2020 WEBINAR SERIES

RPUG Road Profile Users' Group

Update on Real-Time Smoothness Implementation

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The Transtec Group, Inc.

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The World's Pavement Engineering Specialists

Real-Time Smoothness Update

- Overview of RTS Technology
- RTS Implementation Update and Resources
- Using RTS Systems
- Future Implementation

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Overview of RTS Technology

Real-time Smoothness (RTS) refers to measuring and evaluating the concrete pavement surface profile during construction, somewhere along the paving train while the concrete surface is still wet (plastic).

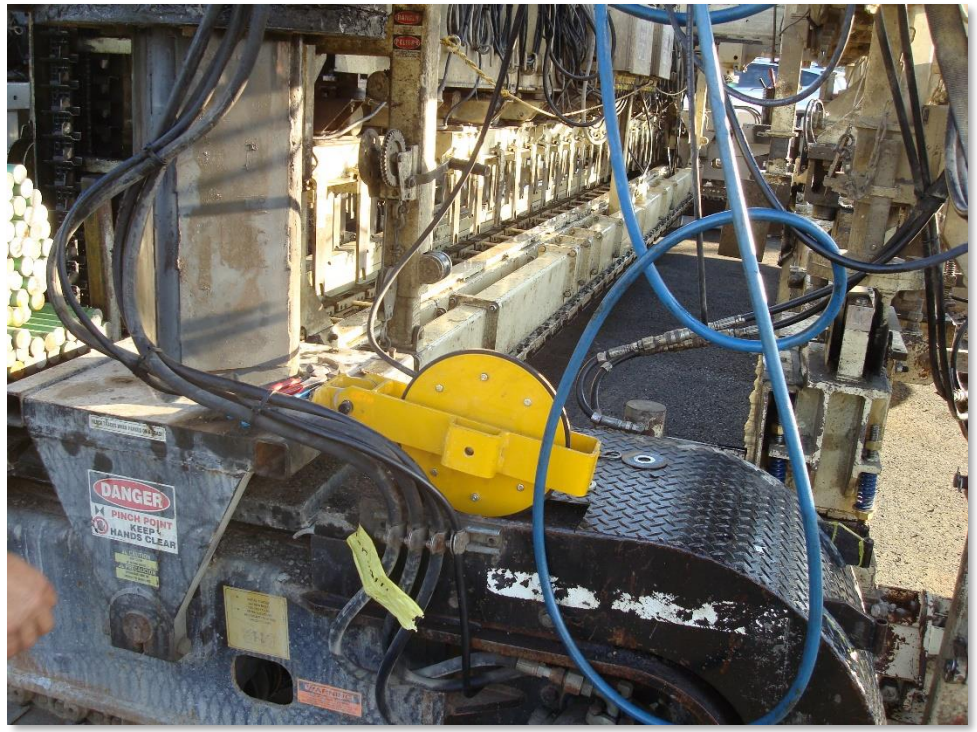
- Tool for evaluating concrete pavement smoothness in real time (vs. 24+ hours later).
- Allows for process improvements as a result of timely feedback.
- Not a replacement for conventional profiling for acceptance – it's a QC tool!

Overview of RTS Technology

- Equipment: Profiling Sensors
  - Ames RTP (laser based)
  - Gomaco GSI (sonic sensor plus slope meter)
  - SSI (not shown)

Overview of RTS Technology

- Equipment: DMI and GPS
  - Stand-alone DMI
  - Tap into paver DMI (GSI on GOMACO pavers)



Overview of RTS Technology

- Equipment: Data Collection and Feedback

Real-Time Smoothness Update

- Overview of RTS Technology
- RTS Implementation Update and Resources
- Using RTS Systems
- Future Implementation

RTS Implementation Update

- 2010 – 2013: SHRP2 Project R06(E) RTS technology evaluation

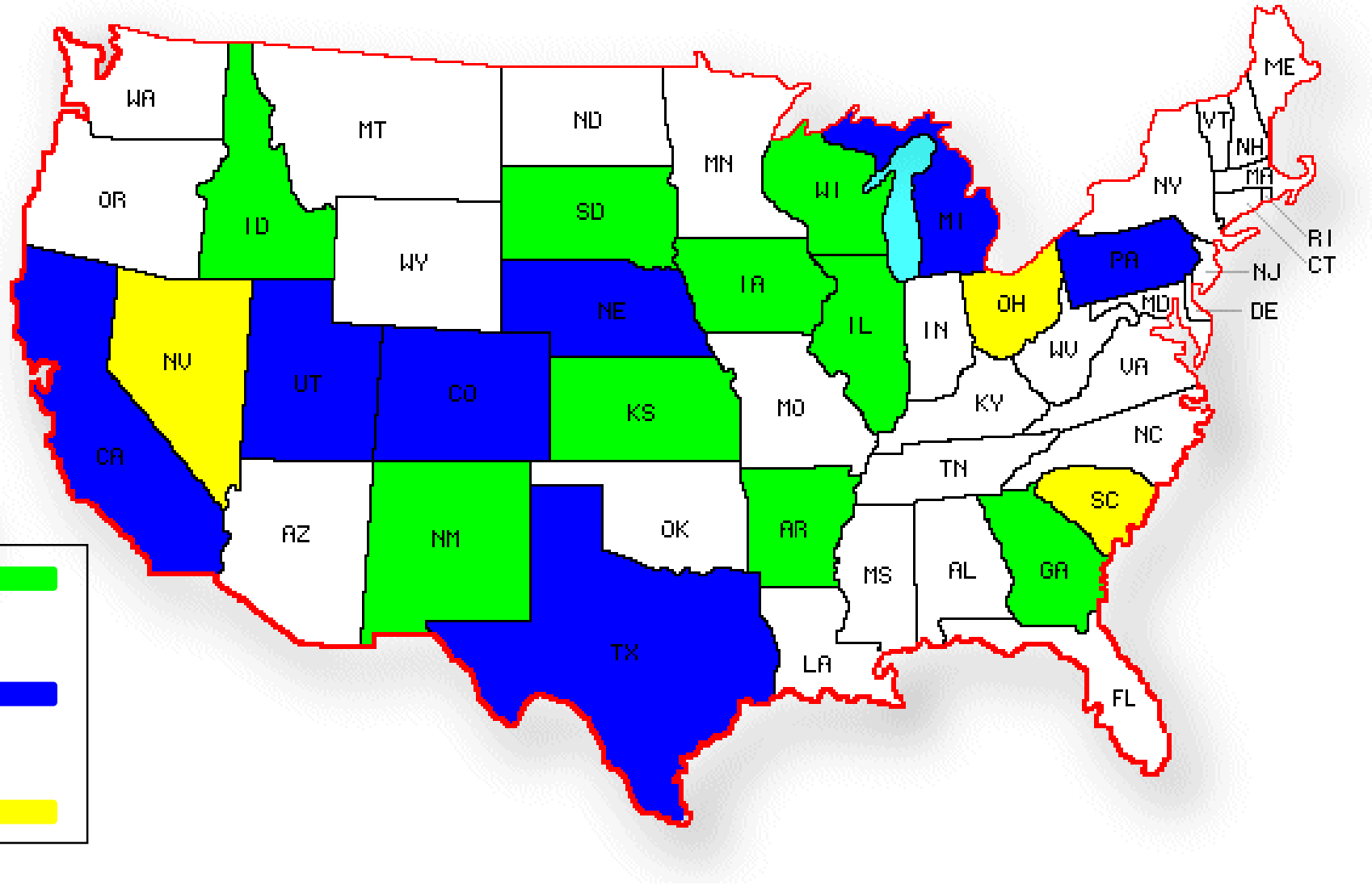
- 2014 – 2017: SHRP2 Solutions RTS technology implementation
  - 11 equipment loans
  - 8 workshops

