, DOT
- Peter Moulton, Pike Industries
- Ed Dalrymple, Chemung Contracting

Presentation will be available for viewing on the AASHTO SHRP2 website:
http://shrp2.transportation.org/Pages/R06C_RapidTechnologiestoEnhanceQualityControl.aspx

R06C Technologies to Enhance QC on Asphalt Pavements

The Challenge: Develop solutions to measure and quantify non-uniformity of asphalt mixture at construction

Localized non-uniform areas fail prematurely. Random testing seldom catches problem

Increased use of night paving makes inspection more difficult

R06C Technologies to Enhance QC on Asphalt Pavements

Thermal Profile during Placement: Pave-IR

Density uniformity after Compaction: Rolling Density Meter

Agenda

- Thermal Profiler Technology
- Equipment and Data Acquisition
- Field Demonstration Projects
- Application and Benefits
- Industry Perspectives and Views
- Questions and Answers

Webinar Objectives

- Describe use of the Paver Mounted Thermal Profiler Technology.
- Identify equipment and understand the installation and use of equipment & software.
- Discuss results/findings from the field demonstration projects.
- List contractor's and agency's opinions and/or perspective of the Thermal Profiler as a QC or QA tool.

SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Part 1: What is it and why use it?

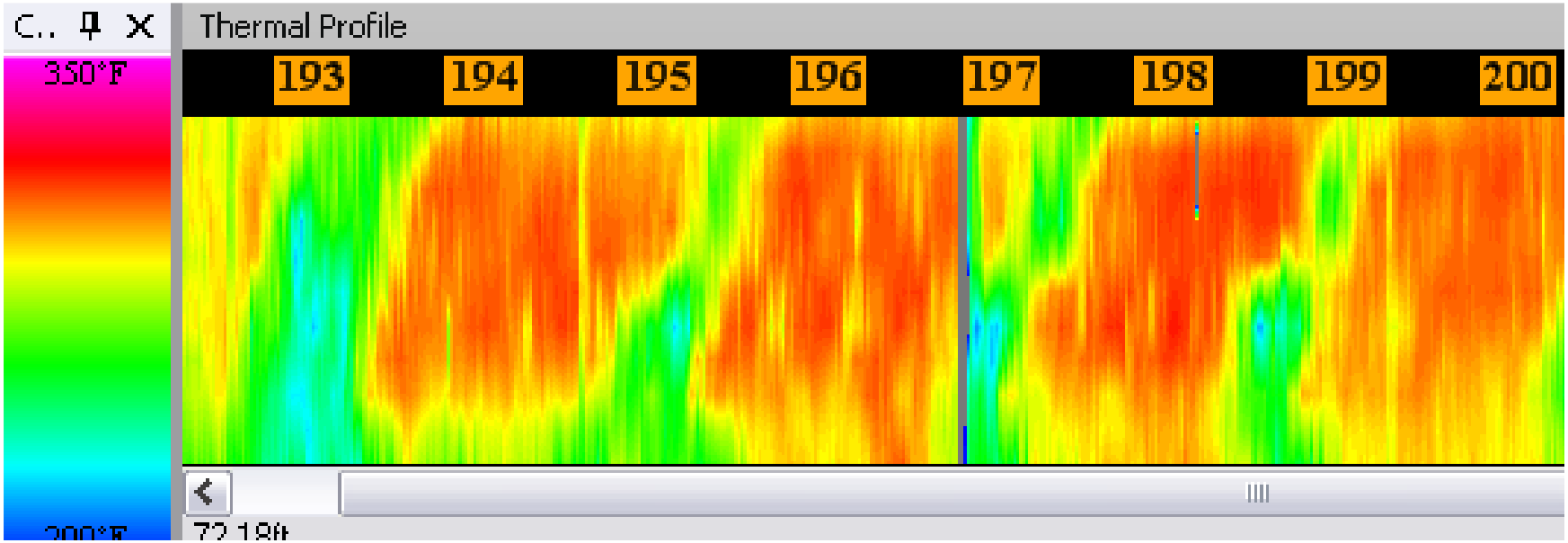
U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Thermal Profiler Technology

Infrared Thermography Defined:

- The mapping of temperature contours (equal temperature) over the surface of a material.
- Contours are used to evaluate materials by measurement of their surface temperature and its variation.



Thermal Profiler Technology

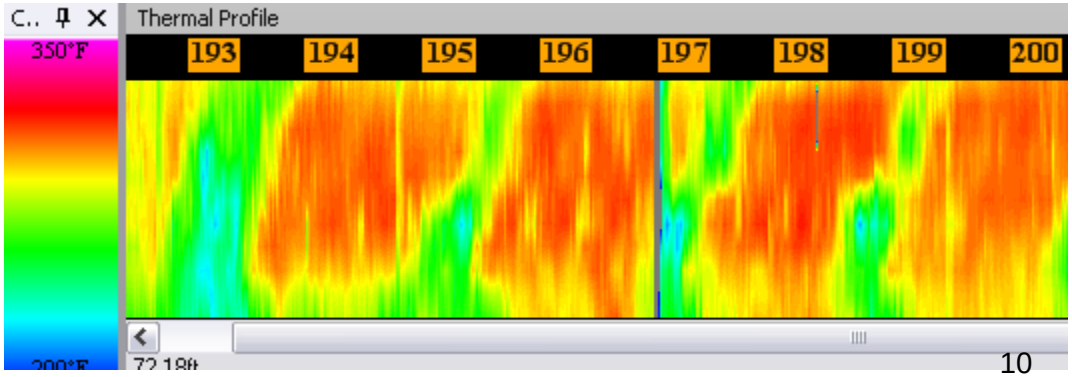
Mat Temperature Measurements:

- **IR sensors, IR-Bar**; first device for continuous readings.
- **Pave-IR Scanner**; second generation device for continuous readings.

Thermal Profiler Technology

How is the thermal profile measured?

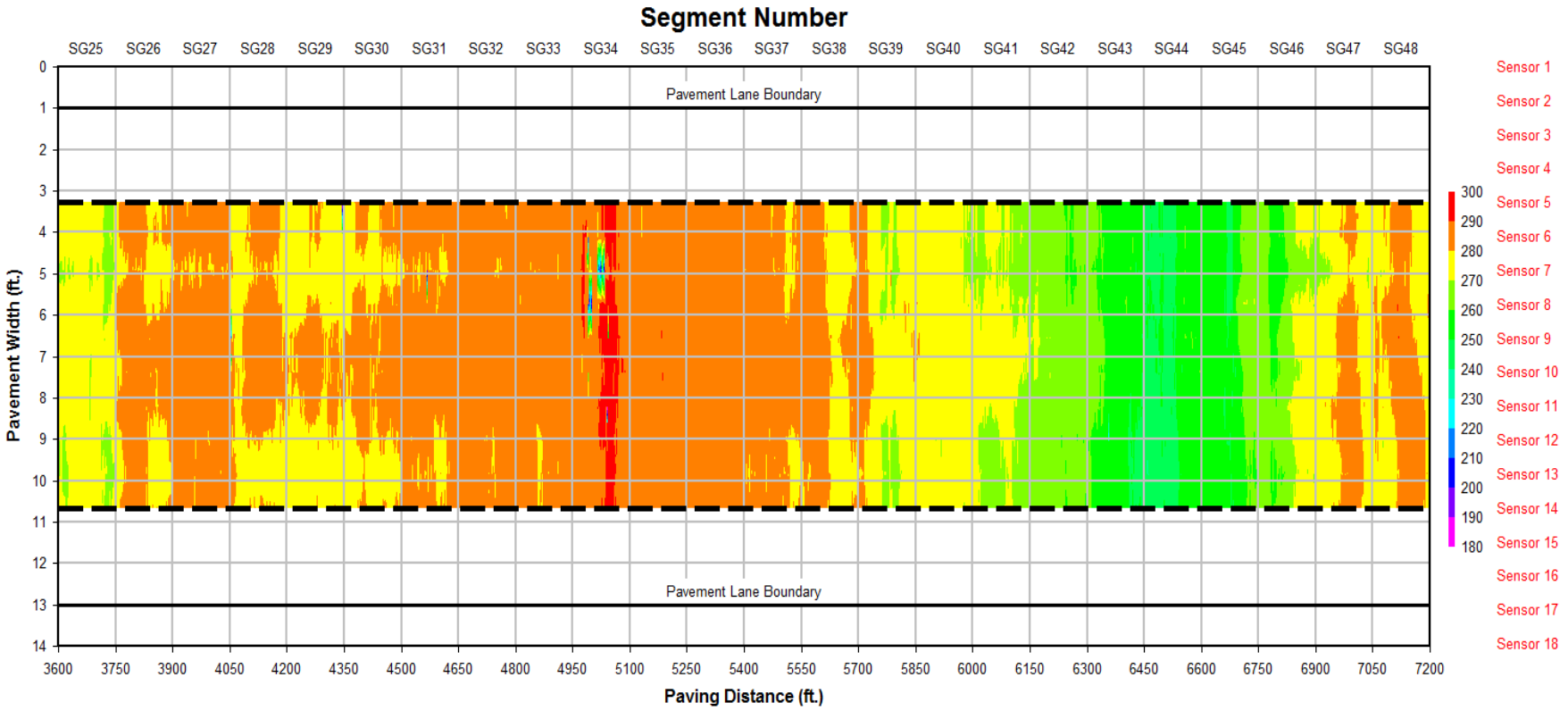
- Sensor—detects infrared radiation emitted from the mat.
- Scans the mat 6 to 10 ft. behind the screed.
- Creates thermal profile of the mat surface.



Thermal Profiler Technology

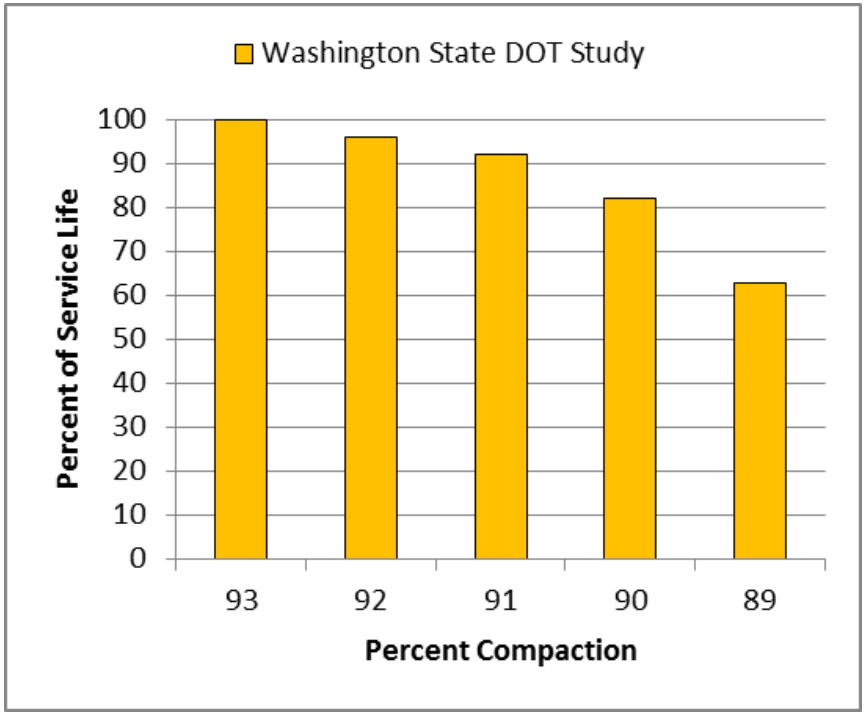
Why is it important?

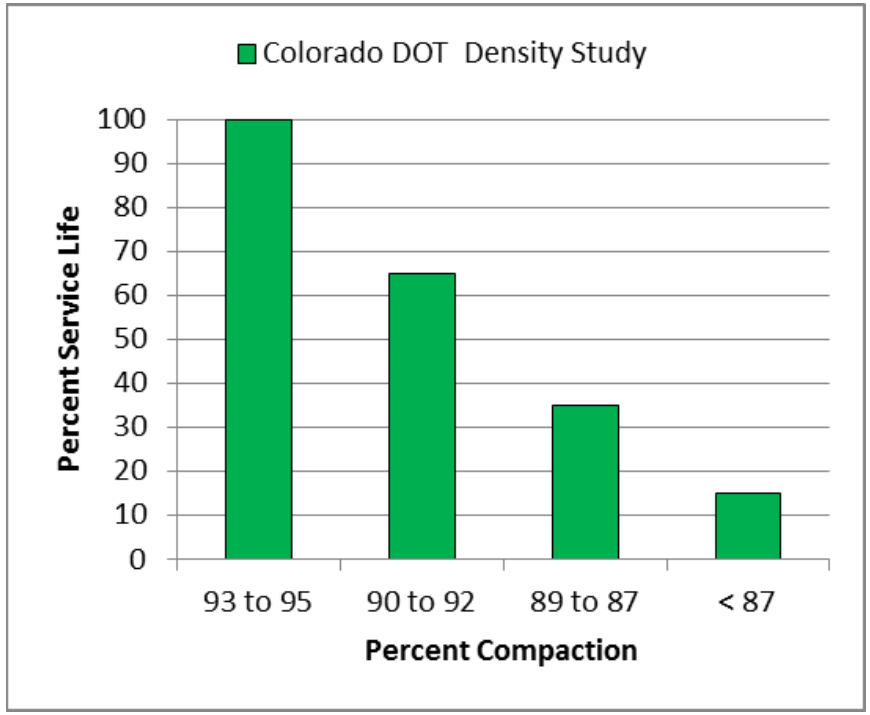
- Aggregate segregation in mat = temperature differentials
- Non-uniform temperatures = non-uniform densities



Thermal Profiler Technology

- Lower mat temperatures in localized areas results in lower mat density (reduced compaction) and reduces the service life or increases maintenance.

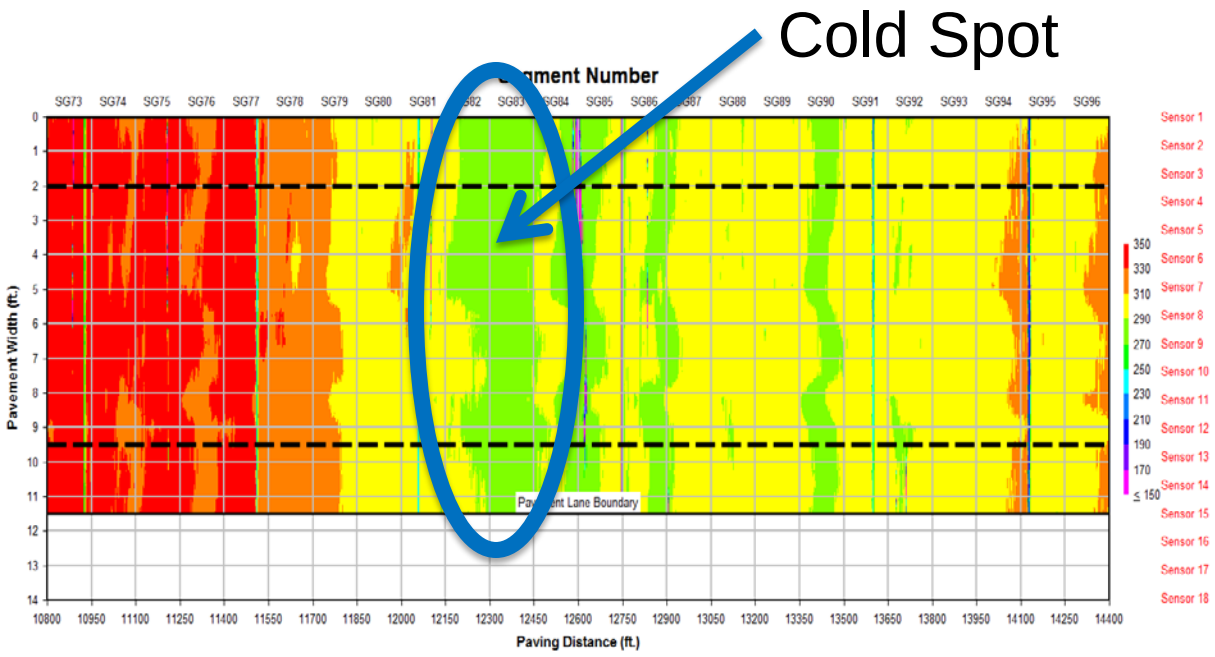




Thermal Profiler Technology

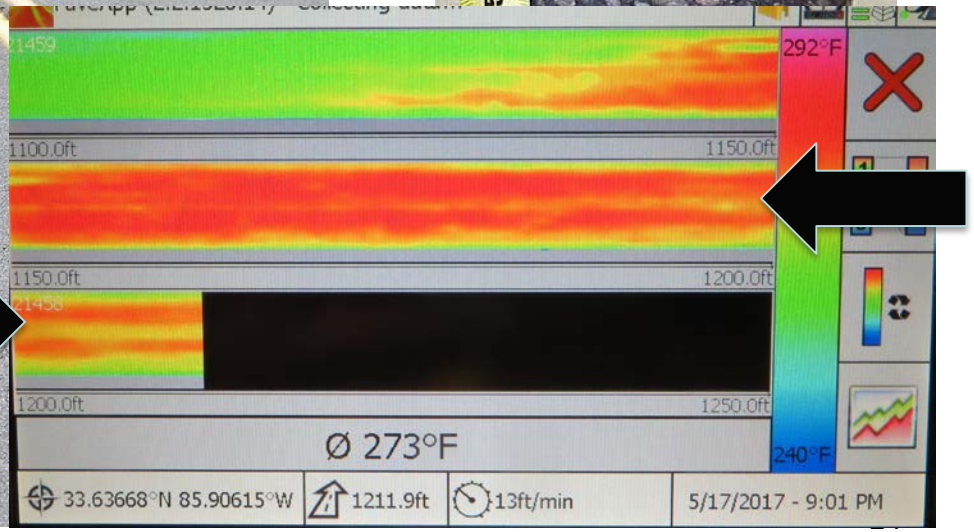
Cold spots; areas with increased potential for:

- Fatigue cracks
- Raveling
- Pot holes



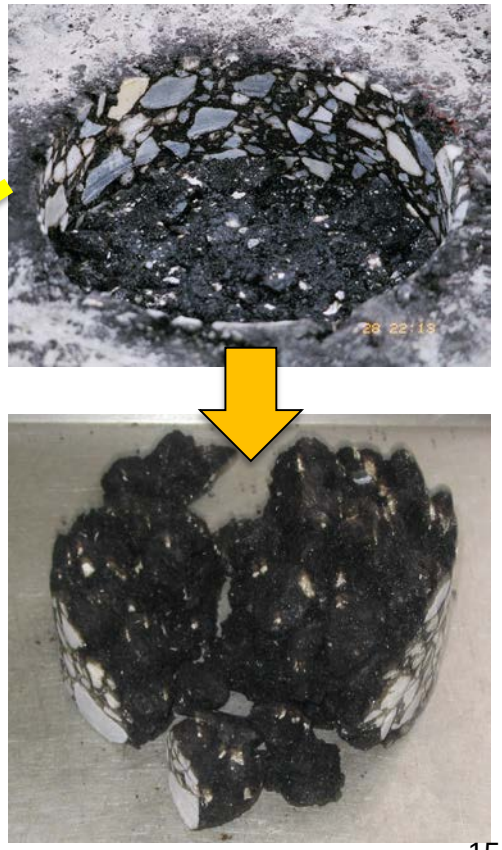
Thermal Profiler Technology

Thermal streaks with increased potential for longitudinal cracking and raveling.



Thermal Profiler Technology

Segregation – A difficult issue to resolve, when it is difficult to identify or confirm.



SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Part 2: Equipment Installation & Use and Data Acquisition

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Equipment and Its Installation

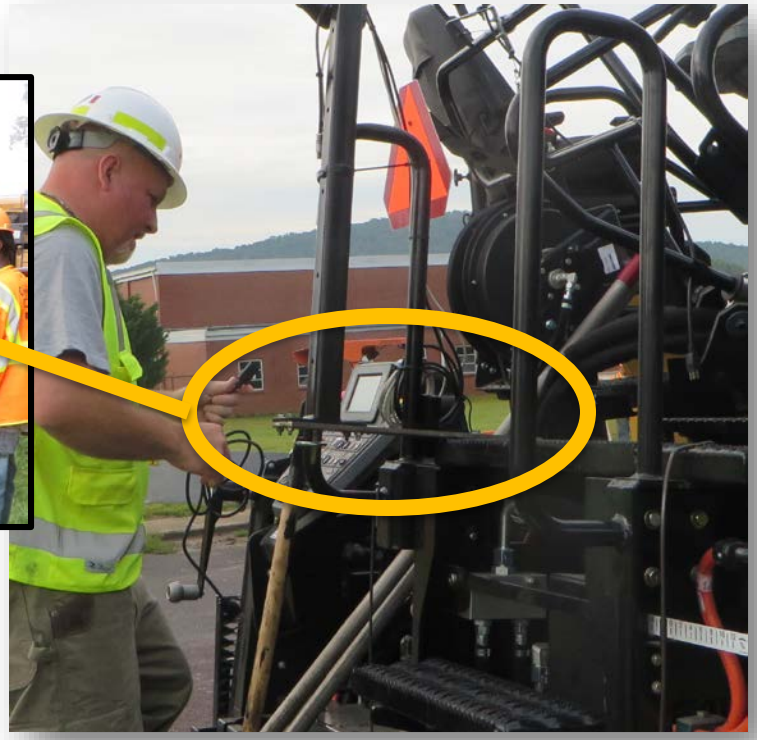
Equipment

- Mast Base
- Mast Extension
- Mast Arm
- IR Scanner
- DMI
- GPS Unit
- Wiring
- Connection bolts & materials

Equipment and Its Installation

IR mast base and extension attached to paver.

Mounted Directly to Screed



Mounted to a Steel Plate Attached to Work Platform

Equipment and Its Installation

Equipment and Its Installation

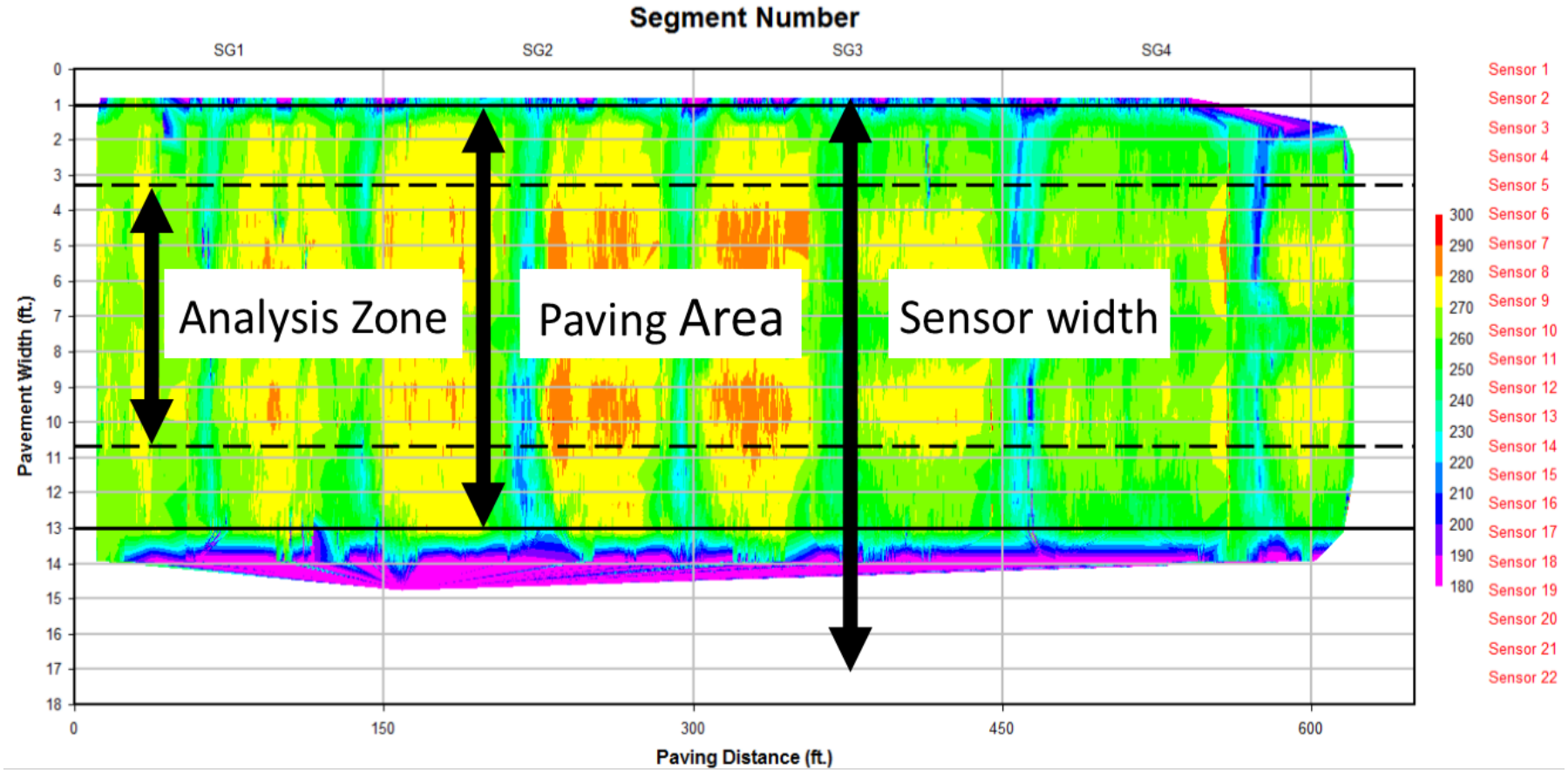
DMI placed on wheel hub to measure distance during paving operation.

Equipment and Its Installation

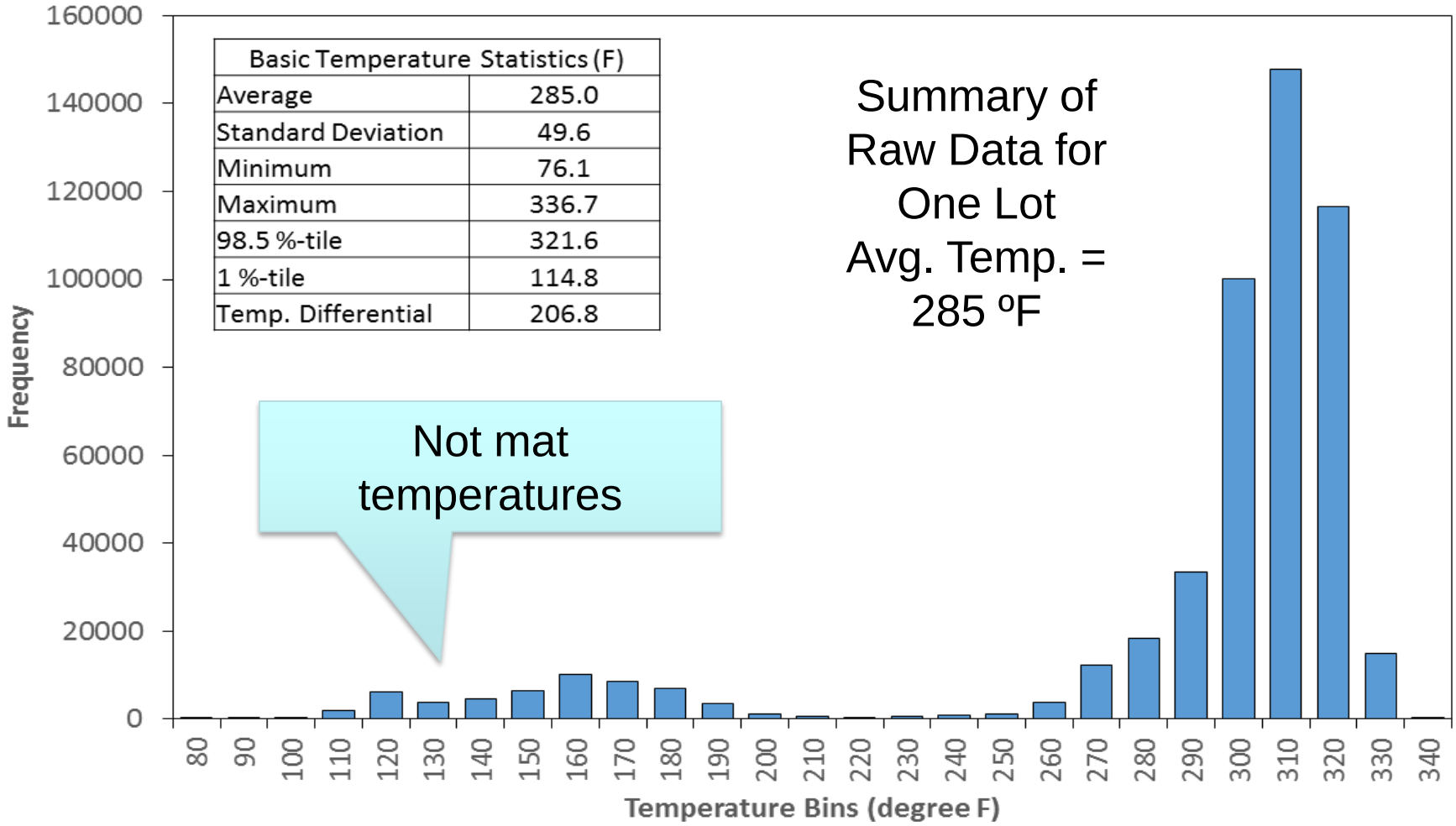
IR scan screen used to see/monitor mat temperatures in real time; attached to the mast post or extension.

Data Processing and Reports

Raw Temperature Profile; all data collected and retained in the data file.



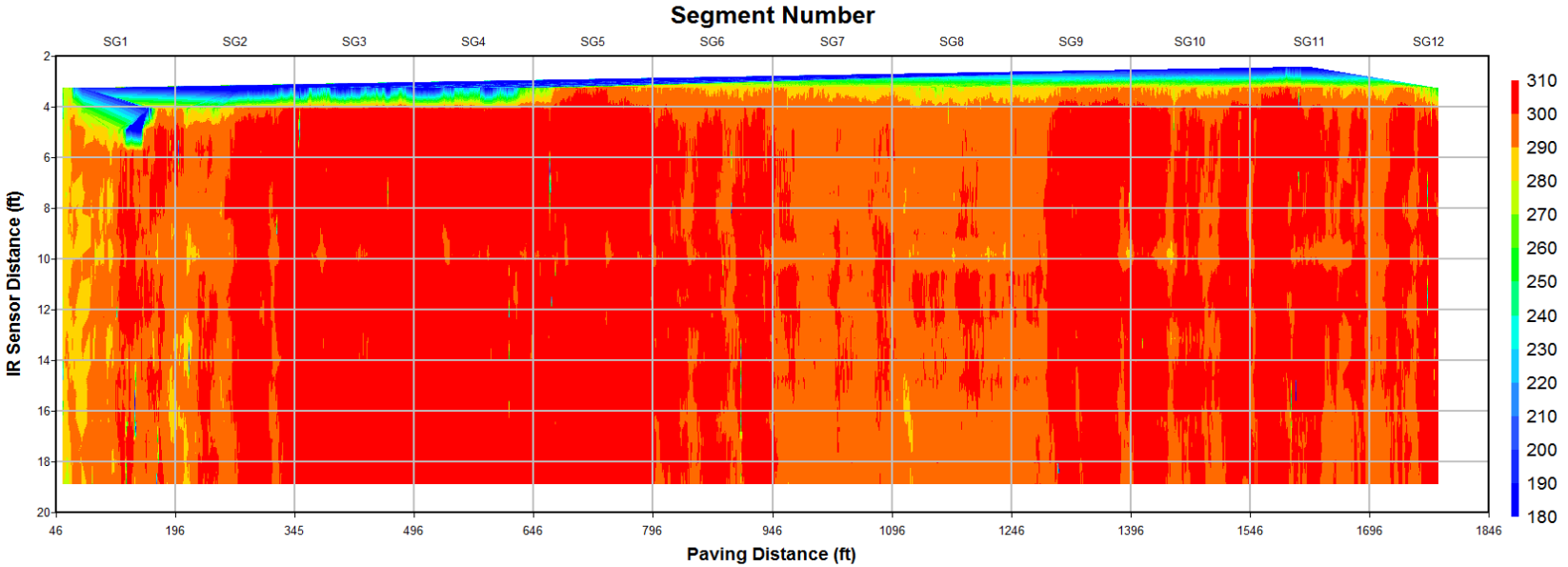
Data Processing and Reports



Data Processing and Reports

Data Processing—eliminate invalid temperature measurements, 3 steps:

1. Eliminate measurement locations within 2 feet of the mat's edge.

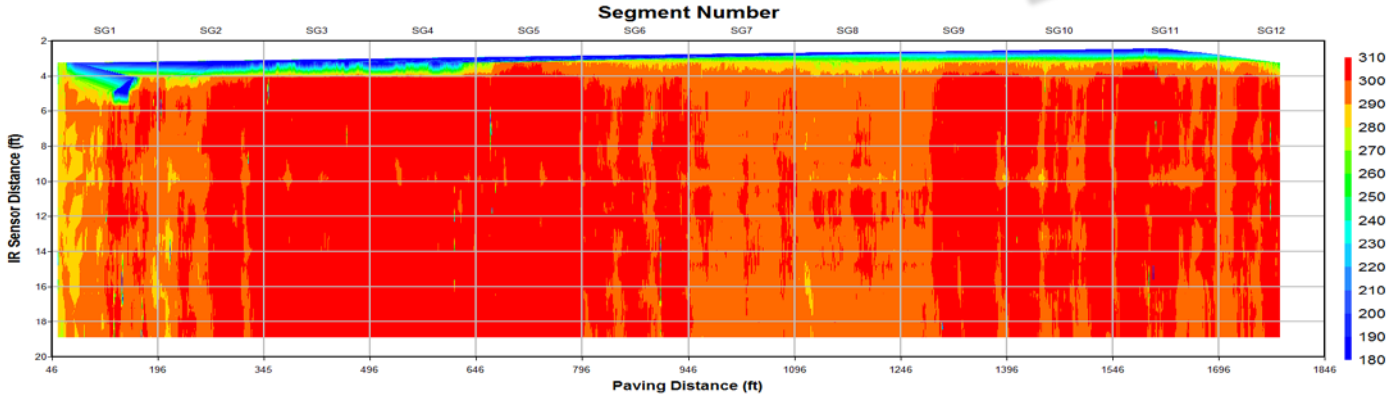


Data Processing and Reports

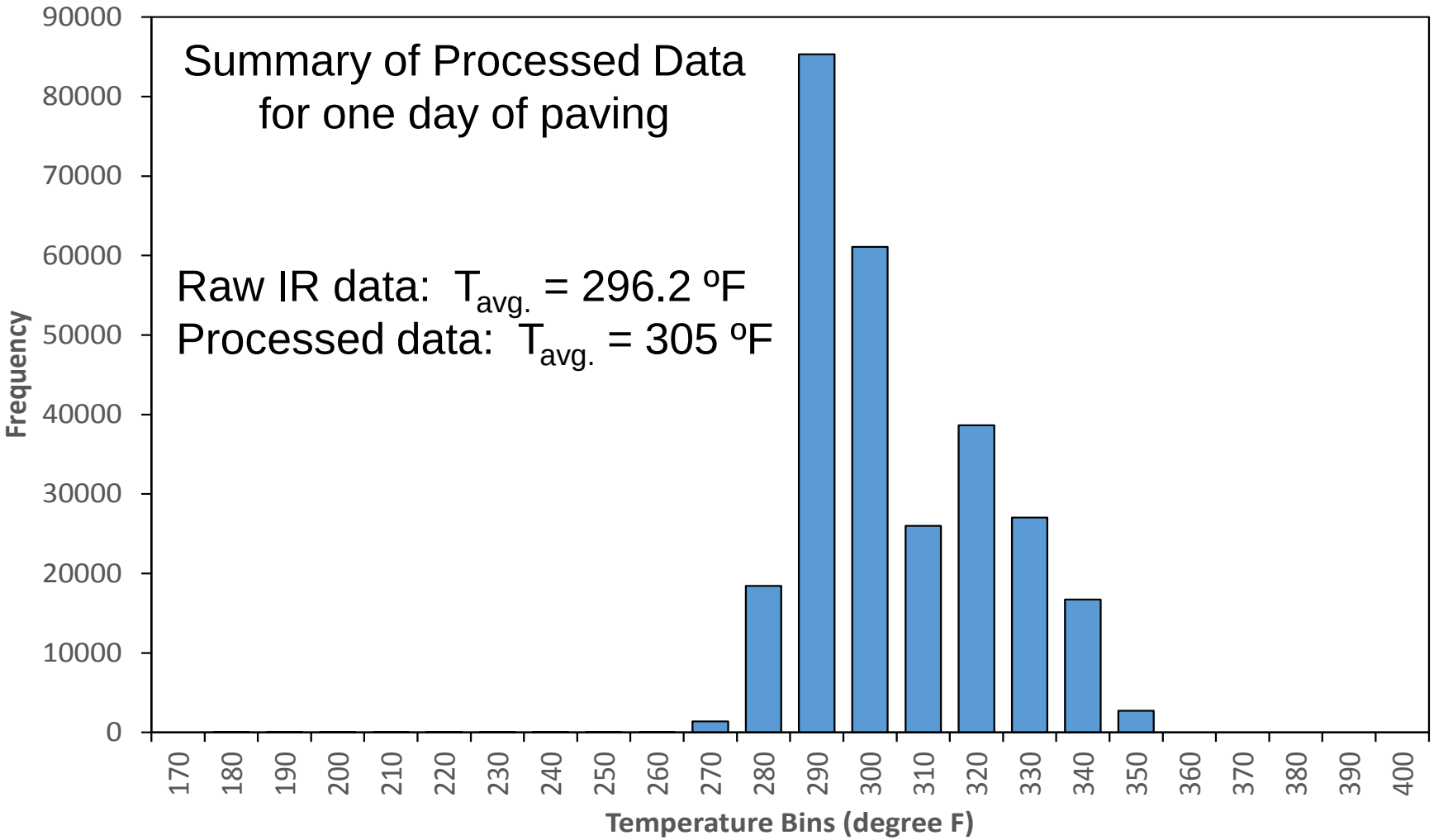
Data Processing—eliminate invalid temperature measurements, 3 steps:

2. Eliminate temperature readings < 170 ºF and > 400 ºF.
3. Eliminate data with paver stops greater than 60 seconds. Data eliminated between locations:
   - 2 feet behind measurement location of stop
   - 8 feet in front of measurement location of stop

Step 3 can be excluded.



