Quality Control Behind The Paver

Using IR Technology

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Topics

- SHRP2 Pilot Project Information
- IR Technology Quick Overview
- Project Results
- Potential for Use
- Questions

SHRP2 Project Information

- May 2017 on AL-202 in Anniston, AL: STPAA-0202(523); 4.355 mi.
- Roadway was milled and surface treated, minor patching/leveling
- 401B-100 E Treatment – 171,000 square yards
- 401B-108 G Treatment – 42,680 square yards
- 1.5” of 424A-360 ½” Wearing Surface - 14,250 tons
- Produced at Midsouth Paving, Inc.'s Oxford Asphalt Plant which was less than 10 miles from the project
- Roadtec MTD; Roadtec rubber-tired paver; HAMM steel-drum breakdown roller; Sakai steel-drum finish roller; end-dumps
- Night paving
- Much of the information herein comes from the SHRP2/AASHTO report on the project (used by permission)

IR Technology Quick Overview

- Infrared (IR) asphalt pavement scanner technology has been recommended as a part of the second Strategic Highway Research Program (SHRP2) as one of the Technologies to Enhance Quality Control on Asphalt Pavements (RO6C)
- Equipment used on this pilot project was Pave-IR Scan™ and Software, manufactured by MOBA Mobile Automation.
- The equipment is designed to provide real-time thermal visualization of the mat behind the paver as it is being laid and provide analysis and development of a “thermal profile”.
- Consists of several components working together

IR Technology Quick Overview

- Components can include:
  - On board computer
  - IR Temperature Scanner
  - Distance Measuring Instrument (DMI) or
  - High Precision Antenna
  - Weather Station
  - Temperature Sensors
  - Acceleration Sensor
  - Position Converter
  - Signal Conditioner
  - Proprietary Software
IR Technology Quick Overview

**On board computer**

![On board computer image]

**IR Technology Quick Overview**

**IR Temperature Scanner**

**Temperature Sensor**

![IR Temperature Scanner and Temperature Sensor images]

**Weather Station**

**High Precision Antenna**

![Weather Station and High Precision Antenna images]

**Various Configurations – adaptable to any paver**

*One Example...*

**Software Trace – Analysis Zones and Example of Contour Plot**

![Software Trace image]

**Versus on board computer display**

*Temp range is user selected on software and display...If set too wide, can make any asphalt look good and if set too narrow can make any asphalt look bad. Training is very important!*

![On board computer display image]
**Project Results**

- **Prescreen Criteria**
  - Analysis zone did not include data collected within 2’ of the mat edges (adopted from TxDOT Tex-244-F)
  - Eliminate data from locations of paver stops greater than 10 seconds (also from TxDOT Tex-244-F). Thermal profile from 2’ behind and 8’ in front of each paver stop (in the direction of paving) was eliminated.
  - Eliminate any readings below 170 deg. F and over 400 deg. F to minimize impact of any human or other interference or any random error during data collection.

- **Project Results**
  - **Temperature Differential, or T\text{diff}**
    - \( T\text{diff} = T_{98.5} - T_{1.0} \)
    - 98.5 and 1.0 percentiles obtained from temperature data
  - \( T\text{diff} \) less than or equal to 25 deg. F = No thermal segregation
  - \( T\text{diff} \) between 25 deg. F to 50 deg. F = Moderate thermal segregation
  - \( T\text{diff} \) greater than the 50 deg. F = Severe thermal segregation
Project Results
- Longitudinal thermal streaking not observed
- When excluding paver stops, no segments had severe $T_{eff}$
  - TxDOT Spec covers “excludes paver stops”
  - “Includes paver stops” was specific to the SHRP2 Study to show the effects of paver stops
- 30% had moderate thermal segregation, while 70% had none
- Results deemed “excellent” in the SHRP2 / AASHTO report

Potential for Use
- Stated Goals of the Technology:
  - More uniformly constructed hot and warm mix layers
  - Higher or more uniform in-place field density
  - Reduced discrepancies between contractor and agency test data or data to explain possible discrepancies
  - Longer lasting pavements with lower maintenance costs

Potential for Use
- As a pure Quality Control tool:
  - Instant feedback for temperature variations
  - Paver tracking (stops, cycle times, trucking)
  - Project tracking (GPS data)
  - Can be coordinated with Intelligent Compaction and laser profiling
  - Identification of process improvements
    - Equipment maintenance
    - Segregation
    - Loading technique
    - Paving practices

Potential for Use
- As a pure Quality Control tool:
  - Expensive technology (+ $30,000)
  - On large projects may be a cost effective tool for contractors
  - Not a typical application for all projects
    - Let’s get one for every paver! Probably not.
  - Personnel capable of using technology / software
    - Laser profiling
    - Already stretched QC staffs
    - Take attention away from other QC functions
  - Like laser profiling, more widespread use when implemented as a specification requirement