- 2017 – 2019: FHWA RTS technology implementation
  - 10 equipment loans
  - On-call technical support
  - 2 webinars
  - Guide Specification
  - Guidelines for Best Practices

- 2020 – 2022: FHWA-CP Tech Center Cooperative Agreement
  - 4 equipment loans
  - On-call technical support

RTS Implementation Update

- Effort by state



Equipment Loans

Equipment Loans and Workshops

Workshops

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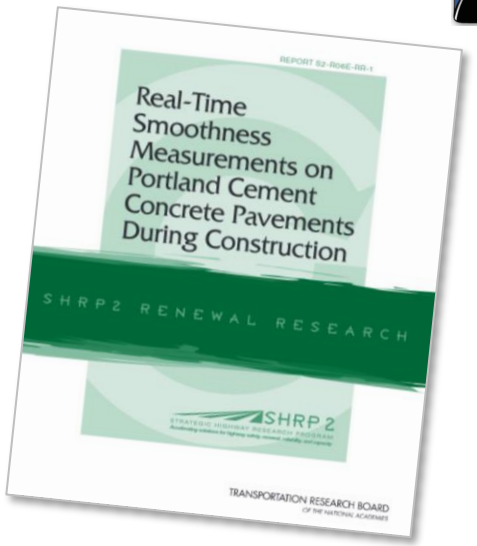
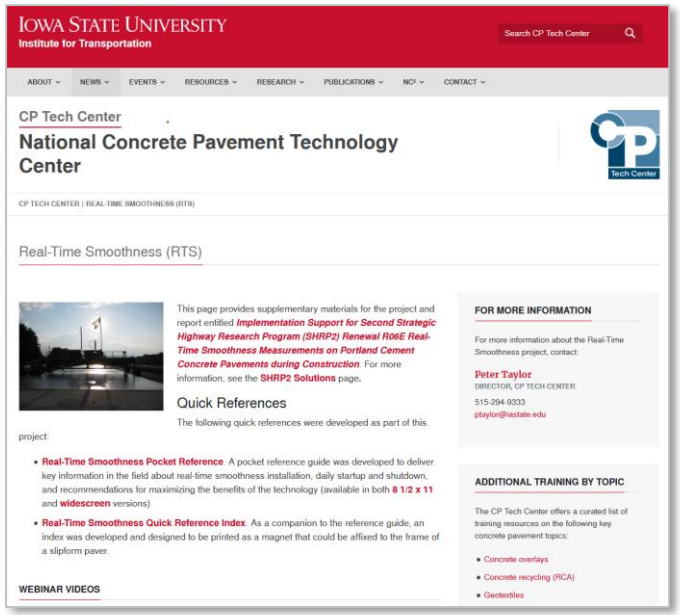
RTS Implementation Update

- Resources:
  - SHRP2 R06(E) Final Report S2-R06E-RR-1
    http://www.trb.org/Main/Blurbs/167282.aspx



  - FHWA and CP Tech Center Implementation

    https://cptechcenter.org/real-time-smoothness/
    - Project Reports and Equipment Loan Reports
    - Presentations and Webinars
    - Implementation and Best Practices for Concrete Pavement Smoothness
    - Guide Specification (AASHTO R54 Commentary)



  - FHWA Concrete Clips (YouTube)

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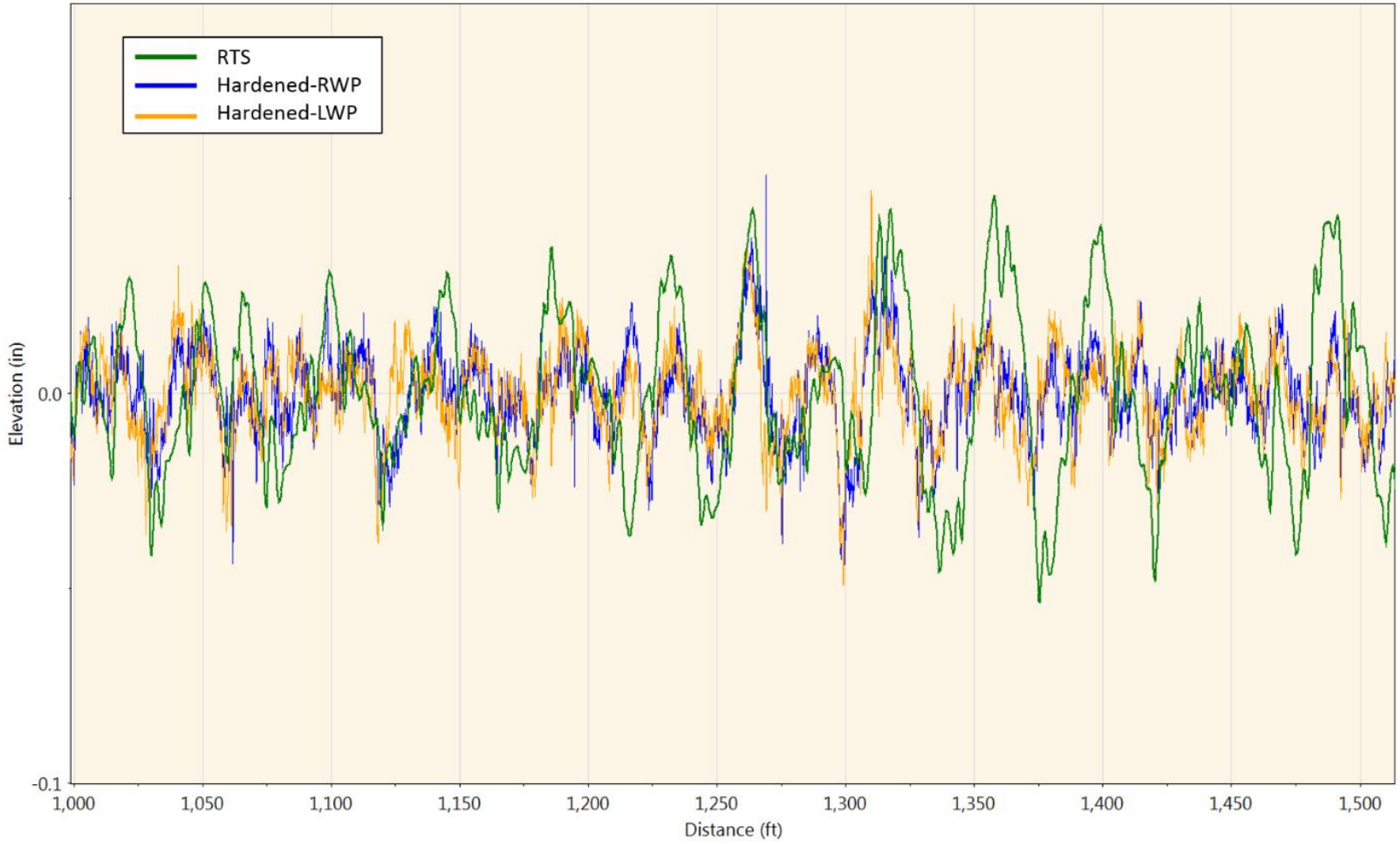
Using RTS Systems