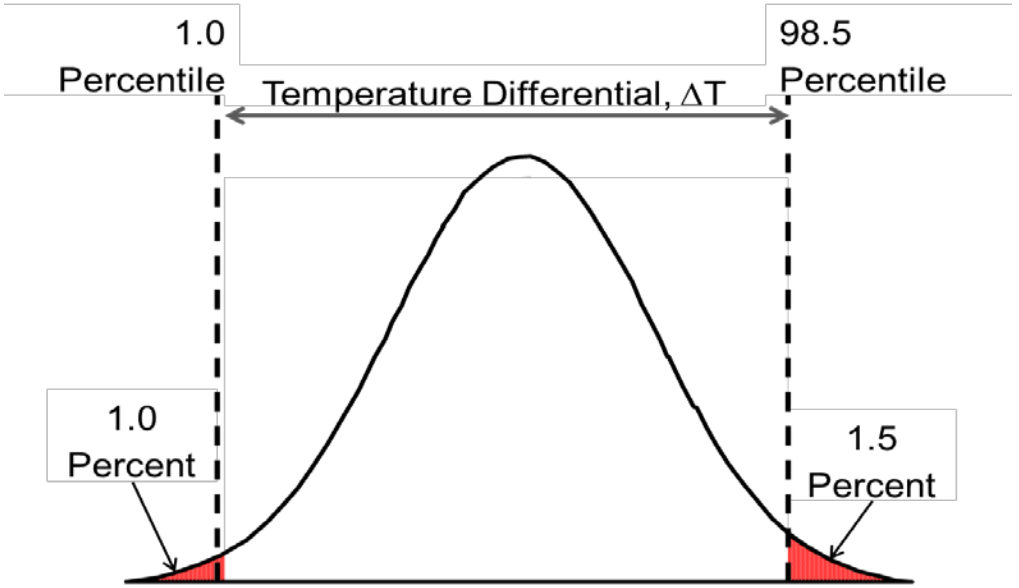
Data Processing and Reports



Data Processing and Reports

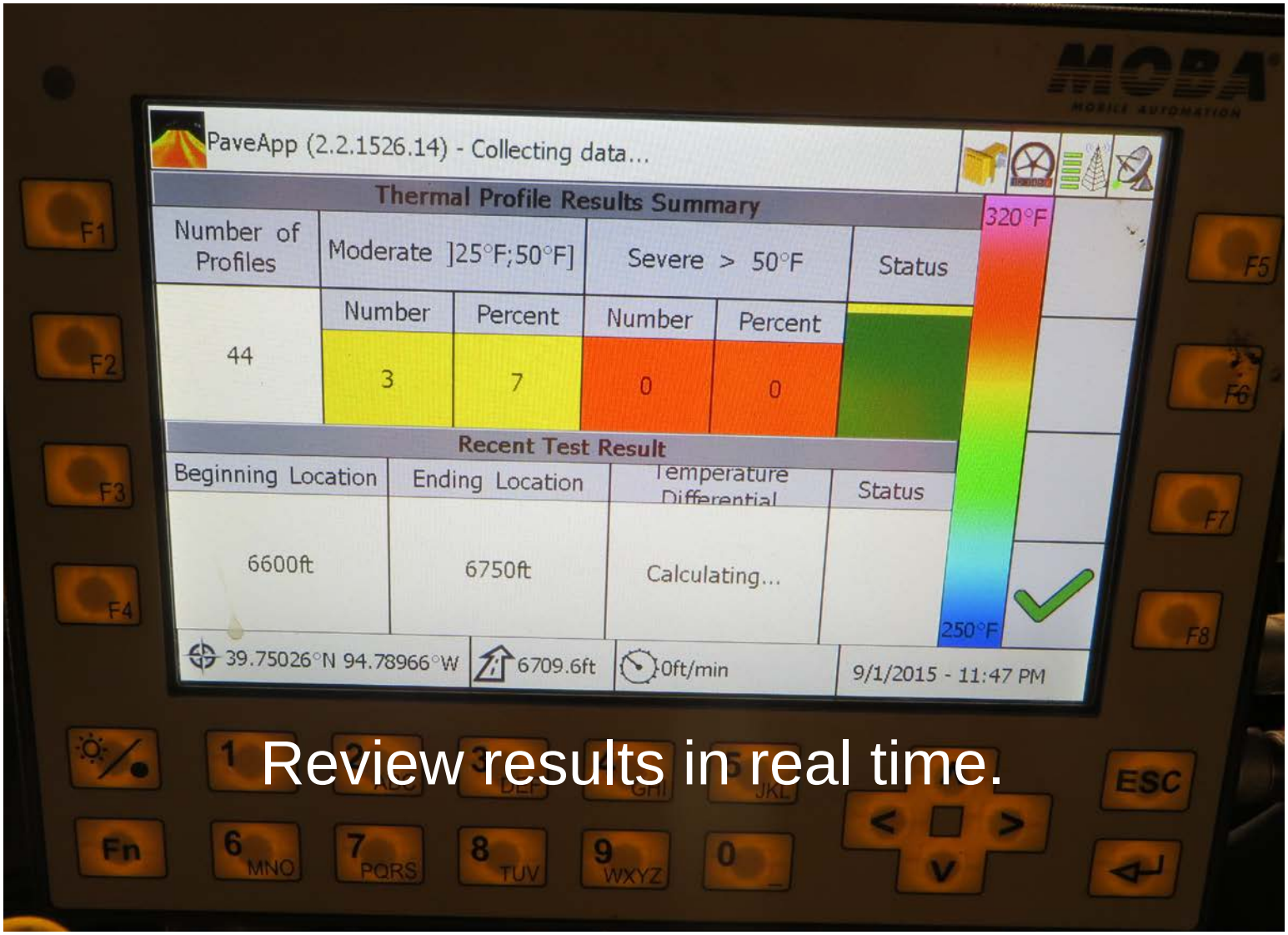
Temperature Differential Criteria, each 150 foot segment:

$$\Delta T = T_{98.5} - T_{1.0}$$



- **$\Delta T \leq 25$ ºF** — **Minor temperature difference**
- 25 ºF < $\Delta T \leq$ 50 ºF — Moderate temperature difference
- **$\Delta T > 50$ ºF** — **Severe temperature difference**

Data Processing and Reports



Review results in real time.

Data Processing and Reports

Report; Tex 244-F

Tex 244-F

Thermal Profile Summary Report

Profile ID:	95sb	Profile Date:	9/24/2015 9:18:13 AM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	194	Special Provision:	
Material Code:		Mix Type:	
Material Name:			
Producer:			
Area Engineer:		Project Manager:	

Course/Lift:	3	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	-

Thermal profile summary.

Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
	Number	Percent	Number	Percent
28	0	0	0	0

Locations without thermal segregation.

1	194.49	68.12363437 W, 46.11892049 N	193.00	68.12419593 W, 46.11879052 N	303.4	287.8	15.7
2	192.99	68.12419985 W, 46.11878960 N	191.50	68.12476079 W, 46.11866149 N	304.9	289.6	15.3
3	191.49	68.12476285 W, 46.11866104 N	190.00	68.12532427 W, 46.11853654 N	301.1	286.3	14.8
4	189.99	68.12533012 W, 46.11853523 N	188.50	68.12589203 W, 46.11840836 N	299.3	285.8	13.5
5	188.49	68.12589363 W, 46.11840800 N	187.00	68.12645526 W, 46.11828259 N	297.7	285.4	12.2
6	186.99	68.12645906 W, 46.11828176 N	185.49	68.12702186 W, 46.11815402 N	298.9	283.5	15.5
7	185.49	68.12702379 W, 46.11815360 N	183.99	68.12758506 W, 46.11802607 N	302.2	283.8	18.4
8	183.98	68.1275889 W, 46.11802512 N	182.49	68.12815126 W, 46.11789818 N	303.1	292.6	10.4
9	182.49	68.12815319 W, 46.11789773 N	181.00	68.12871395 W, 46.11777111 N	306.1	288.1	18.0
10	180.99	68.12871621 W, 46.11777052 N	179.50	68.12928274 W, 46.11764036 N	302.2	284.4	17.8
11	179.49	68.12928577 W, 46.11763966 N	178.00	68.12985205 W, 46.11751058 N	302.9	287.6	15.3
12	177.99	68.12985387 W, 46.11751020 N	176.50	68.13042113 W, 46.11738235 N	302.0	288.0	14.0
13	176.49	68.13042482 W, 46.11738148 N	175.00	68.13099093 W, 46.11725309 N	301.8	289.2	12.6
14	174.99	68.13099275 W, 46.11725265 N	173.50	68.13155886 W, 46.11712703 N	302.2	288.0	14.2
15	173.49	68.13156263 W, 46.11712618 N	171.99	68.13212684 W, 46.11699931 N	303.6	286.3	17.3
16	171.99	68.13212971 W, 46.11699866 N	170.49	68.13269254 W, 46.11687031 N	302.9	286.5	16.4
17	170.48	68.1326963 W, 46.11686947 N	169.00	68.13325913 W, 46.11674378 N	305.8	288.9	16.9
18	168.99	68.13326314 W, 46.11674285 N	167.50	68.13382973 W, 46.11661558 N	302.0	286.0	16.0
19	167.49	68.13383168 W, 46.11661512 N	166.00	68.1343973 W, 46.11648481 N	298.6	284.2	14.4
20	165.99	68.13440119 W, 46.11648392 N	164.50	68.13497078 W, 46.11635549 N	298.4	282.9	15.5
21	164.49	68.13497271 W, 46.11635503 N	163.00	68.13554162 W, 46.11622699 N	297.5	282.4	15.1
22	162.99	68.13554551 W, 46.11622616 N	161.49	68.13611883 W, 46.11609795 N	296.1	283.6	12.4
23	161.49	68.13612069 W, 46.11609752 N	160.00	68.13668796 W, 46.11596968 N	301.6	277.2	24.5
24	159.99	68.13669173 W, 46.11596883 N	158.49	68.13725615 W, 46.11584140 N	299.7	281.1	18.5
25	158.49	68.13725879 W, 46.11584082 N	157.00	68.1378221 W, 46.11571525 N	301.6	287.4	14.2
26	156.99	68.13782589 W, 46.11571440 N	155.50	68.13839327 W, 46.11558715 N	302.2	288.5	13.7
27	155.49	68.13839721 W, 46.11558631 N	154.00	68.1389655 W, 46.11545741 N	302.2	289.8	12.4

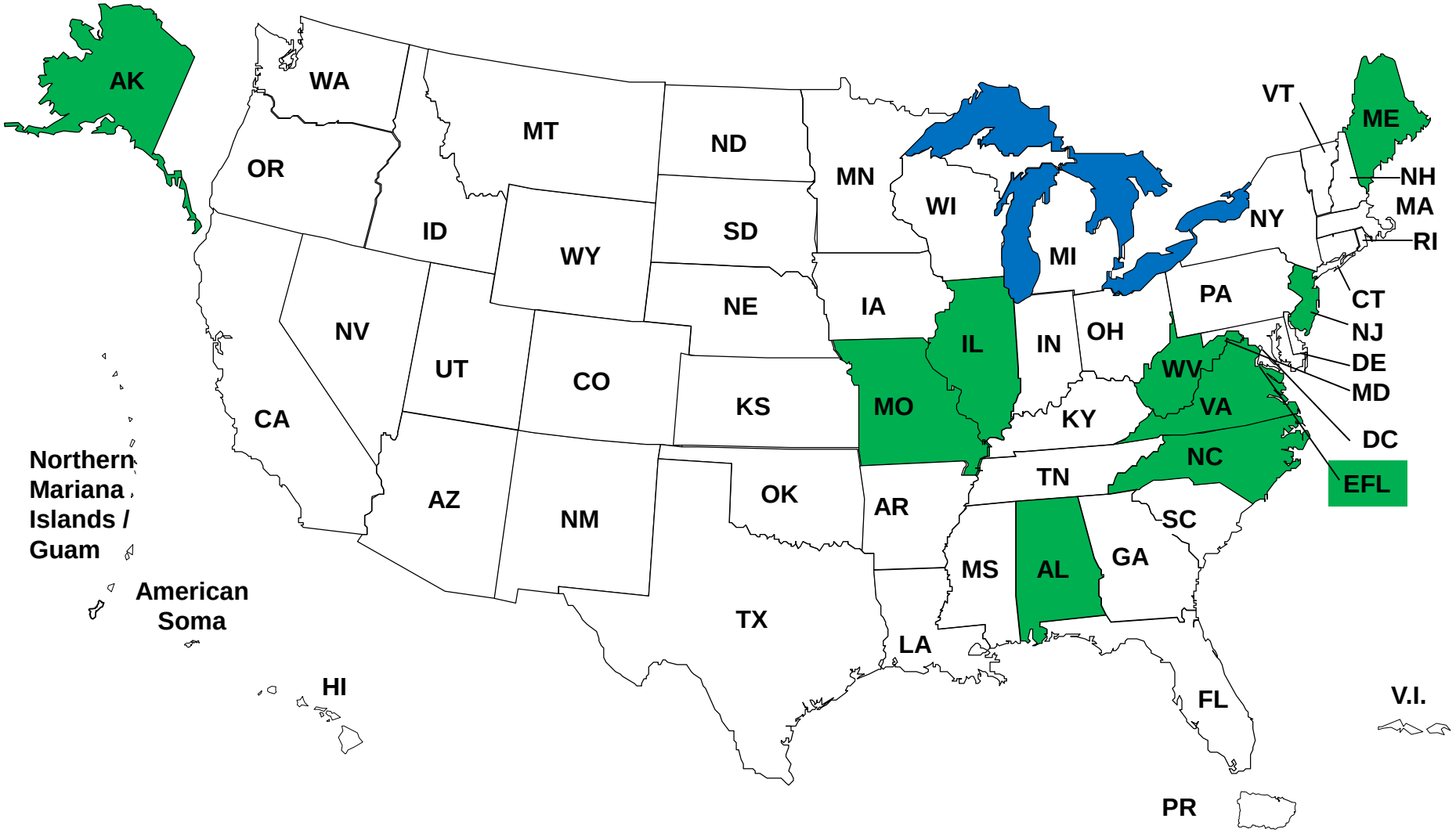
SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Part 3: Field Demonstration Projects; Summary & Findings

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Field Demonstration Projects



Field Demonstration Projects

All field demonstration projects; ***effect of MTVs***:

Project	Delivery Truck Type	MTV Included	Percent Severe Temp. Differentials	Thermal Streaking
Alaska	Bottom-Dump	Windrows	17	None
EFL	***End Dump***	***No***	***83***	***None***
Illinois	***End Dump***	***No***	***40***	***None***
Maine	End Dump	Yes	5	None
Missouri	End Dump & Flow Boys	Yes	25	None
NJ	End Dump	Yes	21	None
Virginia	End Dump	Yes	5	None
NC	End Dump	Yes	18	None
WV	***End Dump***	***No***	***41***	***None***
WV	End Dump	Yes	5	None

Above includes paver stops.

Field Demonstration Projects

Multiple demonstration projects; ***effect of loading trucks:***

- One dump of mix in truck bed – severe temp. differential
- Two dump, no stockpile – reduced temp. differential.

Properly loading trucks significantly reduced the number of severe temperature differentials.

Field Demonstration Projects

Multiple demonstration projects; ***effect of number of trucks:***

- Avg. temperature differential at start of paving project was about 30 ºF.
- Avg. temperature differential after adding two trucks was about 15 ºF.

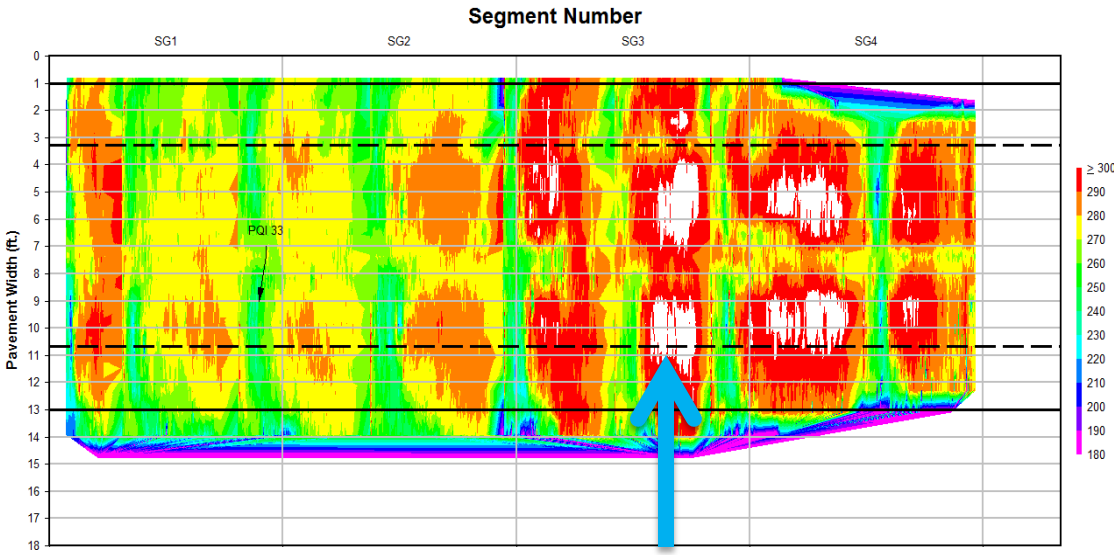
Few trucks with high local traffic = more paver stops.

Two more trucks = fewer paver stops & more uniform temp.

Field Demonstration Projects

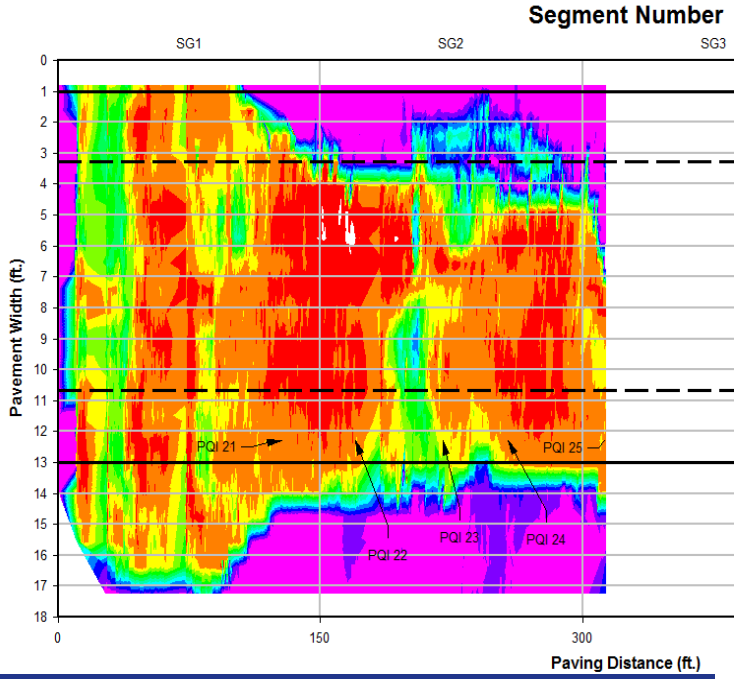
Multiple demonstration projects; ***effect of number of trucks***:

- Significant paver delay between trucks.



Extensive delay with screed heater on.

- Reduced paver delay between successive trucks.



EFFECT: Less variability in mat density, and reduced contractor's risk of being penalized.

Field Demonstration Projects

Multiple demonstration projects; ***effect of tarps***:

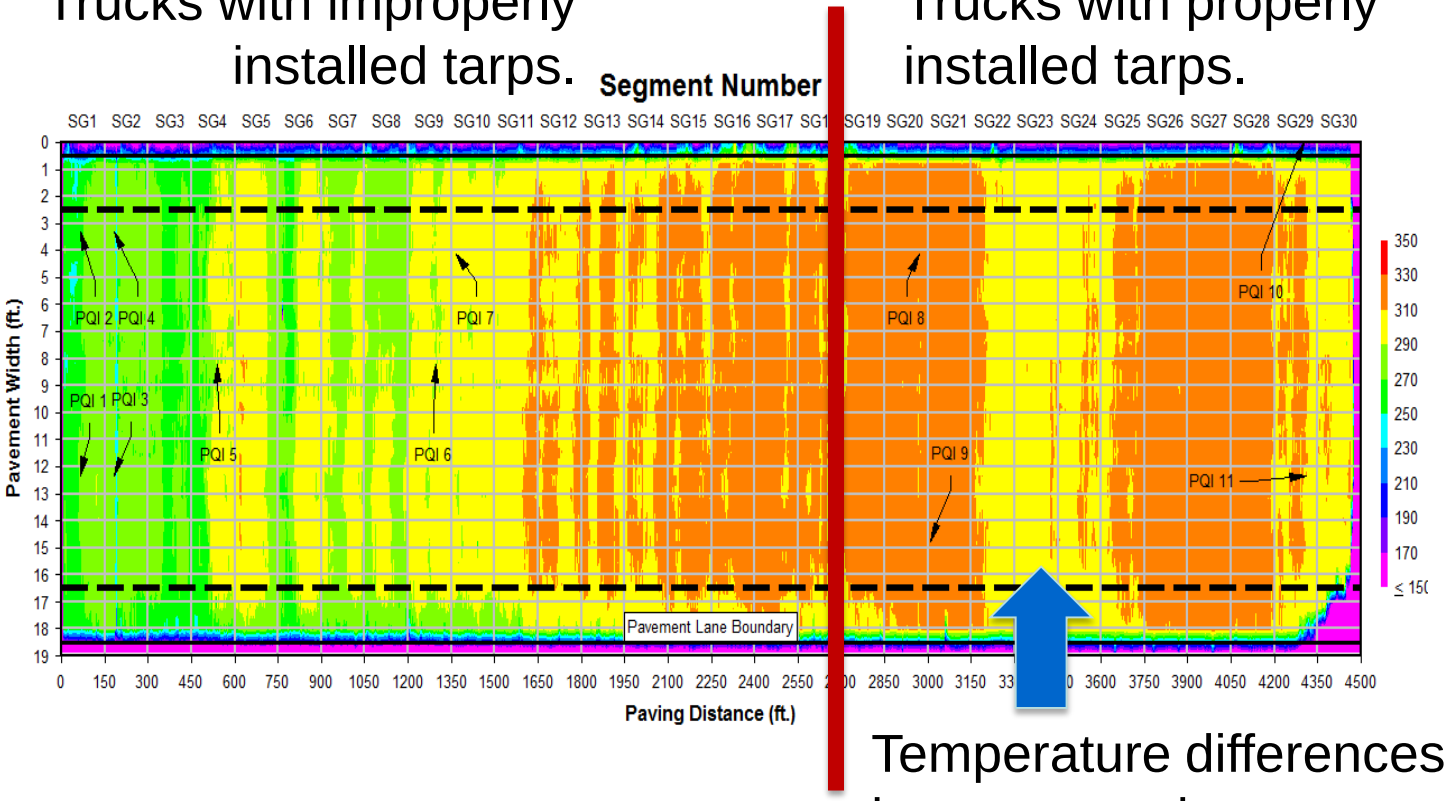
Properly installed and maintained tarps significantly reduced the temperature differentials by about 40 percent.

