Using Intelligent Compaction for Quality Control?

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Using Intelligent Compaction for Quality Control?

What Is Intelligent Compaction?

Why Intelligent Compaction?

Intelligent Compaction and QC

Improving QC with Intelligent Compaction

Mapping Underlying Areas

Summary

Questions
Washington DC 1907

Intelligent Hauling Units?

Thanks to Bob Horan, Asphalt Institute
What is Intelligent Compaction?

Vibratory Single Drum Soil Roller

Vibratory Tandem Drum Asphalt Roller
What is Intelligent Compaction?

An Innovation in Compaction Control and Acceptance
Why Intelligent Compaction?

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 is “a better way”
How Does IC Help with QC?

“Real-Time” Feedback to Roller Operator
- On-Board, Color-Coded Mapping
  - Improved roller patterns
  - Improved temperature control
  - Ability to make adjustments “on-the-fly”
  - Roller Operator Accountability

Permanent Records of Compaction Data

“Mapping” of Underlying Materials
  - RMV (Roller Measurement Values) readings
  - Locates “soft spots”
  - Identifies irregular support for compaction
IC Roller Requirements

- Roller Measurement Value (RMV)
- GPS-Based documentation system
- Color-coded display (on-board)
- Surface temperature measurement system
- Optional: automatic feedback system
Available Tandem Drum IC C Rollers

Bomag

Sakai
## Roller Measurement Values (RMVs)

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<th>Supplier</th>
<th>Roller Measurement Value</th>
<th>Measurement Unit</th>
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<tbody>
<tr>
<td>Sakai</td>
<td>Compaction Control Value; CCV</td>
<td>Unitless</td>
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<tr>
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<td>Vibration Modulus; $E_{VI\text{B}}$</td>
<td>$\text{Mn/ m}^2$</td>
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Color-Coded On Board Display
Global Positioning System (GPS)

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

Real Time Kinematic (RTK) GPS Precision
Mat Surface Temperature

Infrared Thermal Gauge
Improving QC using IC

“Real-Time” Feedback to Roller Operator
Improving QC with IC

- Shortcomings in Density Acceptance Process...

- Limited Number of Locations

- After Compaction is Complete
Sakai Project - CA

- Roller Passes

Shoulder (Supported)

Paving Direction

Longitudinal Joint

Number of roller passes

1 2 3 4 5 6 7 8

Courtesy Sakai America
Roller Operator Training
Improved Rolling Patterns

Before

After

Indiana ICPF Project

Sakai I C roller
Improving QC using IC

Permanent Records of Compaction Related Data and Data Analysis
Data Analysis - PA ICPF
Data Analysis - PA I CPF
Data Analysis – PA I CPF

SW880 breakdown compaction

Mean: 28.48
STD: 15.45
COV: 0.54
Improving QC using IC

“Mapping of Underlying Layers Prior to Paving"
“Mapping” of Underlying Materials

- Use of RMV color-coded mapping to measure support prior to paving of:
  - Subgrade soil materials
  - Stabilized subbase materials
  - Aggregate base materials
  - Existing asphalt pavements
  - Rubblized concrete pavements

- Underlying Support affects compatibility of subsequent layers
Mapping” of underling layers

Mapping of the subgrade / agg. base layer

Minnesota ICPF Project
Reflection of hard spots on the HMA layer

HMA Map

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

Reflection of hard spots on the HMA layer

Subbase Map

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

Reflection of hard spots on the HMA layer

Reflection of soft spots on the HMA layer

CCV
- 0 - 3
- 3 - 6
- 6 - 9
- 9 - 12
- 12 - 15
- 15 - 18
- 18 - 21
- > 21

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

Sakai IC roller

MN I CPF Project
### Test bed 02 Mapping

#### Bomag Evib

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#### Bomag

#### Sakai CCV

#### MD I CPF Project

#### MD US 340 EBL
Operational Instructions (for data collection and transfer) are fairly quick and easy.

However, where manufacturer support is not on-site, collection and transfer of data to agency is problematic.

IC software supplied to agencies and contractors for data analysis is difficult to use.
Summary

- Intelligent Compaction is a major innovation in compaction technology
- Research/field projects show that IC can offer a valuable tool to improve QC of the compaction process
- IC technology is now readily available in U.S.
- More work is needed to address various issues
- Can you use the Technology for QC?
Questions?
Future Research Needs - IC

- Improve correlation of Density vs. RMV
- Standardization of RMV
- Explore GPS Technology
  - Use of advanced, high prec. GPS technology
  - “Stand-Alone” (non RTK) GPS Technology
- IC Data Management
  - Improvements in on-board roller software
  - Data collection/storage
  - Data analysis/reporting
Mountainous, Curvy, Heavily Forested Roadways

Pennsylvania I CPF Project
“Mapping” of Base and HMA Layers

Minnesota ICPF Project
Research and field projects have shown:

- Intelligent Compaction is an important innovation that can improve the compaction process and QC practices.
- IC equipment is available now.
- Generally, roller operators and project personnel find IC technology "user friendly" and a valuable tool.
- More research is needed to address issues with standardizing RMV, with data management, and with GPS.