1. RTS vs. Hardened Profiles
2. Features Picked Up by RTS
3. Guidance for Deployment

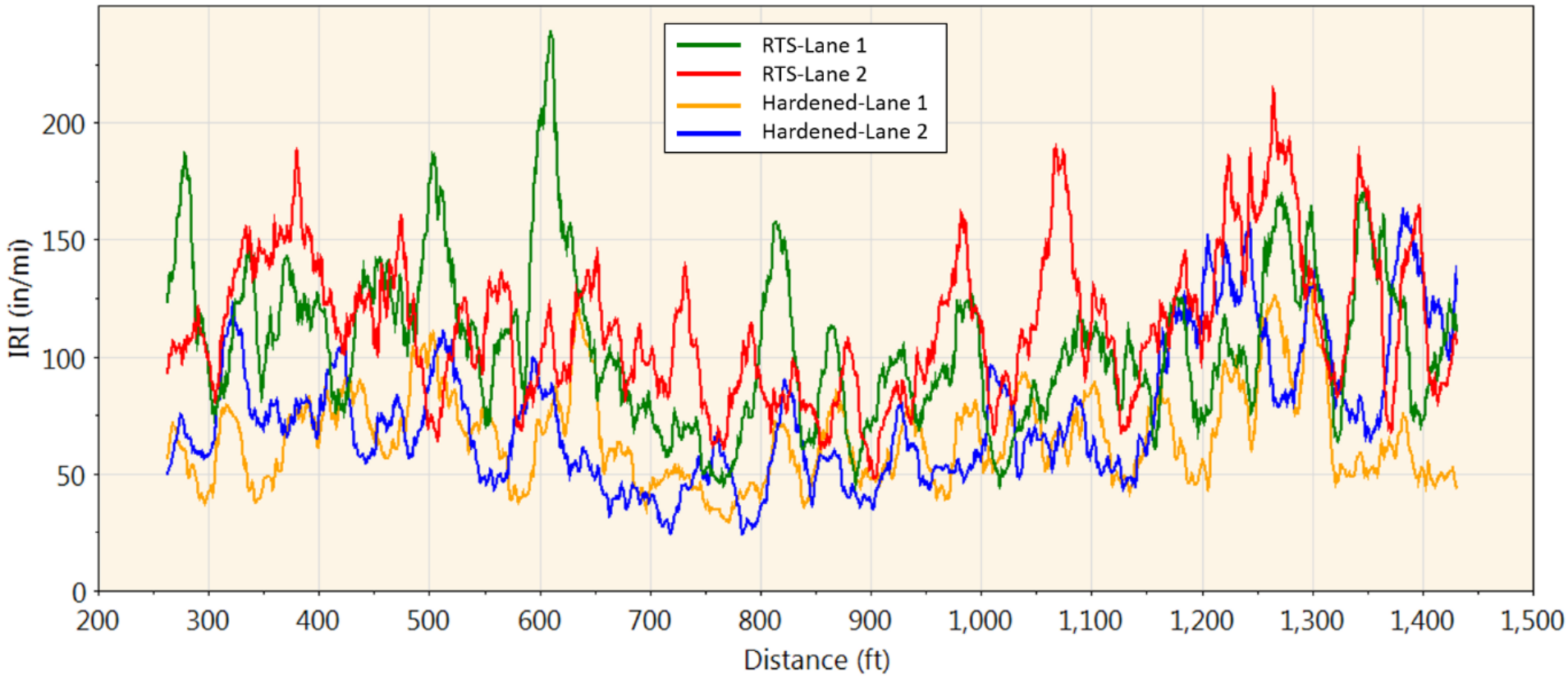
Using RTS Systems:
1. RTS vs. Hardened Profiles

- Raw profiles are different but trends are similar



Using RTS Systems:
1. RTS vs. Hardened Profiles

- Roughness results are different (RTS generally higher) but trends are similar.



Using RTS Systems:
1. RTS vs. Hardened Profiles

- There is no fixed correlation between RTS and hardened profile numbers.
- In general, RTS numbers will always be higher, but the degree is project/crew/equipment specific.
- Any correlation will need to be established during the first few days of paving.

Using RTS Systems:
1. RTS vs. Hardened Profiles

- Rule of thumb: the higher the RTS numbers, the greater the difference between RTS and hardened, the lower the RTS numbers, the smaller the difference.

Project A

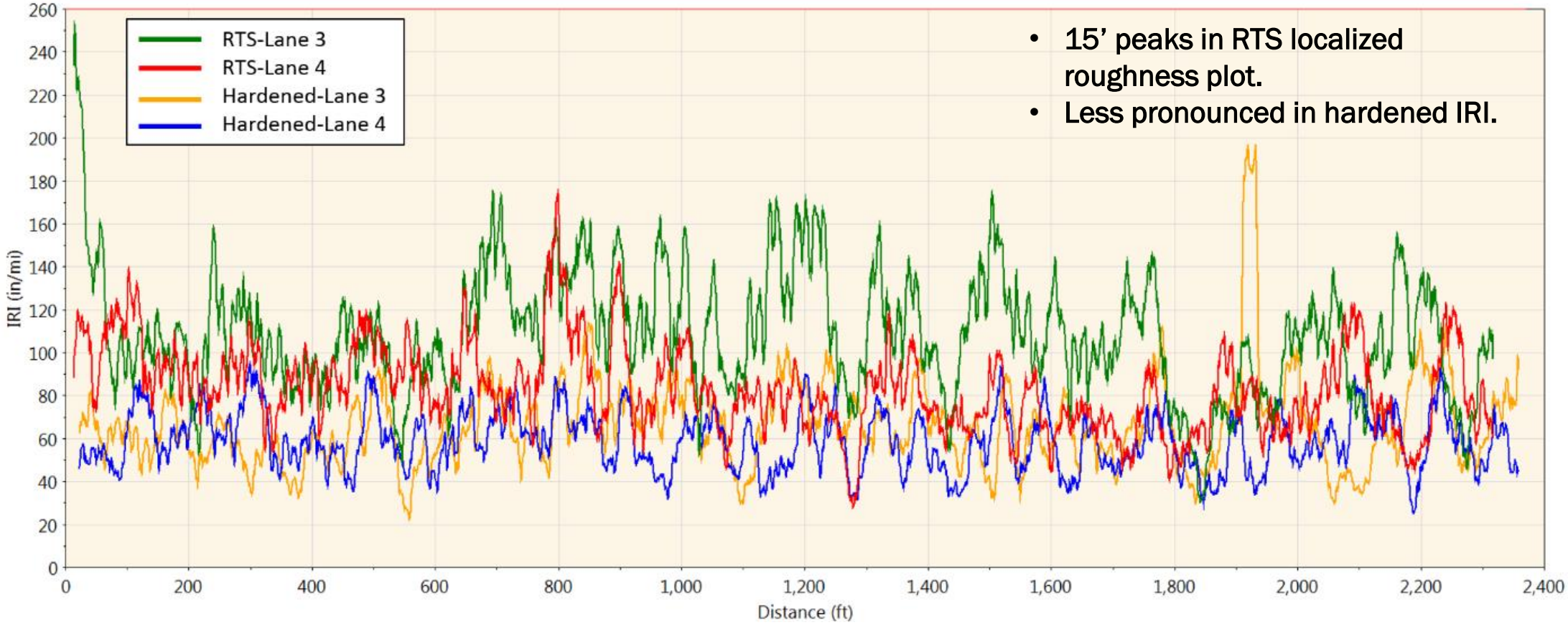
	Segment	RTS IRI (in/mi)	QC MRI (in/mi)	Difference (in/mi)
Day 1	1	113.2	67.0	46.2
	2	77.3	57.0	20.2
	3	79.9	64.6	15.3
Day 2	1	90.0	53.2	36.7
	2	108.9	77.5	31.4
	3	114.4	57.2	57.1
Day 3	1	111.7	65.3	46.4
	2	118.2	71.0	47.2
	3	116.4	68.0	48.4
	4	94.9	61.9	33.1
Day 4	1	122.6	64.5	58.1
	2	122.5	61.9	60.7
	Avg.	**105.8**	**64.1**	**41.7**