Potential for Use
- As a pure Quality Control tool:
  - In conjunction with laser profiling to help improve IRI/MRI results:
    - MoDOT has seen correlation between paver stops/ subsequent severe $T_{eff}$ and high IRI numbers when laser profiling

Potential for Use
- As a Quality Assurance Requirement:
  - What would a specification look like?
    - TxDOT Specification highlights…. (similar to this?)
      - Each subplot / 150 ft. segment evaluated for temp. differential/segregation
      - Graded as “no thermal segregation” ( $T_{eff}$ of 25 deg. F or less), “moderate” or “severe”
      - Areas identified as thermally segregated are tested and evaluated via density segregation testing
      - Paving operations suspended when thermal profile shows $T_{eff}$ greater than 50 deg. F
Potential for Use

As a Quality Assurance Requirement

From a Contractor’s Perspective

What would a specification look like?

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Potential For Use

- Challenges / Concerns of Meeting a Specification:
  - Variables
    - Plant breakdowns / start ups / shut downs / mix switches
    - Equipment / hauler breakdowns
    - Traffic impact on haul cycles (accidents / rush hour)
    - Equipment and plant warm up time
    - Cool weather and wind impact upon mat surface temp.
  - Just another way to penalize contractors
  - Unlike laser profiling implementation
    - Contractors confident in smooth pavements based on “seat of the pants” ride; Smooth ride is a source of pride.

Potential for Use

- As a Quality Assurance Requirement:
  - Realistically, what would a specification look like?
    - Would it include incentives as well as penalties?
    - Would inspectors want to be able to stop paving and require immediate replacement of high temp. differential spots?
      - Impact of this on construction, ride, etc.
    - Application / roll out of technology, specifications, interpretation across multiple ALDOT Operational Areas
      - Laser Profiling
      - Data transfer and interpretation

Potential for Use

- Challenges / Concerns of Meeting a Specification:
  - Contractors and agencies currently “reasonably confident” in uniform density using cores / gauges (existing technology used for years)
  - Contractors only have so much control over temperature. When extremely good technology comes along we have to avoid the desire to overuse it and tighten the specifications too much.
  - When used as a “tool” instead of a specified requirement, the stated goals can still be met.
  - In fact, more density monitoring using gauges and a few more cores could meet the stated goals.

Potential for Use

- Possible specification components:
  - Backup testing (not thermal profile alone) to determine disposition of mix when severe segregation found
  - No on-site, real time corrections required unless very severe
    - Data collection errors, interference, etc.
    - Analysis through software most accurate when compared to visual observation of profile using on board computer
    - Corrected areas excluded from laser profiling
  - Initial testing frequency reduced once certain conditions met
  - Perhaps not an “entire project”, but only during startup and if certain conditions met, no further testing
Potential for Use
• Possible specification components:
  ○ Attainable incentive program, based on max. $T_{off}$
  ○ Options for backup testing in lieu of penalty or vice versa for certain thermal segregation levels
  ○ Only select, certain projects – not on every project
  ○ Buffer zone for start/up warm up
  ○ Consideration for variables discussed earlier and largely out of the control of the contractor
  ○ NOTE – Recent info. from FHWA indicates they would not permit incentives/dis-incentives on Federally funded projects. They currently view IR technology as more of a QC tool to help contractors meet other performance based incentive/disincentive criteria such as density and profiling.

Potential for Use
• Alternative specification suggestion:
  ○ In light of FHWA information, implemented as a QC tool
  ○ Data collection for information purposes only
  ○ Overlay of data with density and laser profile results
  ○ Data used to identify process improvements
  ○ Specific projects only
  ○ Vast amount of variables related to temperature control make it unrealistic to use as an incentive / disincentive QA criteria

Potential for Use
• Suggested: If and only IF a specification will be developed:
  ○ NCAT studies / Test Track
  ○ Industry permitted time to learn about technology
    • Non-specified basis
    • ALDOT “loaner” of their IR equipment, passed around to various contractors
  ○ Joint industry / DOT training courses prior to full implementation
  ○ Joint industry / DOT committee to develop specification
  ○ Industry granted a large review / comment window

References
SHRP2 / AASHTO REPORT (DATA, GRAPHS, ANALYSIS AND INFORMATION)
MOBA WEBSITE (PICTURES, INFORMATION)
TxDOT TEX-244-F; SPECIFICATION ITEM 341 (SPECIFICATION REFERENCES)
GOOGLE EARTH (MAP)

Questions or Comments?

END OF PRESENTATION