Improving QC of Asphalt Paving using Intelligent Compaction

APA of Indiana
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Indianapolis IN

APAI
ASPHALT PAVEMENT ASSOCIATION of INDIANA
asphalt is 100% recyclable

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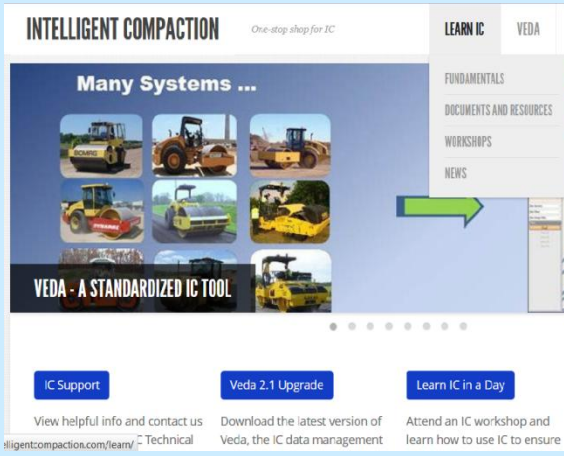

Video

- Report on IC project in Utah from Salt Lake City TV station
- Project was FHWA IC research project in Lehi UT with two different IC rollers
- What to watch for:
  - What two IC rollers were being used?
  - Pronunciation of name of UDOT representative?
  - What current test did reporter say could be eliminated?

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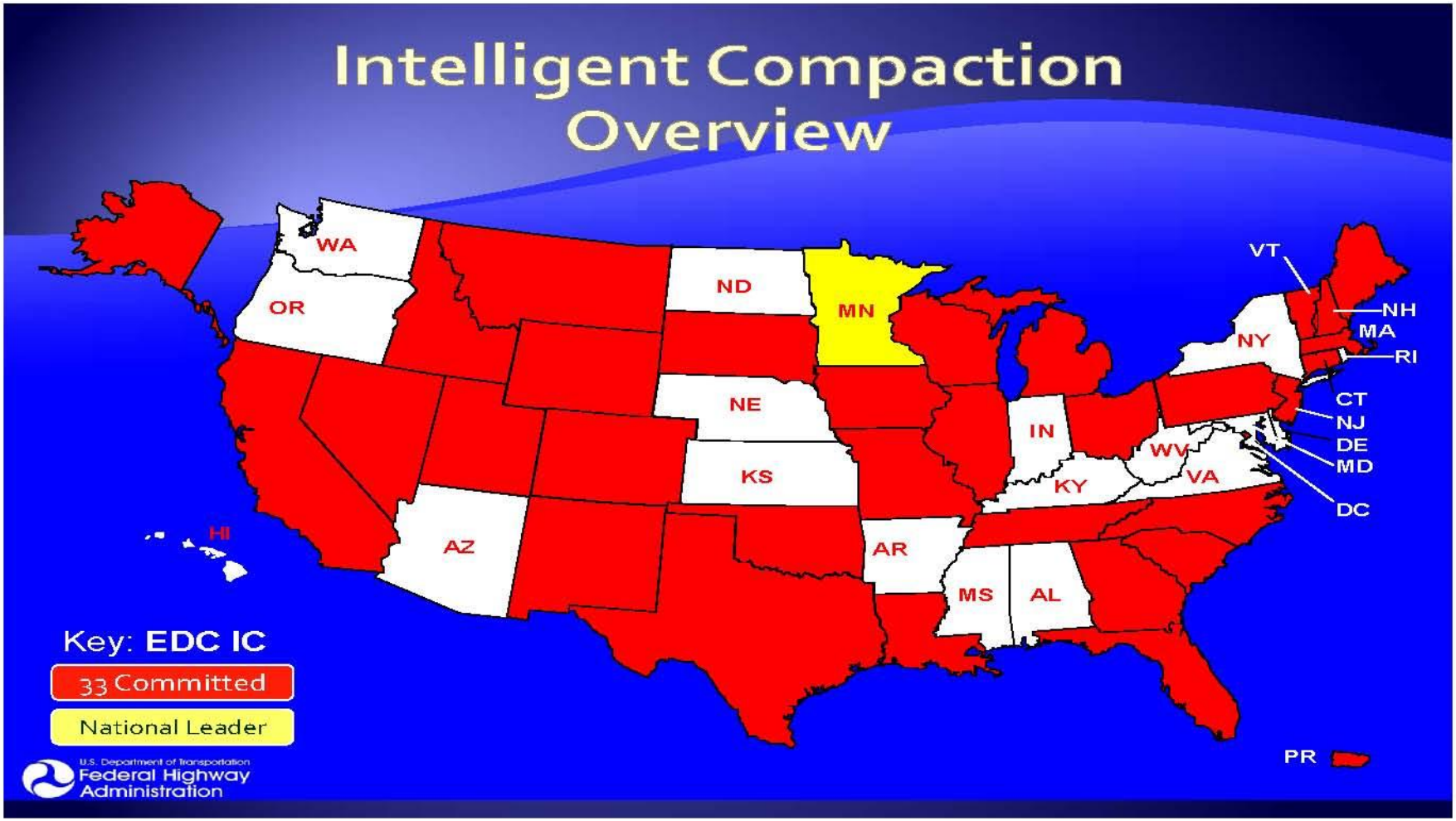
Discussion Items

- Intelligent Compaction Usage Trends
- Importance of Compaction
- Why Do We Need Intelligent Compaction (IC)?
- What is IC and What Are the Benefits?
- Practical Uses of IC to Improve QC of Asphalt Paving Projects
- Preview of Session 2 – Implementation and Logistics

IC Usage Trends

- The number of projects nationwide which include the use of IC has been increasing
  - 2012 – less than 20 projects
  - 2013 – approximately 50 projects
  - 2014 – projected 150 projects
- Reasons for the increase:
  - Improvement and availability of IC technology
  - EDC 2 – 33 states committed to implement IC in the next two years

EDC2 States - IC



Importance of Compaction

How Important is Compaction?