Project B

	Segment	RTS IRI (in/mi)	QC MRI (in/mi)	Difference (in/mi)
Day 1	1	66.2	61.1	5.1
	2	65.7	62.2	3.5
	3	58.0	48.8	9.2
Day 2	1	59.3	51.6	7.7
	2	59.4	47.7	11.7
	3	62.5	45.1	17.4
	4	54.3	48.2	6.2
Day 3	1	54.7	44.1	10.6
	2	65.6	57.8	7.8
	3	69.6	57.6	12.0
	4	70.9	61.1	9.8
Day 4	1	58.1	53.0	5.1
	2	91.8	66.3	25.4
	3	71.2	54.3	17.0
	4	86.5	66.5	20.1
	Avg.	**66.3**	**55.0**	**11.2**

Using RTS Systems:
2. Features Picked Up by RTS

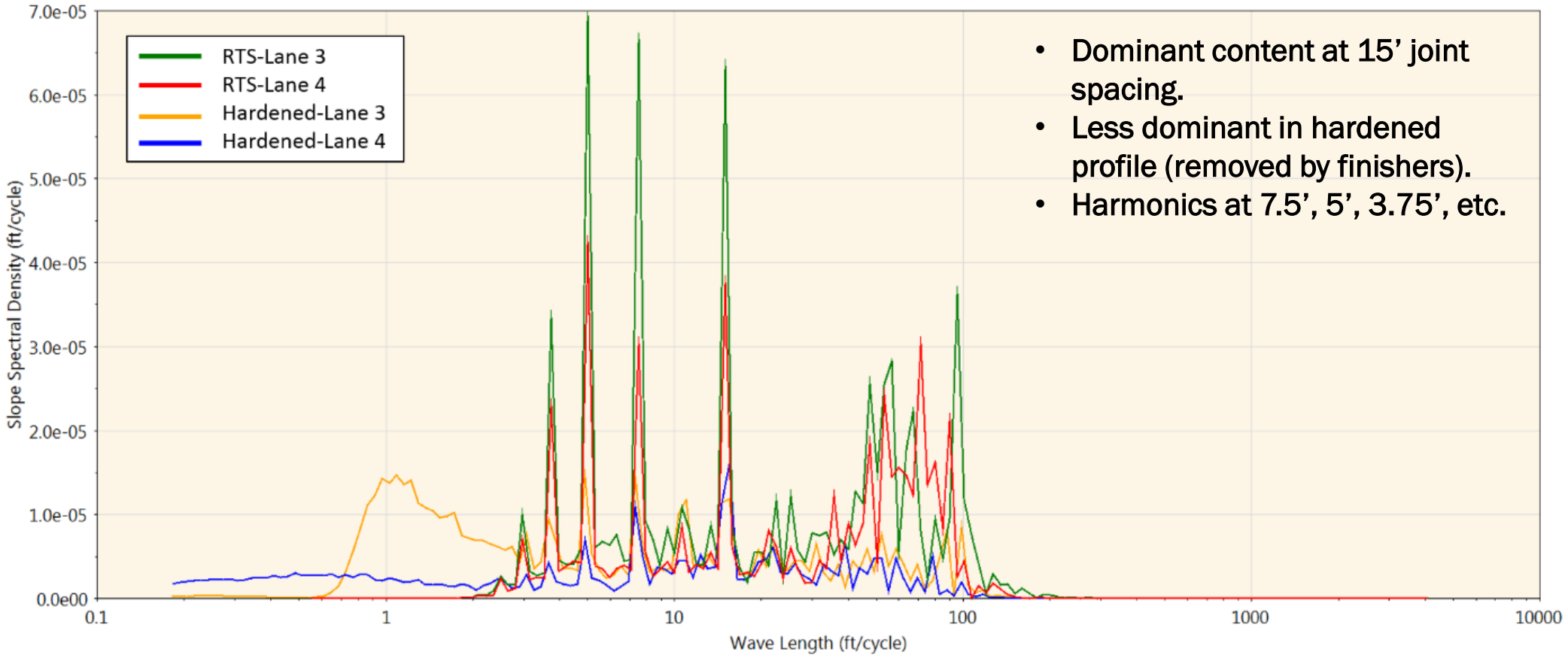
- Joint spacing/dowel basket effects



- 15’ peaks in RTS localized roughness plot.
- Less pronounced in hardened IRI.

