FHWA/TPF Intelligent Compaction Study

By

George Chang, PhD, PE

The Transtec Group
Acknowledgement

- VDOT – Brian Diefenderfer and Trenton Clark
- Superior Paving – Dave Helmick, James Mitchell, Chris Griffith, Todd Atkins, and etc.
- Volvo – Dale Starry, Chad Fluent, Mohammad Siam.
- OU – Prof. Sesh Commuri and students.
- Sakai – Todd Mansell
- Kessler – Larry and Virginia Aicken
- Trimble – Pete Kaz and Bruce Hanes
- Keystone Precision – Mike Winsor
Transportation Pooled Fund #954

“Accelerated implementation of intelligent compaction for embankment subgrade soil, aggregate base, and asphalt pavement material”

- 3-year IC study for all the above materials
- 12 participating States
- 12+ field demonstration
IC Field Demo Schedule

- **2008**: Mini demo in TX
- **2009**: 2 demos in TX
- **2010**: Mini demo in TX
Objectives

- Accelerated development of QC/QA specifications for subgrade soils, aggregate base and asphalt pavement materials
- Develop an experienced and knowledgeable IC expertise base within Pool Fund participating State DOTs
- Identify and prioritize needed improvements to and/or research of IC equipment and field QC/QA testing equipment
Prioritization of IC Improvements

- Simplifying IC usage
- Achieving greater IC value, cost benefit, etc.
- Improved accuracy
Application of Material Types

- Type I : Non-cohesive subgrade soil
- Type II : Cohesive subgrade soils
- Type III : Aggregate base material
- Type IV : Asphalt pavement material
- Type V : Stabilized base material
IC Roller Requirements

- Continuous roller-integrated measurement system
- Real-Time Kinematic (RTK) Global Position System (GPS) based mapping
- Real-time onboard display and integrated software reporting system
- (Optional) Feedback control
Participating Soil/SB Rollers

- Ammann/Case
- Bomag America
- Caterpillar
- Dynapac
- Sakai America
Participating Asphalt Rollers

- Bomag America
- Sakai America
- Volvo
- Ammann/Case
- Caterpillar
- Dynapac
Roller Measurement Values

Ammann/CASE
\( k_b \)

Bomag
\( E_{VIB} \)

Caterpillar
CMV, RMV, MDP

Dynapac
CMV

Sakai
CCV

Courtesy of Dr. David White
Which tests can be used as companion tests to RMV?

Impact Force From Rollers

Distance = Roller travel in 0.5 sec.

In-situ spot test measurements

Area over which the roller MV's are averaged

Influence depths are assumed ~ 1 x B (width)

300 mm □ LWD/FWD
200 mm □ LWD
Nuclear Density Gauge
Dynamic Cone Penetrometer

Courtesy of Dr. David White
In-Situ Test Methods for HMA

NG

LWD-a

NNG

PSPA
In Situ Test Methods for Soils/SB/STB
Key Findings

- Values of mapping existing support before construction or overlay
- Significant improvements of rolling patterns, thus, consistent products
- Improvement of roller operators’ accountability
Key Findings (cont’d)

- Construction process-control greatly improved
- IC-MVs correlate to various in-situ point measurements
- Measurement influence depth varies depending on technology and site conditions
- Machine operation parameters influence MVs
Ultimate Goals of TPF IC

Gain the knowledge needed to develop credible and productive IC specifications for future projects
Future IC Spec

Station 271+00 to 269+00
Nugget = 0
Sill = 35
Range = 8
Distance to Asymptotic "Sill" = 48

<table>
<thead>
<tr>
<th>% Target</th>
<th>CCV</th>
<th>IC Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;130%</td>
<td>55</td>
<td>10%</td>
</tr>
<tr>
<td>90-130%</td>
<td>38 - 55</td>
<td>83%</td>
</tr>
<tr>
<td>80-90%</td>
<td>34 - 38</td>
<td>4%</td>
</tr>
<tr>
<td>70-80%</td>
<td>29 - 34</td>
<td>1%</td>
</tr>
<tr>
<td>&lt;70%</td>
<td>&lt; 29</td>
<td>&lt; 1%</td>
</tr>
</tbody>
</table>

Courtesy of Dr. David White