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All AASHTO and ASTM standards mentioned in this presentation content are non-governmental, voluntary standards and are not required under Federal law.
<table>
<thead>
<tr>
<th>Acronyms and Abbreviations</th>
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<tr>
<td>AA = Agency acceptance</td>
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<td>AASHTO = American Association of State Highway and Transportation Officials</td>
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<tr>
<td>AQC = Acceptance quality characteristic</td>
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<td>CFR = Code of Federal Regulations</td>
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<td>DDIAPT = Development and deployment of innovative asphalt pavement technologies</td>
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<td>DPS = Dielectric profiling system</td>
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<td>DR = Dispute resolution</td>
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<td>GPS = Global positioning system</td>
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<tr>
<td>IA = Independent assurance</td>
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<tr>
<td>IC = Intelligent compaction</td>
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<tr>
<td>ICE = Intelligent construction equipment</td>
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<tr>
<td>IR = Infrared</td>
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<tr>
<td>LA/Q = Laboratory accreditation / qualification</td>
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<td>NDT = Non-destructive technologies</td>
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<td>PMTP = Paver-mounted thermal profilers</td>
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<td>PQ/C = Personnel qualification / certification</td>
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<td>QA = Quality assurance</td>
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<tr>
<td>QC = Quality control</td>
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<td>UNR = University Nevada Reno</td>
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Overview of DDIAPT

Development and Deployment of Innovative Asphalt Pavement Technologies (DDIAPT)

- A Cooperative effort between FHWA and the University of Nevada at Reno.

Objective:

- Stimulate, facilitate, and expedite the deployment and rapid adoption of new and innovative technology relating to the design, production, testing, control, construction, and investigation of asphalt pavements.

Core Project Team:

- University of Nevada at Reno
- Paragon Technical Services
Presentation Outline

- Intelligent Construction Equipment Report
- Other Products Discussing NDT Technologies
- Takeaways/Conclusions
Authors: Harold Von Quintus, Hadi Nabizadeh, Adam Hand, and Elie Hajj

Objective:
- Provide information for including ICE in a QA program conforming to 23 CFR 637 Subpart B.
ICE Technical Report

1. Intelligent Compaction – QC
2. Dielectric Profiling System – QC or Acceptance
3. Paver Mounted Thermal Profiler – QC or Process Control
ICE Technical Report

QA Core Elements:
1. Agency acceptance
2. Contractor quality control
3. Independent assurance
4. Dispute resolution
5. Qualified laboratories
6. Qualified testing/sampling personnel
Quality Control:

- Activities of the contractor required by the agency.

Process Control:

- Voluntary activities of the contractor; not required by the agency.
Asphalt Pavements – Contractor Testing (2022)

States that used contractor test results in the acceptance decision for asphalt pavements.
Intelligent Compaction

AASHTO R 111-22

- Monitors roller passes (level 1).
- Estimates the stiffness (level 2).
- Response feedback to adjust roller energy (level 3).

Coverage uniformity of breakdown rolling pattern.
Technical Issues / Challenges

- Monitoring roller passes (level 1) ready for QC.
- Still considered to be in implementation stage 3 (levels 2 and 3).
  - Impact of mat temperature & cooling rate?
  - Impact of supporting layer/foundation?
1. Quality Control / Process Control
   a. Confirm rolling pattern results in obtaining a uniform mat density (level 1).
Paver Mounted Thermal Profiler

- IR Scanner and GPS attached to paver on a mast or post.
  - IR Scanner measures mat temperature behind screed.
  - GPS used for location.
AASHTO R 110-22

- Estimates surface temperatures of asphalt mat behind the paver.
- Excessive temperature differentials across the mat typically results in excessive variability in mat density.
IR Scanner screen used to "see" and monitor mat temperatures in real time.

Outcomes:
- Measures surface temperatures.
- Time diagram screen; number of stops.
- Paver speed diagram screen.
Paver Mounted Thermal Profiler

QA Potential

- Quality Control / Process Control
AASHTO PP 98-19

- Measures the average dielectric constant/value of the asphalt mat, which can be correlated to mat density.
- Evaluates entire asphalt mat; assumption of a normal distribution not needed.
- Percent conforming between the minimum and maximum limits of AQC.
- Longitudinal profiles measured.
Challenges

- Dielectric value correlated to density/air void, dependent on different variables:
  - Surface condition; dry, damp, wet.
  - Mat thickness.
  - Bulk specific gravity/air void gradient.

- Field-derived relationship using only cores.
  - Lab-compacted may have advantages.

- Operator safety and fatigue.
- Weather / moisture.
- GPS connectivity.
- Data management.
QA Potential

1. Acceptance with agency testing.
   a. Agency or designated agent.

2. Quality Control / Process Control.
   a. Confirm uniformity of mat density.

Dielectric Profiling System
QA Issues / Challenges
Especially when used for acceptance & pay determination

1. Acceptance with contractor testing.
   a. Agency verification.
   b. Validation of contractor results.
2. Independent assurance.
   a. Contractor’s equipment and personnel.
3. Training and certification of construction personnel/paver operator.
   a. Equipment to undergo annual certification.
   b. Equipment should be verified at beginning of the project.
   c. Calibrate GPR sensors each day of use.
   d. Personnel trained in setting up and using the DPS.
4. Dispute resolution.
   a. Cores?
5. Precision and bias of the AQC – dielectric value (density).
   a. Tolerance and threshold values needed.
Presentation Outline

- Intelligent Construction Equipment Report
- Other Products Discussing NDT Technologies
- Takeaways/Conclusions
Other Selected Products Using NDT in QA

TPF-5(443): Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)
- https://www.pooledfund.org/Details/Study/667


FHWA Spotlight on Pavement Density and Uniformity
Presentation Outline

- Intelligent Construction Equipment Report
- Other Products Discussing NDT Technologies
- Takeaways/Conclusions
Takeaways/Conclusions

1. IC, PMTP, and DPS represent opportunities to:
   a. Impact asphalt pavement performance positively.
   b. Provide spatial quality information.

2. Remember the role of the Quality Assurance Program.

3. Management of real-time, continuous data with map-based viewing (e.g., Veta) is a tool for agencies and contractors to assess the uniformity of placement and compaction processes to achieve quality.

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<td>IC</td>
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<td>Yes</td>
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<tr>
<td>PMTP</td>
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<td>Yes</td>
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<tr>
<td>DPS</td>
<td>Yes with Agency testing</td>
<td>Yes</td>
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A Practice for Including Intelligent Construction Equipment in a Quality Assurance Program

Thank you
Questions/Discussion?

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