- Compaction is the important last step in constructing a quality asphalt pavement
- The goal of compaction is to consistently and uniformly obtain optimum density
- Proper in-place density is essential for good performance of asphalt pavements
- Density is directly related to the air void content in the compacted asphalt pavement

Importance of Compaction

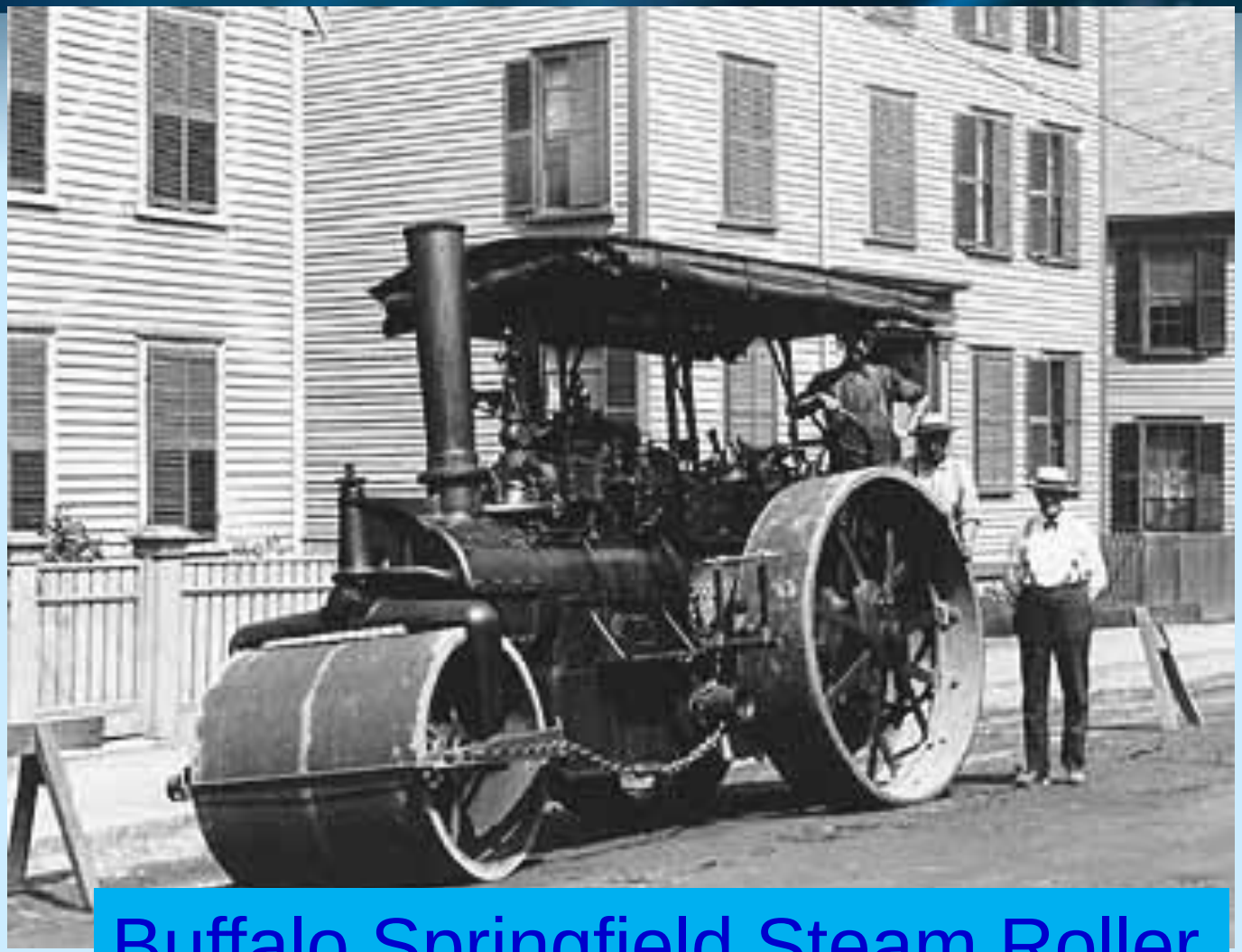
- Numerous research and field studies have verified that obtaining optimum air voids through good compaction practices is vital to achieve expected service life
- Therefore, we must always be looking for innovative ways to improve
  - Equipment
  - QC (process control procedures)
  - QA (acceptance testing and criteria)

Question: Why Do We Need Intelligent Compaction?

Why Do We Need IC?

Comparison of Conventional Compaction versus Intelligent Compaction?

Compaction Technology Has come a Long Way!



Buffalo Springfield Steam Roller

Comparison of Conventional Compaction and IC

- Conventional compaction equipment and processes have shortcomings
- These shortcomings can possibly result in poor and inconsistent densities
- IC technology addresses many of these shortcomings
- By using IC, it is more likely that good compaction practices will be used and target density will be achieved.

Shortcomings in Compaction Process

Limited “On The Fly” Feedback

Over or Under-Compaction Can Occur

Shortcomings in Density Acceptance Process

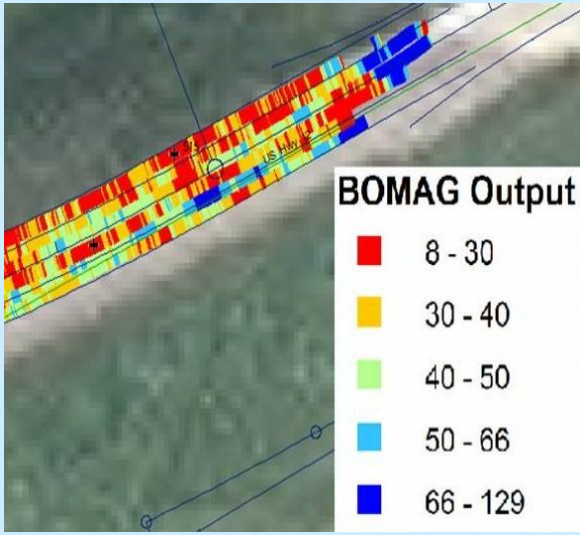
Limited Number of Locations

After Compaction is Complete

What is Intelligent Compaction?

What is Intelligent Compaction?

An Innovation in Compaction and Quality Control Processes



What is Intelligent Compaction?

Current IC technology is accelerometer-based.

Vibratory Single Drum Soil Roller

Vibratory Tandem Drum Asphalt Roller

What is Intelligent Compaction?