Using RTS Systems:
2. Features Picked Up by RTS

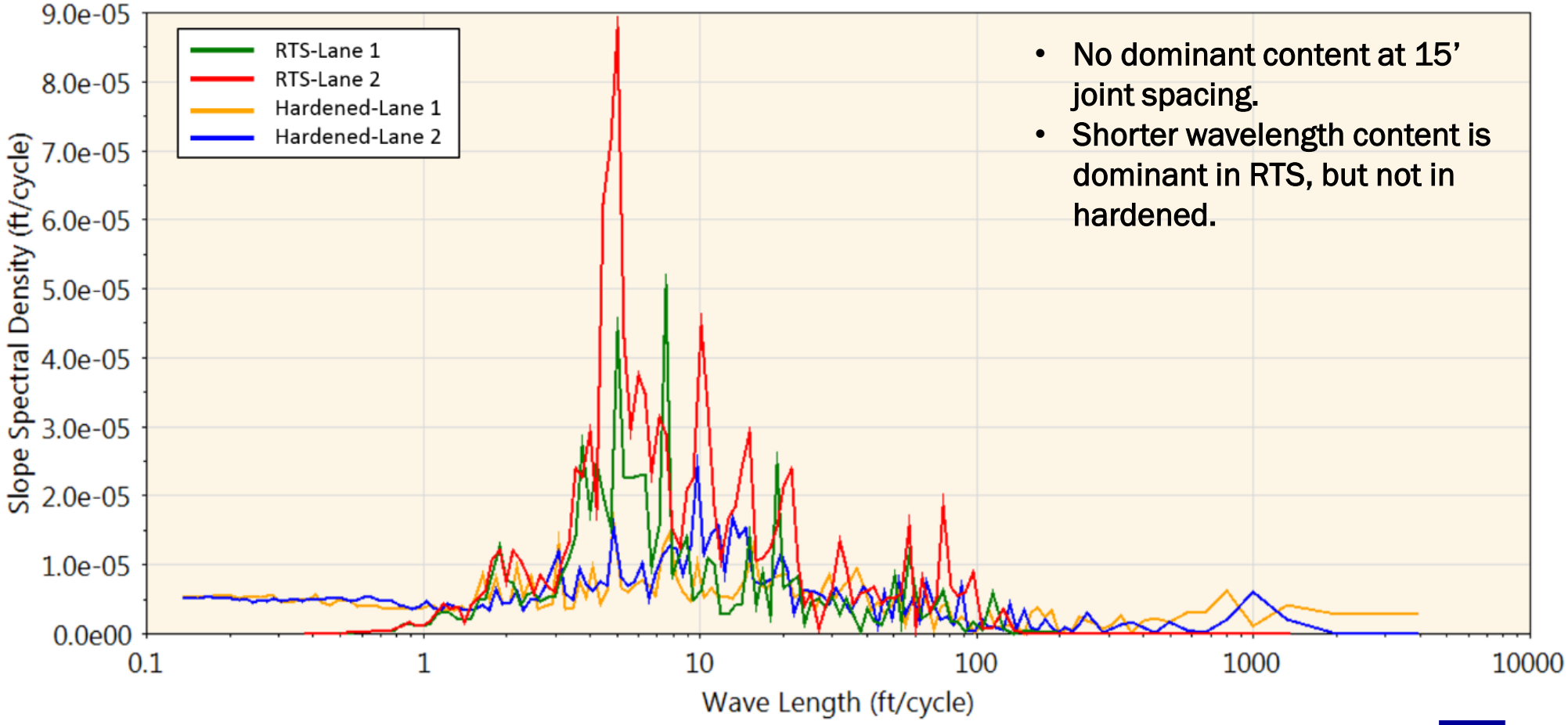
- Joint spacing/dowel basket effects



- Dominant content at 15’ joint spacing.
- Less dominant in hardened profile (removed by finishers).
- Harmonics at 7.5’, 5’, 3.75’, etc.

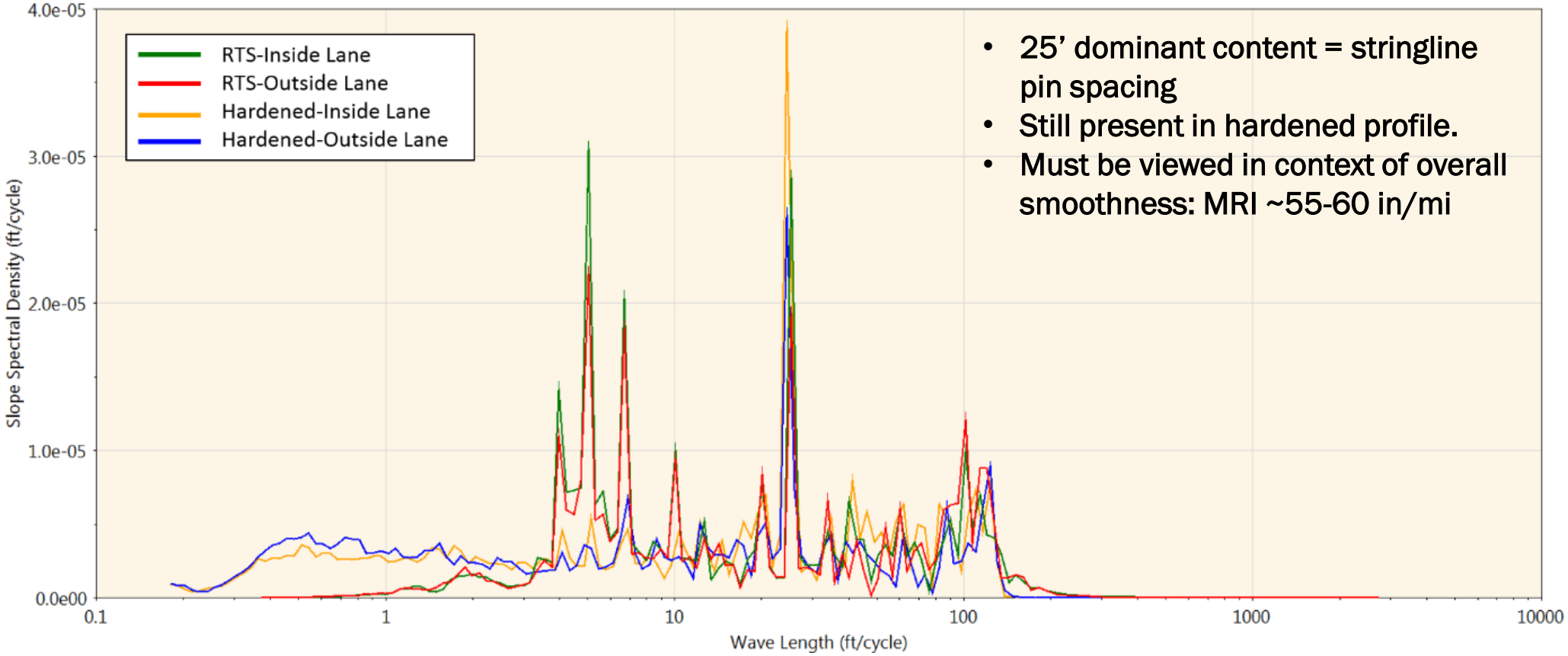
Using RTS Systems:
2. Features Picked Up by RTS

- Project utilizing Dowel Bar Inserter



Using RTS Systems:
2. Features Picked Up by RTS

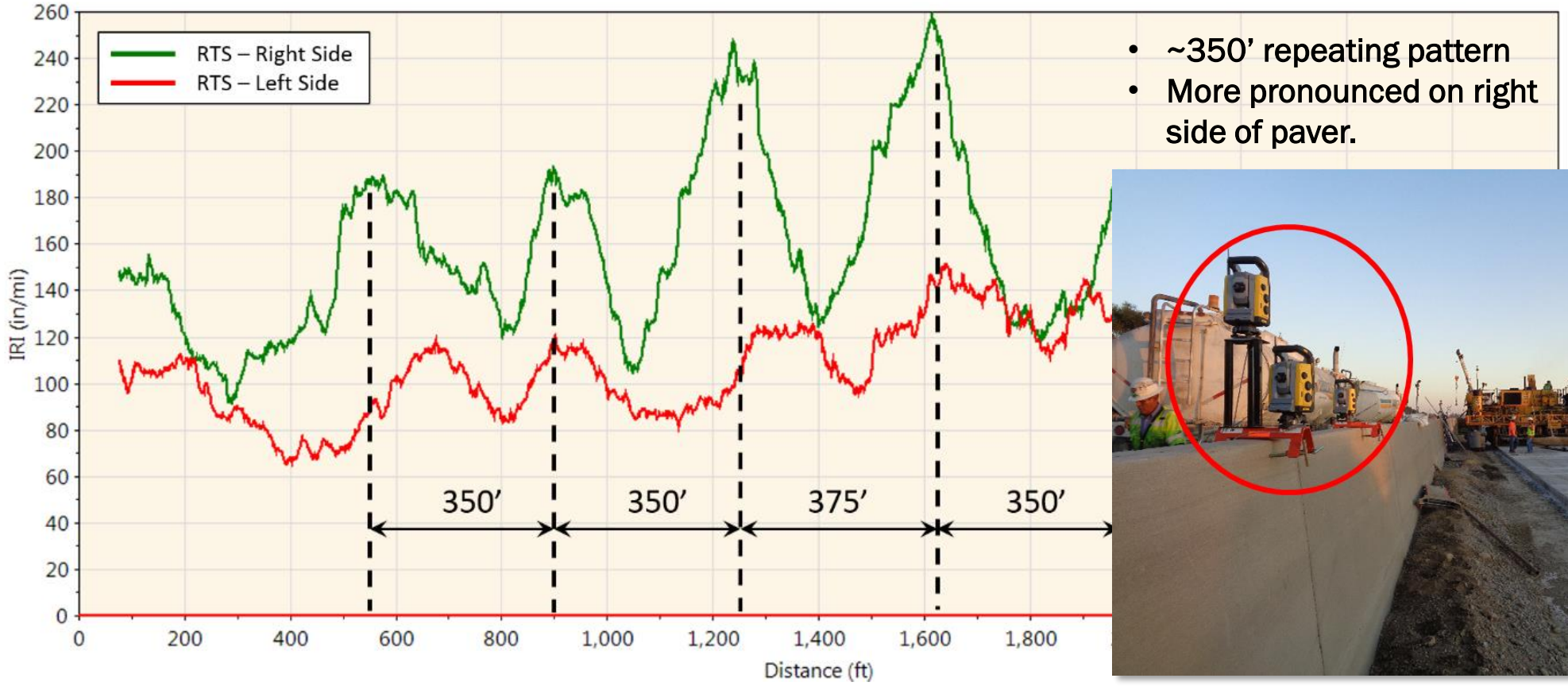
- Stringline and Stringless System Effects



