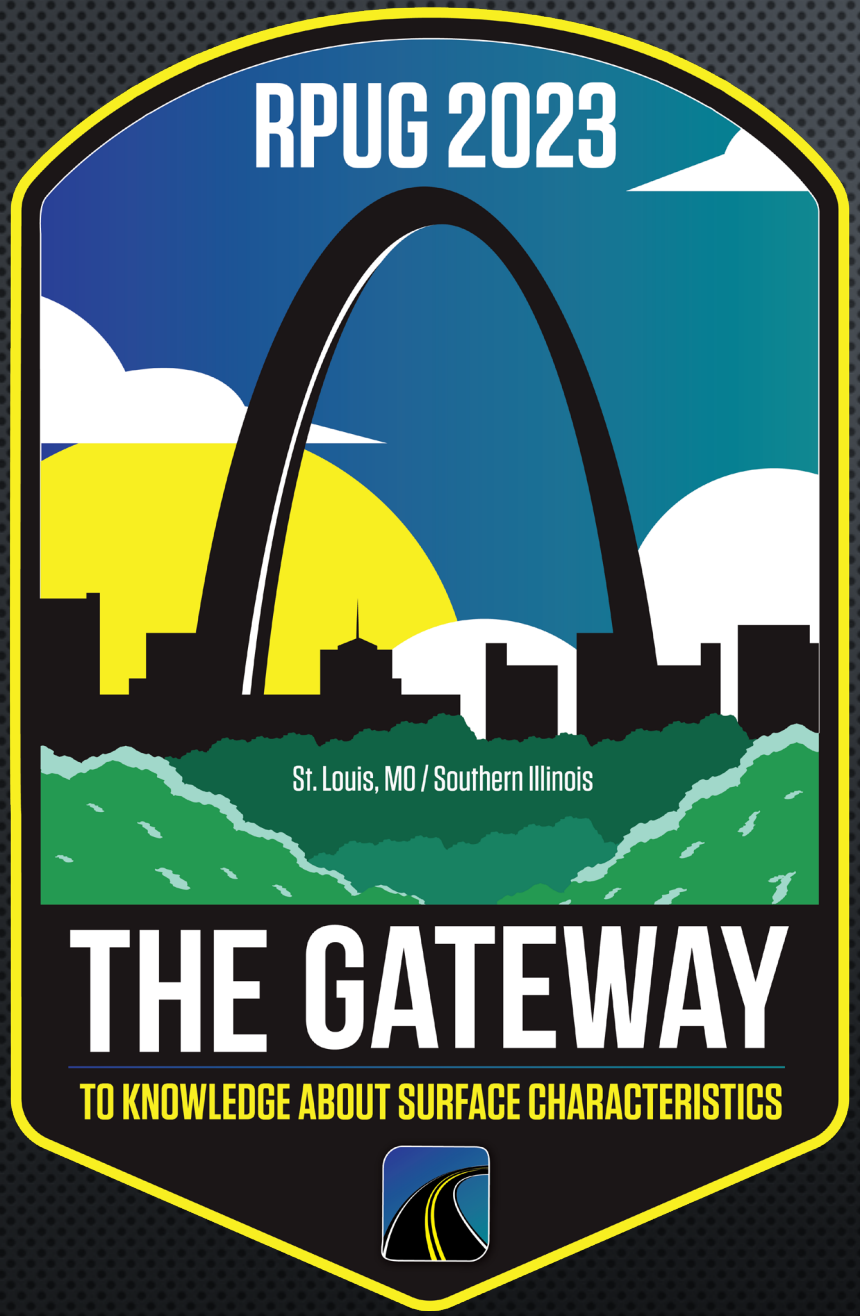

REAL-TIME SMOOTHNESS UPDATES

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Illinois Department of Transportation

RPUG
Road Profile Users' Group

Real-Time Smoothness Updates

- Overview of RTS Technology and Implementation
- RTS for Concrete Paving
- RTS for Asphalt Paving

Real-Time Smoothness Update

- Overview of RTS Technology and Implementation
- RTS for Concrete Paving
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Overview of RTS Technology

Real-time Smoothness (RTS) is a Quality Control tool for assessing pavement smoothness during construction (paving operations).

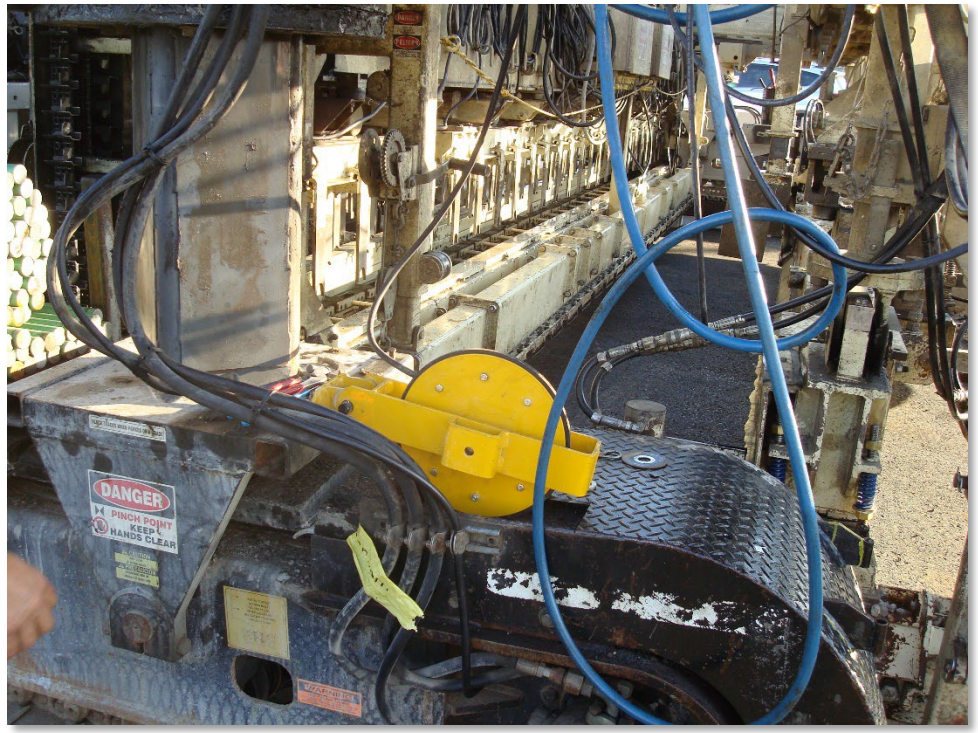
- Three Primary Purposes
  1) Provide a general idea of smoothness (IRI) values during paving.
  2) Assess the impact of changes to paving operations on smoothness during paving.
  3) Identify (and mitigate) systematic paving factors that may be impacting smoothness.

Overview of RTS Technology

- Equipment: Profiling Sensors
  - Ames RTP (laser based)
  - Gomaco GSI (sonic sensor plus slope meter)
  - SSI On-Paver Profiler (laser based)

Overview of RTS Technology

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



Overview of RTS Technology

- Equipment: Data Collection and Feedback

RTS Implementation Updates

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

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

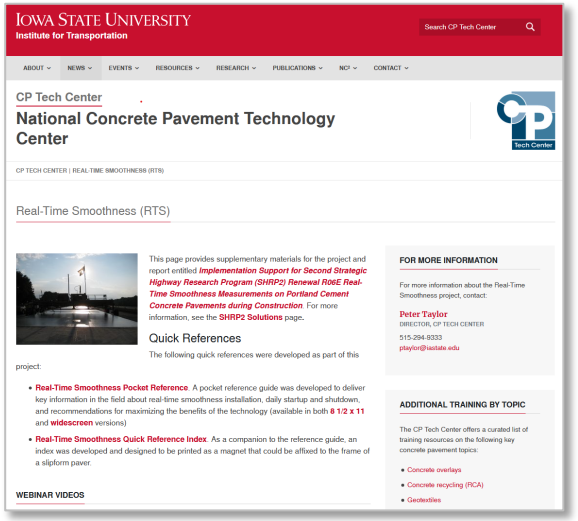
- 2017 – 2019: FHWA RTS technology implementation
  - 10 equipment loans
  - On-call technical support
  - 2 webinars
  - Guide Specification
  - Guidelines for Best Practices

- 2020 – 2024: FHWA-CP Tech Center Cooperative Agreement
  - 6 equipment loans
  - On-call technical support

RTS Implementation Updates

- 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)



Real-Time Smoothness Updates

- Overview of RTS Technology and Implementation
- RTS for Concrete Paving
- RTS for Asphalt Paving