- IC Roller Requirements (FHWA)
  - IC Measurement Value (ICMV)
  - GPS-Based documentation system
  - On-Board, Color-coded display
  - Surface temperature measurement system

Tandem Drum IC Roller Suppliers

Bomag

HAMM-Wirtgen

Caterpillar

Sakai

IC Measurement Value (ICMV)

- IC suppliers have various “stiffness” (or measurement) values
  - Bomag – E_{vib} (MN/m²)
  - Caterpillar/Trimble – CMV
  - Hamm/Wirtgen – HMV
  - Sakai - CCV
- ICMV is a generic term used to describe all suppliers’ measurement value

Global Positioning System (GPS)

GPS Base Station

GPS Radio & Receiver

GPS Rover

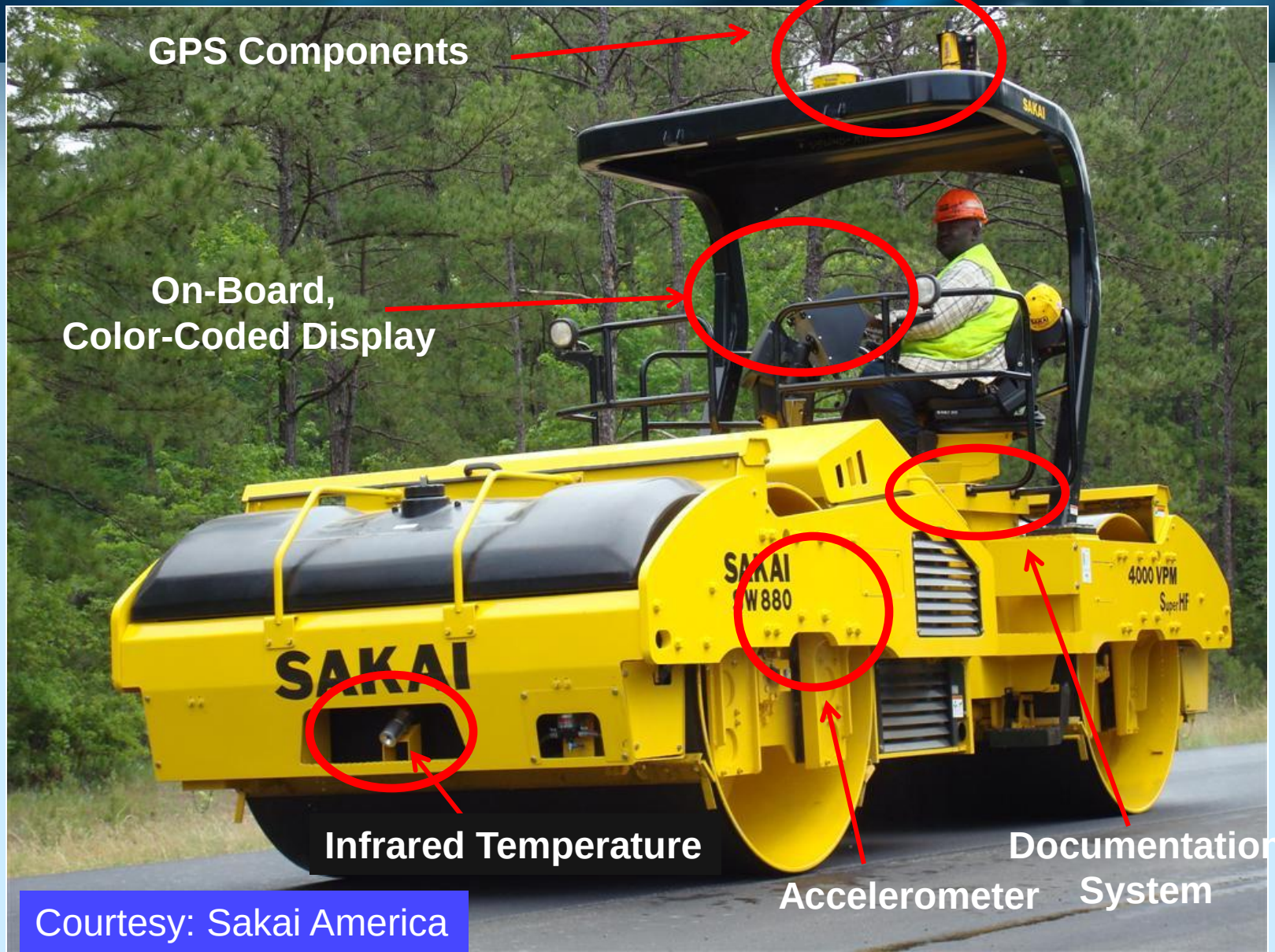
Real Time Kinematic (RTK) GPS Precision

OmniStar HP on Hamm IC Roller

2-4 inch precision?

OmniStar is being evaluated against land-based GPS systems on FHWA research projects at this time.