- 25’ dominant content = stringline pin spacing
- Still present in hardened profile.
- Must be viewed in context of overall smoothness: MRI ~55-60 in/mi

Using RTS Systems:
2. Features Picked Up by RTS

- Stringline and Stringless System Effects



- ~350’ repeating pattern
- More pronounced on right side of paver.

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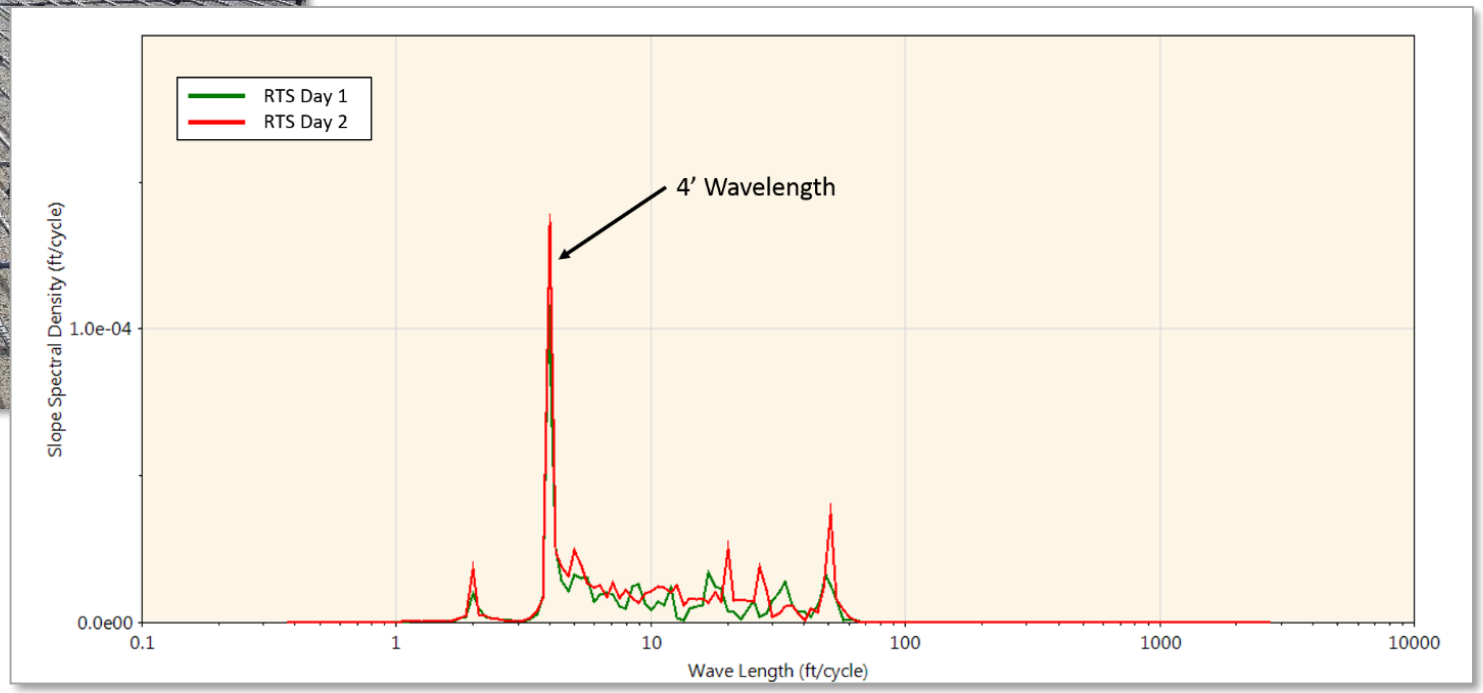
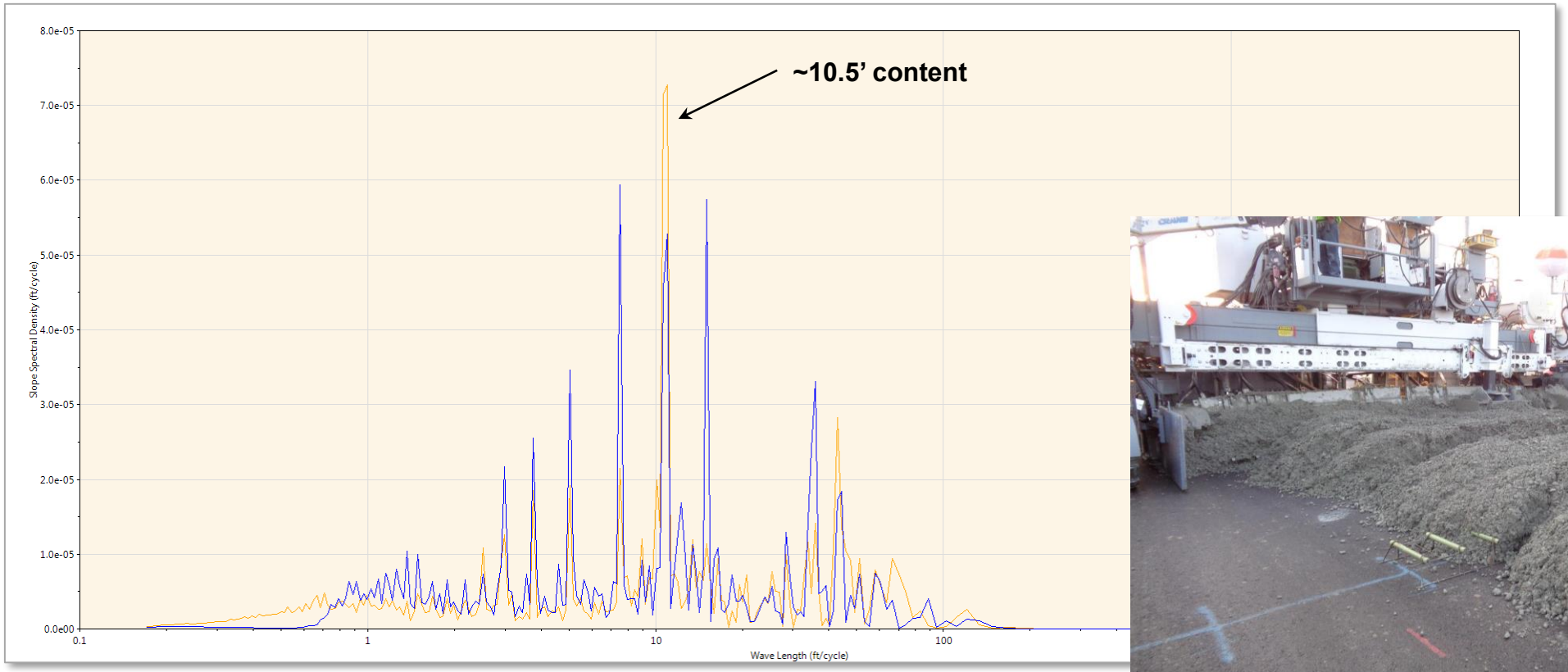
Using RTS Systems:
2. Features Picked Up by RTS