Field Demonstration Projects

Multiple demonstration projects; ***effect of loading trucks***:

Trucks with improperly installed tarps.

Trucks with properly installed tarps.



Temperature differences between trucks.

SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Part 4: Application and Use

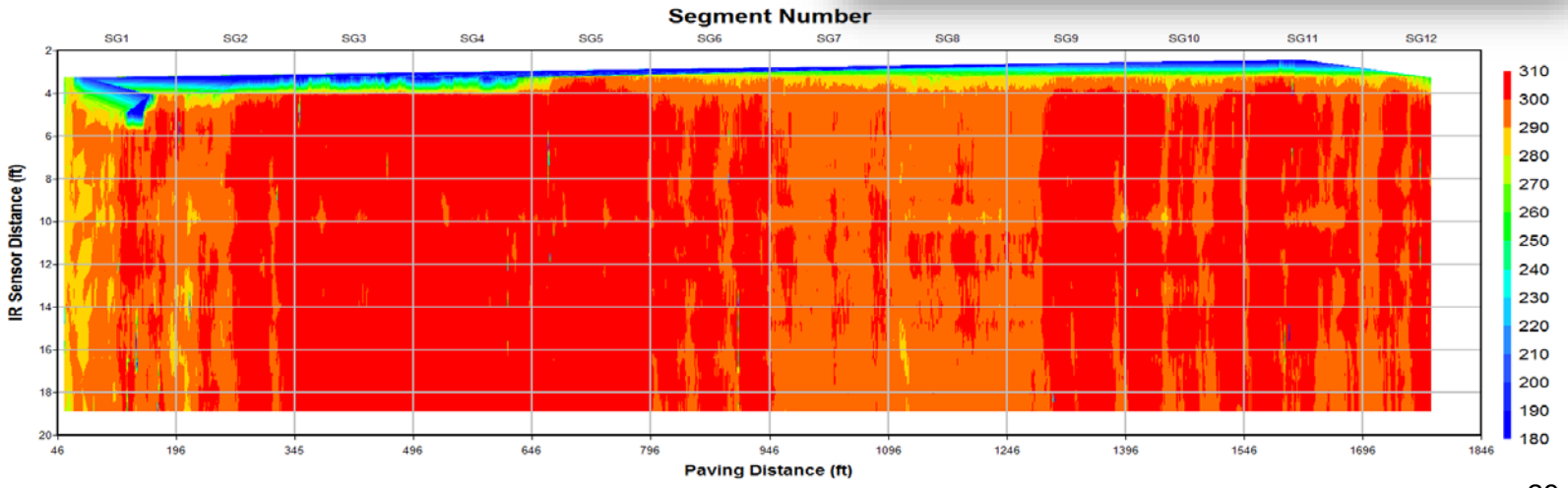
U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Application & Use

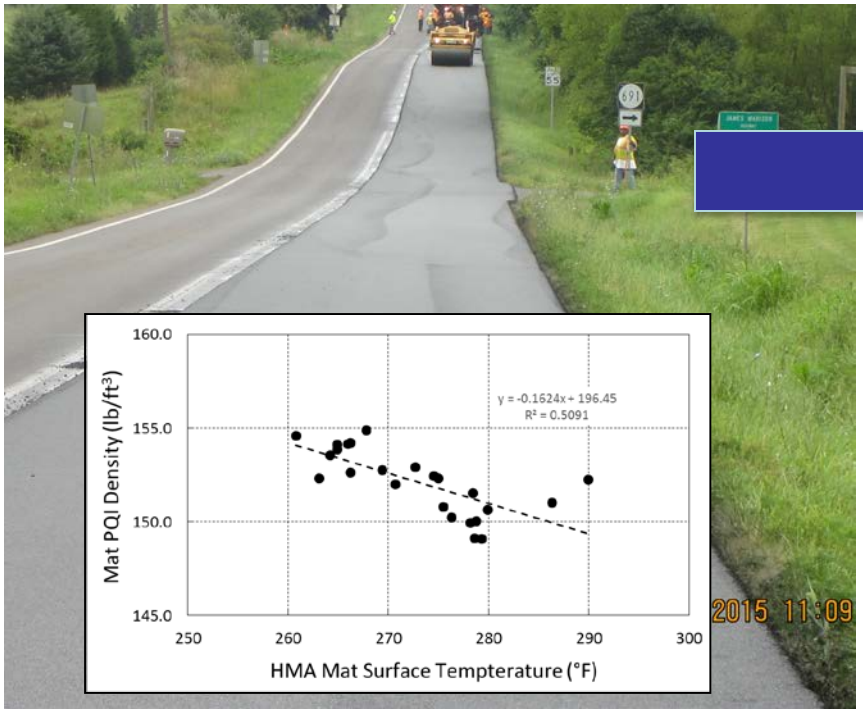
Perspective as a QA Tool:

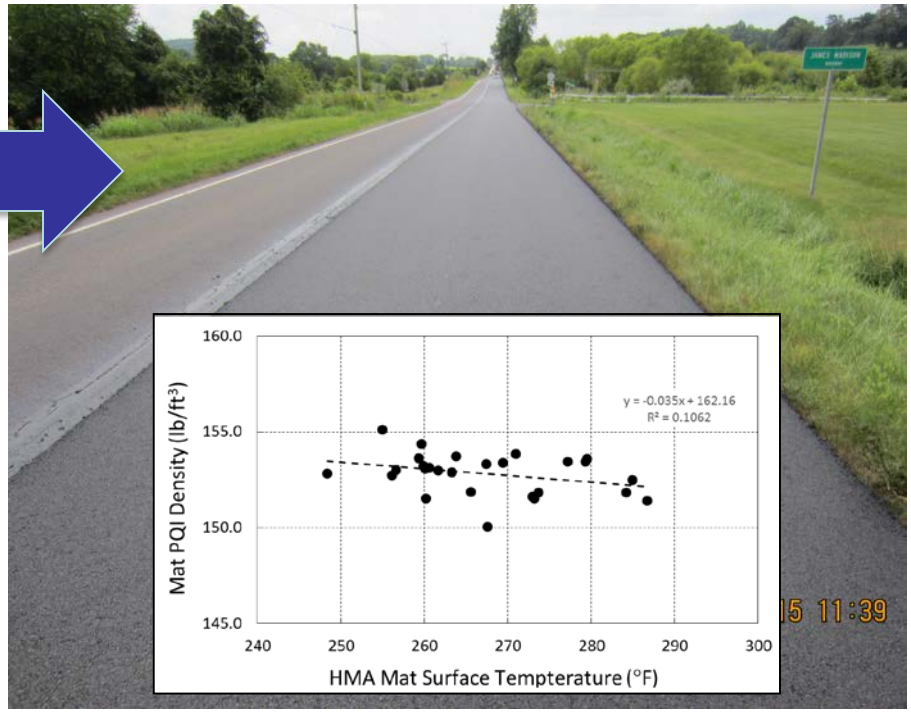
- Continuous readings to evaluate mat uniformity through temperature uniformity.
- Uniform temperatures imply uniform densities, which usually mean lower maintenance.



Application & Use

Impact on Contractor's compaction operation:





After recognizing the effect of temperature sensitive zone; VA DOT demonstration project.

Application & Use

Role of IR in Quality Assurance Programs:

1. Contractor QC plan
   - Monitor production/placement operations to minimize temperature differentials of mat.
   - Minimize risk of being penalized.
   - Forensic tool to trouble shoot low or non-uniform mat densities.
2. Agency acceptance plan
   - Reduce future distress and maintenance costs.
   - Dispute resolution.

Application & Use

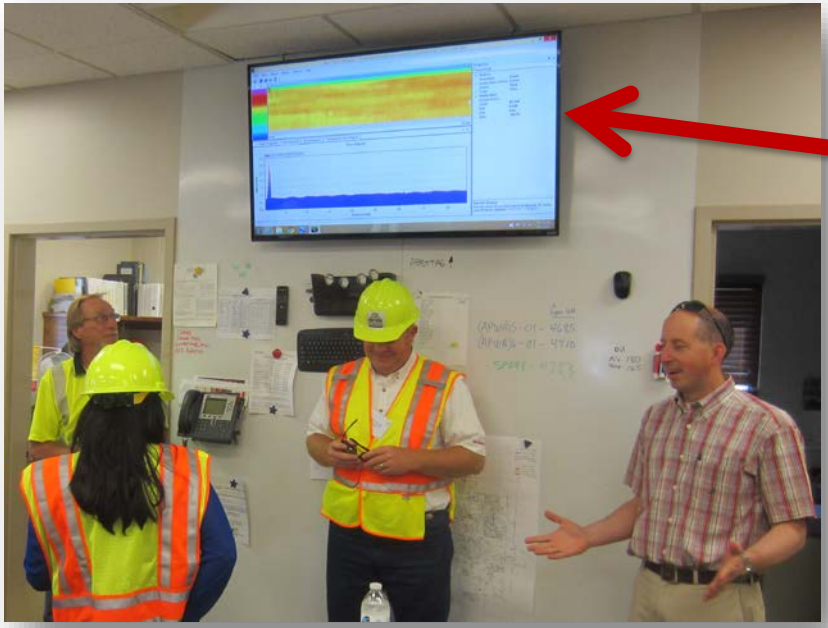
IR role in QC plan, answering specific questions:

- What changes need to be made, if any?
  - Paver delays and speed.
  - Paver maintenance; augers, kick-back flights, slat conveyor, etc.
  - Number & loading of trucks
  - Tarps
  - Etc.
- When to make those changes?

Application & Use

IR role in QC plan—Missouri demonstration project:

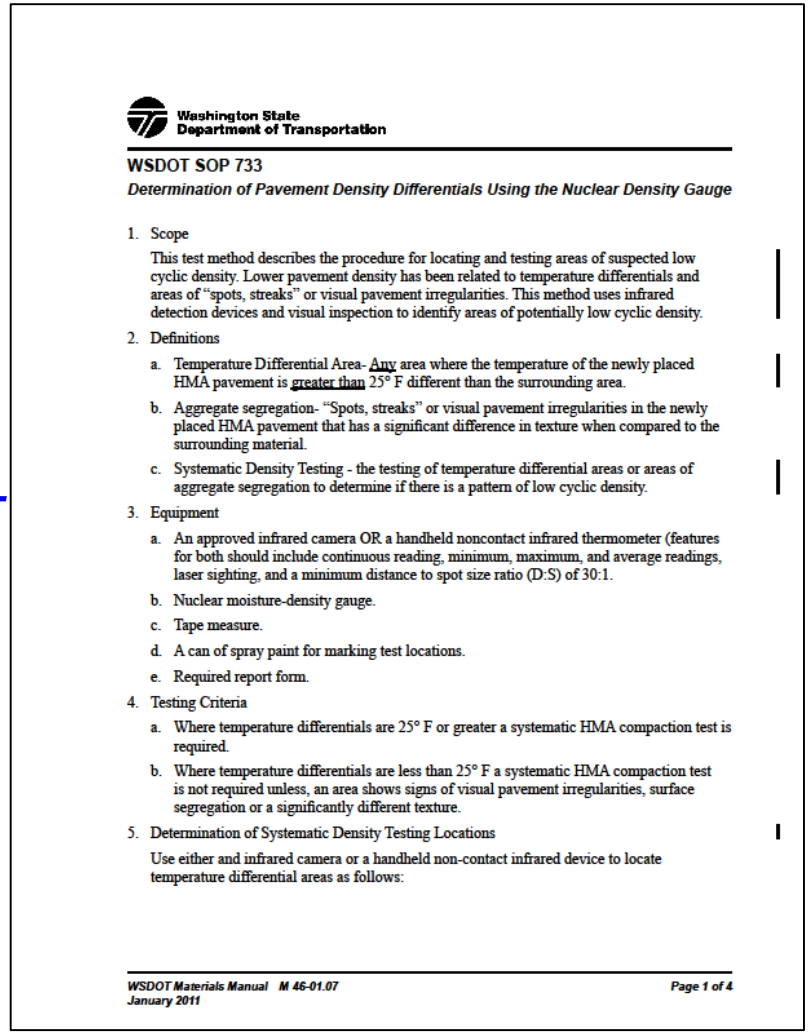
- Increased communication between plant and paver to minimize temperature differentials of mat.



Application & Use

IR Role in Acceptance Plan

- Determine biased areas for sampling and testing: *Washington DOT*
- Modify QA process/suspend paving operations: *Texas DOT*
- Price adjustments for temperature: *Minnesota and Missouri DOT and Quebec*
  - Independent verification is an issue.



Washington State Department of Transportation

WSDOT SOP 733

Determination of Pavement Density Differentials Using the Nuclear Density Gauge

1. Scope

   This test method describes the procedure for locating and testing areas of suspected low cyclic density. Lower pavement density has been related to temperature differentials and areas of "spots, streaks" or visual pavement irregularities. This method uses infrared detection devices and visual inspection to identify areas of potentially low cyclic density.

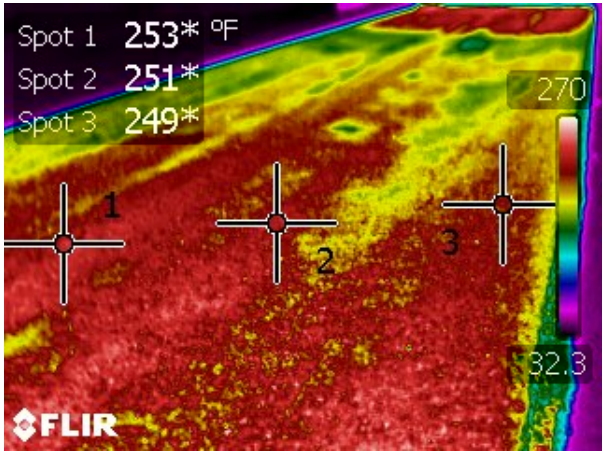
2. Definitions
   a. Temperature Differential Area- Any area where the temperature of the newly placed HMA pavement is greater than 25° F different than the surrounding area.
   b. Aggregate segregation- "Spots, streaks" or visual pavement irregularities in the newly placed HMA pavement that has a significant difference in texture when compared to the surrounding material.
   c. Systematic Density Testing - the testing of temperature differential areas or areas of aggregate segregation to determine if there is a pattern of low cyclic density.
3. Equipment
   a. An approved infrared camera OR a handheld noncontact infrared thermometer (features for both should include continuous reading, minimum, maximum, and average readings, laser sighting, and a minimum distance to spot size ratio (D:S) of 30:1.
   b. Nuclear moisture-density gauge.
   c. Tape measure.
   d. A can of spray paint for marking test locations.
   e. Required report form.
4. Testing Criteria
   a. Where temperature differentials are 25° F or greater a systematic HMA compaction test is required.
   b. Where temperature differentials are less than 25° F a systematic HMA compaction test is not required unless, an area shows signs of visual pavement irregularities, surface segregation or a significantly different texture.
5. Determination of Systematic Density Testing Locations

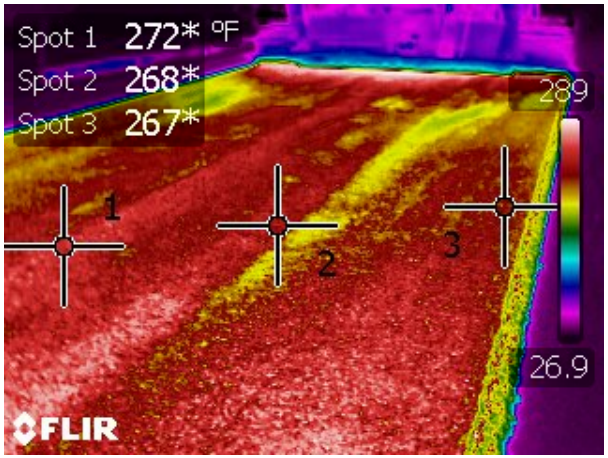
   Use either and infrared camera or a handheld non-contact infrared device to locate temperature differential areas as follows:

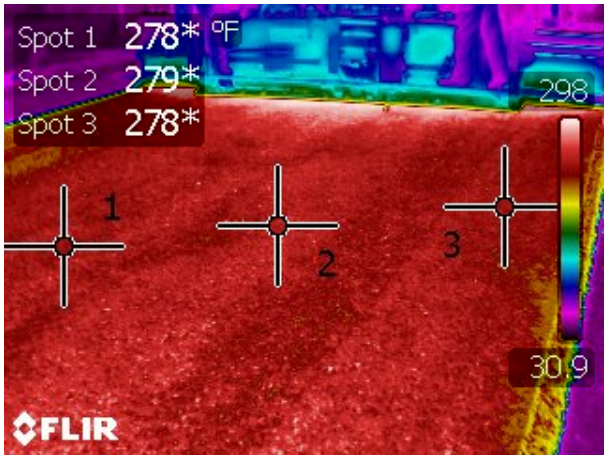
Application & Use

IR Role in Acceptance Plan; examples:

1. Identify cold spots
   - Alaska, Minnesota, Missouri, Quebec, Texas, Washington
2. Identify thermal streaks
   - Quebec

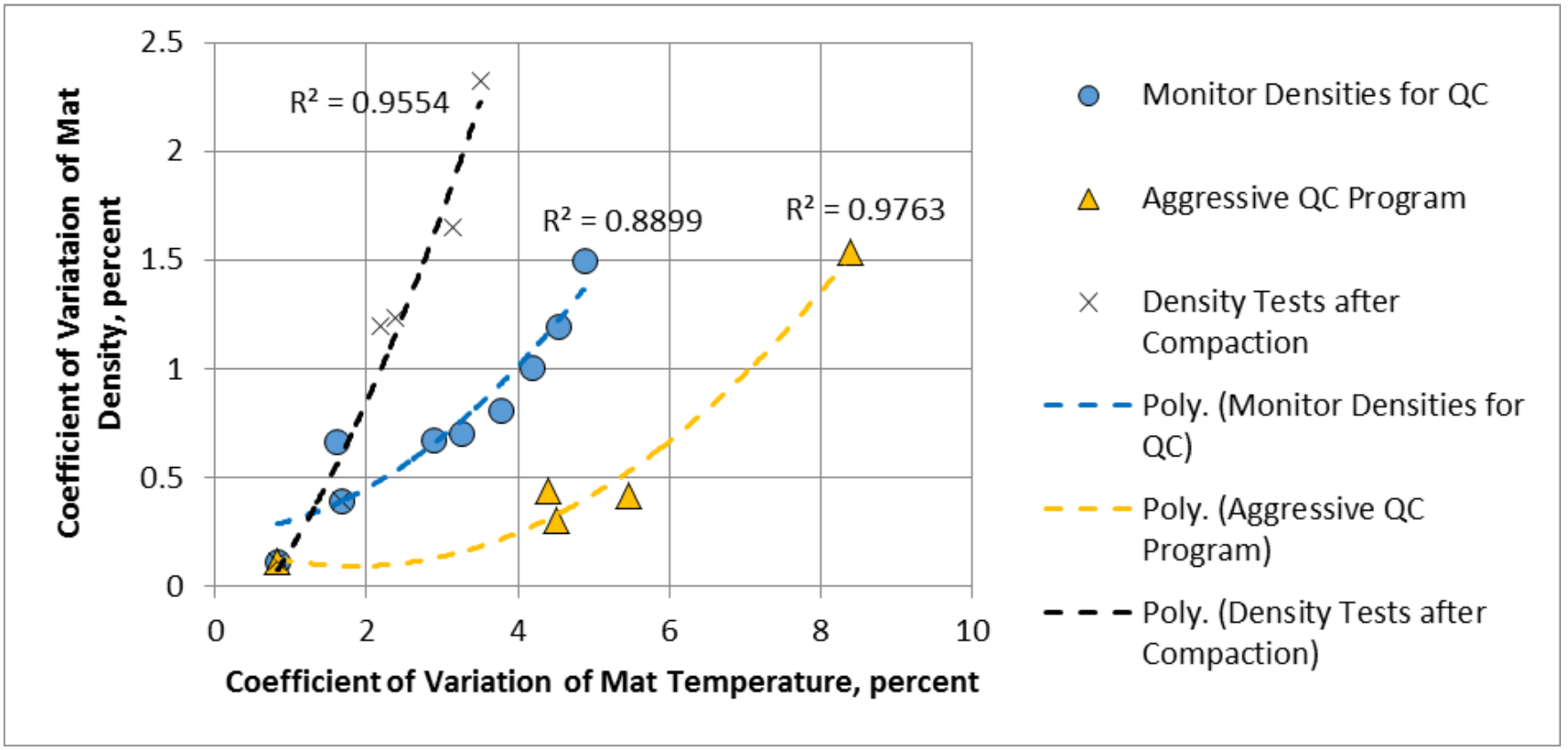






Application & Use

Percent within limits specification: higher variability implies greater risk for being penalized.