Components of IC Roller

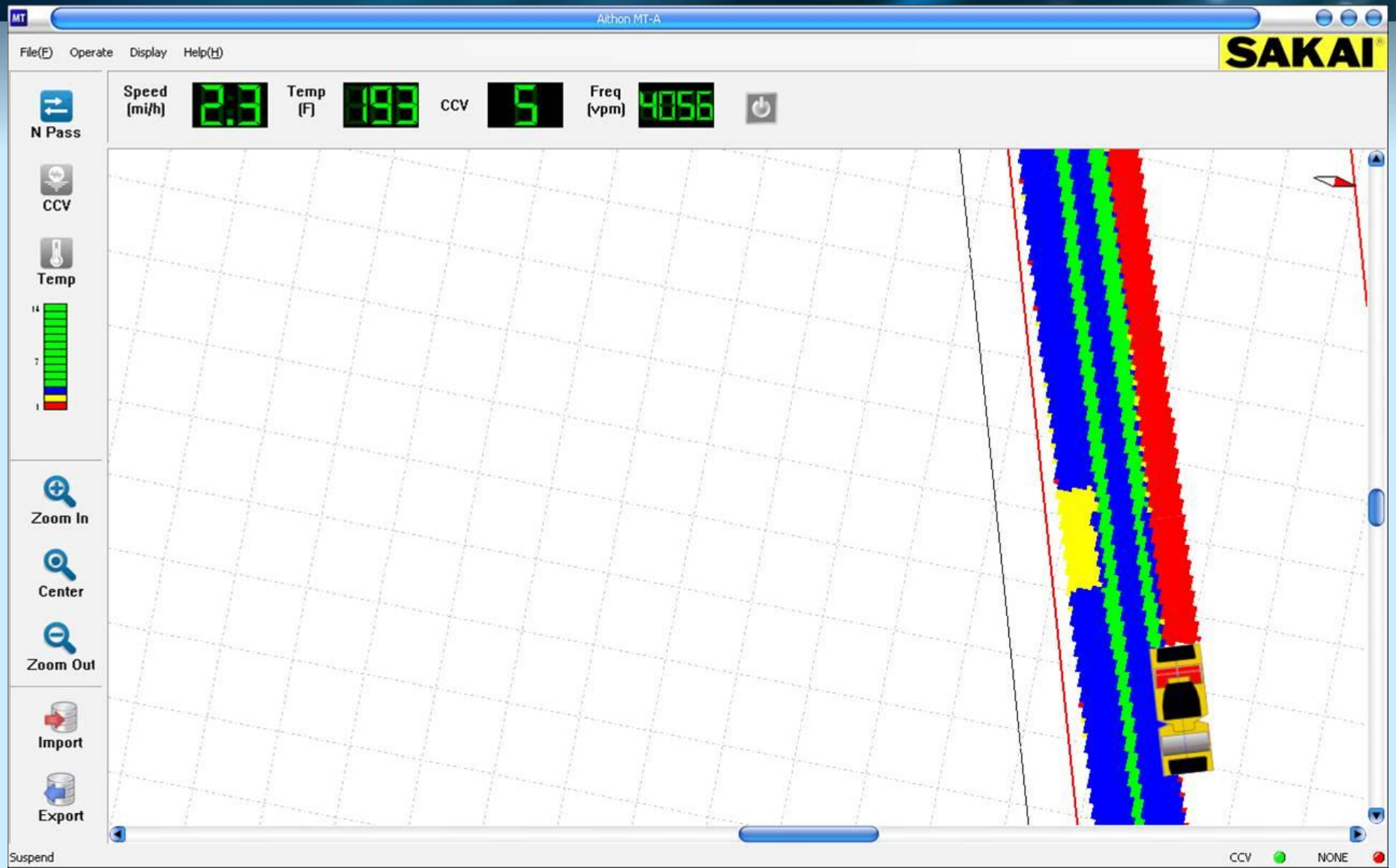


Courtesy: Sakai America

Sakai IC Onboard Display Unit

Hamm IC Onboard Display Unit

Color-Coded On Board Display



Benefits of IC for HMA

- Improve density….better performance
- Improve efficiency….cost savings
- Increase information…better QC/QA

- Overall Benefit:

  Improved Pavement Performance!

Practical Uses of IC to Improve Quality Control

- Mapping of underlying layers prior to asphalt pavement placement
- Improved roller patterns
- 100% coverage of asphalt pavement with roller passes/ICMV

Mapping of Underlying Layers Prior to Asphalt Pavement Placement

IC Mapping of Underling Layers

Minnesota ICPF Project

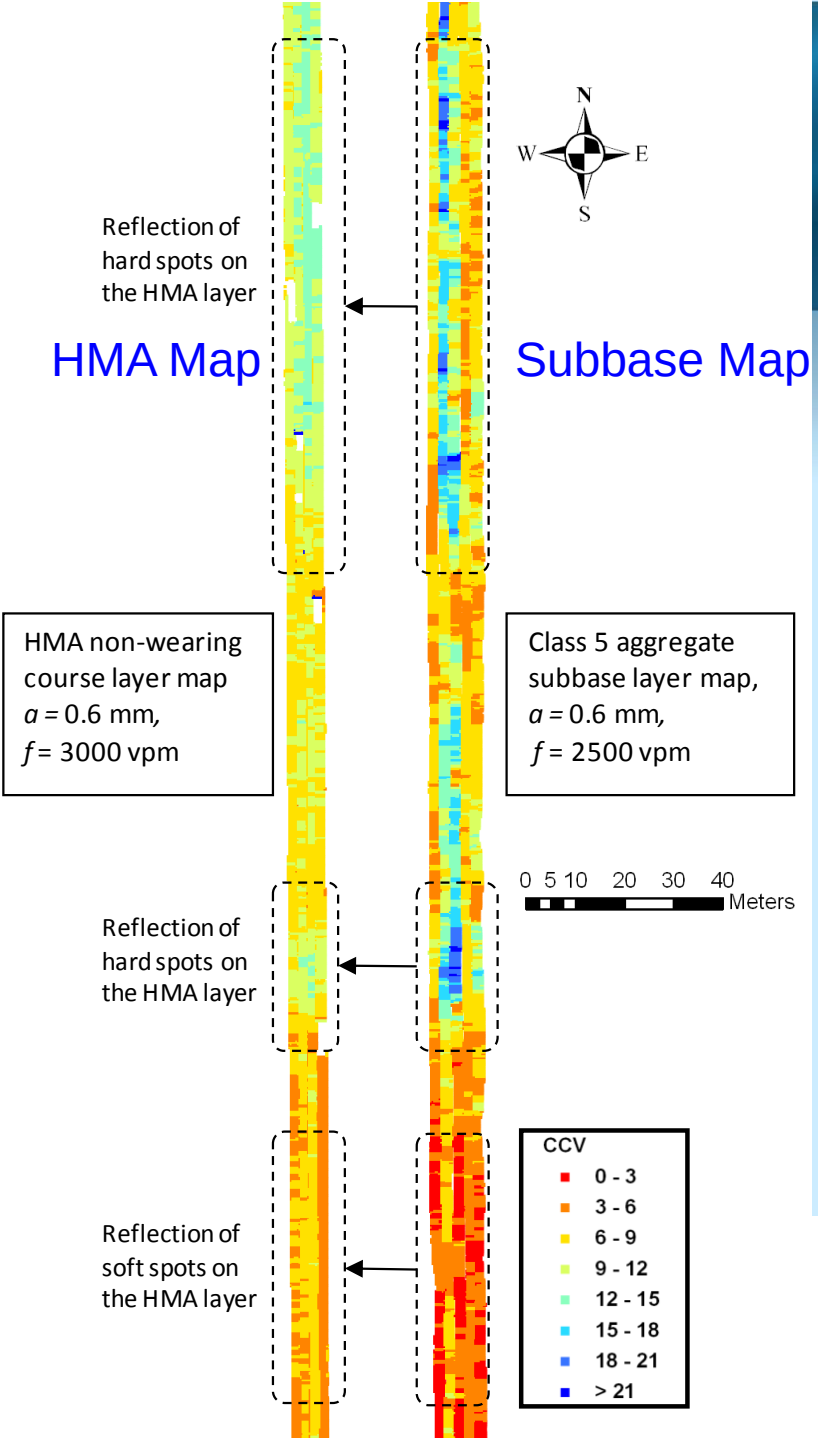
Mapping of the subgrade / agg. base layer