- CRCP Bar Supports



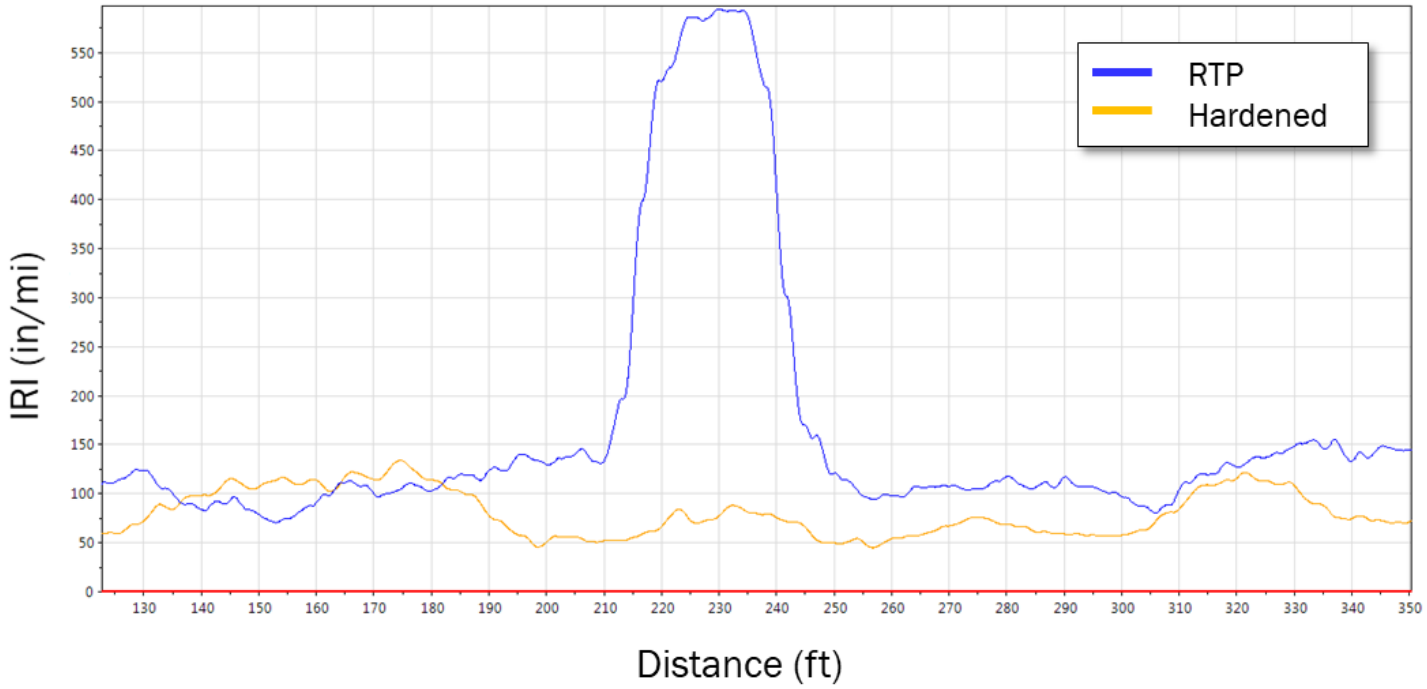
Using RTS Systems:
2. Features Picked Up by RTS

- Load Spacing



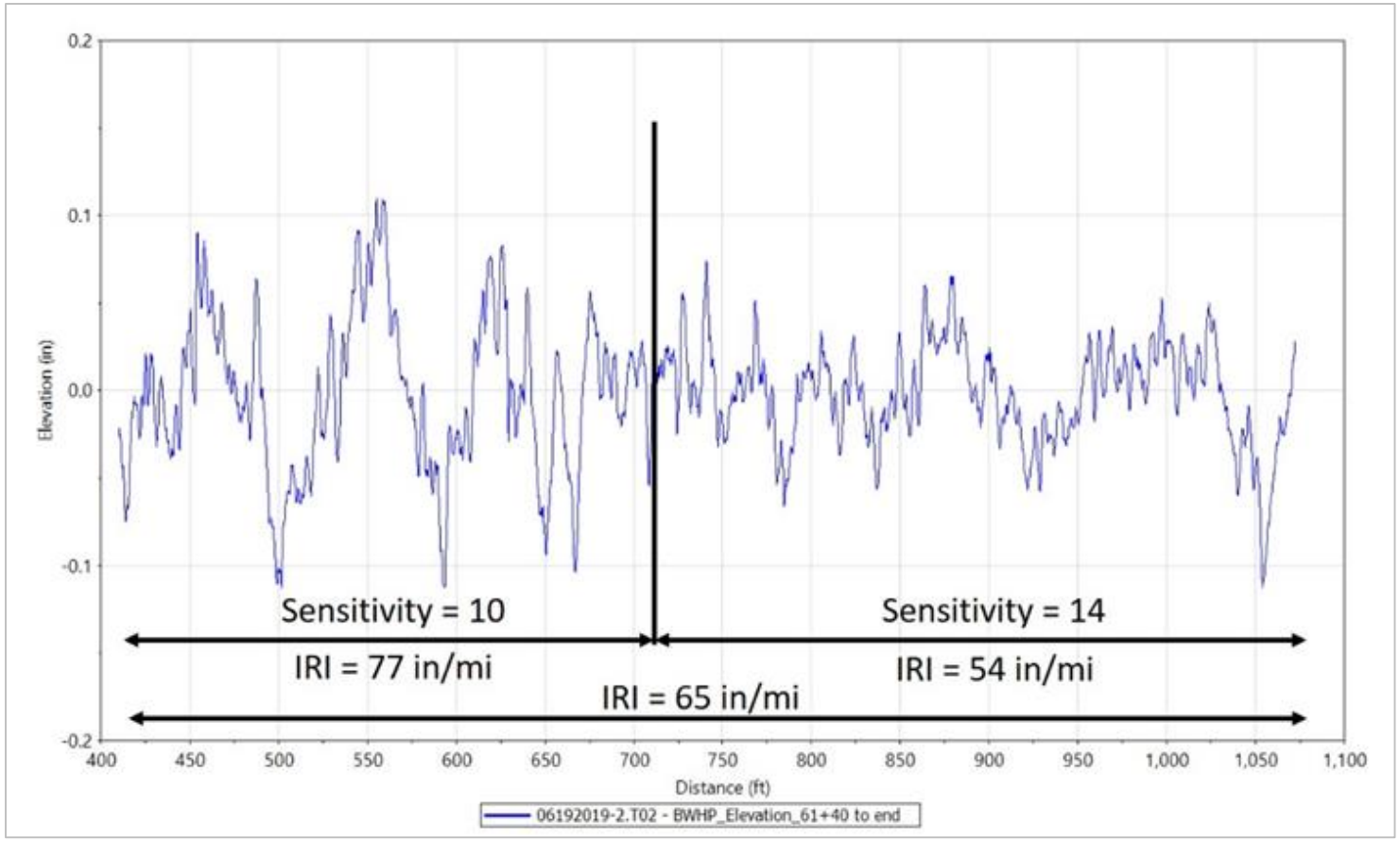
Using RTS Systems:
2. Features Picked Up by RTS