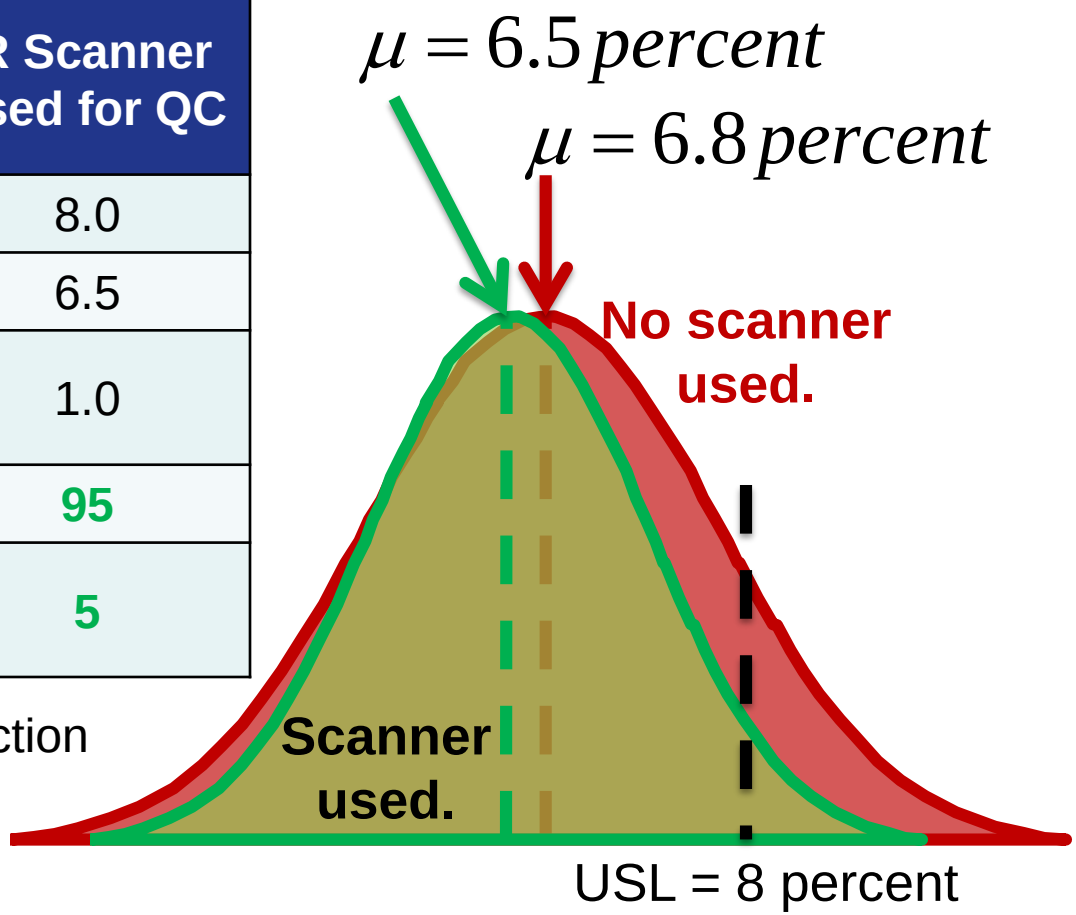


Application & Use

PWL Specification, example.

Air Voids	No IR Scanner Used for QC	IR Scanner Used for QC
Upper Limit	8.0	8.0
Average	6.8	6.5
Standard Deviation	1.5	1.0
PWL	**76**	**95**
Percent Defective	**24**	**5**

Air voids = 100 – Percent compaction



Application & Use

Comments from Contractors and Agencies that have used the IR Scanner:

1. If the IR scanner technology ***saves one grind of a project, the equipment paid for itself***; Maine DOT.
2. The IR scanner equipment is a ***self-policing tool***.
3. Pike Industries purchased their first IR unit about 2 years ago and used it on a project in Vermont. Pike Industries found it to be a ***good tool to make real time adjustments***.
4. It is a ***good forensic tool***, compared to cores, especially to explain why an area has low density. A drop of 15 ºF can result in a significant drop in mat density.
5. The scanner helps in adding trucks for increased uniformity, adjusting practices, and shows the benefits of short hauling.

Application & Use

Comments from Contractors and Agencies that have used the IR Scanner:

6. Contractors see it as a ***great training tool*** for new operators or additional training for experienced crews.
7. The scanner data is a vivid ***tool for showing how rideability is influenced by the uniformity of temperatures.***
8. Even though the EFL project had extensive thermal differences throughout the project, the contractor still achieved desired density – so ***PaveIR is not the whole story***.
9. If the agencies provided the scanner equipment for free, then contractors would most likely take and use the equipment

SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Part 5: Industry Perspective & Opinions

Bill Stone, Missouri DOT
Peter Moulton, Pike Industries
Ed Dalrymple, Chemung Contracting

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Agency Perspective

Agency Perspective; Bill Stone, Research Administrator, Missouri DOT

MoDOT IR Updates

MoDOT Infrared Use Update

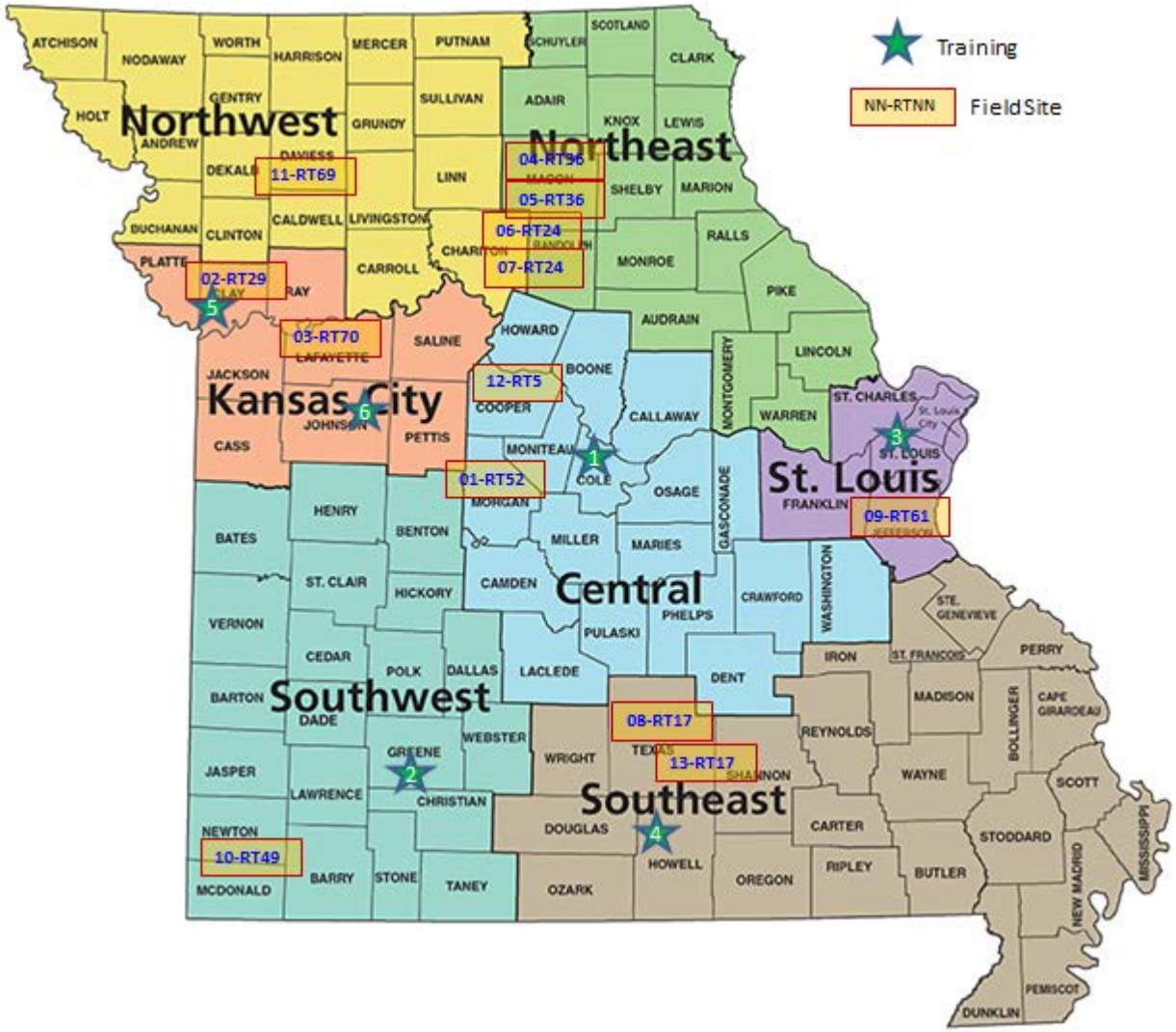
Agency Perspective

MoDOT-FHWA AID IR-IC Projects

- Funded by FHWA AID and MoDOT
- 13 Field Projects in FY 2017
- 7 Training Workshops
- 2017 IC and IR Specifications
- Protocols for IC-IR Field Projects
- Data Management via MoDOT SharePoint

(AID)-Accelerated Innovation and Deployment

Agency Perspective



Agency Perspective

No.	Job No	District	County	Route	Start Date	End Date	Paving Days
1	5P3117	CD	Morgan	52	5/9/2017	7/13/2017	19
2	4I3111	KC	Clay	29	8/18/2017	Ongoing	7
3	3I3042	KC	Lafayette	70	8/14/2017	9/13/2017	18
4	2P3099	NE	Macon	36	5/8/2017	5/17/2017	7
5	2P3100	NE	Macon	36	5/25/2017	6/21/2017	12
6	2P3051	NE	Randolph	24	10/21/2016	11/3/2016	8
7	1P3005	NW	Chariton	24	4/24/2017	5/16/2017	9
8	9P3161	SE	Texas	17	9/28/2017	10/19/2017	11
9	6S3123	SL	Jefferson	61	5/31/2017	6/9/2017	9
10	7I3072	SW	McDonald	49	6/5/2017	7/6/2017	13
11	1S3028	NW	Daviess	69	6/29/2017	7/7/2017	5
12	5P3170	CD	Cooper	5	9/8/2017	9/19/2017	10
13	9P3296	SE	Texas	17	7/5/2017	8/18/2017	16

Agency Perspective

MoDOT IR and IC Specifications

INTELLIGENT COMPACTION

1.0 Description. This work shall consist of collecting location, temperature, speed and resistance measurements from properly instrumented rollers within the mainline paving limits and then submitting the Intelligent Compaction (IC) Data in the defined format. This provision shall apply for each lift of mainline pavement. This work shall be completed in accordance with the general principles set forth in AASHTO PP81-14, and specifically as stated in the following sections.

2.0 IC Asphalt Rollers. All asphalt rollers with the exception of the finish roller shall be properly instrumented. These instrumented rollers will be referred to as IC Rollers. Steel wheel rollers shall be self-propelled double-drum vibratory rollers equipped with accelerometers mounted to acquire signals from the vibratory response in the drum measuring the interactions between the rollers and compacted materials in order to evaluate the applied compaction effort known as the Intelligent Compaction Measurement Value (IC-MV). Rubber tire rollers will not be required to collect resistance measurements. IC Rollers shall be equipped with non-contact temperature sensors for measuring pavement surface temperatures as well as a Global Positioning System (GPS) to map the roller position history. A Roller Approval Form generally consistent with PP81 Appendix X4 "Department Approval of Instrumented Rollers for Use" shall be completed and submitted to the engineer prior to use of a roller for measurement of passes demonstrating that the roller meets the requirements of this provision.

3.0 Equipment Accuracy. IC Roller accuracy shall be in accordance with the following.

Operating Parameter	Accuracy
Global Positioning System	±50 mm (±2 in.) in the X and Y Direction
Rolling Speed	±0.5 kph (±0.3 mph)
Frequency	±2 Hz
Amplitude	±0.2 mm (±0.008 in.)
Temperature	±1.5°C (±2.7°F)

Infrared Scanning

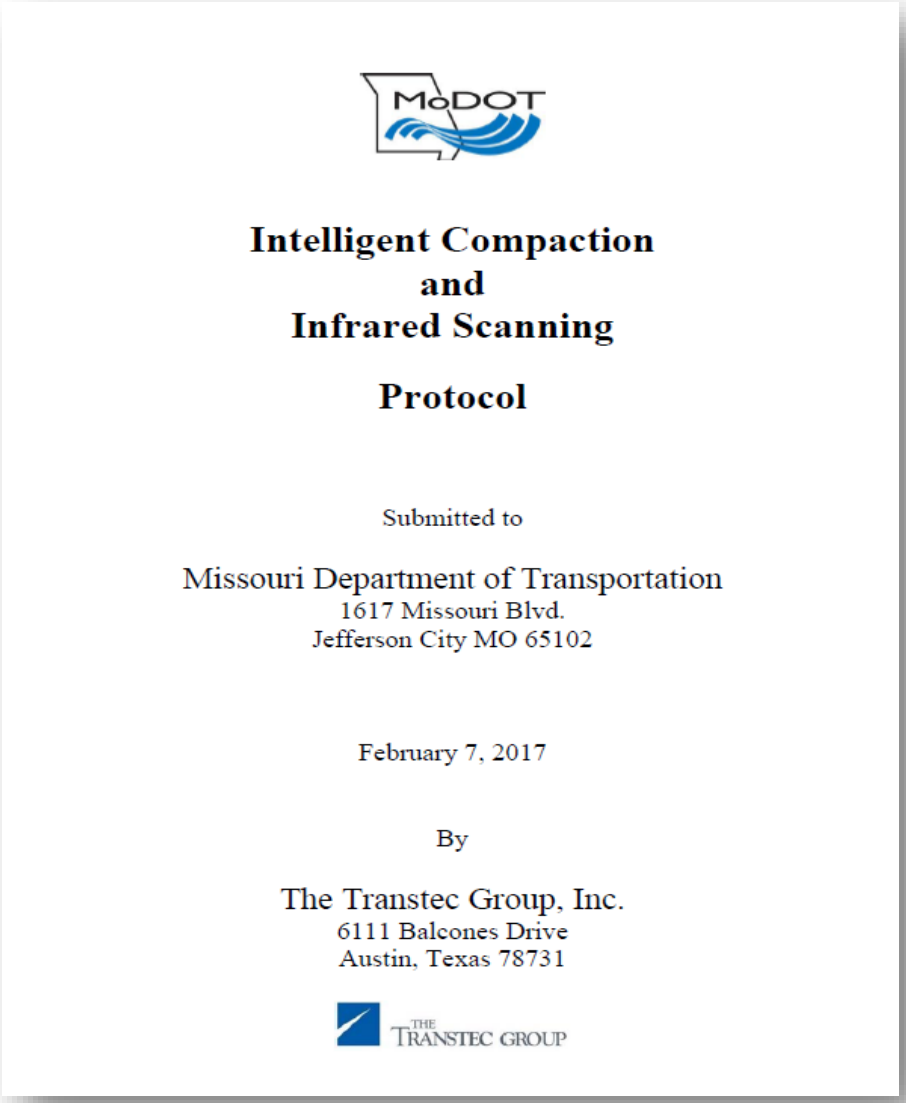
1.0 Description This work shall consist of collecting the paving location, surface temperature and paver stops with a Contractor supplied, Contractor retained MOBA Pave-IR Infrared Scanner System for the each lift of mainline asphalt pavement. The Infrared (IR) scanner shall be used to continually monitor the surface temperature of the mat immediately behind the paver screed during paving operations in order to determine the temperature differential for each segment. The scanner itself mounts overhead at the back of the paver. Data from the scanner shall be automatically uploaded and processed through a wireless data connection.

2.0 IR Scanning Equipment The system shall consists of a temperature scanner, wheel speed sensor, GPS antenna, control panel and necessary cabling. The IR scanner shall measure the surface temperature over the complete paving width. The current position shall be recorded via the GPS antenna. The control panel shall feature all of the keys and displays necessary to control the system as well as the software (PaveApp) for data recording and visualization during the paving process. The system shall store the data locally on the memory stick and also upload the data directly to e-Routes Software that is available from MOBA and shall be supplied by the contractor for use on this project.

3.0 Pave-IR Training A 2 - 4 hour training session will be provided by the Engineer. The Quality Control Staff and screed operator shall attend the training. This training will familiarize the contractor staff on the set-up, operational monitoring and software requirements as well as generation and interpretation of output reports. A trained screed operator and quality control staff shall be on site when the IR scanner is in use. If trained personnel are unavailable IR scanning and mainline paving shall not be performed.

Agency Perspective

MODOT IC-IR Protocol



MoDOT

Intelligent Compaction and Infrared Scanning

Protocol

Submitted to

Missouri Department of Transportation
1617 Missouri Blvd.
Jefferson City MO 65102