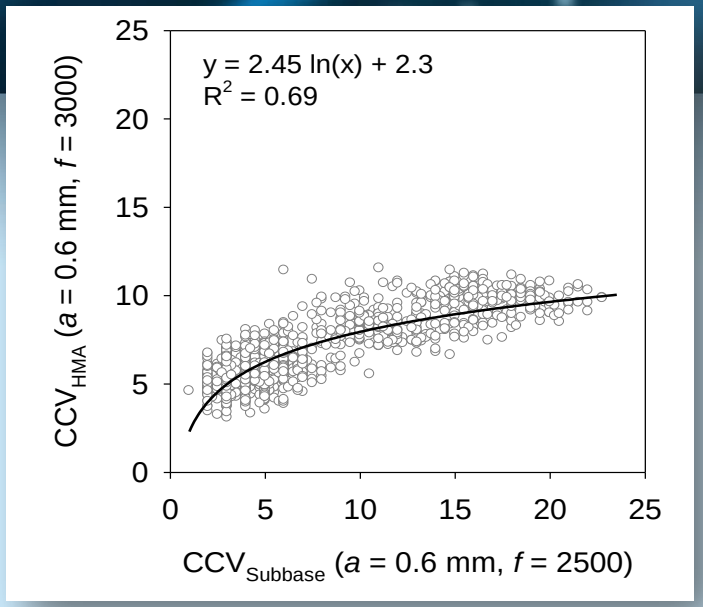
IC Mapping of Underling Layers

Minnesota ICPF Project

Compaction/mapping of HMA base course layer

Mapping Aggr. Base





MN ICPF Project

Test bed 02 Mapping

Mapping Milled HMA

Bomag

Bomag Evib

Done	650 m²
Start date	12:35:17 PM 7/21/2009
End date	12:41:51 PM 7/21/2009

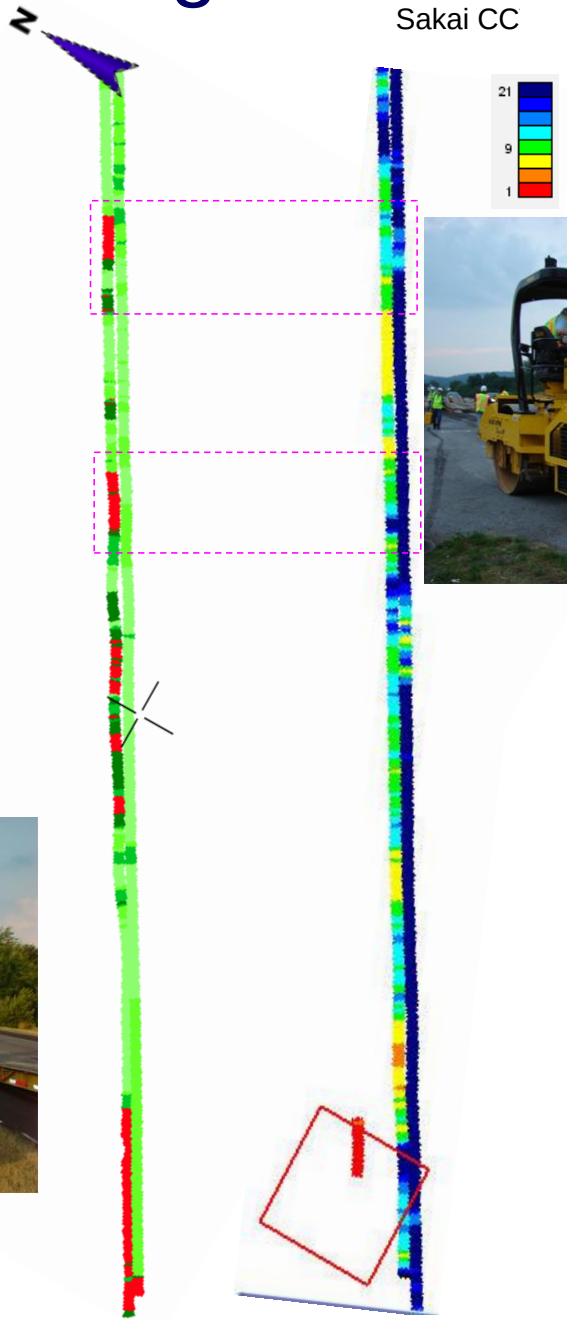
	AVG	Min	Max
EVIB [MN/m²]	286	101	350
Amplitude [mm]	0.3	0.2	0.6
Frequency [Hz]	50	16	67
Speed [km/h]	5.5	1.0	6.6