Using RTS Systems

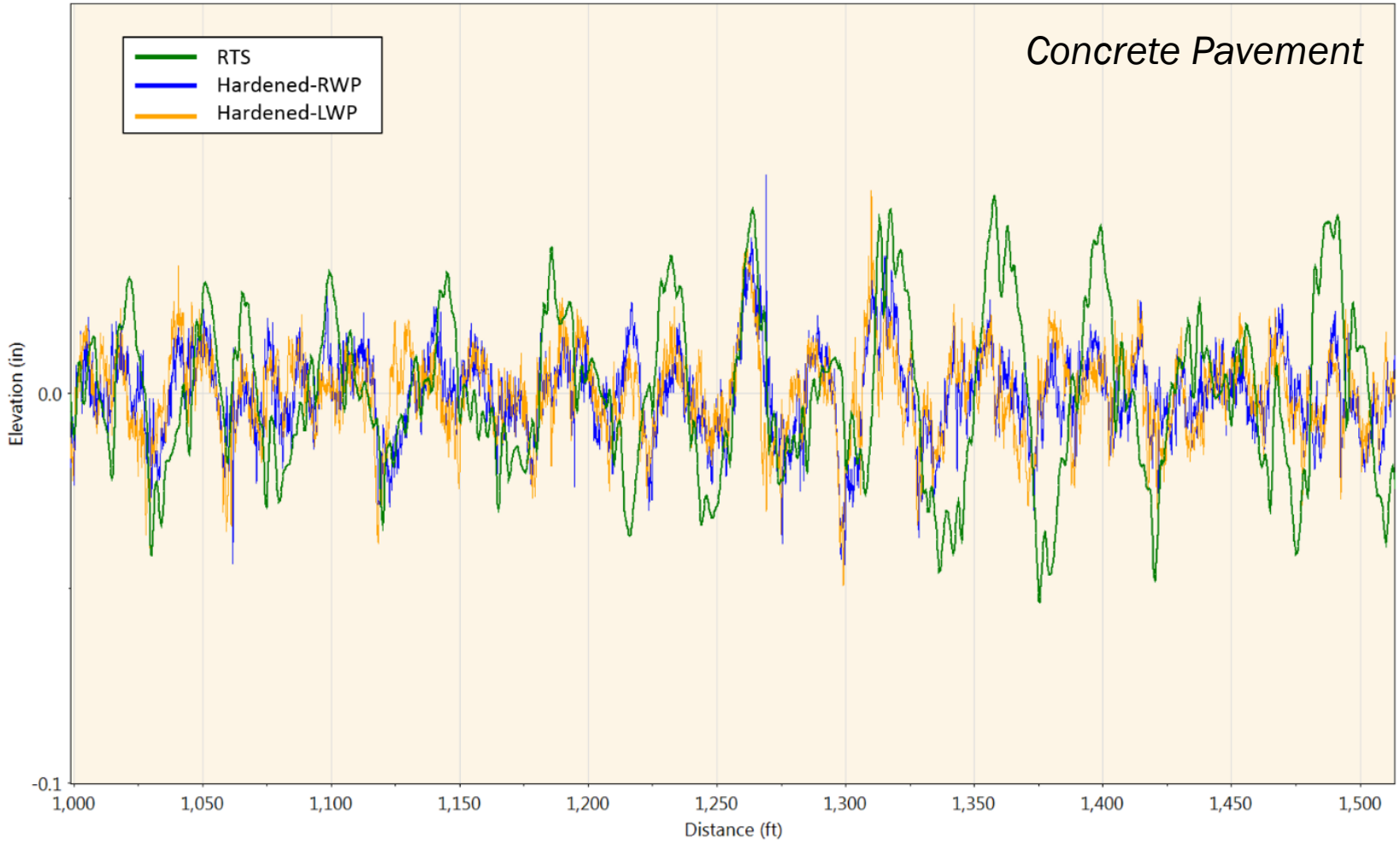
1. Provide a general idea of smoothness (IRI) values during paving.
2. Assess the impact of changes to paving operations on smoothness during paving.
3. Identify (and mitigate) systematic paving factors that may be impacting smoothness.

Using RTS Systems

1. Provide a general idea of smoothness (IRI) values during paving.
   - General trends for smoothness during paving.
   - No “surprises” when QC profile data is collected.
   - RTS vs. QC IRI

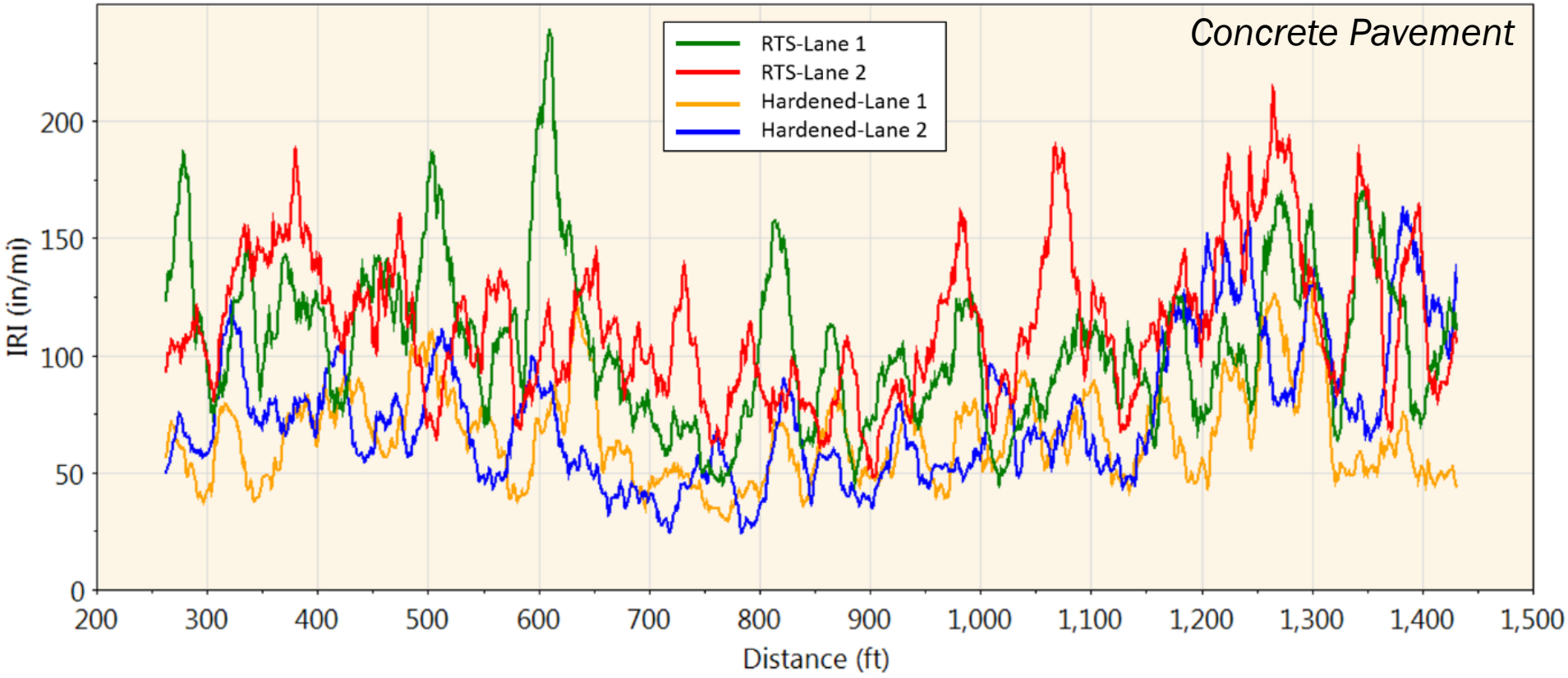
RTS vs. QC Profiles

- Raw profiles are different, but trends are similar



RTS vs. QC Profiles

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



RTS vs. QC Profiles

- There is no fixed correlation between RTS and QC 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.