February 7, 2017

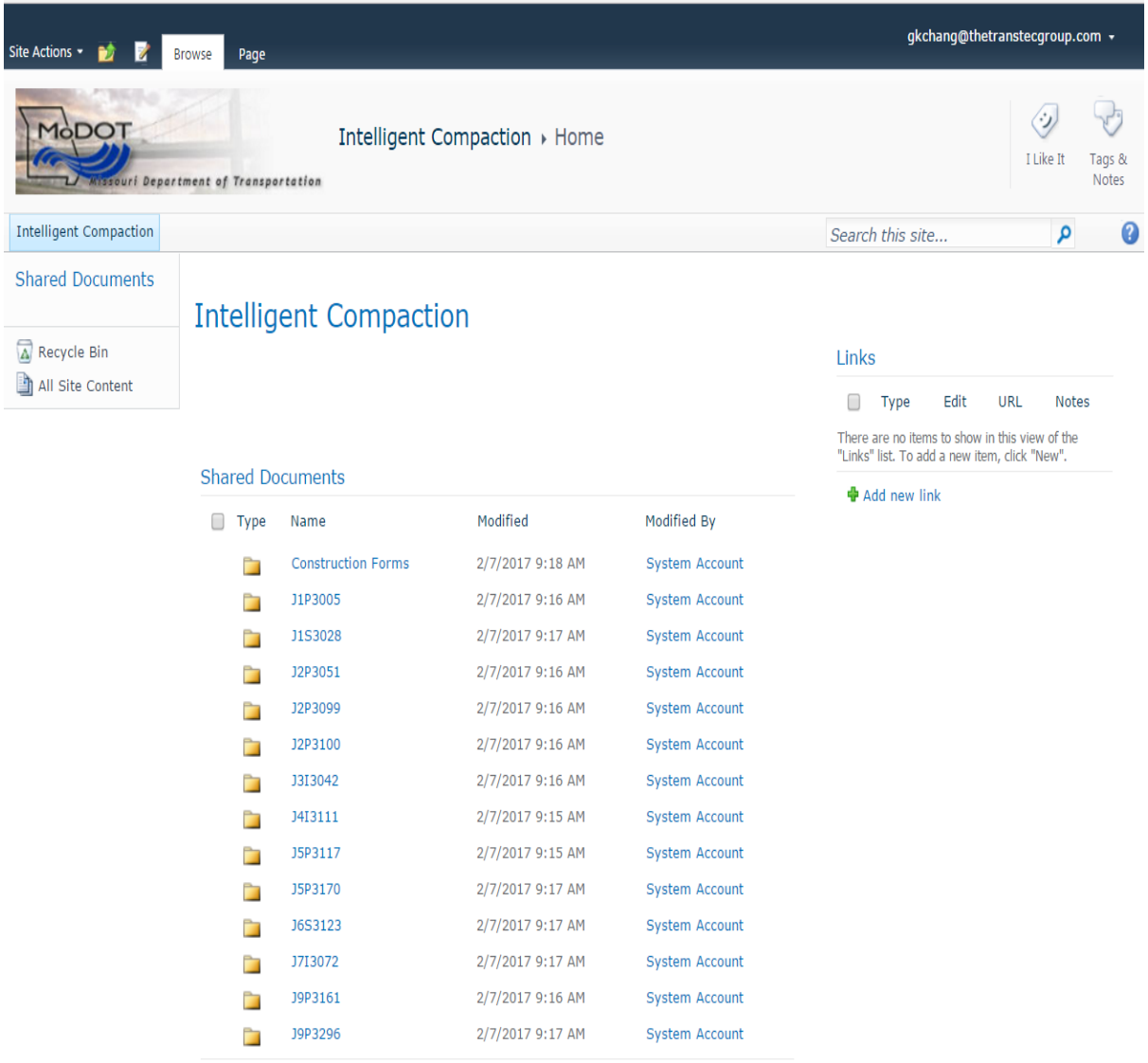
By

The Transtec Group, Inc.
6111 Balcones Drive
Austin, Texas 78731

THE TRANSTEC GROUP

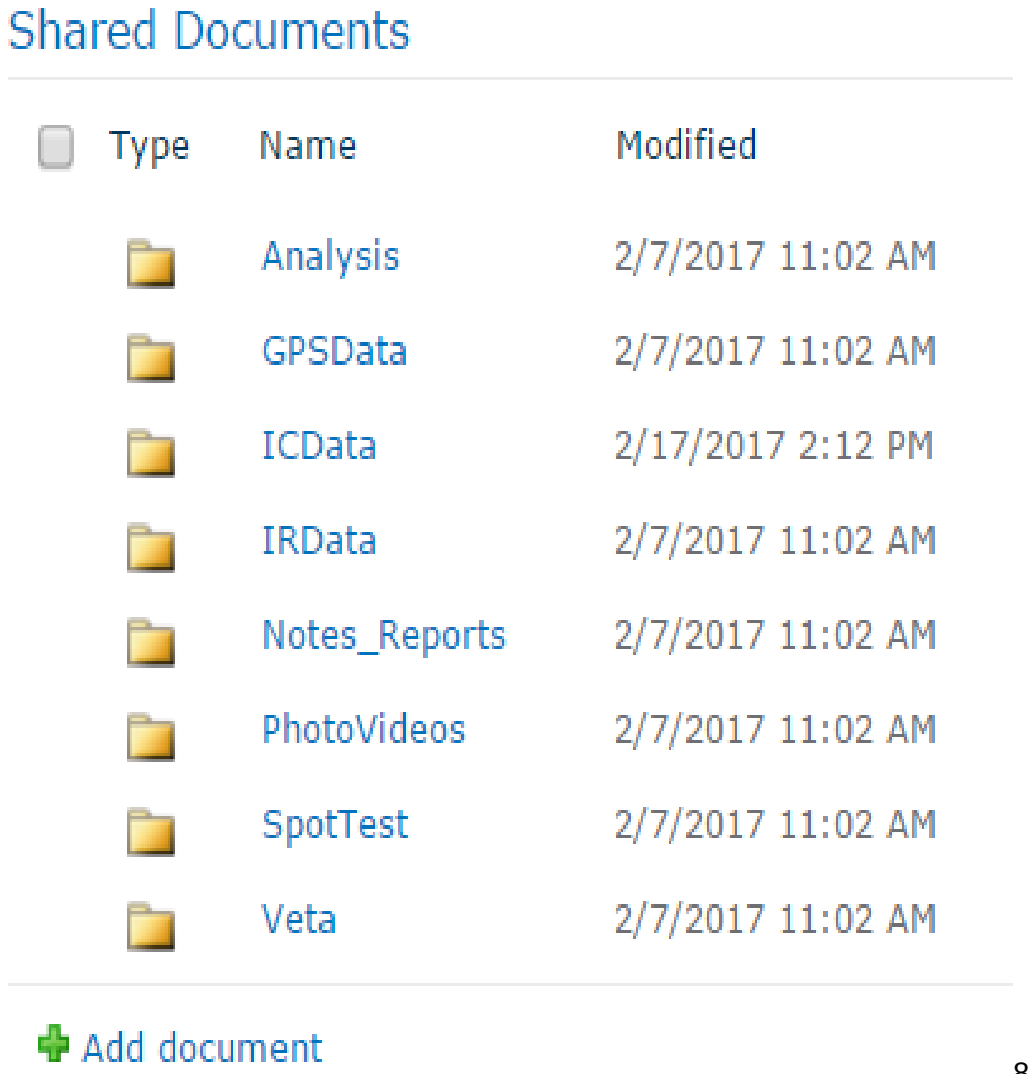
Agency Perspective

IR-IC Data Management; MoDOT SharePoint Site



Agency Perspective

IR-IC Data Management; MoDOT SharePoint Site



Agency Perspective

Contractor's Check List

Contractor's Check List

Route	
Job No.	
Date	
Contractor	

	Yes	No
Conduct IC GPS verification..		
Conduct IR scanner DMI calibration.		
Construct a trial section.		
Record and export IC data.		
Record and export daily production boundaries.		
Record IR scanner data.		
Record spot test data.		
Create a Veta project file for IC data.		
Produce MOBA IR Segment Report.		
Fill daily paving record form.		
Transmit all files to MoDOT SharePoint.		

Agency Perspective

Contractor's Daily Forms

Route: Job No.
IC System:
IR System:
GNSS Ref:
Date:
Start time: Start Milepost: Length (ft): 0
Stop Time: Stop Milepost: HMA (tons):

GPS Verification

	Nothing (m)	Easting (m)	Diff. (mm)	< 30mm?
IC GPS				Y
Rover				Y

Trial Section

Opt Passes	
Patterns	

Paving

Direction	Lane	Lift	Width (ft)	Thickness (")

Compaction

Position	Roller	Passes	Static/Vib	Amp (mm)	Freq (vpm)
Breakdown					
Intermediate					
Finishing					

Agency Perspective

RE’s Daily Check List

RE's Daily Check List

Route	
Job No.	
Date	
RE	

	Yes	No
Record daily field diaries.		
Review IC Veta Project file submitted by contractor.		
Review IR segment report submitted by contractor.		
Transmit daily diaries to MoDOT SharePoint.		

Agency Perspective

MoDOT IR-IC Workshops

Agency Perspective

IR and IC Equipment

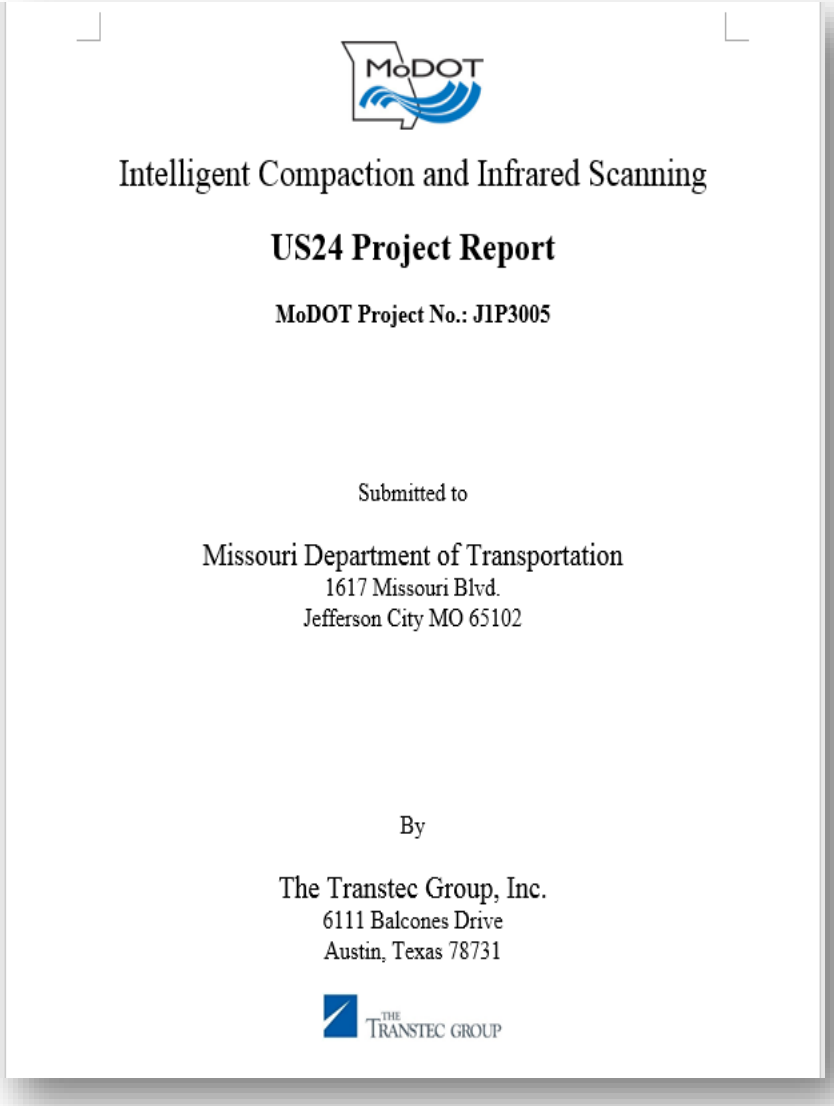






Agency Perspective

MoDOT IR-IC Project Reports



Intelligent Compaction and Infrared Scanning

US24 Project Report

MoDOT Project No.: J1P3005

Submitted to

Missouri Department of Transportation
1617 Missouri Blvd.
Jefferson City MO 65102

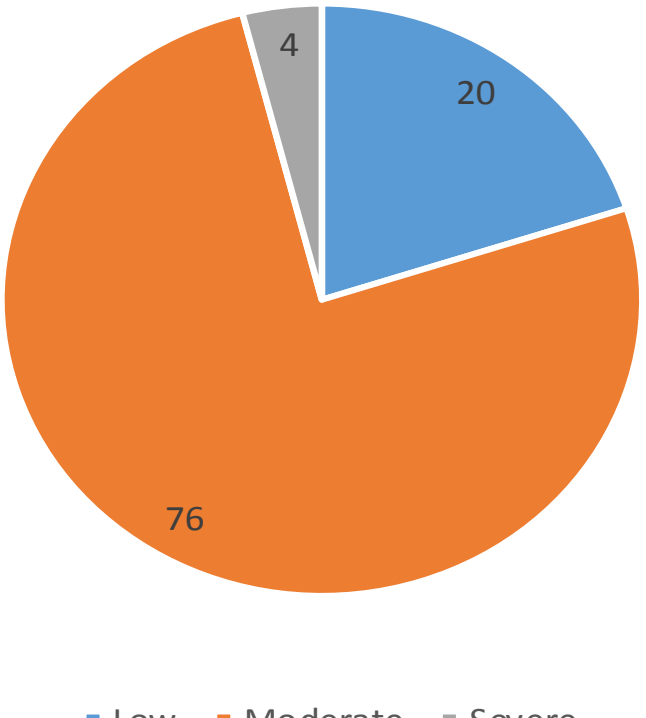
By

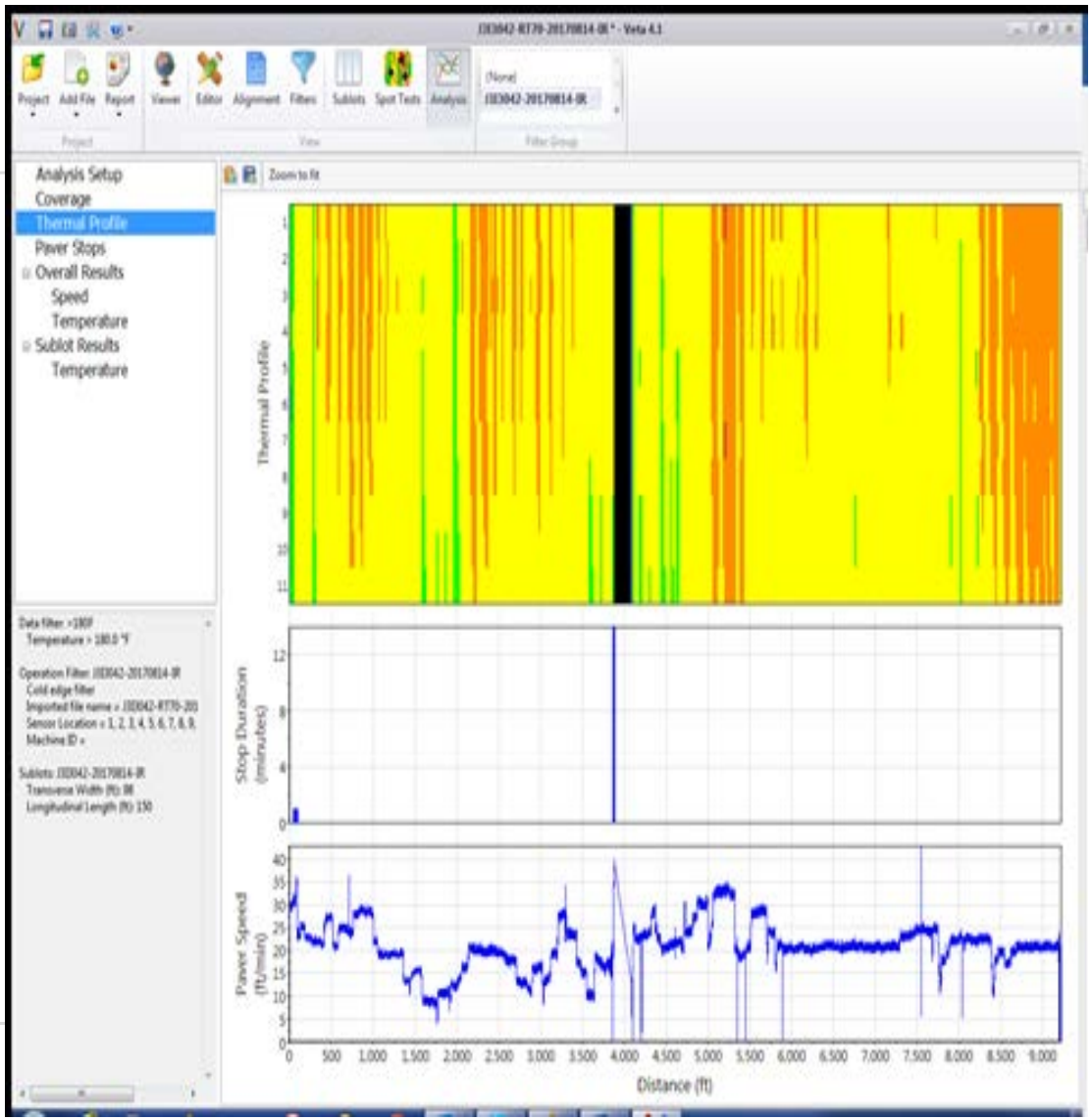
The Transtec Group, Inc.
6111 Balcones Drive
Austin, Texas 78731

THE TRANSTEC GROUP

Agency Perspective

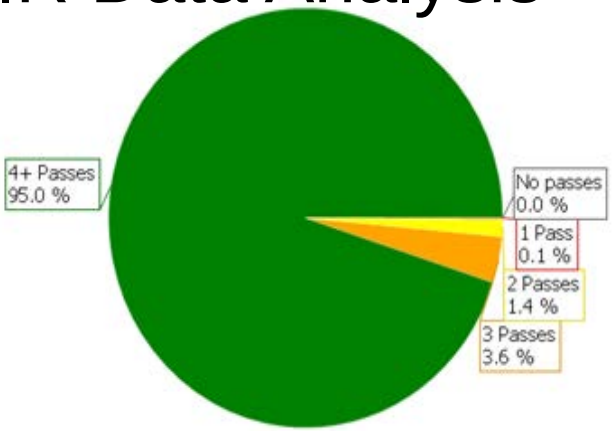
IR Data Analysis

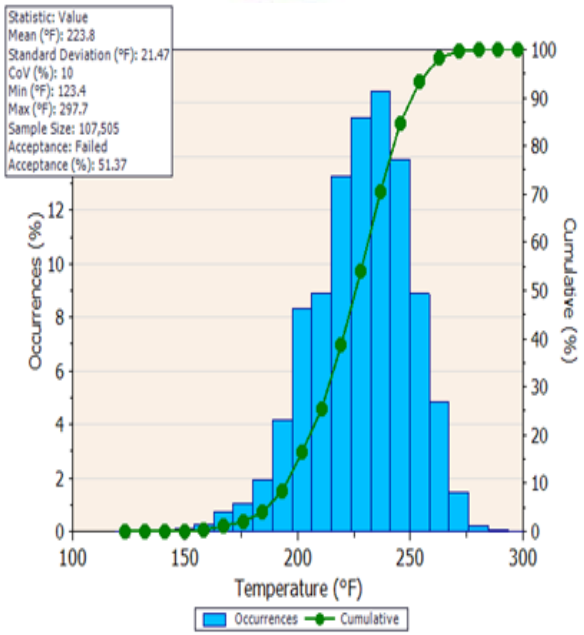


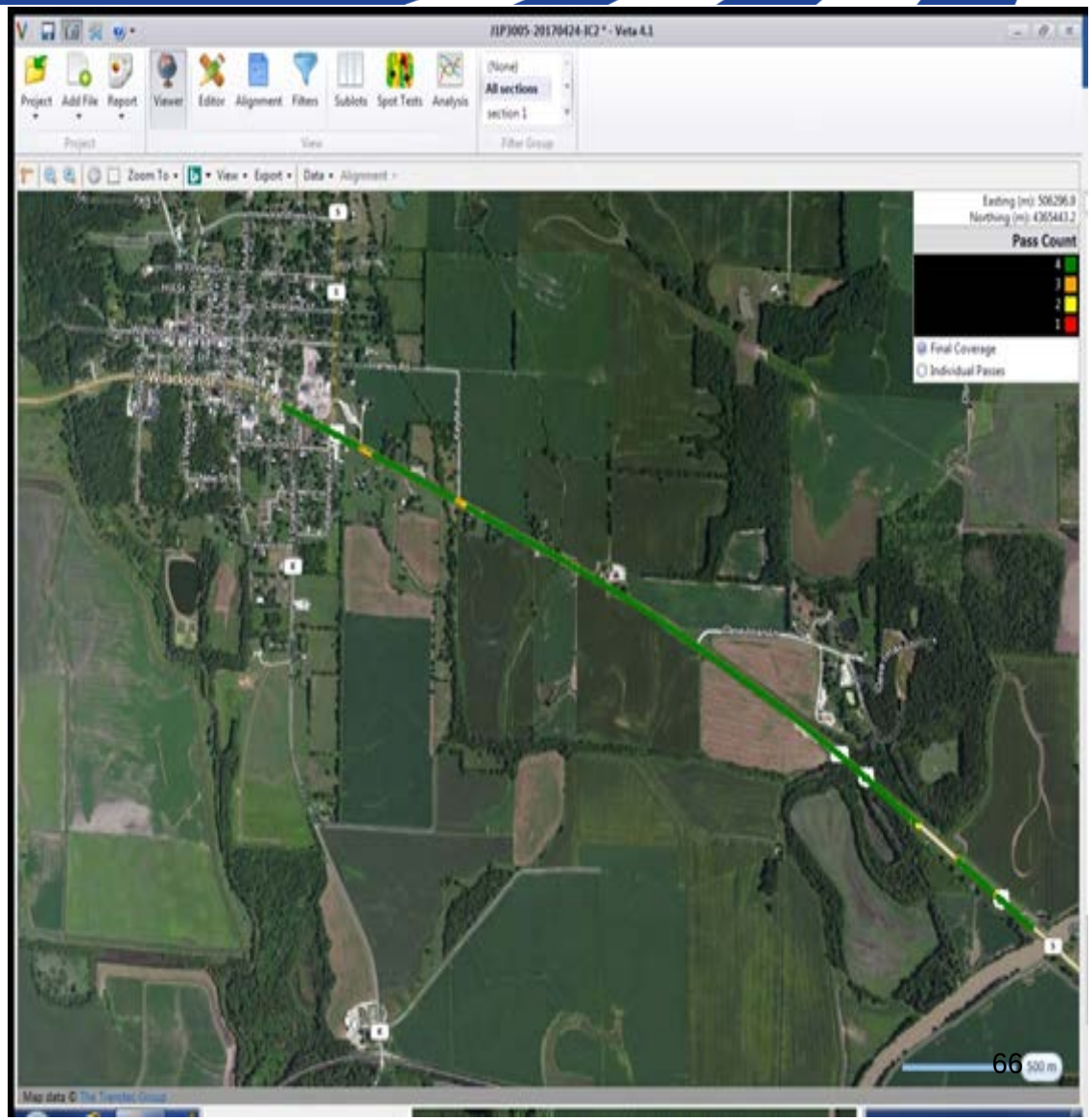


Agency Perspective

IR Data Analysis



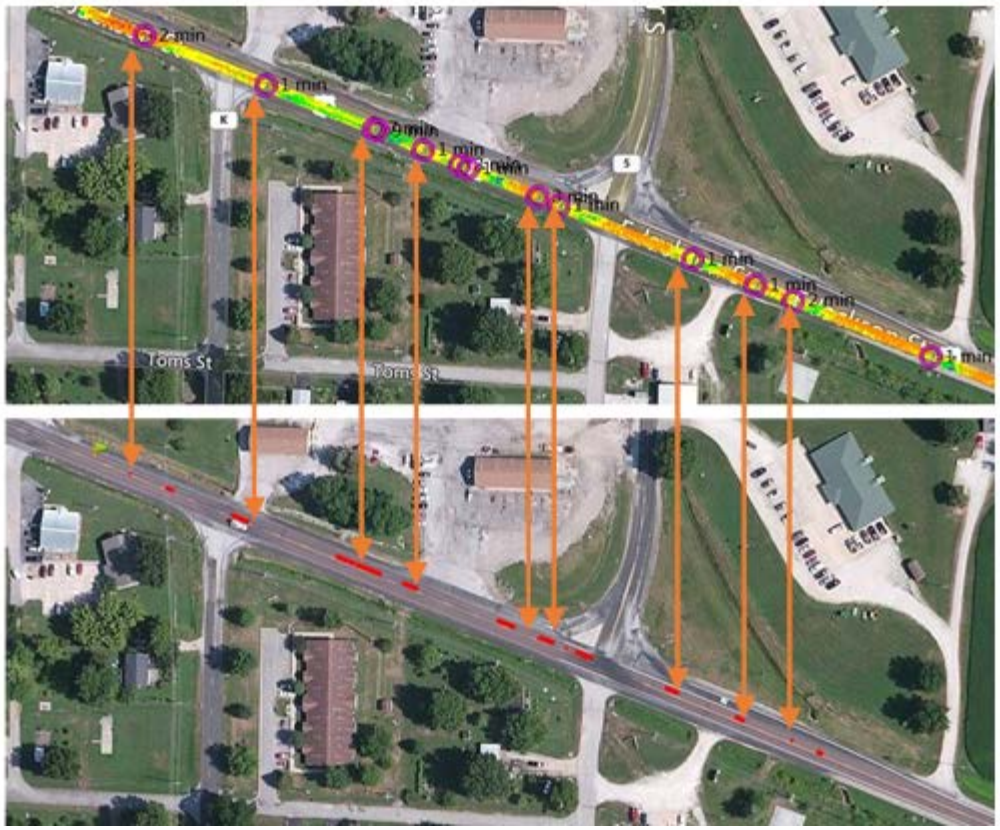




Agency Perspective

IR & Paver Stops

IRI ALR



MoDOT IC-IR Final Report

MoDOT Publication No. MODOT-17-NN

MoDOT Project TR201716/ TR201802

Intelligent Compaction and Infrared Scanning Field Projects with Consulting Support

