Intelligent Compaction Technology
An Innovation in Compaction Control and Testing

Lee Gallivan
Asphalt Pavement Engr.
Office of Pavement Technology
Federal Highway Administration
www fhwa dot gov/pavement/
What is “Intelligence?”

– Oxford Dictionary: “…able to vary behavior in response to varying situations and requirements”

– Ability to:
  • Collect information
  • Analyze information
  • Make an appropriate decision
  • Execute the decision
FHWA IC Team

- 12 State Pooled Fund Partners…
- Roller & Test Equipment Manufacturers
- Lee Gallivan, HIPT
- Michael Arasteh, RC
- Fred Faridazar, R&DT
- Tom Harman, RC
- John D’Angelo, HIPT
- Bob Horan, SaLUT *(Support Staff)*
We’ve come a long way!
Because we always ask…

How can we do it better?

What’s the next innovation?
Roadway Compaction

- Proper in-place density is vital for good performance
- Conventional compaction procedures have some limitations…
- Intelligent compaction technology appears to offer “a better way”
Conventional Limitations

- Density Acceptance…

Limited Number of Locations

After Compaction is Complete

Intelligent Compaction
Intelligent Compaction

Can we make the process...smarter?

Improved Roller Technology

Sophisticated / Clear Documentation Systems

ACE
Ammann Compaction Expert

Advanced Hardware & Software
Intelligent Compaction, IC
IC TPF / FHWA Definition

1. Vibratory rollers with measurement / control system
   - Measurement system, ex. material stiffness
   - Control system automatically changes parameters (amplitude and possibly frequency) based on measurement...
IC TPF / FHWA Definition

2. GPS-based documentation systems
   - Continuous recordation of materials stiffness
   - Continuous recordation of corresponding roller location
   - Color-coded mapping of stiffness
Ex. Caterpillar

Caterpillar

VariVibe

Job: E8719-pm (1500 x 950)
7/19/2005 5:33:30 PM

X size: 1500
Y size: 1200
Zoom: 10

Scale Max: 120

X: -377
Y: 145

Find

Passes: 6
CMV: 22.78
Evib: 4.00
Energy: 3.50

R^2: 0
Slope: 0
Offset: 0

CMV
Evib
Energy

Log Pt.
Export Report
Export Raw Data
Exit

Global Coordinates

Courtesy of Caterpillar
Sakai IC Roller Project

- Temperature

Longitudinal Joint

Shoulder side (Supported)

Paving Direction

Intelligent Compaction
Benefits of IC

- Maximum productivity of the compaction process
- Improved density of pavement materials
- Measurement and recordation of materials stiffness values
- Identification of non-compactable areas
- Improved depth of compaction
- Reduction in highway repair costs
National Research Efforts

• NCHRP 21-09 “Examining the Benefits and Adoptability of Intelligent Soil Compaction”

• Transportation Pooled Fund #954 – “Accelerated Implementation of Intelligent Compaction Technology for Embankment Subgrade Soils, Aggregate Base and Asphalt Pavement Material”
• Study of IC of subgrade soils (limited aggregate base/subbase)

• Objectives: Based on data / information obtained from field studies:
  – Develop generic IC construction specifications for subgrade soils
  – Evaluate the reliability of IC system components
NCHRP 21-09
Phase One Project

July 2006; MnROAD Research Center
Pooled Fund (Soils / HMA)

- 3 year study of IC for all materials
- Solicitation period ended on Dec 2005
- 12 participating states
- Estimate 1+ project / State / year ~ 15-20?
- Close coordination with NCHRP project
- Stated goal to work closely with roller suppliers to increase the number of IC rollers and manufacturers
Accelerated Implementation of IC
Pooled Fund, Objectives

- Objectives: Based on data obtained from field studies:
  - Accelerated development of QC/QA specifications for granular and cohesive subgrade soils, aggregate base and asphalt pavement materials...
Pooled Fund, Objectives

- Develop an experienced and knowledgeable IC expertise base within Pool Fund participating state DOT personnel

- Identify and prioritize needed improvements to and/or research of IC equipment and field QC/QA testing equipment (DCP, FWD, GeoGauge, etc)
State DOT IC Research

- Limited number of projects by several State DOTs (MN, NC, MD)
- Mn/DOT has conducted an ongoing research effort over last several years
  - 5 projects complete
  - Subgrade soils only
  - 3 different roller manufacturers
  - Compare roller-generated output to in-situ test methods (DCP, LWD and GeoGauge)
  - Required GPS-based, color coded mapping of roller output and locations
IC Rollers
Current Status

• 5 Roller Manufacturers have announced their intentions to supply IC rollers in US
  – 4 have announced plans to have both single drum soils rollers and tandem drum asphalt rollers
  – 1 has only single drum soils rollers, at this time

• 4 Manufacturers that currently have IC rollers for public display, at this time:
  – Bomag America (both single and tandem drum)
  – Ammann America (single drum)
  – Caterpillar (single drum)
  – Sakai America (tandem drum)
Special Issues for HMA IC

- Thin lift construction
- Allowable temperature ranges
- Surface vs. internal temperature measurement
- Non-destructive, in-situ stiffness
- Response parameters
IC – Goals / Benefits

• Short Term
  – Improve density… better performance
  – Improve efficiency… cost saving$
  – Increase information… better QC/QA
Thank you!

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