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SEAUPG
2009 Annual Meeting

**INTELLIGENT COMPACTION
FOR HMA**

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Why Intelligent Compaction? asphalt institute

Why Do We Need IC?

- Proper in-place density is vital for good performance
- Conventional compaction equipment and procedures have shortcomings and too often produce poor results
- **Intelligent compaction technology appears to offer "a better way"**



What is Intelligent Compaction? asphalt institute

An Innovation in Compaction
Control and Acceptance






BOMAG Output


0 - 30
30 - 40
40 - 50
50 - 66
66 - 129




What is Intelligent Compaction? asphalt institute



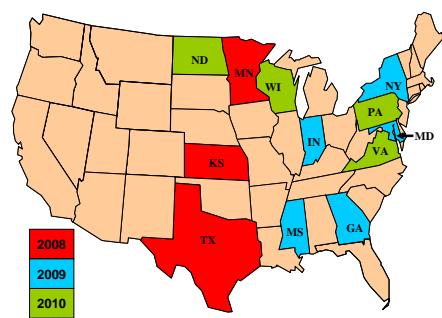
Vibratory Single Drum
Soil Roller



Vibratory Tandem Drum
Asphalt Roller




IC Pooled Fund (ICPF) asphalt institute



2008
 2009
 2010

ICPF States / Year



Tandem Drum IC Roller Suppliers

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Ammann/Case 	Volvo 	Dynapac 
Bomag America 	Caterpillar 	Sakai America 

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IC Roller Requirements

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- IC Roller Requirements
 - Roller Measurement Value (RMV)
 - GPS-Based documentation system
 - Color-coded display (on-board)
 - Surface temperature measurement system
 - **Optional: automatic feedback system**

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Available Tandem Drum IC Rollers

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Bomag 	Sakai 
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Mat Surface Temperature Measurement

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Infrared Thermal Gauge

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Surface Temp vs Internal Temp

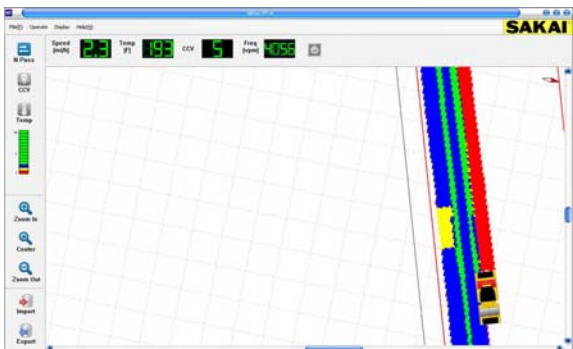
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Color-Coded On Board Display

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Georgia ICPF Project

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TB 01A Intermediate HMA Layer

Roller pass

Sakai CCV

Surface temperature (°C)

Sakai IC roller

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Issues with IC for HMA?

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Special Issues for IC on HMA

- Thin lift construction
- Allowable temperature ranges to eliminate binder viscosity stiffening
- Surface vs. internal mat temperature measurement
- Non-destructive, in-situ stiffness / modulus companion tests

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Global Positioning System (GPS)

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GPS Base Station

GPS Radio & Receiver

GPS Rover

Real Time Kinematic (RTK) GPS Precision

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How Does GPS Work?

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- High Precision RTK GPS used on projects
- GPS base station at fixed location
- GPS receiver and radio on mobile IC rollers
- Both base and rollers get GPS location
- Roller receives radio signal of base location/ compares to its location/ corrects roller location
- Typical nominal accuracy of 1 cm ± horizontally and 2 cm ± vertically

Real Time Kinematic (RTK)

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In Situ Test Devices / Methods

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NG

LWD-a

NNG

PSPA

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Correlation w/ In-Situ Testing

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Area over which the roller MV's are averaged

In-situ test measurements

Distance = Roller travel in 0.5 sec.

Impact Force From Rollers

300 mm □ LWD/FWD

200 mm □ LWD

Nuclear Density Gauge

Dynamic Cone Penetrometer

2.1 m

0.3 m

0.2 m

0.3 m

1.0 m

Influence depths are assumed ~ 1 x 8 (width)

Courtesy of Dr. David White

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Key Questions to Answer

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- Are the IC compaction results improved over conventional compaction?
- Is the IC compaction more efficient than conventional compaction?
- Does the IC measurement values correlate well with properties measured using other independent testing?