	EVIB [MN/m²]	
	> 350	19 %
	313 -350	29 %
	276 -313	21 %
	238 -276	7 %
	200 -238	8 %
	< 200	16 %
Σ	200 -350	65 %

AVG-value [MN/m²]	286
Increase	8
Standard deviation	66

Sakai

Sakai CC



MD ICPF Project

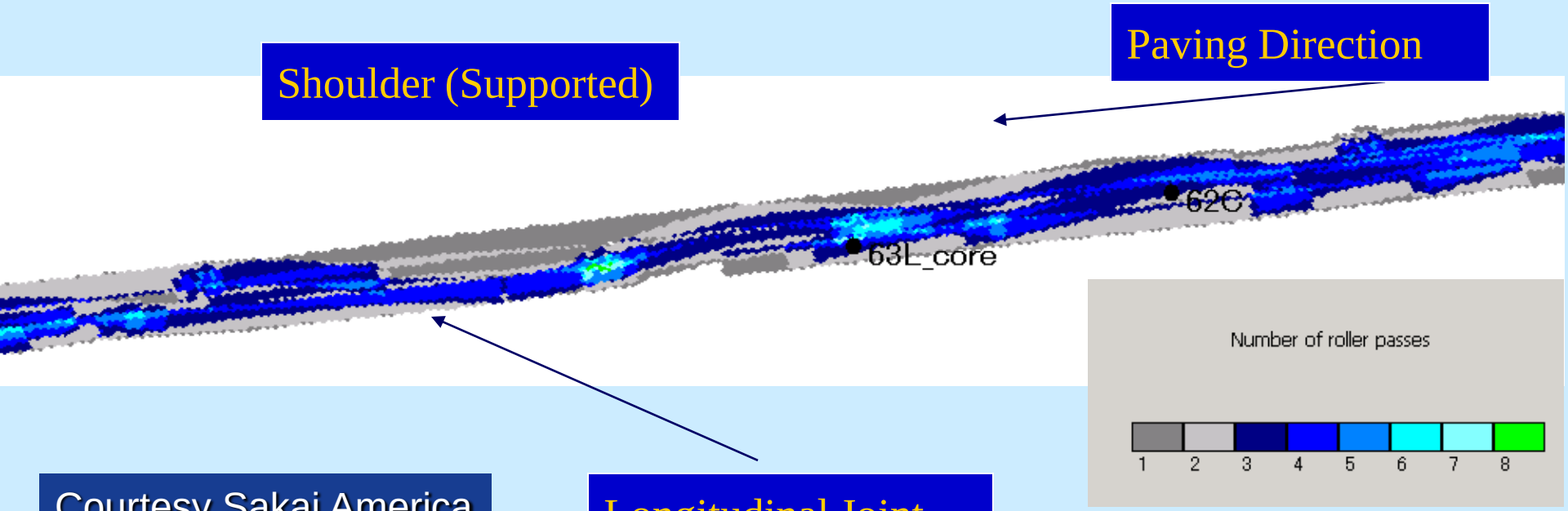
Summary – IC Mapping

- All mapping was done with tandem drum IC roller
- Typical settings were low amplitude and 2500 vpm frequency
- No damage to roller or material was noted
- IC mapping seemed to be effective in identifying soft spots in all underlying materials except rubblized PCC

