EVALUATION OF NON-DESTRUCTIVE DENSITY DETERMINATION FOR QA/QC ACCEPTANCE TESTING

LTRC/DOTD Research Project 17-2B
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BACKGROUND

- Measures to Quality Control and Quality Assurance of the pavement:
  - Density is often considered the most important variable in the construction of durable, longer-lasting asphalt roads.
  - The QC/QA aim for density on hot-mix asphalt pavement is normally around 92 to 93 percent.
  - Low density pavement may result in premature pavement distresses. These distresses may be in the form of pavement settlement, rutting, oxidation, cracking, netting, structure weakening, cracking, or stripping.

INTRODUCTION

- For final density acceptance:
  - Nuclear density gauge for soils
  - Cuts for asphalt
INTRODUCTION

- Destructive density methods disadvantages:
  - Safety concerns
  - Destructive testing
  - Long testing times
    - 24 hours

- Non-destructive density methods advantages:
  - Non-destructive
  - Easy to use
  - Quick results
  - Accurate?
  - Cheaper device and Lower maintenance

OBJECTIVE

- LTRC objective:
  - Determine if Non-destructive density methods can reduce coring for asphalt density acceptance.
  - Provide updated QA/QC procedures if gauges prove to be efficient in providing similar density results as cores.

METHODOLOGY

- Density readings and core obtained from seven asphalt paving sites (seven asphalt mixtures/lifts) in Louisiana. The sites included low and high volume roads for different mat thicknesses and mixture designs to be evaluated.
- A minimum of five density spots were obtained from each site for density gauge and core comparisons. All cores were trimmed to proper thicknesses.
- Sand patch testing was implemented to determine the surface texture impact on density readings of gauges.
- Data collected were analyzed using linear regression and analysis of variance (ANOVA) calculations.
METHODOLOGY

RESULTS

Density gauges vs Cores (No offset)

Density gauges vs Cores (with offset through AASHTO T343)
CONCLUSION

- The linear regression analysis showed that the results of the NNDG and TLNDG presented fair to good correlation to roadway cores, while NDG presented fair to poor correlation.
- ANOVA analysis found that without offset calibration, both NDG and NNDG results were differed from core densities, while with offset they are not significantly different. Based on the P-value, calibrated NNDG results agreed better with cores comparing to NDG results.
- Device usage and practicality were observed when taking the readings. Both NNDGs were easy to operate. NDG and TLNDG testing time was typically 10 to 15 minutes while NNDG took 5 minutes from gauge setup to density results.
- Cost Comparison of each density measuring tool (Core rig, NDG, and NNDG) exhibited that NNDGs would provide the most cost savings. Core rig and NDG cost entail higher maintenance and training costs versus the NNDGs.
STATUS

- In the 2018 special provision as an option for contractors to use
  - the goal is to collect data and make sure the logistics of the specification are working
- Contractors have not really been using the option
  - Only a few
  - Pilot projects for next summer
    - Both methods will be in the contracts
    - Collect data and finalize the specification to replace coring for pay

QUESTIONS?

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SOILS RESULTS

- 3 Soils Projects
  - Cost of each device After 5 years
    - Nuclear gauge = $45,000
    - low-nuclear = $21,000
  - Nuclear Moisture Density Gauge
    - EGauge, Model 4950 Density Gauge
    - Model 6760 Moisture Probe (syncs with EGauge)
    - Initial Cost
      - 0 (already have)
      - High ($21,000)
    - Apply Cost
      - Badges
        - Yes $7,860/year
        - No $0
      - Leak Testing
        - Yes $0
        - No $0
    - License
      - Certification
        - yes ~$1108/year
        - No $0
      - Paperwork
        - Extensive
        - Reduced Reduced
    - Safety
      - Safe when used properly
      - Safe
    - Training & Ease of Use
      - User friendly with familiarity
      - Easy to learn and easy to operate
      - Easy to learn and easy to operate
  - low nuclear
    - $21,000
    - 8-10 year service life