RTS vs. QC Profiles

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

Project A (Concrete)

	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 (Concrete)

	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

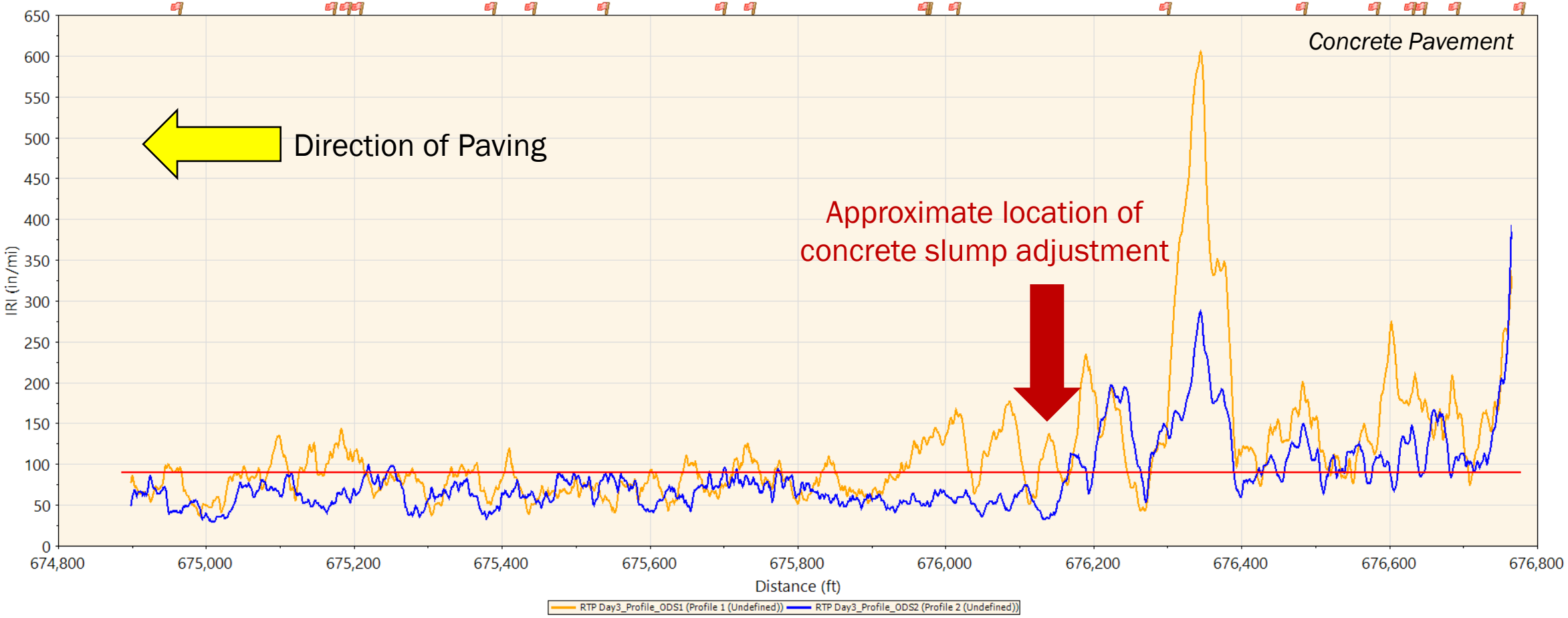
Using RTS Systems

2. **Assess the impact of changes to paving operations on smoothness during paving.**
   - Changes to concrete mix
   - Changes to paver settings
     - Grade control sensitivity
     - Vibrator settings
     - Concrete (or asphalt) head

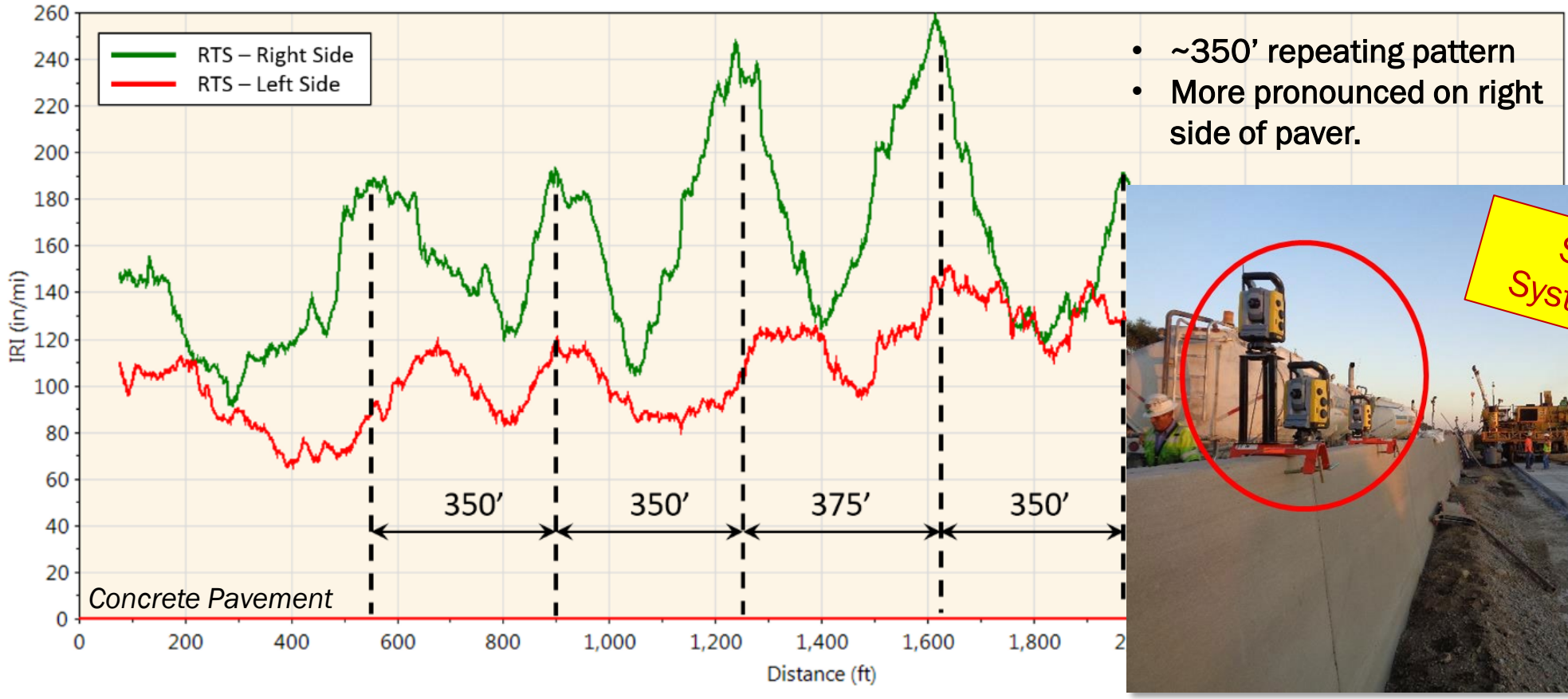
   - *NOTE: Changes don't show up immediately!*

Impact of Paving Operation Changes

- Concrete Mixture Adjustments



Impact of Paving Operation Changes



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

Impact of Paving Operation Changes

- Paver Padline Effects

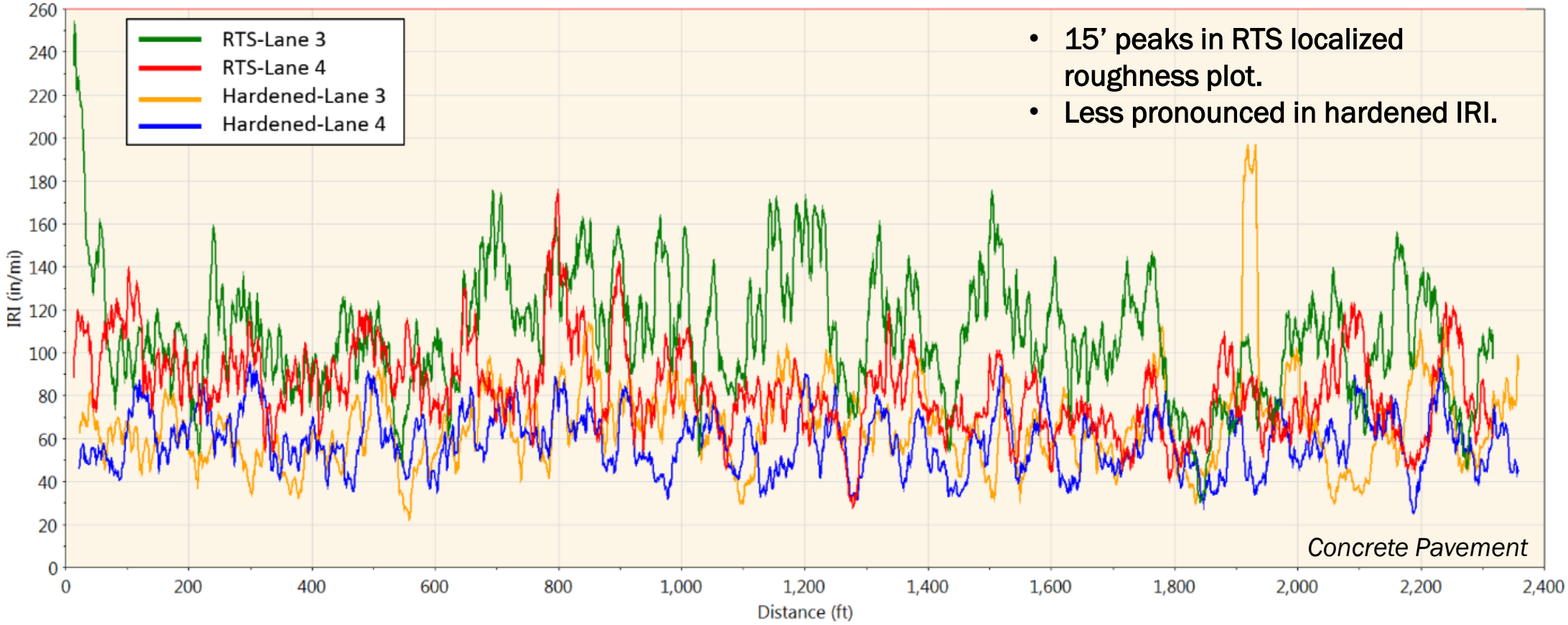
Using RTS Systems

3. **Identify (and mitigate) systematic paving factors that may be impacting smoothness.**
   - "Patterns" in pavement profile related to paving factors.
   - What shows up in both the RTS and QC profiles.

