Determining Pavement Density Using Radar Specification Development

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Outline

• Brief introduction to Density Profiling Systems
  • What are they, how do they work, and what can we use them for?

• Description of the specification development process for innovative technologies in the NYSDOT Materials Bureau
  • How it works with the case study of the DPS specification development to date
But first…Terminology

- RDM – Rolling Density Meter
- PaveScan

These all mean *basically* the same thing
What is the DPS?

DPS uses ground penetrating radar to continuously assess asphalt compaction.

- Produces real time data
- Creates a “heat” map of the entire pavement area

Can be used as a QA or QC tool

New York State DOT is part of a pooled fund study (TPF-5 (443)) to research this technology and intend to implement it in some capacity in the future.

Photo: Geophysical.com
How does it work?

Ground penetrating radar or GPR uses the dielectric constant of a material along with some calibration data to calculate real time compaction. By producing pucks of varying known density and measuring the dielectric, we can develop the relationship between those properties for a given mix. This relationship calibrates the radar to show real time measurements of density.
In the Field

With the PaveScan calibrated, this is what the data in the field will look like

Photo: Geophysical.com
Outputs – Data

- Raw data files
  - Shows every dielectric value measured accompanying reference data
    - GPS coordinates, noise level, height of the sensor off the pavement, stationing, serial number of the sensor. Etc …
  - Thousands of lines of data per scan

- Segment statistics (100ft segments)
  - Min, max, average density
  - Standard deviation
  - Histogram density data
  - Average and max signal noise level

- Core location files
  - Separate scans which are performed at core locations to further calibrate the data to traditional measurements
Outputs – Visualization

Google earth overlay

Photo: Geophysical.com
Specification Development Process for innovative technologies

1. Publish a new Spec.
2. Partner with stakeholders
3. Try the spec on the jobs
4. Document opportunities for spec improvement
5. Prepare updates to address observations
DPS Specification Development

Short Term Goals
• Establish background with this technology within the Department and construction industry
• Compare test results of DPS with current acceptance methods
• Show what accepting projects based on DPS results would look like

Long Term Goals
• Have DPS available as an option for full project acceptance
• Reduce or eliminate cores from 50 and 60 series project acceptance
Spec. Development – Phase 1

2020 Season- Completed first 2 paving jobs in New York

Goals
• Visibility of the technology
• Determine capabilities

Features
• Shadow program
• Basic instructions
• No data manipulation
• Full Coverage

Phase 1- lessons learned
• 100% coverage unmanageable at this stage of development
• Operator training is essential
• Core vs Nuclear Gauge vs DPS need to be prioritized moving forward
Spec. Development – Phase 2

2021 Season- Completed 6 paving jobs

Changes from previous spec version
• Reduced coverage from 100% to 50%
• Added new reporting requirements for static testing at core locations
• Increased usage both in number of jobs and in geographic area

Phase 2- lessons learned
• Greater personnel investment from DOT Main Office was needed to advance effort further
• Number of calibration specimens can now be reduced without concern
• Job selection needs to focus on 60 series and 50 series whenever possible
• Distinction between QC and QA use of this technology needs to be drawn
Spec. Development – Phase 3

2022 Season- Completed 7 paving jobs

**Specification changes**
- Reduced number of calibration specimens
- Increased the reporting requirements

**Other Changes**
- Now that the foundation of this specification has been established, new resource investments are made to shift focus from investigating the technology to developing a program around the technology.
  - More presence at paving jobs
  - Discussions about formatting the submissions with operators
Lessons Learned

• Calibration specimens can be reduced in size as well as quantity
• A sensor array with multiple sensors is required to ensure redundancy
• A clear way to determine if a scan is along a confined or unconfined joint is required
• There is a need for NYSDOT operator certification
• Given the diversity of possible data output options there is need for standardized NYSDOT documents for data submission
• There is need for a Materials Method to describe the particular ways in which the Department will require field operations to be conducted
• As much data comparing measurement methods as possible is needed to ensure stakeholder buy-in
Spec. Development – Phase 4

Currently finalizing changes to the specification for the 2023 season

Focus of the development process has shifted. We are now working to get the special spec closer to a fully defined process that would be acceptable as a standard specification

• Primary focus is no longer investigation of the technology, we are now investigating the implementation of the technology in State projects
Spec. Development – Phase 4

• MM99 provides standardized submittal forms which allow us to continue to define the accuracy of this method compared to others

• It also defines the submittals for the rest of the data that is collected under only this method
  • This is where we break QA with QC
  • This specification has not been used to date for acceptance, we are now developing what a method of acceptance would look like under this program
    • Lots, Averages, Statistical analysis, triggers for corrective actions, pay adjustments. We are working through all of this now
Spec. Development – Phase 4

Vision for the future

• We are using the same specification development process to develop the project acceptance version of the spec
• NYSDOT operator certifications rolling out next year
• Returning to 100% pavement coverage in 2024
• Initially it will again be used as a shadow specification with reports to the contractor to show what would have been had the project been based on DPS
• Hope to accept first projects based solely on DPS in 2025 and reduce coring schedules in 2026
• Core free pavements remains a long term aim
Questions?

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