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New Jersey Department of Transportation
Bureau of Research

Technical Brief

Implementation Plan for Alternatives to Nuclear Density Testing

Background

Naturally existing soils and quarry-produced aggregates play a crucial role in highway infrastructure. These materials are typically used to construct base or subbase layers in rigid and flexible pavements. During the construction of these pavements, it is essential to properly compact base/subbase and subgrade materials to suitable density levels. This is primarily because the performance of rigid or flexible pavements is highly dependent on the quality of the compacted subgrade and unbound base/subbase layers. In other words, any compaction defects in these layers typically result in distresses in the upper hot mix asphalt (HMA) or Portland cement concrete (PCC) layers.

In the state of New Jersey (NJ) the nuclear density gauge (NDG) is used as the method to determine if the compaction quality of a soil layer is passing or failing. Despite the popularity and advantages of the NDG, there are several concerns and safety risks associated with using this device including (1) expensive operational costs, (2) difficult to maintain and transport, and (3) an overall safety hazard. Therefore, alternative non-nuclear compaction devices are being evaluated for their potential to replace the NDG for compaction quality testing. Several types of compaction tests were evaluated through a previous FHWA-NJDOT funded project (Alternatives to Nuclear Density Testing, Report No. FHWA-NJ-2016-003). From this project, it was concluded that the Dynamic Cone Penetrometer (DCP) was the best alternative non-nuclear compaction testing method, however, due to its lack of familiarity in highway compaction quality testing, the implementation of the DCP is challenging.

Research Objectives and Approach

Therefore, the goal of this study was to facilitate the use of the DCP and initiate implementation in NJ by providing training to NJDOT personnel and contractors in the State of New Jersey on how to operate the DCP and interpret the test results. To achieve this goal, field demonstrations were conducted at NJDOT job sites to present how to operate the DCP and determine the compaction quality of the unbound layer. The test sites were tested with both the NDG and DCP to evaluate the accuracy of the DCP on field sections. Questionnaires were also distributed to evaluate the opinions of NJDOT personnel and contractors on the use and implementation of the DCP. Additionally, a training video was developed for the purpose of further implementation of the DCP to personnel that were not at the field demonstrations

Conclusions

Based on the test data collected from the field demonstrations and the subsequent data analyses performed, the following conclusions were drawn:

- The DCP provided the same field compaction quality determinations as the NDG at all NJDOT job site locations.
- The majority of the attendees felt comfortable using and implementing the DCP by ranking the operation and interpretation of the DCP as a four out of five (five being the greatest).

Recommendations

The following are the recommendations from the study:

- Based on the responses from the questionnaires, it was found that partial, or full automation, of the DCP is required for feasible widespread implementation.
  - This will alleviate the strength and height requirements necessary to operate the DCP.
  - This will maximize the field testing efficiency and data recording.

- Further validation of the DCP using field test sites and comparisons with the NDG.

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A final report is available online at: http://www.state.nj.us/transportation/refdata/research/.
If you would like a copy of the full report, send an e-mail to: Research.Bureau@dot.state.nj.us.

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