   - *NOTE: Always keep it in context of overall IRI values.*

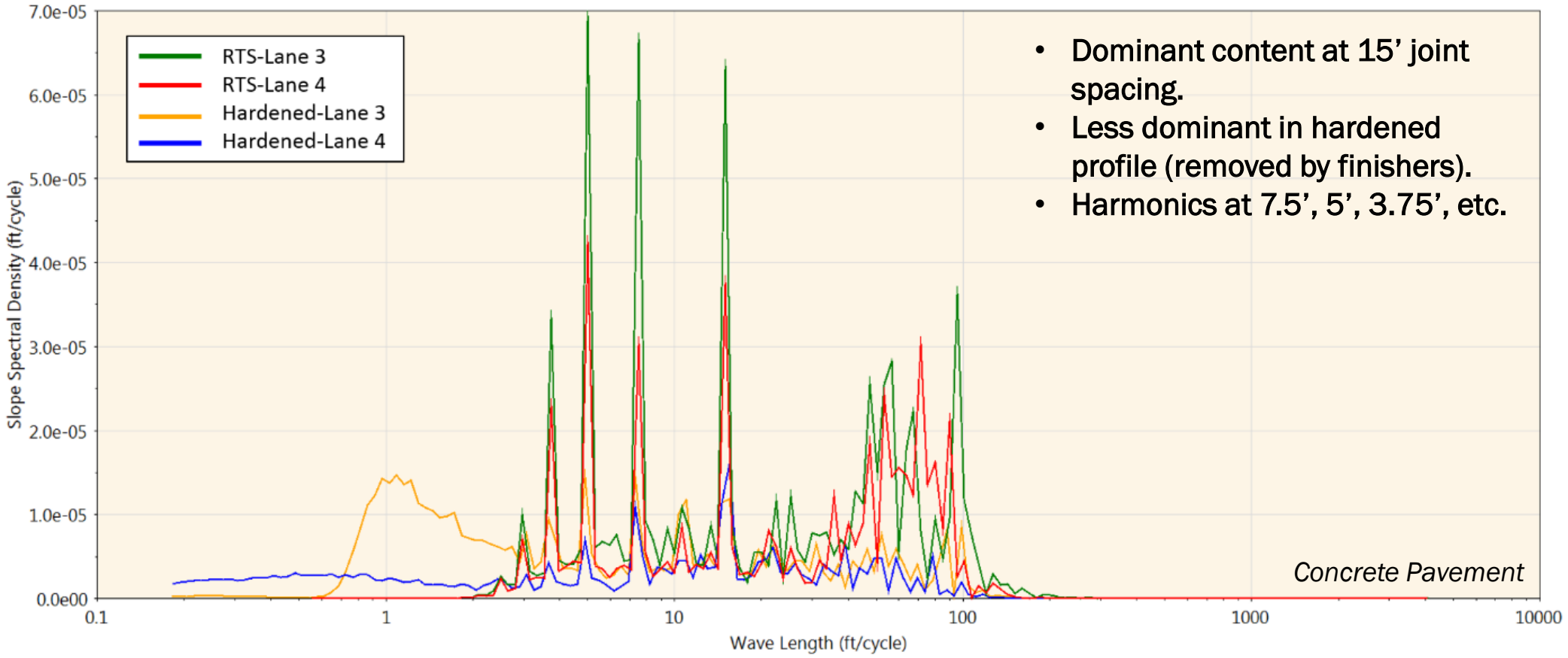
Identifying Systematic Factors

- Joint spacing/dowel basket effects



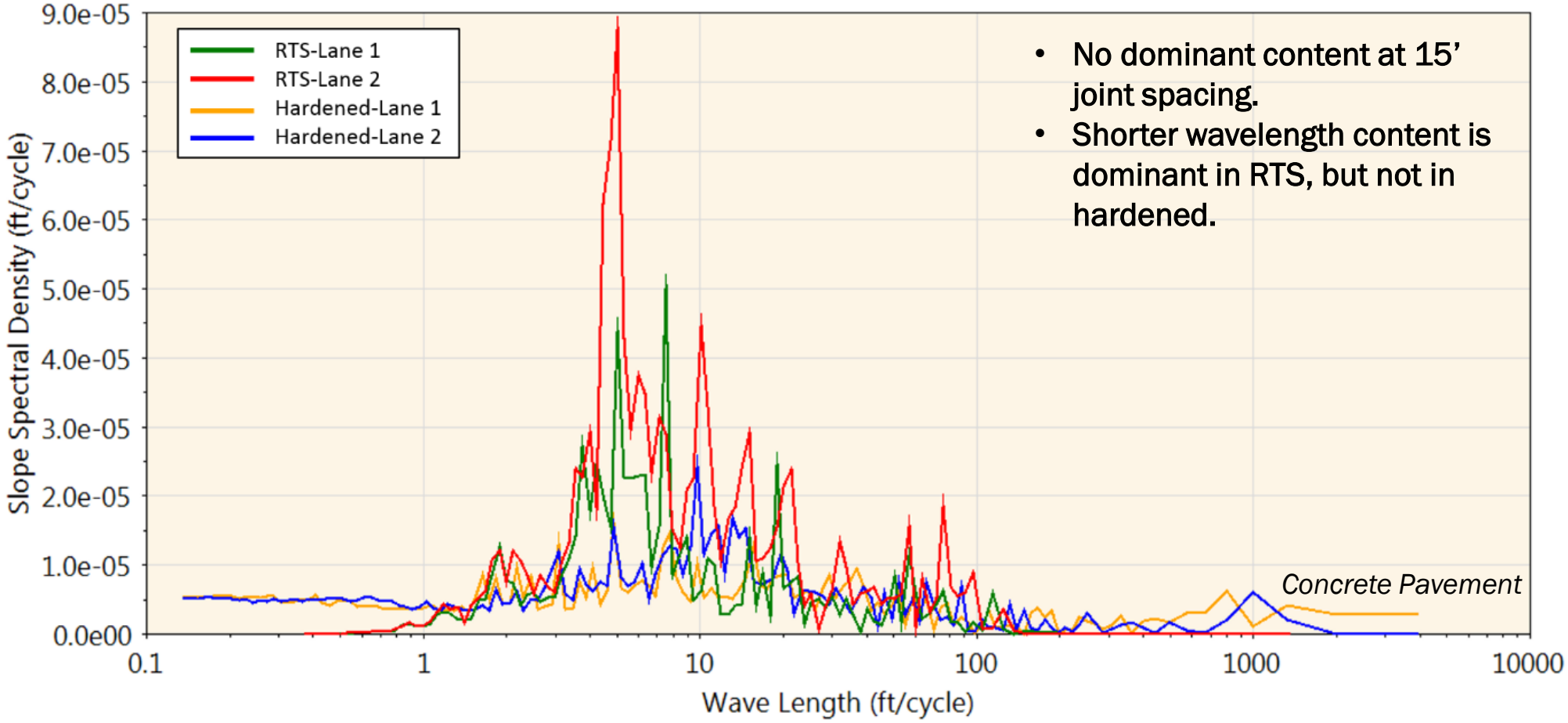
Identifying Systematic Factors

- Joint spacing/dowel basket effects



