How to Use Intelligent Compaction Effectively
Session W34, Wednesday, March 23, 2016

JILL M. THOMAS, P.E.
EXECUTIVE DIRECTOR
MINNESOTA ASPHALT PAVEMENT ASSOCIATION
What is IC?

On-Board Control Box

GPS Receiver

SNM940 Connected Site Link

Temperature Sensor

Compaction Sensor

Temperature Sensor

Figure Courtesy of Trimble
12 sensors spaced 1 foot apart, reading interval = every 12 inches
Scanner Measures Thermal Profile

Photo Courtesy of Moba Corporation
IC & IR Implementation Timeline for MnDOT

Percent of MnDOT Projects meeting project selection requirements.

- **2014**: 10% (10-15%)
- **2015**: 10% (10-15%)
- **2016**: 40-50%
- **2017**: 50-75%
- **2018**: 100% (100%)

50 Intelligent Compaction Projects
60 Thermal Profiling Projects
## Project Selection Requirements

<table>
<thead>
<tr>
<th>Technology</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligent Compaction (IC)</td>
<td>Base, FDR, SFDR, CIR, Ultrathin Bonded Wearing Course*, Plant Mixed Asphalt Pavement, Stone Matrix Asphalt</td>
</tr>
<tr>
<td>Paver Mounted Infrared Thermal (PMIT) System</td>
<td>Plant Mixed Asphalt Pavement, Stone Matrix Asphalt</td>
</tr>
</tbody>
</table>

* IC is recommended with UTBWC only when used in conjunction with Asphalt Pavement

- Chapter 8 (pp. 55-56) of MnDOT Pavement Design Manual
- ≥ 6 Lane Miles
- Cellular Coverage (at least one time per day)
- 100% Global Navigation Satellite System Coverage within project limits
# MnDOT Support / Review of Data

<table>
<thead>
<tr>
<th>Software</th>
<th>Construction Year</th>
<th>Report Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary</td>
<td>≤ 2014</td>
<td>MnDOT</td>
</tr>
<tr>
<td>Veta 3.0</td>
<td>2015</td>
<td>MnDOT</td>
</tr>
<tr>
<td>Veta 4.0*</td>
<td>2016</td>
<td>Contractor (MnDOT – QA)</td>
</tr>
<tr>
<td>Veta 4.0 or Later</td>
<td>2017</td>
<td>Contractor (MnDOT – QA)</td>
</tr>
<tr>
<td>Veta 4.0 or Later</td>
<td>2018 (Full Deployment)</td>
<td>Contractor (MnDOT – QA)</td>
</tr>
</tbody>
</table>
Veta

IC – All Current Vendors

IR – Scanning System & Static Bar

Future: GPR, Smoothness, Digital Test Rolling

QC / QA Spot Tests
## IC - Measurement Passes

### Required Measurement Pass Locations

<table>
<thead>
<tr>
<th>Specification</th>
<th>Measurement Pass Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subbase</strong> 2105 / 2106</td>
<td>All roller passes on the Top of Subgrade. (When the depth is within 6 ft (2 m) of Grading Grade.)</td>
</tr>
<tr>
<td></td>
<td>All roller passes on final Grading Grade Lift.</td>
</tr>
<tr>
<td><strong>Bases, CIR</strong> 2211, 2215, 2331</td>
<td>All roller passes on each Lift.</td>
</tr>
<tr>
<td><strong>Asphalt Pavement</strong> 2353, 2360, 2365</td>
<td>All roller passes on each Lift.</td>
</tr>
</tbody>
</table>

100% Mainline including Control Strips
## Monetary Price Adjustment – Roller Coverage

### Monetary Price Adjustment for Roller Coverage (RC)

<table>
<thead>
<tr>
<th>Roller Coverage (RC) (%)</th>
<th>Total Price Adjustment Per Lift</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 70</td>
<td>No Price Adjustment</td>
</tr>
<tr>
<td>&lt; 70</td>
<td>$ = (20 \times RC - $1400) \times (LM)$</td>
</tr>
</tbody>
</table>

where:
- PPC = Project Percent Coverage, %
- LM = Total Number of Lane Miles for the given lift, miles
# Thermal Segregation Severity Level

<table>
<thead>
<tr>
<th>Sublot Temperature Differential</th>
<th>Thermal Segregation Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range ≤ 25.0°F</td>
<td>Low</td>
</tr>
<tr>
<td>25°F &lt; Range ≤ 50°F</td>
<td>Medium</td>
</tr>
<tr>
<td>50 °F &lt; Range</td>
<td>High</td>
</tr>
</tbody>
</table>

Range = \( \text{Temp}_{98.5\text{Percentile}} - \text{Temp}_{1\text{Percentile}} \)
## Monetary Price Adjustment – TC

<table>
<thead>
<tr>
<th>Thermal Coverage (%)</th>
<th>Total Price Adjustment Per Lift</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 70</td>
<td>No Price Adjustment</td>
</tr>
<tr>
<td>&lt; 70</td>
<td>Total Price Adjustment (Deduct) = (20 × TC – $1400) × (LM)</td>
</tr>
</tbody>
</table>

where:
- **TC** = Thermal Coverage for given lift, %
- **LM** = Total Number of Lane Miles for the given lift, miles
Web sites to review

- http://www.dot.state.mn.us/materials/intelligentcompaction.html
- https://www.youtube.com/watch?v=jmrl_bpcRVY
- http://www.dot.ca.gov/hq/construc/ic/
Goal for Asphalt Contractors

- Provide growth opportunities for our employees and make a profit
- Safely construct high quality, long lasting pavements
- Need:
  - The Right Equipment
  - The Right People
  - The Right Methods
  - The Right Materials
Things that effect our goal

- Mix Design
- Mix Temperature
- Air Temperature
- Ground Temperature
- Humidity
- Wind
- Traffic
- Technology
- Sunny or Cloudy
- Day or Night
- Time of Year
- Education
- Communication
- Leadership
- Equipment
- Others?
A change of trucks is often a reason for temperature differences in mixed materials and can quickly be detected as a unique cold spot.

