Application of Intelligent Asphalt Compaction Analyzer (IACA) in Improving the Compaction Quality of Asphalt Pavement

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Introduction

- The United States has more than 2 million miles of paved roads and highways, 94 percent of those are surfaced with asphalt.
- In 2011, more than $46B was spent in U.S.A. for maintenance and upgrades of these roadways.
- Compaction is one of the important elements in pavement construction that affects the quality of the pavement.
- Continuous compaction quality control can help improve pavement quality and reduce the long term maintenance costs of this critical infrastructure.

Objective

Investigate the use of Intelligent Asphalt Compaction Analyzer (IACA) for improving the quality of asphalt pavement.

Background of IACA

- IACA is an Intelligent Compaction Technology that estimates the density of asphalt pavement in real-time during compaction.
- It is based on the hypothesis that during compaction, the roller and the underlying pavement form a coupled system.
- The vibrations of the roller is affected by the density of the underlying pavement.
- Analysis of the roller vibrations can help estimate the density.

Procedure

- Site selection.
- Instrumentation of roller with IACA.
- Calibration using a control strip.
- Continuous monitoring of compaction and identification of under compacted areas.
- Remedial compaction of under compacted areas.

Results

- Table 1: Field evaluation of IACA (Highways for Life Technology Partnerships Program, FHWA)

<table>
<thead>
<tr>
<th># Cores</th>
<th>Type</th>
<th>Mean Density (Correct)</th>
<th>Std. Dev (Correct)</th>
<th>Mean Density (IACA)</th>
<th>Std. Dev (IACA)</th>
<th>Error (IACA-Cor)</th>
<th>Std. Dev Error</th>
<th>Max Error (IACA)</th>
<th>R²</th>
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<tbody>
<tr>
<td>20</td>
<td>AC base (Full Depth)</td>
<td>92.29</td>
<td>1.62</td>
<td>92.21</td>
<td>1.44</td>
<td>-0.06</td>
<td>0.55</td>
<td>1.7</td>
<td>0.80</td>
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<td>27</td>
<td>Intermediate (Full Depth)</td>
<td>93.24</td>
<td>0.9</td>
<td>93.12</td>
<td>1.13</td>
<td>-0.06</td>
<td>0.58</td>
<td>-1.3</td>
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<td>15</td>
<td>Surface (Full Depth)</td>
<td>92.1</td>
<td>0.87</td>
<td>92.07</td>
<td>1.03</td>
<td>-0.03</td>
<td>0.62</td>
<td>-1.2</td>
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<tr>
<td>49</td>
<td>AC base &amp; Intermediate (HMA Overlay)</td>
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<td>1.53</td>
<td>92.91</td>
<td>1.56</td>
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<td>0.65</td>
<td>-1.5</td>
<td>0.83</td>
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<tr>
<td>64</td>
<td>Surface (HMA Overlay)</td>
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<td>1.04</td>
<td>93.83</td>
<td>1.07</td>
<td>0.15</td>
<td>0.77</td>
<td>-2.2</td>
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</tr>
</tbody>
</table>

Fig 1. Components of IACA
Fig 2. IACA during operation
Fig 3. Test location
Fig 4. Density map of final pass in the soft region after traditional compaction R1, R2 and R3 are selected test locations
Fig 5. Density map of final pass after remedial compaction
Fig 6. Improvement of density through IACA compaction
Fig 7. Comparison between IACA and Lab Density for selected test stations

Conclusions

- Generation of density map in real-time by IACA can be used to identify under compacted regions during compaction.
- Real-time identification of under compacted regions can be used to implement remedial actions.
- Remedial compaction can help improve the overall density and uniformity of the construction pavements.

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References