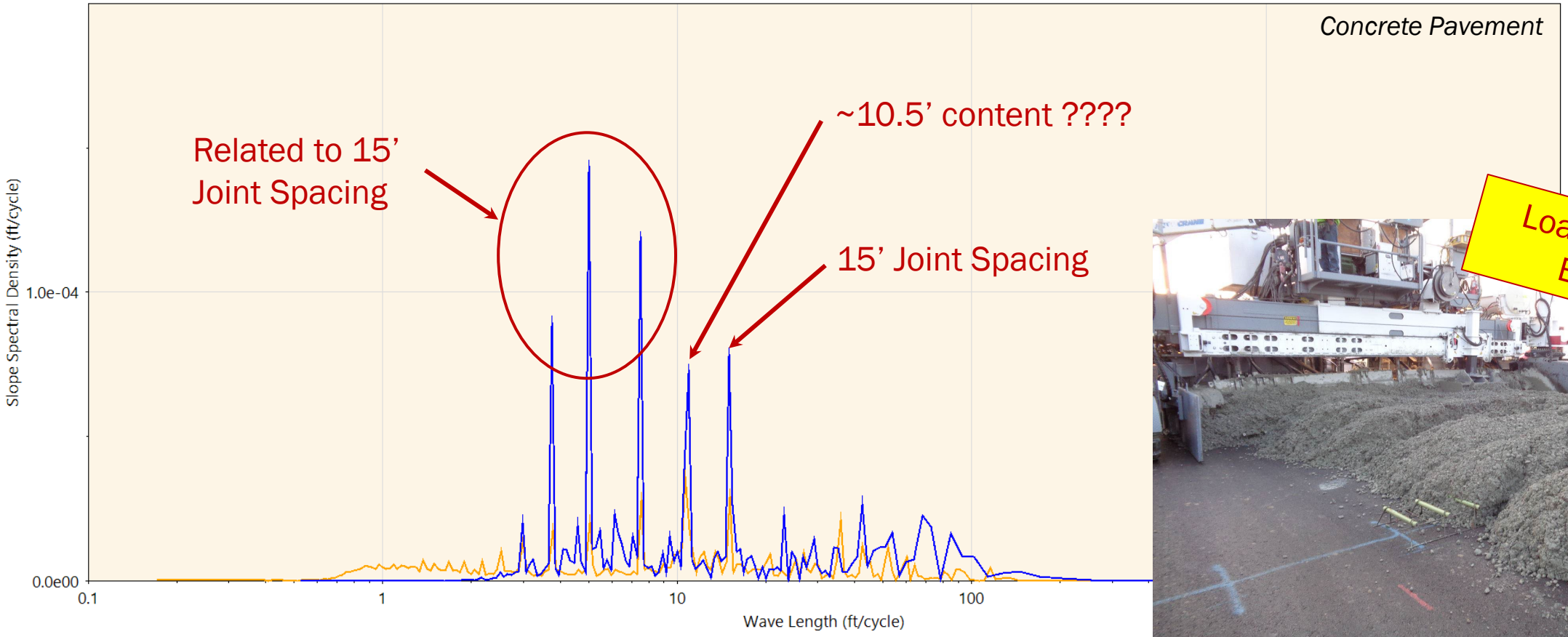
Identifying Systematic Factors

- Project utilizing Dowel Bar Inserter



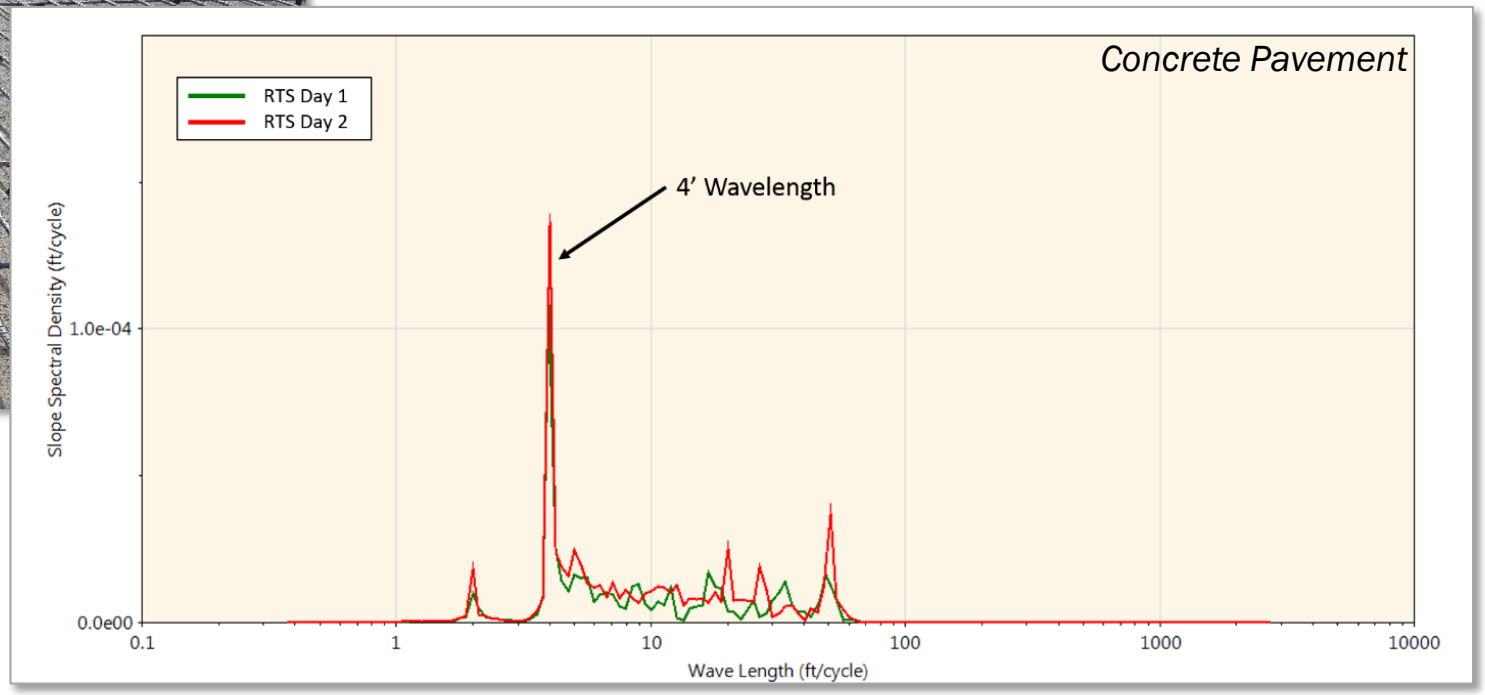
- No dominant content at 15' joint spacing.
- Shorter wavelength content is dominant in RTS, but not in hardened.