- Localized roughness/improvement from finishers



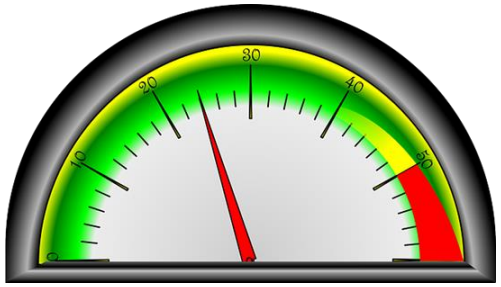
Using RTS Systems:
2. Features Picked Up by RTS

- Sensitivity Adjustments (paver hydraulic response)



Using RTS Systems:
3. Guidance for Deployment

- Sensor generally placed in the center of each lane
  1) Establish a “baseline” smoothness for your paving operation
  2) Eliminate the big “events” that lead to localized roughness (paver stops, stringline/stringless interference, padline issues, etc.)
  3) Systematically make changes in small increments
     - Get a minimum of 0.1 mile with consistent paving (no big events) and then evaluate if the adjustment made things smoother
     - Continue adjusting in small increments and evaluating every 0.1 mile



- Collect hardened profile data *ASAP* after paving for comparison with RTS data.

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Future Implementation

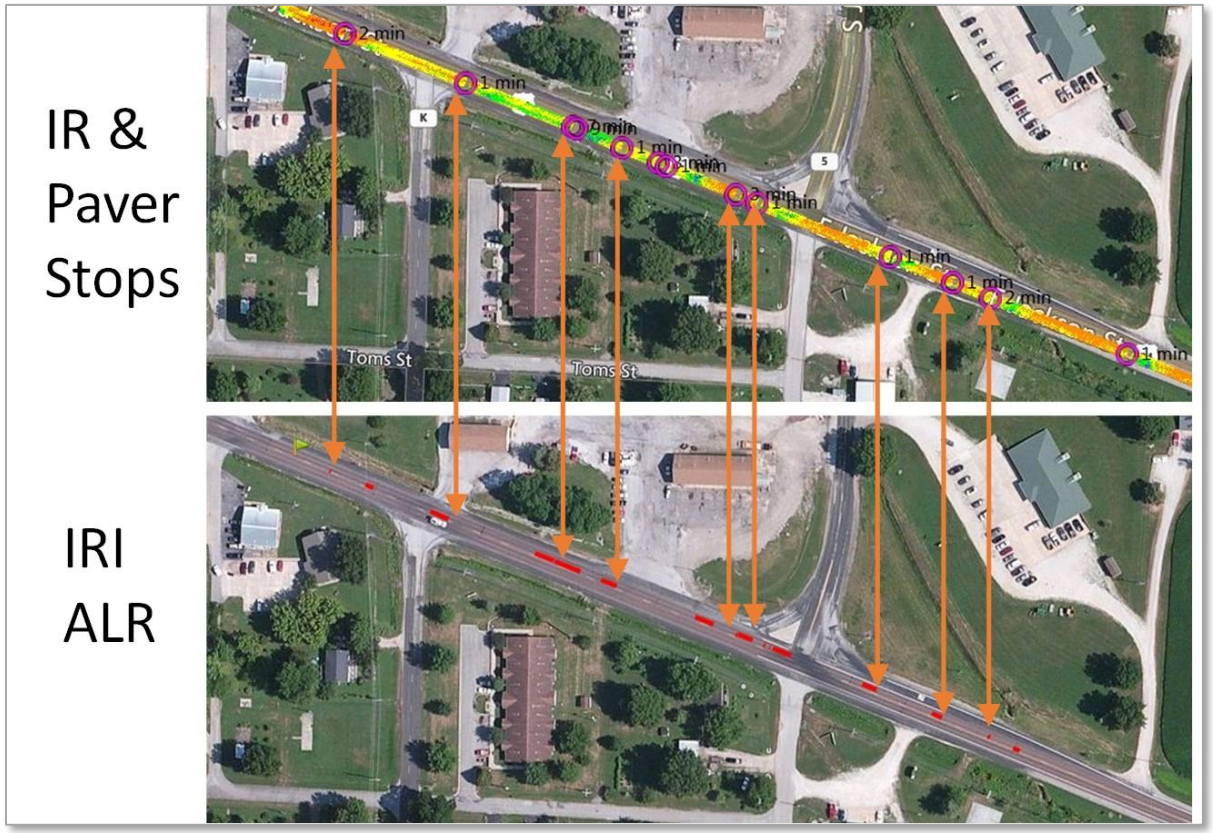
- Additional equipment loans (2020-2022) through FHWA-CP Tech Center Cooperative agreement (4 total)
- On-site and Remote Technical Support

National Concrete Pavement Technology Center

CP Tech Center

Future Implementation

- RTS for Asphalt Pavement: “ARTS”



Stolen from: George Chang

DEPARTMENT OF TRANSPORTATION

Road Research

NRRA Intelligent Construction Technologies Team

NRRA National Road Research Alliance

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Asphalt Real Time Smoothness (ARTS) for Asphalt Paving

Status: Contract development

Summary

The Real-Time Smoothness (RTS) technologies are height sensors mounted on the back of a paver to measure the profile elevations on the pavement surfaces during the paving operation. The FHWA SHRP 2 “Real-Time Smoothness Measurements On Portland Cement Concrete Pavements During Construction (R06E)” was to enable real-time control of concrete pavement smoothness during construction by providing proven technologies for measuring smoothness in real-time, and model specifications and guidelines for transportation agencies (SHRP2 2020). This study includes a ten-year field demonstration, webinars, on-call support, guideline development on the RTS technologies for concrete paving between 2009 and 2019. Of seven devices studied, two were selected for further evaluation and demonstration: the GOMACO Smoothness Indicator and the Ames Engineering Real-Time Profiler. The devices were evaluated during concrete paving projects in Georgia, Arkansas, Texas, Michigan, and New York. The final report from this project indicates that RTS allows early diagnosis of paving equipment settings and operation that would impact smoothness on the finished harden concrete (National Academies of Sciences, Engineering, and Medicine 2013). Therefore, changes can be made to the paving operation (e.g., evening the spreader of fresh concrete) to improve smoothness.

Thank You!

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