After having optimised process flows, road construction companies are now able to attain uniformly high-quality road surfaces with a consistent temperature.
Temperature & Pass Count Mapping

- The CCS900 system provides:
  - Pass count maps
  - Real-time temperature maps
TH59 at Paver

- 3 Mile Dead Haul
- 30% Good
- 57% Moderate
- 13% Severe
- $3,480 for Thermal Image at Paver
- $21,596 in Density Incentive 65.9%
TH86

- **Paver**
  - 20 Plus Mile Dead Haul
  - 22% Good
  - 63% Moderate
  - 32% Severe
  - $240 for Thermal Image at Paver

- **Rollers**
  - 74.8% Over Required
  - 11.5% Required
  - 13.7% Under Required

- **Density**
  - $51,815 Incentive paid 66.8%
  - $11,413 First Lift
  - $40,412 Second Lift
# TH 86 Thermal Profiles

<table>
<thead>
<tr>
<th>Date</th>
<th>% Good</th>
<th>% Moderate</th>
<th>% Severe</th>
<th>Mean Temp, °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/25</td>
<td>60</td>
<td>38</td>
<td>1</td>
<td>283</td>
</tr>
<tr>
<td>9/26</td>
<td>67</td>
<td>33</td>
<td>0</td>
<td>280</td>
</tr>
<tr>
<td>9/27</td>
<td>61</td>
<td>39</td>
<td>1</td>
<td>280</td>
</tr>
<tr>
<td>9/29</td>
<td>60</td>
<td>37</td>
<td>2</td>
<td>273</td>
</tr>
<tr>
<td>9/30</td>
<td>11</td>
<td>62</td>
<td>29</td>
<td>264</td>
</tr>
<tr>
<td>10/1</td>
<td>14</td>
<td>52</td>
<td>33</td>
<td>282</td>
</tr>
<tr>
<td>10/3</td>
<td>7</td>
<td>61</td>
<td>31</td>
<td>260</td>
</tr>
<tr>
<td>10/4</td>
<td>13</td>
<td>76</td>
<td>11</td>
<td>263</td>
</tr>
</tbody>
</table>

Different Equipment Used
Results Pass Count and Temperature with Rollers

- Roller operators were able to stay in proper working range
- Over rolling decreased
- Rubber rollers were able to keep tires cleaner
- Less release agent used
- Checking with nuclear gauge showed more consistency
- Our best practices were enhanced
Results Temperature Measurement at Paver

- Important reinforcement:
  - Truck Tarps
  - Balanced truck cycle
  - Overlapping loads
  - Wasting Loads
  - Match plant and paver productivity
  - Keep work zone “tight”
Opinion or Question

- Is the investment in people and equipment worth it?
- Do we have enough best practices in place if used correctly?
- Do we have the specifications in place to give the customer a quality road already?
- Will the direction we are heading give us better roads or just higher cost for each mile we drive?
SAPA Survey: 1) IC?  2) IR?

*California*
- Caltrans has a number of IC pilot projects for CIR and HMA.
- As of this dispatch, no spec for the infrared bar.

*Illinois*
- No, however, in partnership with IL APA, IL DOT is working on PAVE-IR loaner program. In addition, the Department will be evaluating new Material Transfer Devices by using PAVE-IR.
- For IC, IL APA members have experimented with using the equipment. However, the DOT currently has no plans to mandate its use.

*KY*
- No, however have done some experimental IC projects. Have a spec drafted but it is not fully implemented nor is it incorporated in our spec book, experimental basis.
Maryland
- We have done an FHWA assisted IC demo and it was not huge success. Part of the time the GPS did not work because of the proximity of trees the correlation to the cores did not fare too well although the data was never officially presented.

Massachusetts.
- Massachusetts has IC projects underway with job specific specifications. The plan is to develop a spec in the next 2 years.

New Jersey
- Piloted Projects. The state is currently in demonstration phase for both technologies. It's up to them to decide.

New Mexico
- IC – is being done on a case by case basis mostly on Hot Mix but sometimes on the base course.
Ohio
▶ No, only as QC tools

Oklahoma
▶ 1-ODOT is letting pilot projects this year using IC to see if this adds value.

Pennsylvania
▶ 1-YES

South Carolina:
▶ No IR Bar Specification, but several SCDOT projects used an IR Bar this year in one district to monitor paver speed/stops for information only.

Texas
▶ YES Under the following link you will find the 2014 TxDOT specification
Utah

- Utah experimented with IC several years back (demo in partnership with FHWA) and even put a special provision but abandoned due to glitches.

Washington

- No implementation planned anytime soon. Washington State DOT believes the technology is still not well suited for HMA compaction control.
- WSDOT had 3 or 4 Infrared Bar demonstration projects two & three seasons ago. While the information was interesting, it was not seen to result in better pavement compaction and there are no plans to implement a spec. Using an MTV has eliminated most concerns about temperature differentials.
Thanks for your Participation

Please complete the evaluation to provide your feedback on this session and suggest topics for future events.

Remember to mark these upcoming events on your calendar!

March 7-11, 2017
www.conexpoconagg.com
www.ifpe.com