Identifying Systematic Factors



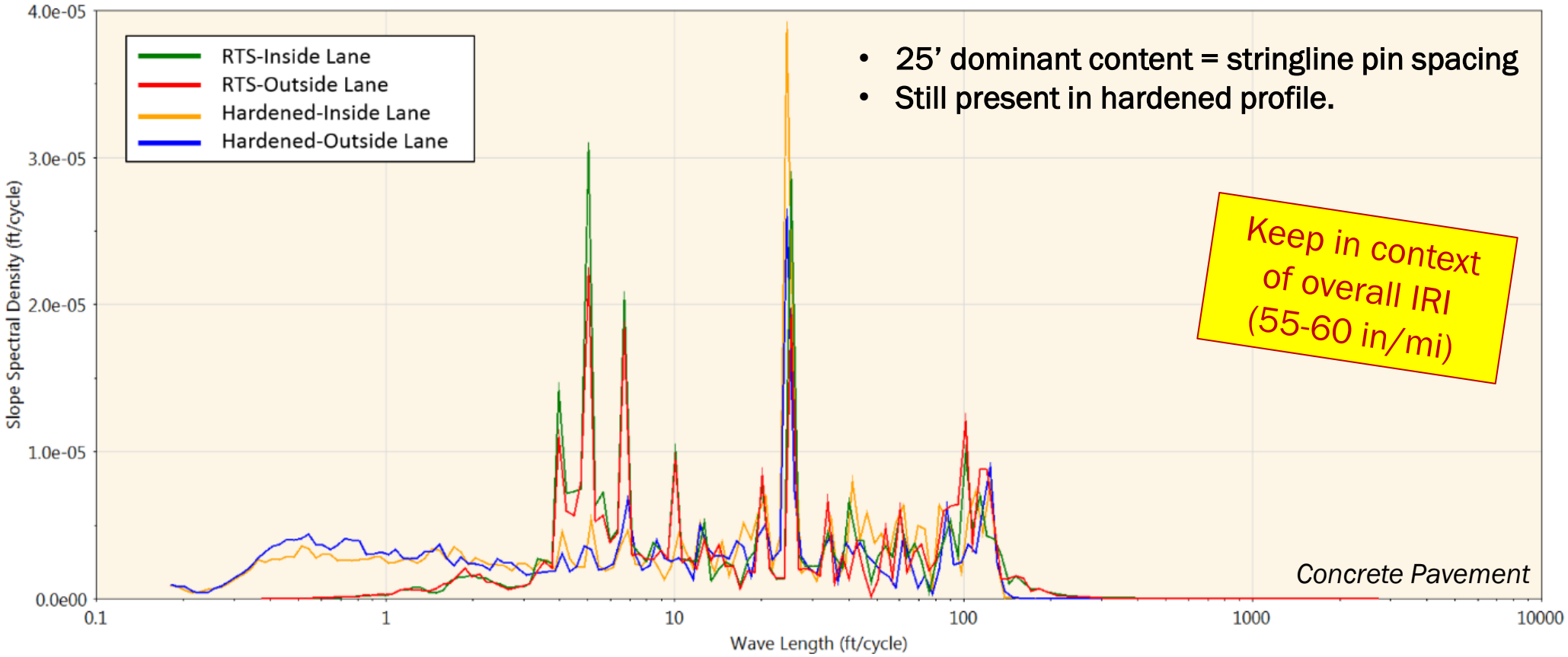
Identifying Systematic Factors

- CRCP Bar Supports



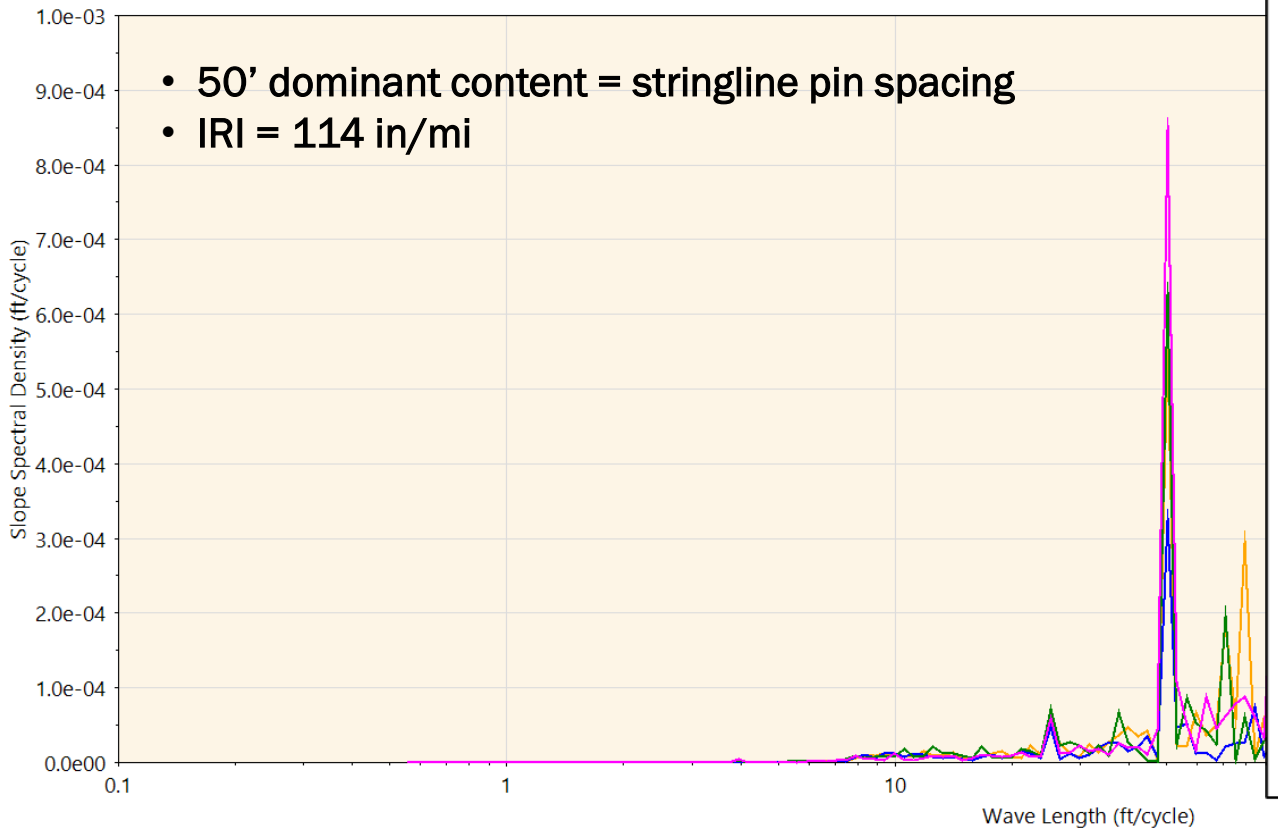
Identifying Systematic Factors

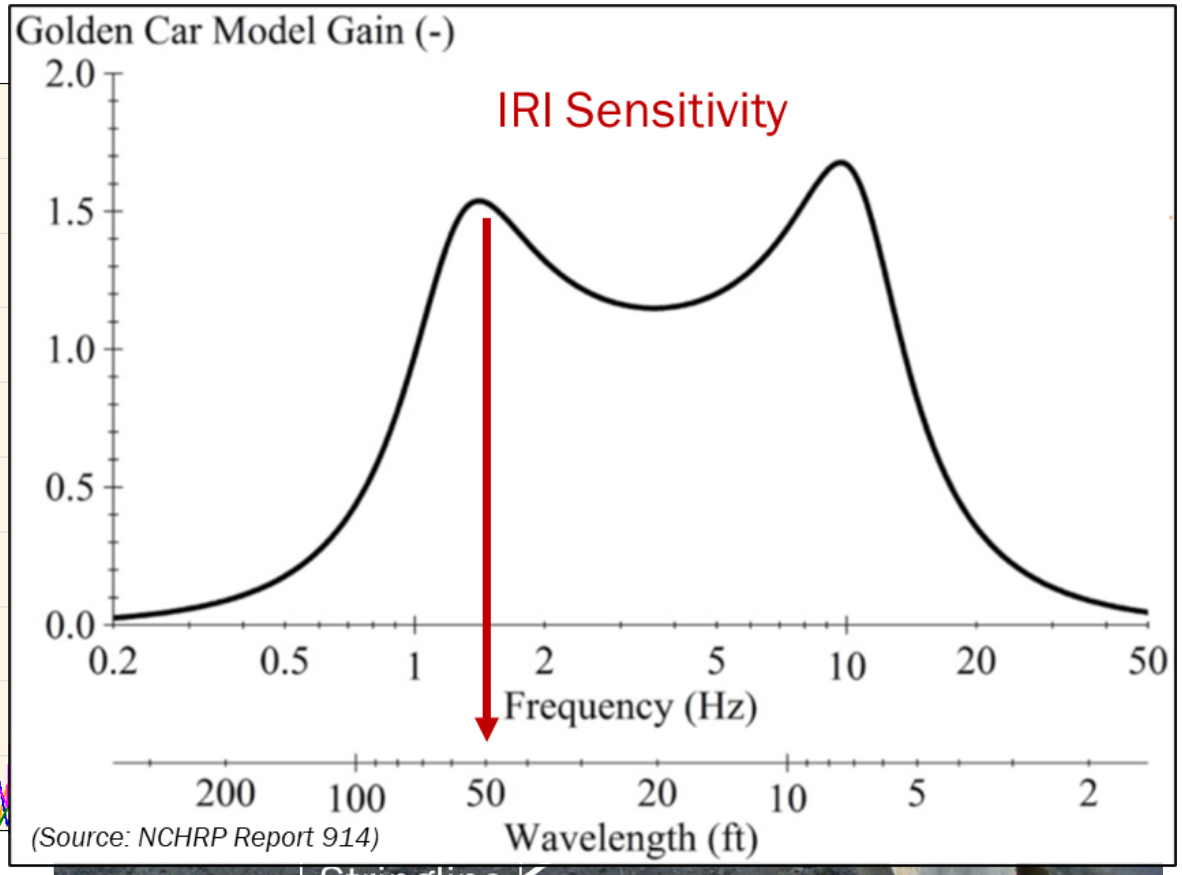
- Stringline Effects



Identifying Systematic Factors

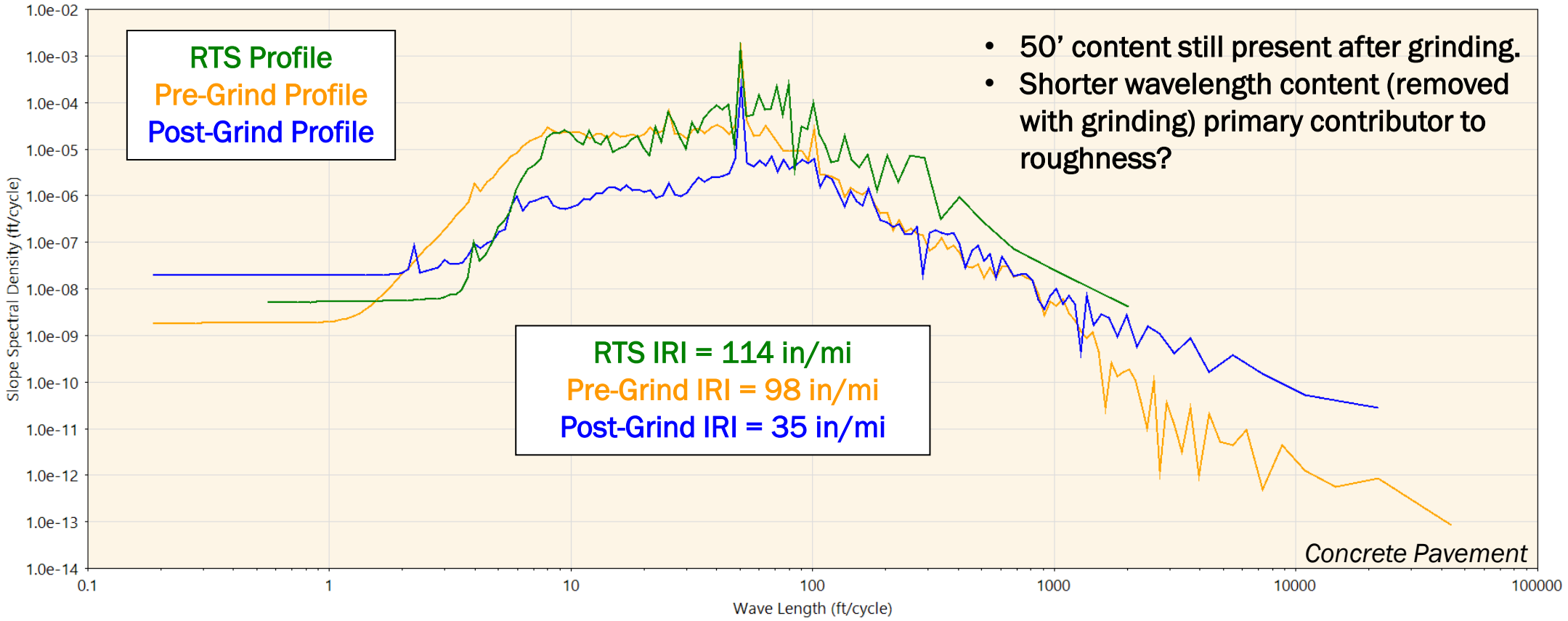
- Stringline Effects





Identifying Systematic Factors

- Stringline Effects



Real-Time Smoothness Update