Improved Roller Patterns

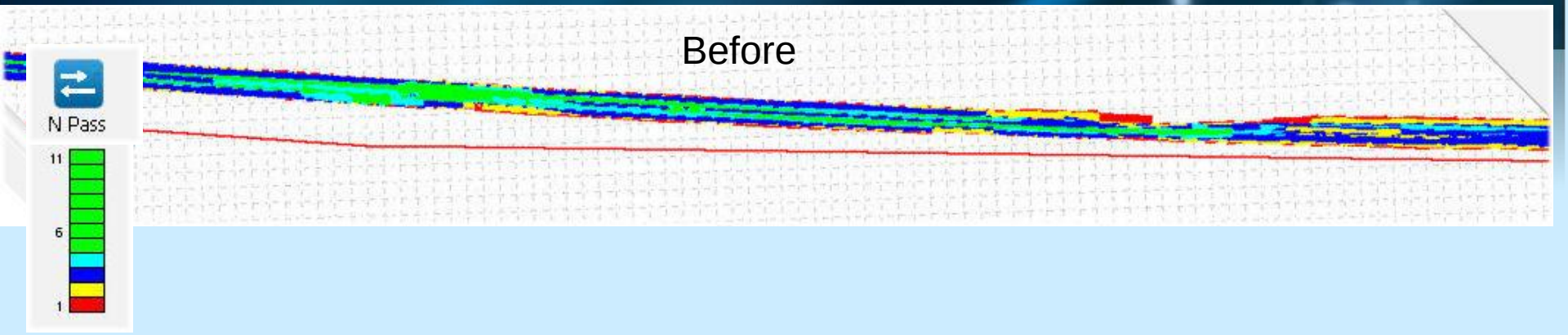
Inconsistent Roller Passes

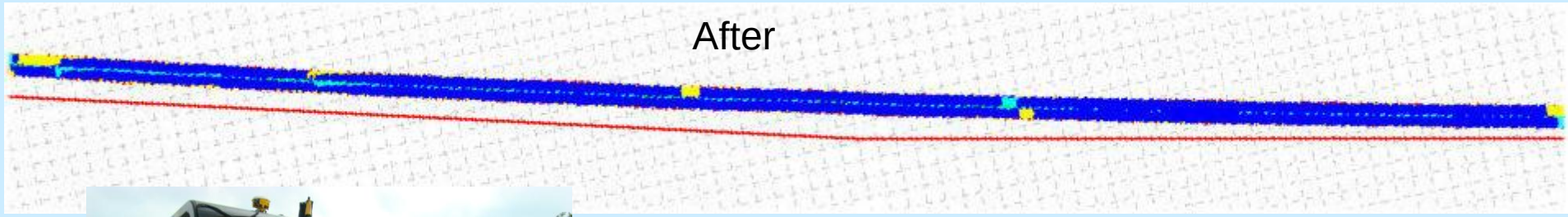
- Roller Passes



Courtesy Sakai America

Improved Rolling Patterns





Sakai IC roller

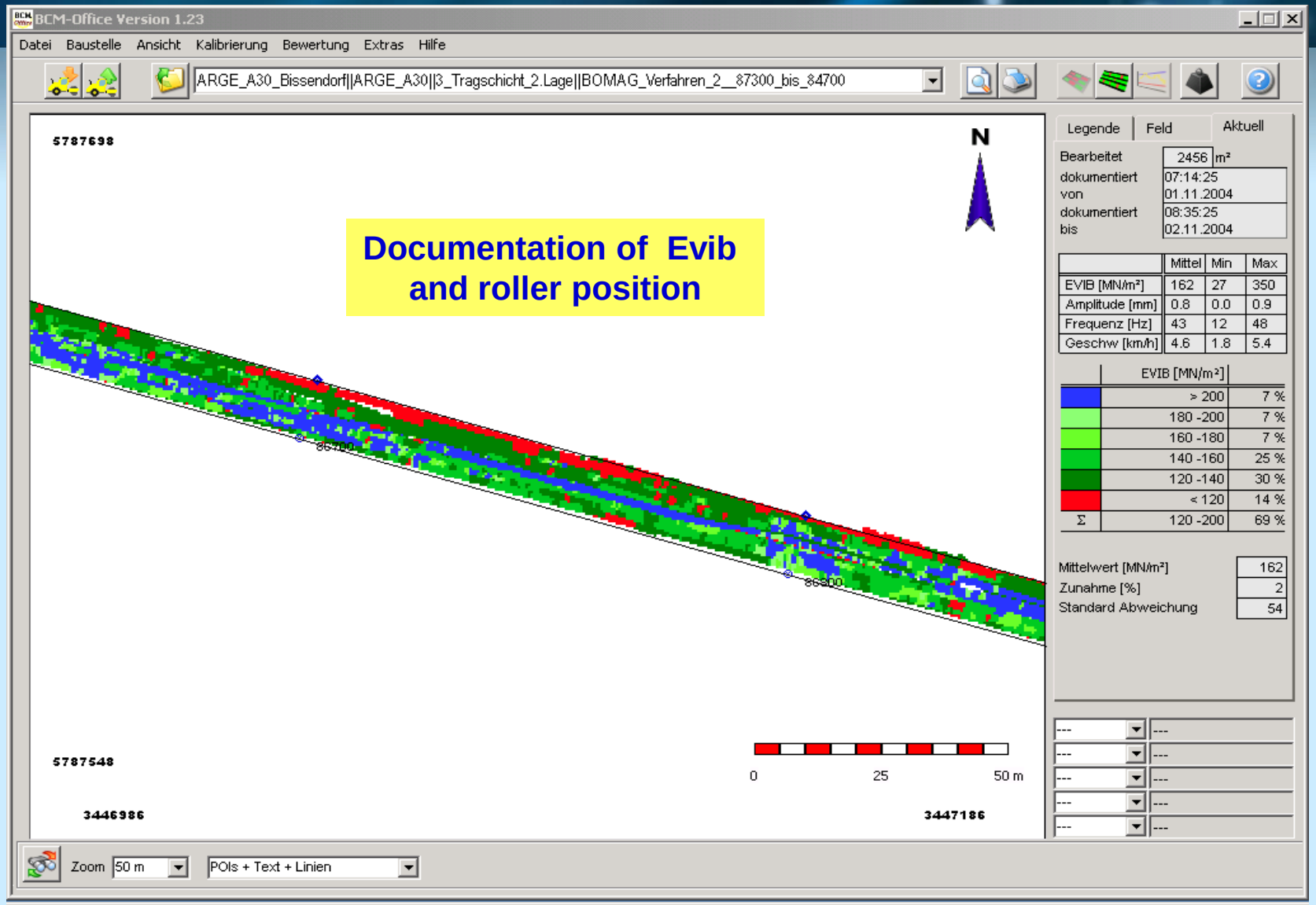
Indiana ICPF Project

100% Coverage of Compaction Area with Roller Passes/ICMV

Concept of “100% Coverage”

- During IC, data is collected continuously during the compaction process:
  - Roller passes
  - Temperature
  - ICMV
- When data is analyzed, color-coded maps are produced that show these results for the entire roadway
- This capability provides much more information than current method of spot testing

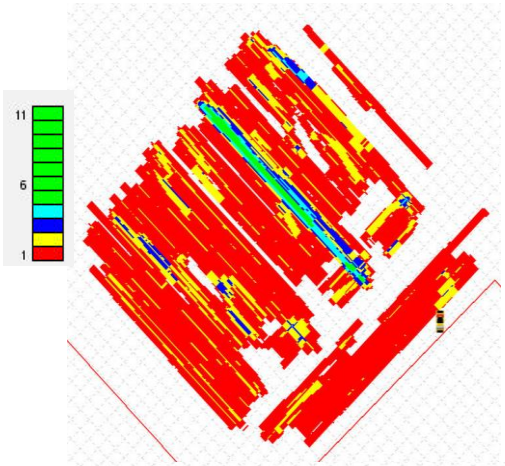
ICMV Maps Provide 100% Coverage



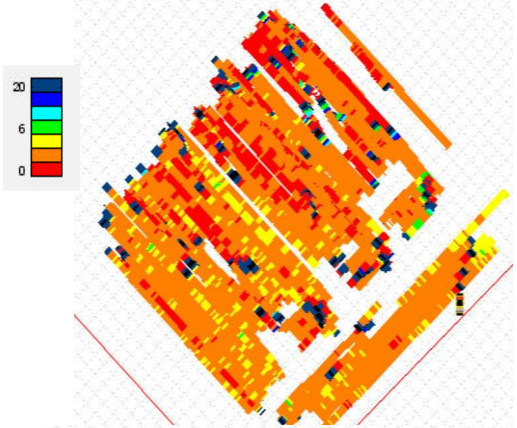
TB 01A Intermediate HMA Layer

100 % Coverage

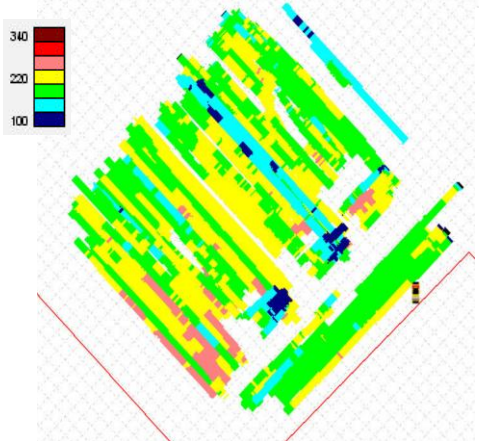
Roller pass



Sakai CCV



Surface temperature (°C)



Georgia ICPF Project

USE AND ACCEPTANCE BY ROLLER OPERATORS

Acceptance by Roller Operators

Georgia HMA Demo

What's Next?

- Improvement and further innovation in IC technology
- More suppliers
- More research and validation
- Increase in education/training
- Accelerated implementation
- Increased interest from contractors

Summary – IC for Asphalt

- IC technology is available from multiple suppliers in the United States
- IC offers many advantages over conventional compaction equipment
- IC offers valuable new tools to the contractor to improve Quality Control
- IC offers a way for owner/agencies to specify innovative technology that can improve pavement life

Bottom Line

- IC technology is an exciting innovation that can provide many benefits to both the agency and contractors,
- However, there are challenges that need to be understood and addressed to accomplish a successful construction project using IC technology.

www.intelligentcompaction.com

IC is a Beautiful Thing!