Final Report

Submitted to

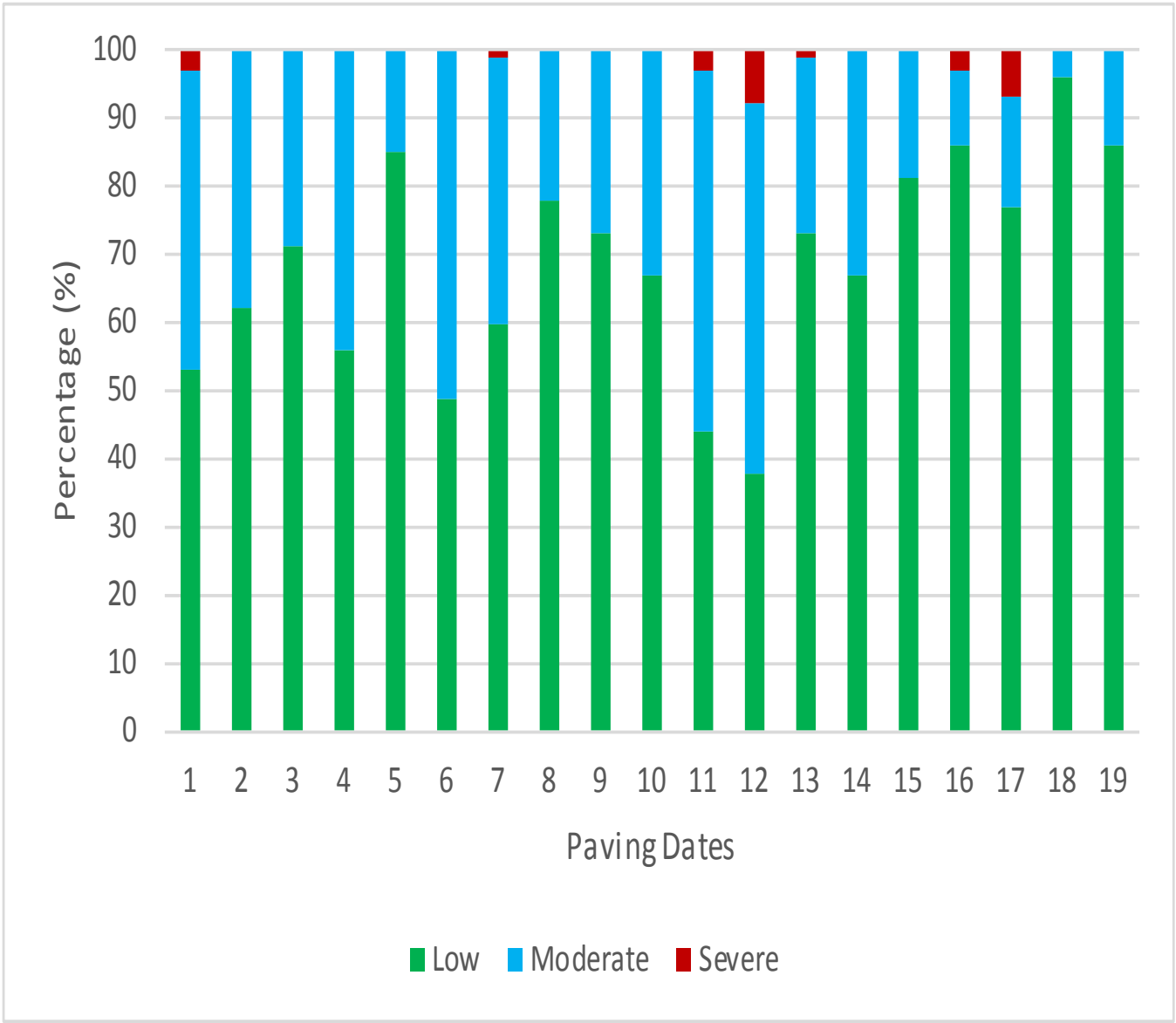
Missouri Department of Transportation
1617 Missouri Blvd.
Jefferson City MO 65102

December 2017

By

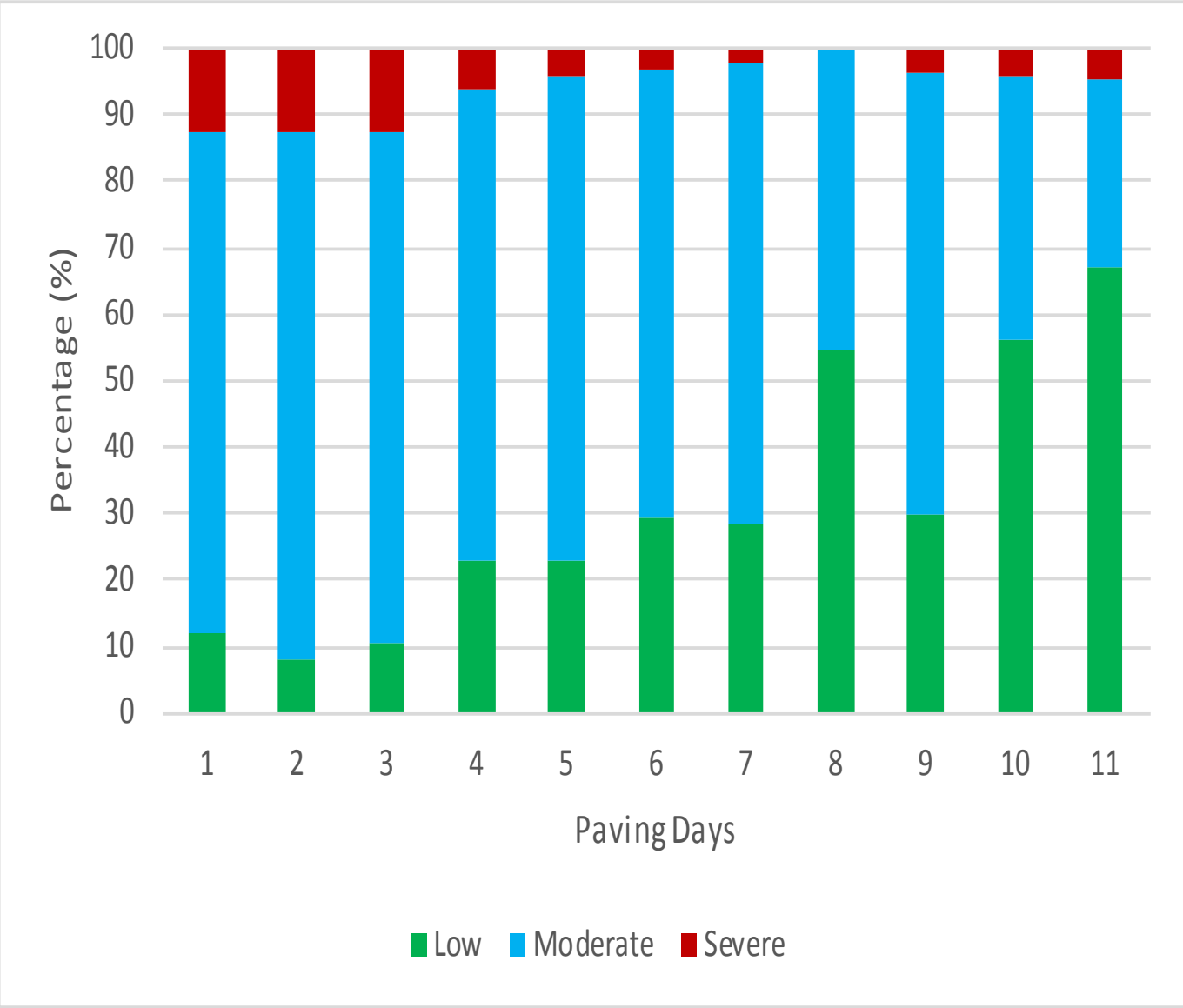
The Transtec Group, Inc.
6111 Balcones Drive
Austin, Texas 78731