Preliminary Findings

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- Use and acceptance by roller operators
- Improved roller patterns / passes
- Use of IC rollers for "mapping" of underlying materials (Soils, GAB, Existing Asphalt Pavements)
- Underlying support affects compactability of subsequent layer
- Correlations of RMV to in situ test results is challenging



Roller Operator Training

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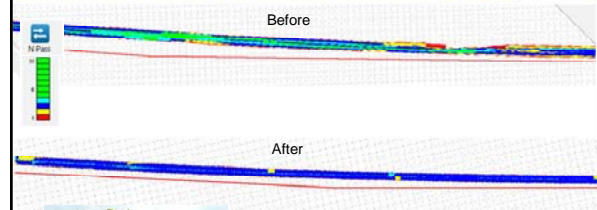


Georgia HMA Demo



Improved Rolling Patterns

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Sakai IC roller

Indiana ICPF Project



Mapping of underling layers

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Minnesota ICPF Project



Mapping of the subgrade / agg. base layer



Mapping of HMA layers

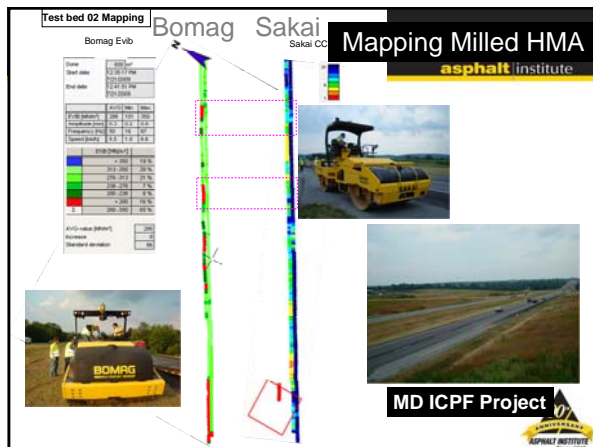
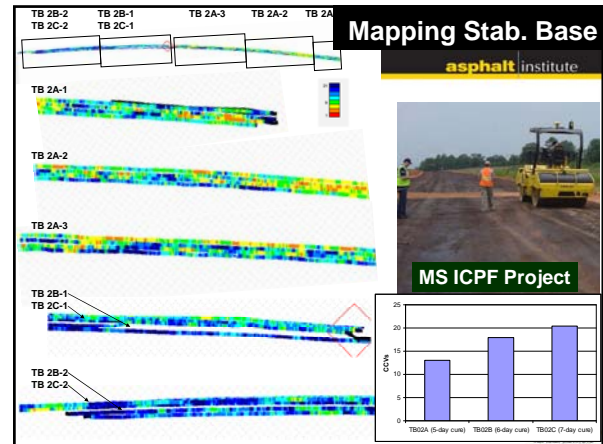
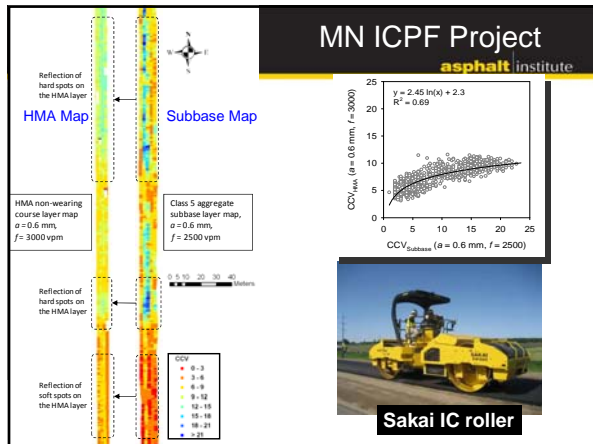
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Minnesota ICPF Project



Compaction/mapping of HMA base course layer





Correlations of RMV vs Density

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- Still analyzing data from 2009 ICPF projects
- Results to date indicate many variables that can adversely affect correlation
 - Mat temperature (min. 220° F?)
 - Mat temperature variations
 - Underlying material support / variability
 - Accuracy / calibration of density gauges

Issues with IC Data Management

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- Data format
- Data collection
- Data storage
- Data processing
- Develop independent software tool
 - Efficient
 - Accurate
 - Fast

Benefits of IC for HMA

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- Improve density....**better performance**
- Improve efficiency....**cost savings**
- Increase information....**better QC/QA**
- Overall Benefit:
Improved Pavement Performance!