- Overview of RTS Technology and Implementation
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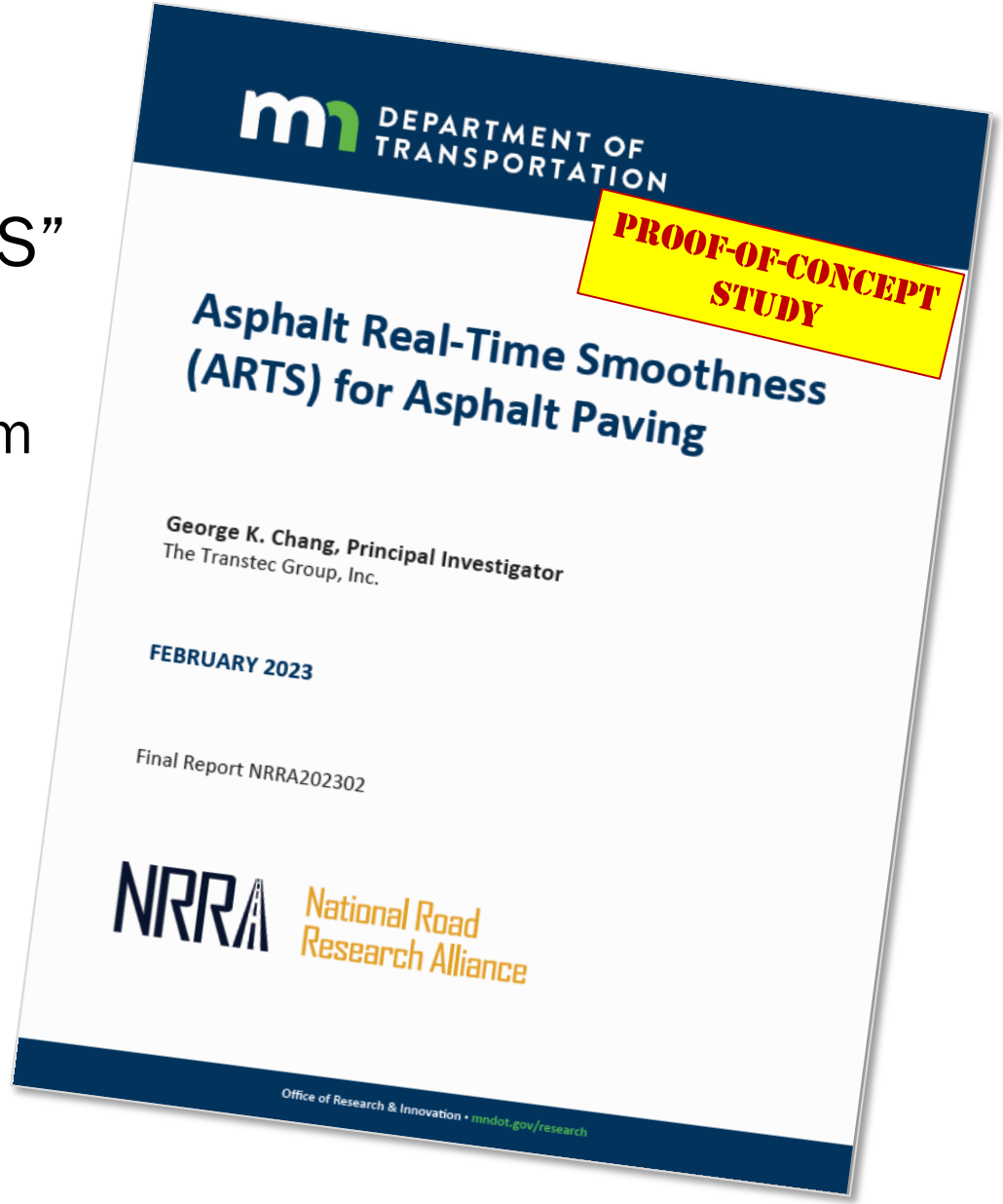
RTS for Asphalt Paving

- Asphalt Real-Time Smoothness: “ARTS”
- NRRA Proof-of-Concept Study
  - Not an equipment rodeo or loan program
- Two Evaluations
  - Iowa (2021)
  - Wisconsin (2022)

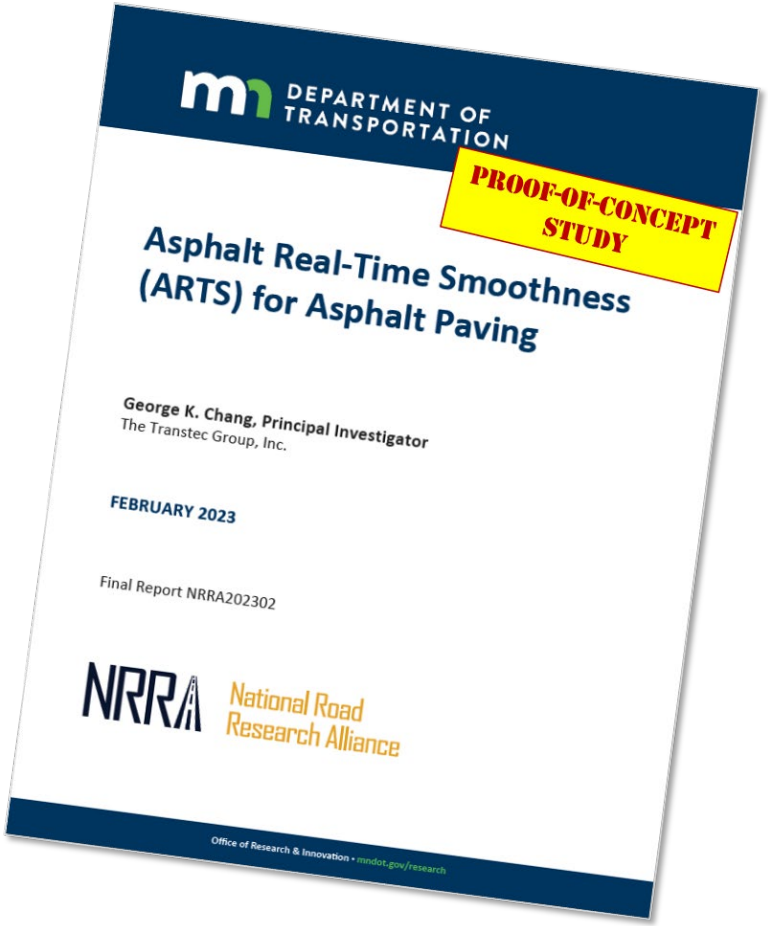


NRRA ARTS Proof-of-Concept Study

- Asphalt Real-Time Smoothness: “ARTS”

