Intelligent Compaction

2012 ARIZONA PAVEMENTS/MATERIALS CONFERENCE
INTELLIGENT COMPACTION

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COMPONENTS OF INTELLIGENT COMPACTATION

- OPERATIONAL SYSTEMS
- MAPPING SYSTEMS
- GPS
Intelligent Compaction?

WHAT IS

INTELLIGENT COMPACTATION
INTELLIGENT COMPACTION IS:

- A SYSTEM THAT MEASURES THE STIFFNESS OF THE MATERIAL BEING COMPACTED
- A MEASUREMENT OF THAT STIFFNESS AS RELATED TO DENSITY
- A SYSTEM THAT MAKES OPERATIONAL CHANGES ON THE ROLLER EXCLUSIVE OF THE OPERATOR
INTELLIGENT COMPACTION IS:

- A system that documents the stiffness of the material, the location, and the # of passes.
- A quality control system that improves density and smoothness of the material being compacted; and is a Prof Roller.
What is “intelligence”
What is “intelligence”

“... the ability to adapt its behavior in response to varying situations and requirements”
INTELLIGENT COMPACION IS NOT:

- A SYSTEM THAT MEASURES DENSITY ON THE ROLLER.
- AS SYSTEM THAT MEASURES THE RELATIONSHIP BETWEEN DENSITY ON THE MATERIAL AND STIFFNESS ON THE ROLLER; IF YOU DO NOT HAVE A BASE WITH CONFINEMENT.
- A SYSTEM THAT CAN BE USED ON PNEUMATIC OR STEEL STATIC ROLLERS.
Intelligent Soil Compaction

Soil reaction force $F_B$

Compression (loading)

Expansion (unloading)

Vibration path $s$

$E_{VIB}$ [MN/m²]
3 TYPES OF VIBRATORY SYSTEMS

- ROTARY- STANDARD SYSTEM ON MOST VIBRATORY ROLLERS
- OSCILLATION- MOVEMENT OF DRUM IS OSCILLATING
- DIRECTED- MAXIMUM FORCE IN VERTICAL MOVEMENT OF DRUM
Exciter Method Variations

Rotary exciter

Oscillation

Directed exciter
Exciter Method Variations

Rotary exciter

Directed exciter

True Intelligent Compaction
The Traditional Way of Compacting

- High or Low Amplitude Choices
- Pre-defined number of passes – or Experience
- Potentially Low Efficiency
- Potentially Low Effectiveness
- Contractor loses time and money
Electronic Documentation

BCM05 Display
Documented Low Stiffness Area
Documented Low Stiffness Area will have repeat failure without drainage work.
Compaction Bonuses
Locate Non-Compactable Areas
Operation Improvement
Complete Surface Documentation
IC for Asphalt
Asphalt Manager with new measuring value $E_{\text{VIB}} \ [\text{MN/m}^2]$ and temperature gauge.
Asphalt Manager Versatility

Horizontal Vector

# 4 Mid Vector

# 6 Vertical Vector
Vario Directed Exciter

From Horizontal to Vertical
6 Force Outputs Created by Vectoring
Bomag Operational Panel

PRINTER
- Start
- Stop
- Print out
- Delete

Test procedure:
- Mark the track to be compacted
- „Manual operation mode“ with
- Fixed amplitude
- Fixed working speed
Changing From Metric To U.S. Units
6 Settings From Horizontal To Vertical
## Basic Printed Documentation

- Number of Passes
- Temperature
- Evibe Min and Max
- Evibe Average
- Frequency
- Average Speed
- Track Length

### BOMAG Terrameter

**PASS No. 2 FOR.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplitude</td>
<td>1.8 mm</td>
</tr>
<tr>
<td>Evib max.</td>
<td>83 N/m²</td>
</tr>
<tr>
<td>Evib min.</td>
<td>67 N/m²</td>
</tr>
<tr>
<td>Average Evib</td>
<td>76 N/m²</td>
</tr>
<tr>
<td>Evib increase</td>
<td>12%</td>
</tr>
<tr>
<td>Frequency</td>
<td>30 Hz</td>
</tr>
<tr>
<td>Average oper. speed</td>
<td>2.6 km/h</td>
</tr>
<tr>
<td>Track length</td>
<td>23.1 m</td>
</tr>
</tbody>
</table>

**Scale:** 5m

### Graphs

- Graph showing amplitude and frequency over distance.
- Graph showing percentage of track length.

Scale: 5m

<table>
<thead>
<tr>
<th>Percentage</th>
<th>10%</th>
<th>13%</th>
<th>9%</th>
<th>15%</th>
<th>9%</th>
</tr>
</thead>
</table>
\( E_{\text{VIB}} \) - Printer

\( E_{\text{VIB}} \) Max. / \( E_{\text{VIB}} \) Min.

\( E_{\text{VIB}} \) Average Frequency

Average Speed

Track length

Temperature
8.8.2 Test Strip Construction

- Simulating Actual Conditions
- Establishing Roller Pattern
- Effective Roller Speed
$E_{VIB}$ and Density as function of passes; BW 174 AD Asphalt Manager, Automatic mode; Asphalt Base 0/32 CS B65, Nürnberg A3
Outlook: DATA-LINK

BCMNET

Process and quality improvement by datalink between compaction and pavement equipment
A PROOF ROLLER
2 PASSES VERSUS 3 IN TEST STRIP
ULTIMATE SMOOTHNESS

- ONE DRUM VIBRATING IN HORIZONTAL VIBRATION DIRECTION--FRONT DRUM
- REAR DRUM SHUT OFF
- 13/4INCH LOOSE LIFT 2PASSES--DENSITY 93.7% MTD
- SMOOTHNESS 38.5-42.0 IRI MEASURED WITH A LAZER MOUNTED VEHICLE
IC Vario Benefits – Why IC ???
$ VALUE

- I/C MEASURES THE STIFFNESS OF A LIFT OF HMA
- DENSOMETERS MEASURE DENSITY OF HMA
- THIS GIVES US TWO MEASUREMENTS OF THE STABILITY OF THE HMA
- WHY CUT SO MANY CORES THAT COST $800.00-$1000.00 A CORE
THANK YOU