Courtesy of Bruce Christianson

Preview of Session 2

HOW CAN YOU SPECIFY INTELLIGENT COMPACTION ON YOUR ASPHALT PAVING PROJECT?

Specifying IC

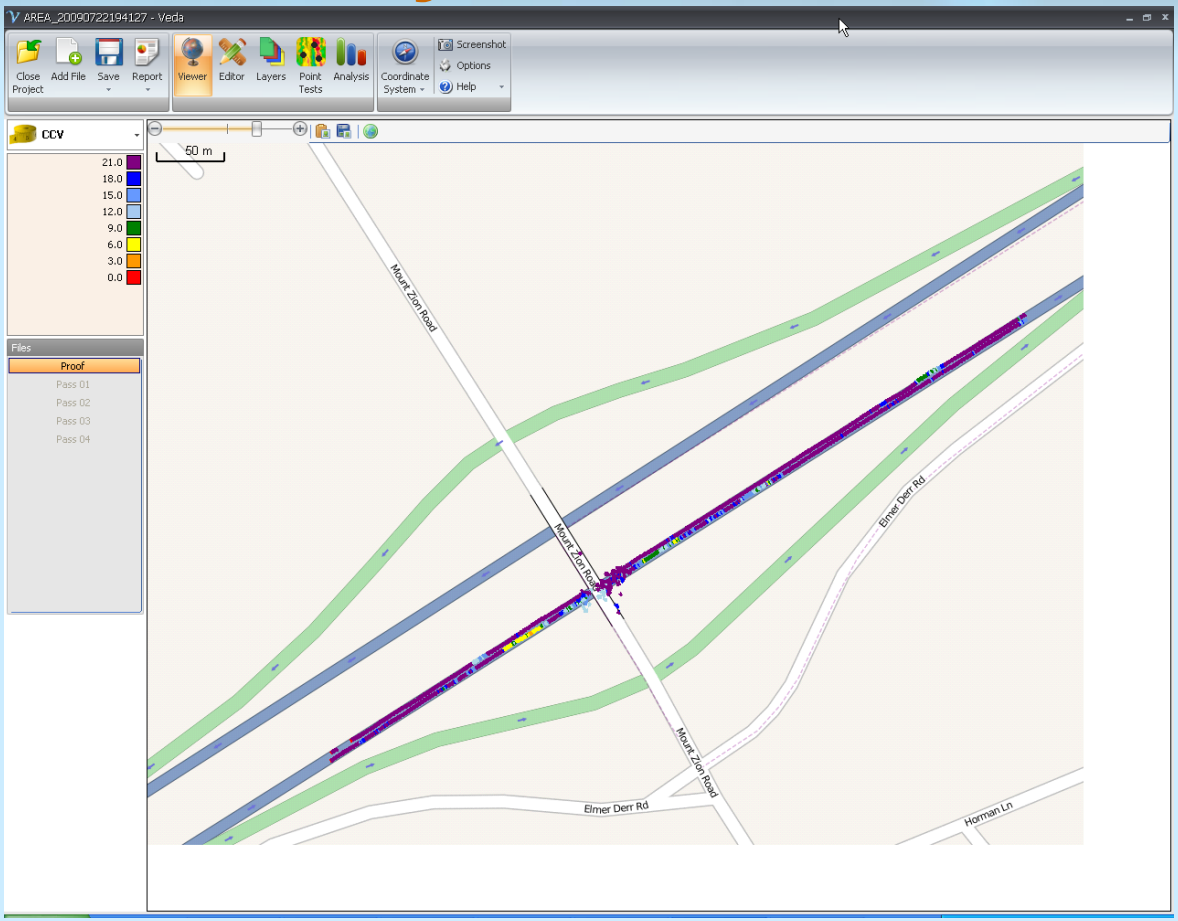
- Read up on IC: www.intelligentcompaction.com
- Get some training: Contact FHWA about IC Workshops
- Generic Specifications on IC Website
  - Click on “Specifications” link
  - Select Materials Type
    - Soils and Subbase
    - Asphalt Pavement

Generic IC Specifications

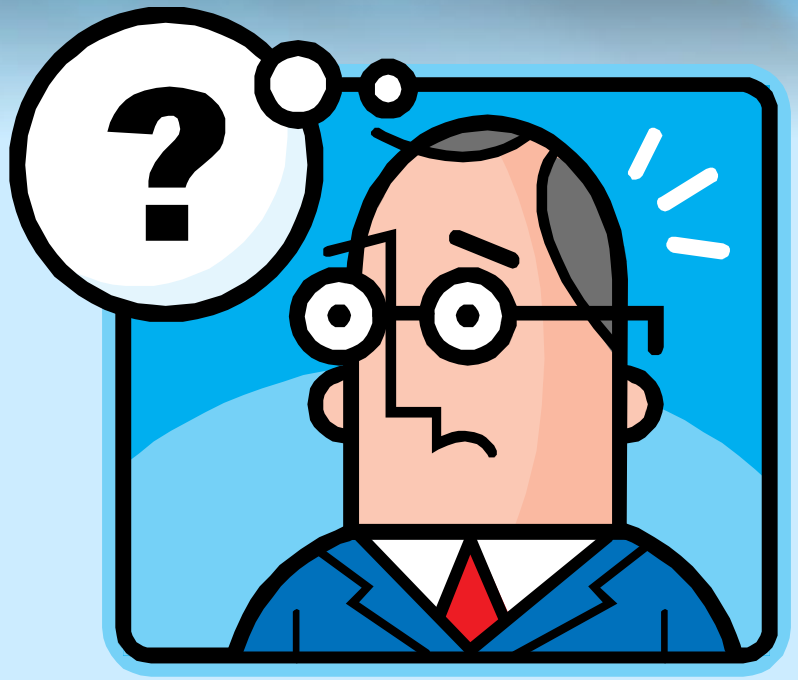
- Equipment
  - Rollers
  - GPS
- Equipment Setup and Verification
- Technical Support
- Quality Control Plan
- Establishment of Target Value
- IC Construction

FHWA Specs Require Use of Veda

IC Analysis with *Veda*



IC for Asphalt



Questions? Discussions?