Intelligent Compaction for Hot Mix Asphalt

Intelligent Compaction Demo and HMA Density Project
October 18, 2012
Cocoa, Florida

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Intelligent Compaction is a Smarter Way to Get Things Done!
Compaction Technology has come a Long Ways!

Buffalo Springfield Steam Roller
Compaction is the final (and very important) step in construction of asphalt pavements. Proper in-place density is essential for good performance of asphalt pavements. Numerous research and field studies have verified that obtaining optimum density through good compaction practices is vital to achieve expected service life.
Importance of Compaction?
Discussion Items

- What is Intelligent Compaction (IC)?
- Conventional versus Intelligent Compaction
- Practical Uses of IC to improve QC
  - IC mapping of underlying layers
  - Improving roller pass consistency
  - 100 % coverage showing areas of low ICMV (low density, poor subgrade support?)
- What are benefits of IC?
What is Intelligent Compaction?
What is Intelligent Compaction?

An Innovation in Compaction Control and Acceptance
What is Intelligent Compaction?

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
Comparison of Conventional versus Intelligent Compaction?
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
California Paving Project

- Inconsistent Roller Coverage

Shoulder (Supported)

Paving Direction

Longitudinal Joint

Courtesy Sakai America
Shortcomings in Density Acceptance Process

Limited Number of Locations

After Compaction is Complete
Practical Uses of IC to Improve Quality Control

- Mapping of underlying layers prior to asphalt pavement placement
- Improved roller patterns
- 100% coverage of 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 Underlying Layers

Minnesota ICPF Project

Compaction/mapping of HMA base course layer
Reflection of hard spots on the HMA layer

HMA non-wearing course layer map
\( a = 0.6 \text{ mm}, \ f = 3000 \text{ vpm} \)

Reflection of hard spots on the HMA layer

Class 5 aggregate subbase layer map,
\( a = 0.6 \text{ mm}, \ f = 2500 \text{ vpm} \)

Reflection of soft spots on the HMA layer

CCV = 2.45 \ln(x) + 2.3
\( R^2 = 0.69 \)

MN 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
Color-Coded On Board Display
Improved Rolling Patterns

Before

After

Indiana ICPF Project

Sakai IC roller
100% Coverage of ICMV
TB 01A Intermediate HMA Layer

100 % Coverage

Georgia ICPF Project
Summary – IC for Asphalt

- IC technology is readily available from multiple suppliers in the United States.
- IC offers many advantages over conventional compaction equipment.
- IC provides valuable new tools to the contractor to improve Quality Control.
- IC offers valuable new tools to the owner/agency to improve pavement service life.
What’s Next?

New / Improved IC Technologies

Caterpillar Remote Wireless Capabilities
Benefits of IC for HMA

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

- Overall Benefit:
  Improved Pavement Performance!
IC for Asphalt

Questions? Discussions?
USE AND ACCEPTANCE BY ROLLER OPERATORS
Tandem Drum IC Roller Suppliers

Bomag

HAMM-Wirtgen

Caterpillar

Sakai
Global Positioning System (GPS)

- GPS Base Station
- GPS Radio & Receiver
- GPS Rover

Real Time Kinematic (RTK) GPS Precision
What is Intelligent Compaction?

Mat Surface Temperature Measurement
### Test bed 02 Mapping

**Bomag Evib**

<table>
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<th>Parameter</th>
<th>AVG</th>
<th>Min</th>
<th>Max</th>
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<tr>
<td>EVBD (MN/m²)</td>
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<td>193</td>
<td>352</td>
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<tr>
<td>Amplitude (mm)</td>
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<td>0.2</td>
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<td>Frequency [Hz]</td>
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<tr>
<td>Speed (km/h)</td>
<td>5.5</td>
<td>1.0</td>
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**Sakai CC**

**Mapping Milled HMA**

**MD ICPF Project**
Summary – IC Mapping

• IC mapping did show a difference between ICMV of “rubblized” (14) and “crack and seated” sections (18)

• IC mapping did show a dramatic difference in ICMV between the soil shoulder and the rubblized PCC
Generic IC Specifications

• Equipment
  • Rollers
  • GPS
• Equipment Setup and Verification
• Technical Support
• Quality Control Plan
• Establishment of Target Value
• IC Construction
INTELLIGENT COMPACTION EQUIPMENT

Yesterday

1924 Buffalo Springfield Steam Roller
FHWA Intelligent Compaction
And In-Place Density Projects
August 9, 2012
Orem, Utah

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for Hot Mix Asphalt

By
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