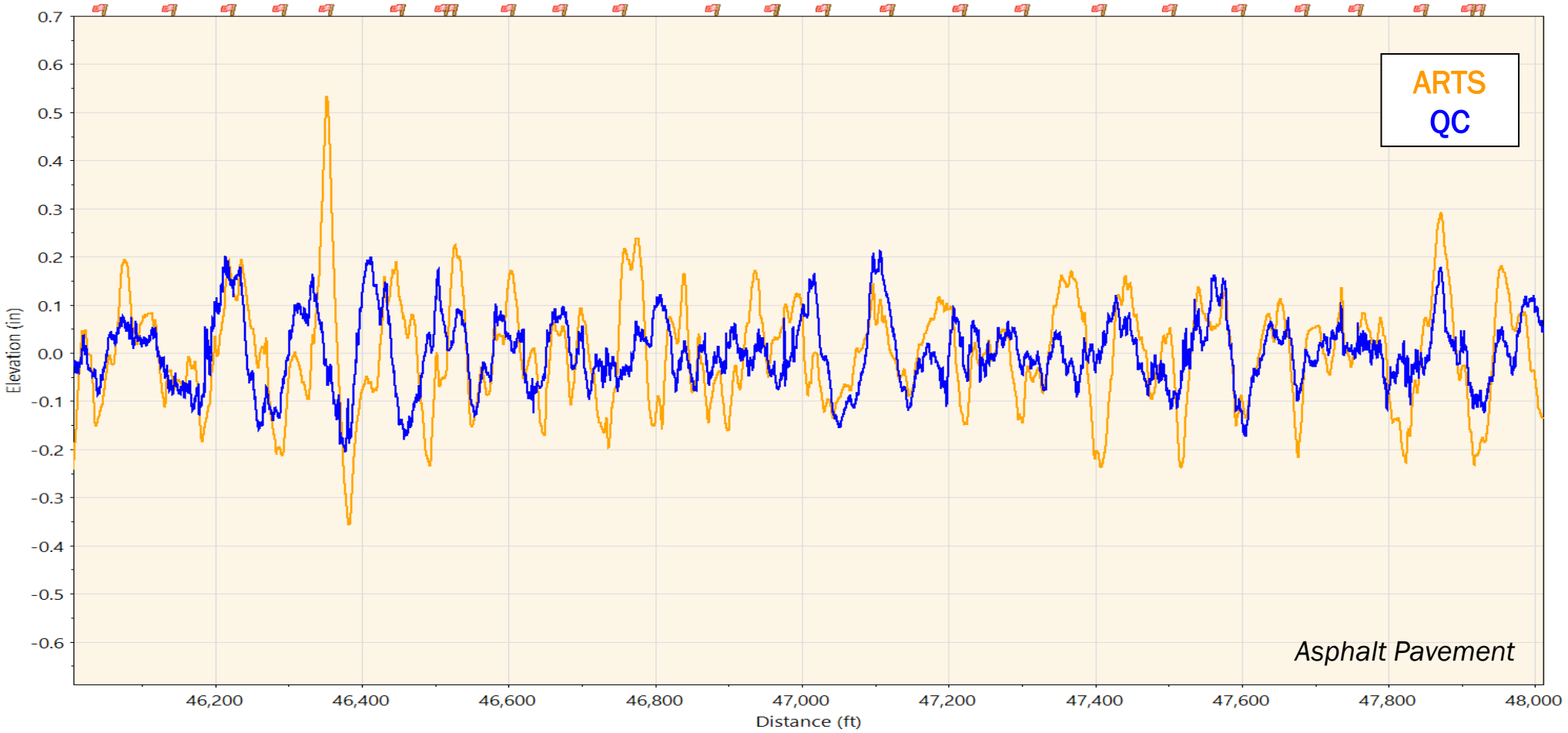
NRRA ARTS Proof-of-Concept Study

- Key Aspects of Evaluation
  - RTS Sensors
    - Mounting locations
    - Durability in high temperatures
  - Impact of various paving factors:
    - Material delivery (e.g., use of MTV)
    - Material movement through paver
    - Lift thickness
    - Grade control
    - Tow point movement
    - Screed movement/vibration
    - Paver stops
    - Compaction/rolling (behind RTS)
    - Grade and superelevation transitions
    - Etc.



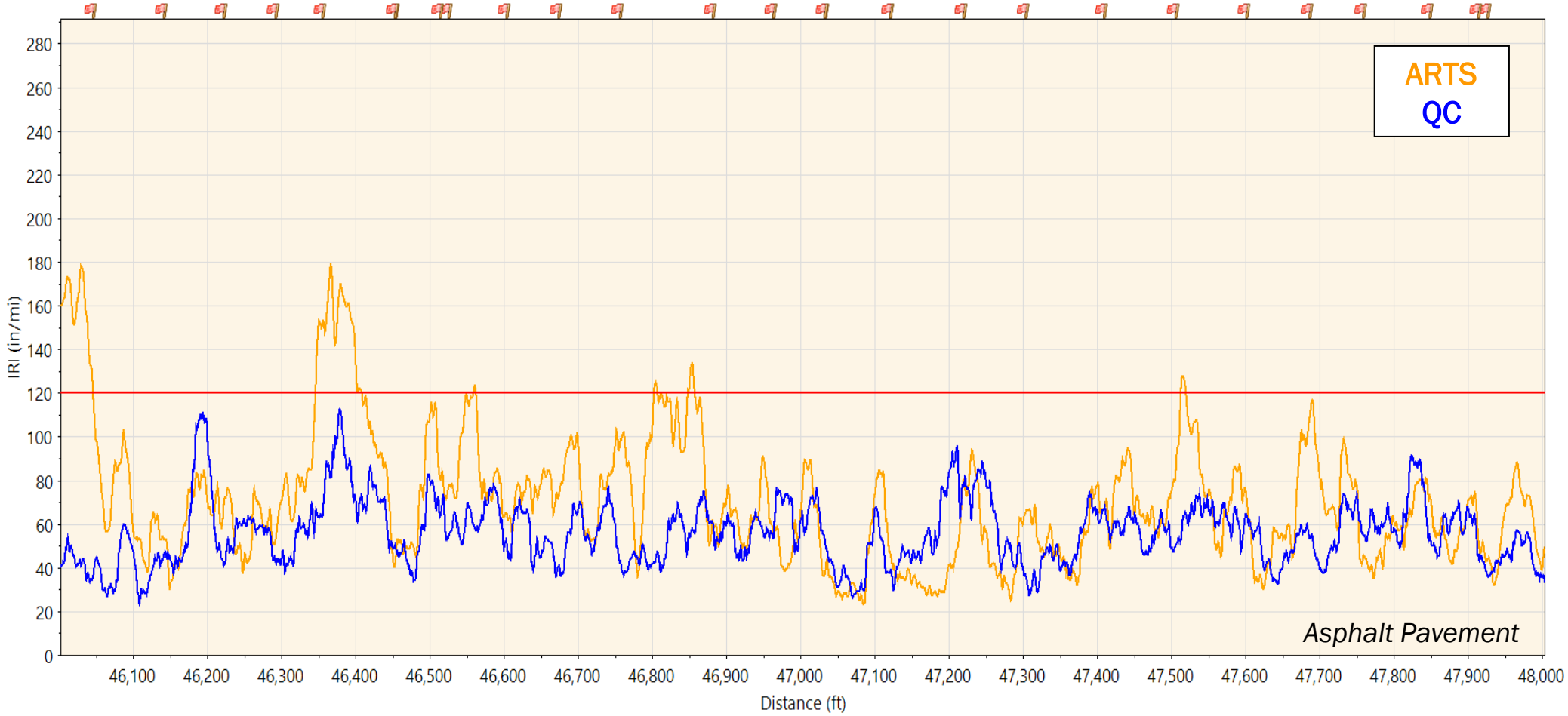
NRRA ARTS Proof-of-Concept Study

- General Observations
  - Good correlation (similar trends) between ARTS and QC profiles.



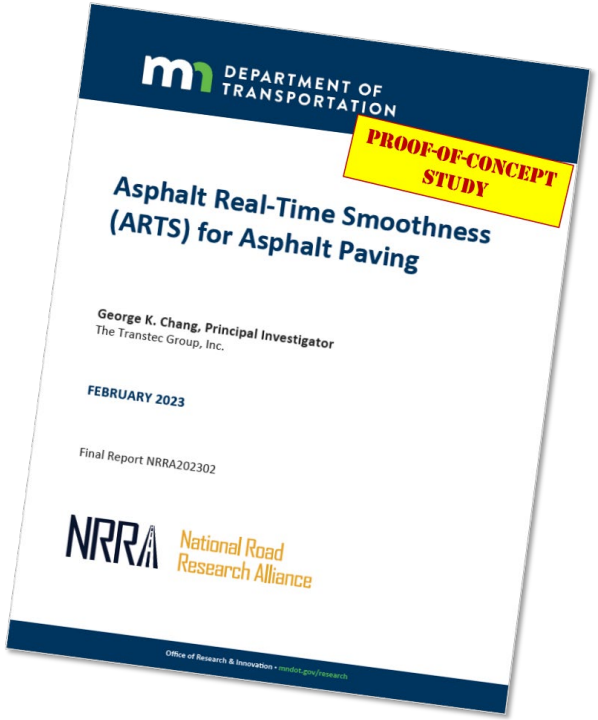
NRRA ARTS Proof-of-Concept Study

- General Observations
  - ARTS IRI values consistently higher than QC IRI profiles.



NRRA ARTS Proof-of-Concept Study

- General Observations
  - Use of MTV vs. end dump for material delivery apparent in profile data.
  - Grade control is important: averaging skis vs. slope control.
  - Roller compaction appeared to reduce long wavelength profile content and improve smoothness (when compared to ARTS data).
  - Tow point movement is believed to have a significant impact, but it could not be directly correlated to roughness.
  - More data under varying conditions is needed!



REAL-TIME SMOOTHNESS UPDATES

Thank You!

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