Intelligent Compaction: Fifty years of Development

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IS IC READY FOR PRIME TIME?

- IC FOR SOILS
  - YES
- IC FOR GRANULAR BASES
  - YES
- IC FOR HOT MIX ASPHALT
  - YES

---Definition---

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

3000-4000 TIMES A MINUTE

Shortcomings Density Acceptance...

Limited Number of Locations
**Benefits of Intelligent Compaction**

*We have found-----*

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

**Soil/Bases Rollers**

- Ammann/Case
- Caterpillar
- Bomag America
- Sakai America

**HMA Rollers**

- Ammann/Case
- Caterpillar
- Bomag America
- Sakai America

**What IC rollers need to have to be IC**

- Vibratory Roller;
- Real time Kinematics (RTK) GPS system for roller positioning measurement computer systems;
- Integrated measurement computer systems to collect & analyze roller and pavement response information;
- Accelerometers mounted in or about the drum to monitor applied compaction efforts;
- Temperature instrumentation (HMA)
- GPS – based documentation system
GPS Base Station
GPS Radio & Receiver
GPS Rover

Real Time Kinematic (RTK) GPS Precision

(Courtesy of Sakai America, Inc.)

(Courtesy of Bomag America, Inc.)
Correlation w/ In-Situ Testing

Area over which the roller MV's are averaged

Impact Force from Rollers

300 mm □ LWD/FWD

200 mm □ LWD

Nuclear Density Gauge

Dynamic Cone Penetrometer

Distance = Roller travel in 0.5 sec.

In-situ spot test measurements

Influence depths are assumed ~ 1 x B (width)

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In-situ spot test measurements

Distance = Roller travel in 0.5 sec.

Influence depths are assumed ~ 1 x B (width)
Objectives: Based on data obtained from field studies:

- Accelerated development of QC/QA specifications for granular and cohesive subgrade soils, aggregate base and Hot Mix Asphalt (HMA) pavement materials...
- Short, Long and Future Term Goals
- 3-year IC study for all the above materials
- 12 participating States
- 12+ field demonstration

US 52, West Lafayette, IN
Mapping milled HMA surface
New HMA overlay

Sakai
Bomag

Double-drum IC roller
Intelligent Compaction

- US 340EB, Frederick, MD
- SMA overlay
- Mapping milled HMA surface

Bomag double-drum IC roller
Sakai double-drum IC roller

Test bed 02 Mapping
Bomag Sakai

Mapping Milled HMA

TB 03A Mapping on Exiting HMA Pavement

- US 340 EB
- Mapping Milled HMA

Sakai double-drum IC roller

Sakai CCV Surface Temperature

Semi-variogram - exponential model
Nugget=16.5
Sill=28.5
Range=40
**Intelligent Compaction**

**Existing pavements**

- PSPA vs FWD

**New SMA construction**

- PSPA vs IC

**IC RMV vs NG**

- Sakai Double-drum IC roller

**Density vs CCV**

- Linear (Density vs CCV)

**Sakai Double-drum**

- Peter’s Road, Springville, NY
- Mapping existing subbase
- New HMA construction

**Federal Highway Administration**
Future Initiatives:
- Regional Conferences – that target practitioners
- Establishment of Optimum Measurement Values
- Guidance Manual/Best Practices for both Soils and Hot Mix Asphalt Materials
- Mini-IC Demo's: Limited support for field trials with Non-TPF States
- Web-Page Continuation
- Specification development
- National and International Conferences

Implementation of IC for Contractors and Agencies
- Validating RTK-GPS on each IC roller
- Target IC RMV with the optimum number of roller passes on a test strip to density
- Mapping underlying materials prior to paving
- Utilize IC roller-integrated temperature measurements to facilitate compaction at the optimum temperature ranges
- Utilize IC roller location capabilities to facilitate complete coverage of the HMA and to assist the roller operations, particularly at night
- Report and monitor RMV in segments to identify weak areas and facilitate agency acceptance
- Utilize IC Roller data as part of the QC/QA operations
Thank you