IR Results - Good



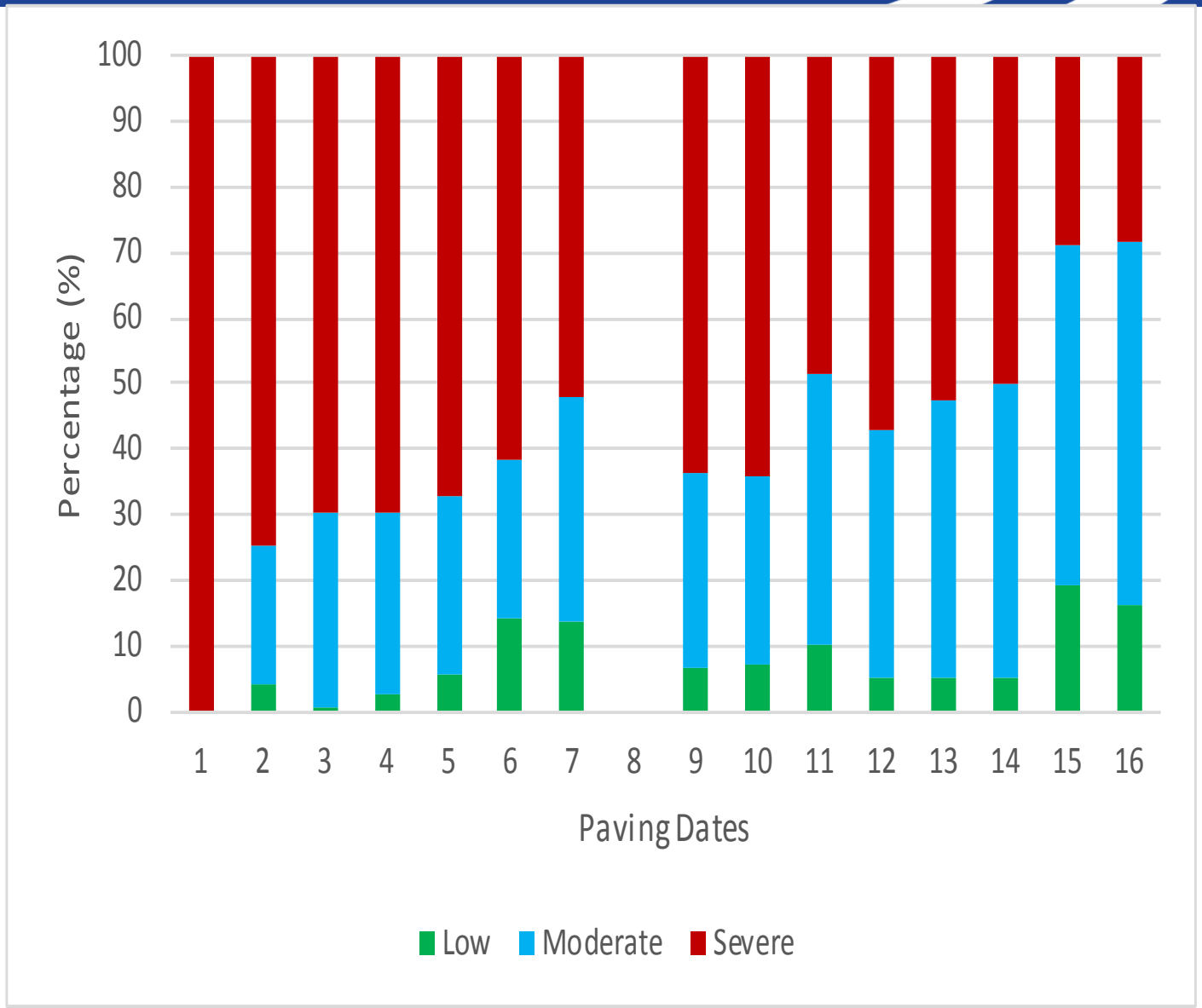
J5P3117
RT 52

IR Results - OK



J9P3161
RT 17

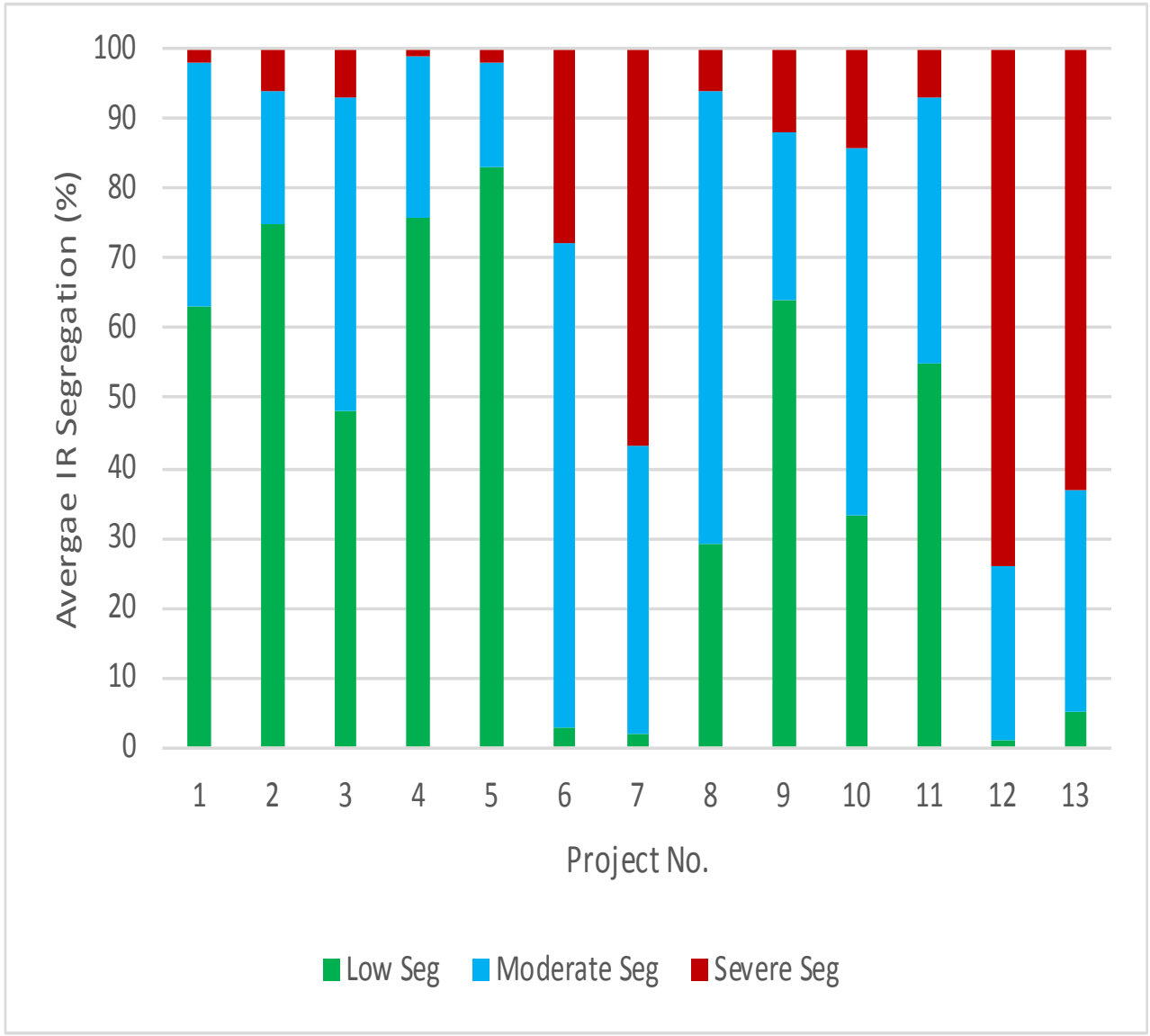
IR Results – Poor



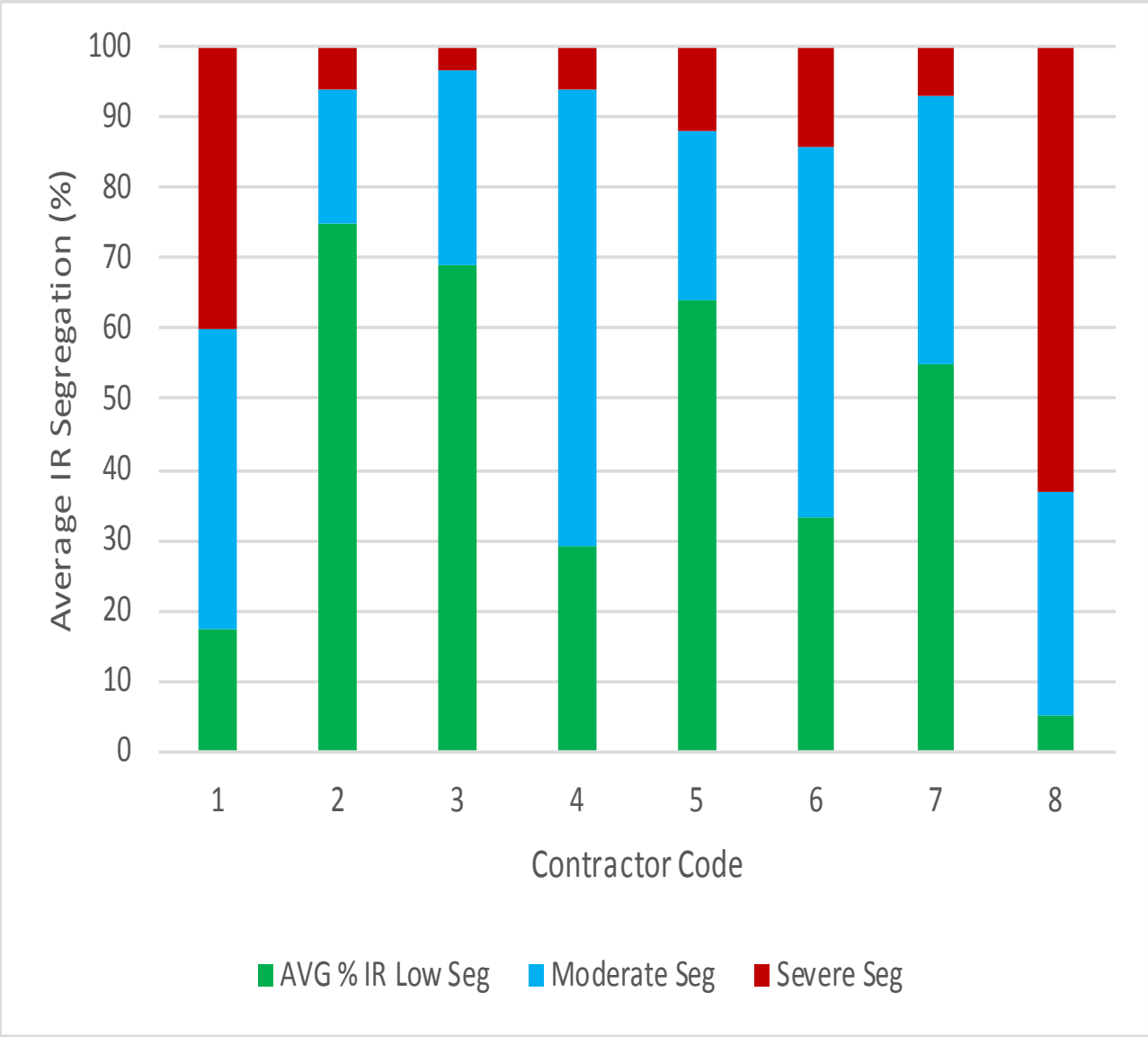
J9P3296
RT 17

Surface
Leveling
Mix

IR Segregation for All Projects



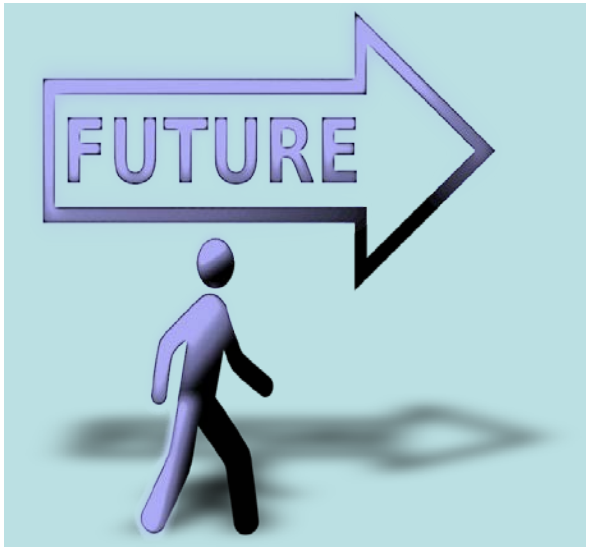
IR Segregation for All Contractors

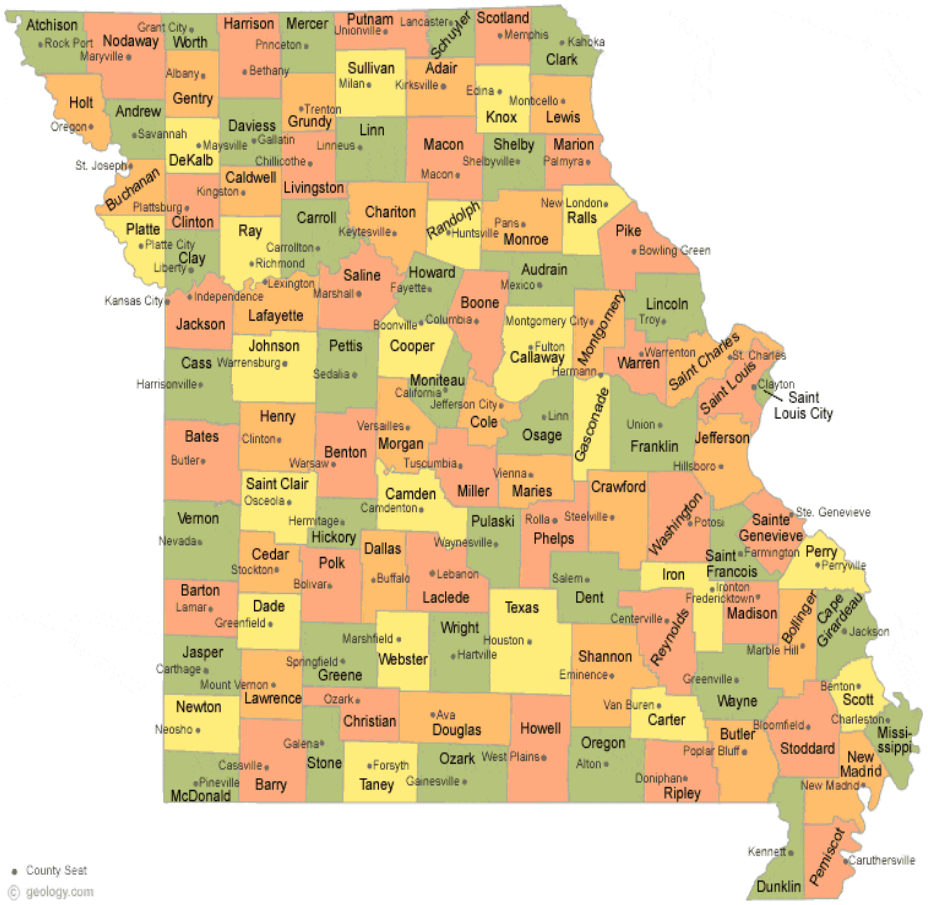


Agency Perspective

Outlooks in 2018

- IR-IC projects to be let
- Updated IR and IC Specs.
- 14 projects are targeted
- Additional Training
- Learning/Experiences





Industry Perspective

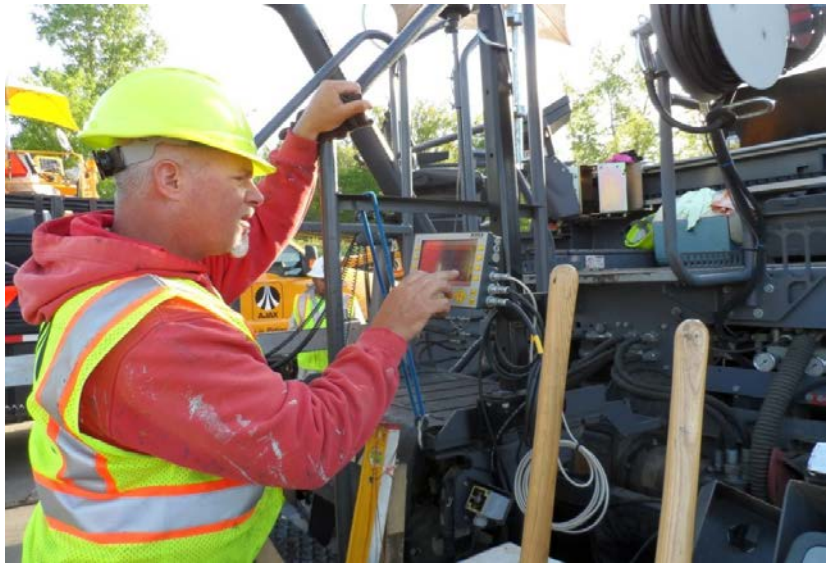
Contractor Perspective; Peter Moulton, Pike Industries; Maine

Contractor Perspective

Peter Moulton, Pike Industries

- MDOT Project WIN#023052.00 Fairfield/Skowhegan Cyclical Pavement Resurfacing
- ¾” overlay with shim
- MOBA data made available by MDOT, Dale Peabody, Ulrich Amoussou-Gueno, Bruce Yeaton
- Pike Industries HMA placement
- ASMG project

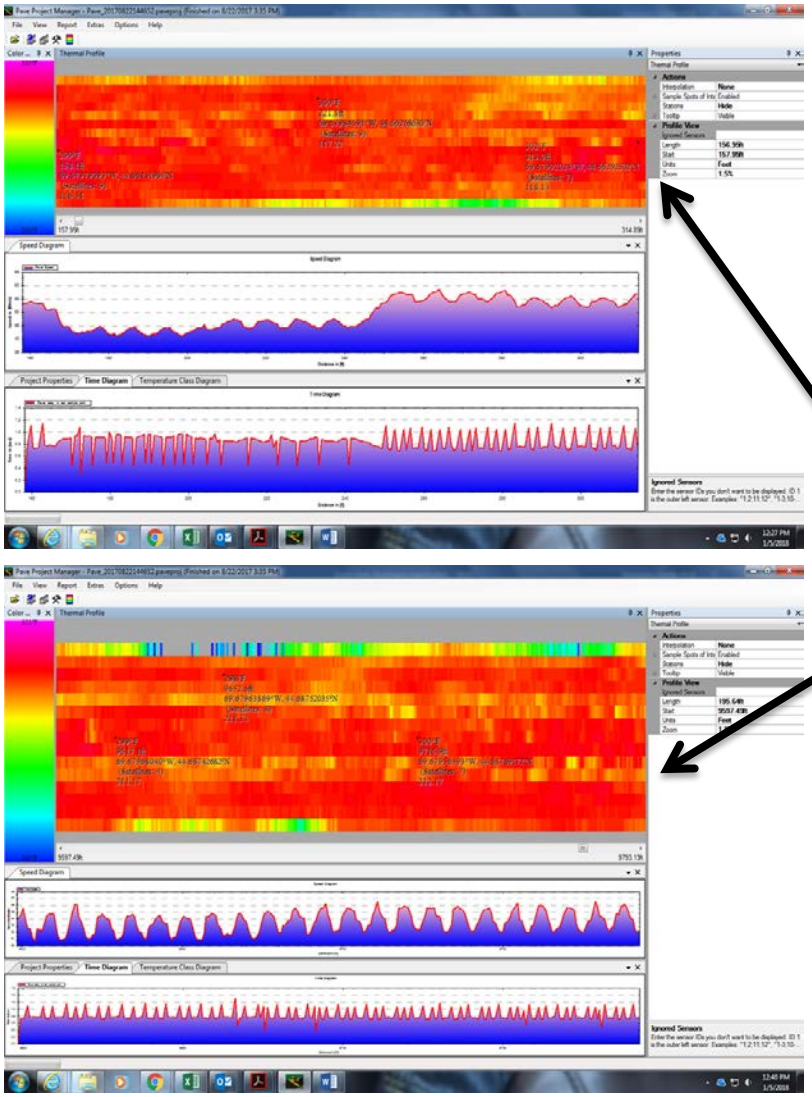
Contractor Perspective



Getting Started:

1. Safety
2. Mounting equipment on paver.
3. Power to all pieces.
4. Setting the distance/DMI calibration.
5. Enter project information.
6. Start paving and collecting temperature data.

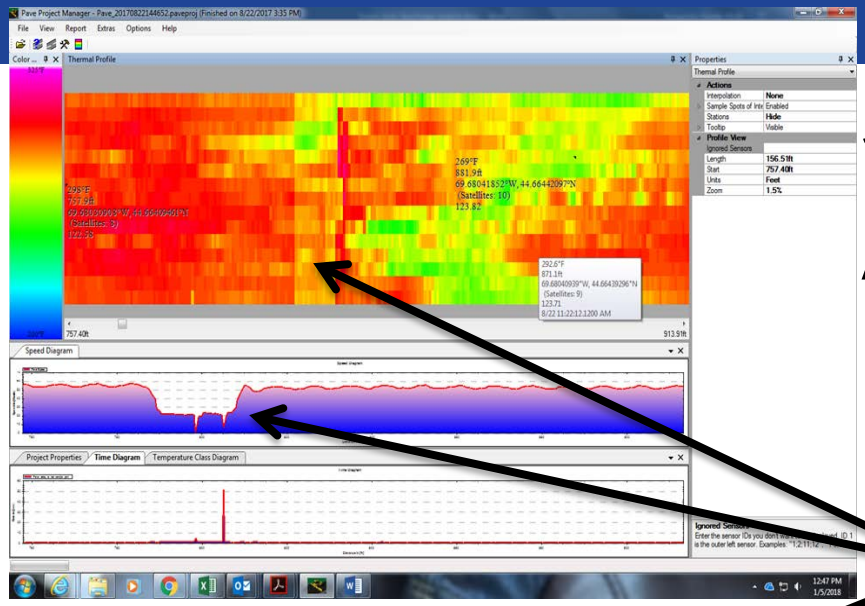
Contractor Perspective

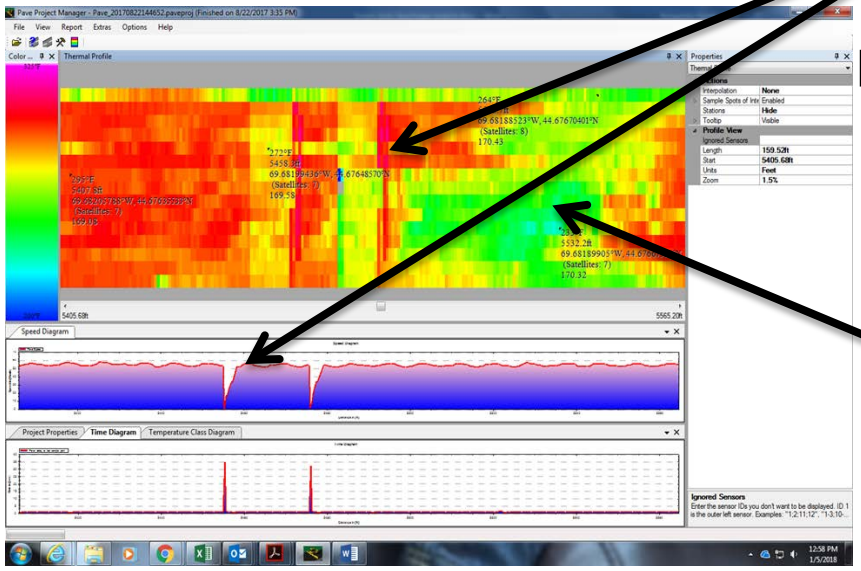


Small Section Data:

1. A & B **minor thermal segregation**.
2. Data area in a small section.
3. Speed and time charts.
4. Less than 25ºF variation.

Contractor Perspective





Small Section Data, cont.:

A. Moderate thermal segregation:

i. Major changes in temperature can be detected.

ii. Variation less than 50ºF but more than 25ºF.

iii. Paver slowed and stopped.

B. Severe thermal segregation:

i. Speed of paver and time at any location are easily identified.

ii. Variation more than 50ºF.

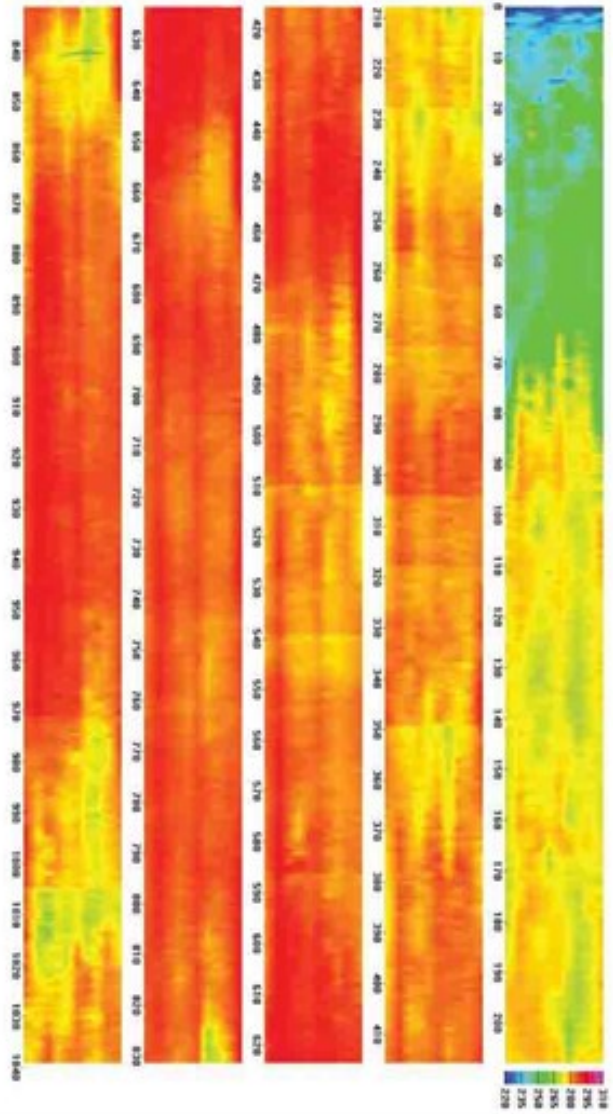
iii. Cold spot.

Contractor Perspective

Project Data for a paving shift

- Trends are easily spotted
- Problem areas are easily spotted
- Number of times the paver stopped all day
- Different reports can be generated from data produced

Contractor Perspective



Trucking considerations

- MTV?
- Flow boys or dump trucks?
- Distance to the project.

Plant production considerations

- How many crews are lifting out of that plant?
- Weather forecast?
- Do we have production enough for continuous paving?

QC Considerations

- Are we making our own issues?
- Is compaction consistent?
- Are we following Best Paving Practices?
- Are we finding the information helpful?

Training/Decisions

- Have we taught the crew how to interpret the data?
- Do we know what to do if we see poor results?
- Have we taken the data and made any improvements?
- Demonstrating Best Practice will reflect consistency.

Industry Perspective

Contractor Perspective; Ed Dalrymple, Chemung Contracting; Virginia

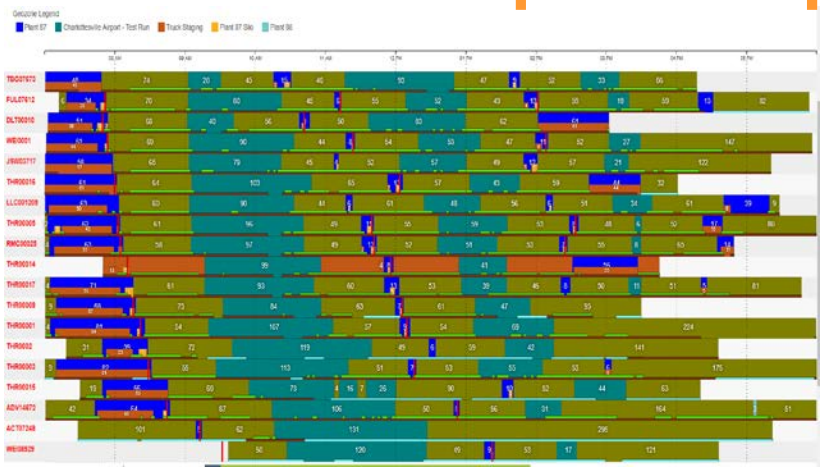
Contractor Perspective

The Right Equipment

- To meet a uniform thermal reading the right equipment is necessary:
- Trucks with good beds.
- MTV's with remixing capability, large enough to handle full loads 20 +/- tons,
- Follow me feature which allows paver and MTV works together.
- Paver Automation

Contractor Perspective

An Adequate Supply of Mixture



- Thermal readings showed the importance to assure that a continuous flow of material to the paver.
- Adding trucks did not assure that supply, trucks by nature bunch or run in packs.
- Added Fleetwatch GPS systems to trucks, set up Geo Fences to control stops on way to the paver.
- Allowed for the implementation of e-tickets which assures the dump person will stay in place and monitors the movement of the paver.

Contractor Perspective

Quality Control

- Uniform thickness is required to obtain uniform densities, ruts of 2” will not allow for uniform density.
- Use of incentives will encourage concentration of Quality standards.

Use of the right equipment to accomplish quality:

- Wider pavers eliminating joints
- Rollers that both vibrate and oscillate

Technicians that understand and guide speed and passes, as well as type of pass.

Contractor Perspective

Virginia Education Center for Asphalt Technology

VECAT

- Thermal imagining showed the need for a better understanding of all material properties & equipment abilities.
- Apprentice program developed by Germanna Community College, Virginia Asphalt Association and VDOT is used to meet those needs.
- Apprentices design mixes, operate and maintain plants, work in placing mix, & final testing. They are our future and they understand.

http://www.vaasphalt.org/program-of-study/
http://www.nxtbook.com/naylor/NAPS/NAPS0118/index.php?startid=20#/20

Contractor Perspective

Quality comes at a cost:

- Thermal imaging can offer better pavements, but it isn't free.
- Incentives allow contractors to invest in equipment and people to obtain the incentive.
- Penalties result in contractors taking a defensive approach to avoid the penalty not maintain the quality.

R06C Technologies to Enhance QC on Asphalt Pavements

Ten 4-Hour Paver Mounted Thermal Profiler Workshops are Available to Agencies.

AASHTO: Kate Kurgan
Tel: 202-624-3635
kkurgan@aashto.org

FHWA: Steve Cooper
Tel: 443-257-7145
Stephen.J.Cooper@dot.gov

ARA: Joe Reiter
Tel: 217-356-4500
jreiter@ara.com

SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Part 6: Questions and Answers

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

R06C Technologies to Enhance QC on Asphalt Pavements

Contacts for More Information:

- Stephen Cooper: Stephen.J.Cooper@dot.gov
- Kate Kurgan: kkurgan@aashto.gov
- Joe Reiter: jreiter@ara.com
- Harold Von Quintus: hvonquintus@ara.com

Websites:

- https://www.fhwa.dot.gov/goshrp2/Solutions/RiskManagement/R06C/Rapid_Technologies_to_Enhance_Quality_Control_on_Asphalt_Pavements
- http://shrp2.transportation.org/Pages/R06C_RapidTechnologiestoEnhanceQualityControl.aspx