Research Project

02-1GT

Capsule

LTRC

Technology Transfer Program

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Assessment of In-situ Test Technology for Construction Control of Base Courses and Embankments

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Problem

The current Louisiana state quality acceptance criteria for the construction of pavement base layers and other geo-materials is mainly based on achieving adequate field density relative to a maximum dry density obtained in the laboratory. However, the design of these materials in a given project is based on engineering parameters such as strength and/or stiffness. It is anticipated, in any project, to produce a durable material that can perform satisfactorily in the field throughout its expected design life. The primary parameters that affect the performance of materials are the stiffness and/or the strength of that material. The densest state of a material may not provide adequate strength/stiffness criteria as required in the design. Therefore, the quality control/quality assurance procedures of construction should be based on criteria that closely correlate to the parameters used in the design.

The use of non-destructive in-situ tests such as the Dynamic Cone

DCP

Geo-gauge

LFWD

Penetrometer (DCP), the Light Falling Weight Deflectometer (LFWD), and Geo-gauges in characterizing materials can be significant in Q_C/Q_A prior to, during, and after project construction. The DCP, LFWD, and Geo-gauges test can be used as effective tools in the assessment of subsurface conditions due to their simplicity and ability to provide rapid measurements of in-situ strength/stiffness of base layers and embankments. In order to develop a reliable process for Q_C/Q_A of base layers and embankments, the in-situ tests (DCP, LFWD, and Geo-gauges) need to be correlated with the strength parameters of the material.

Objectives

The main objective of this research is to assess the use of non-destructive in-situ tests (DCP, LFWD, and Geo-gauge) in order to evaluate the strength/stiffness characteristics of highway materials for application in the Q_C/Q_A procedures during construction of pavement layers (base and subbase) and embankments. Test procedures will be developed and specifications will be recommended to implement the use of these tests in the Q_C/Q_A procedures prior to, during, and after construction. The proposed research will focus on defining strength/stiffness evaluation criteria that can be implemented for Q_C/Q_A with minimum manpower. The objectives of the proposed research are as follows:

1) Conduct an extensive literature review of current practices used in evaluating strength/stiffness properties for Q_C/Q_A of crushed stone base, soil-cement base, and embankments.

2) Evaluate the strength/stiffness properties of crushed stone base course, soil-cement base course, and embankment soils using the DCP, PLT (Plate Load Test), Geo-gauge, and LFWD.

3) Develop correlations between strength/stiffness properties, moisture content, thickness, and density of crushed stone base course, soil-cement base course, and embankment soils.

4) Develop a correlation between strength properties, cement content, and curing time of soil-cement base course.

5) Develop procedures and standards for Q_C/Q_A in evaluating base layers and embankments.

Description

The following tasks are identified to achieve the objectives:

Task 1 - Conduct literature review on the use of DCP, Geo-gauge, and LFWD tests in evaluating strength/stiffness properties of base courses and embankments.

Task 2 - Study the boundary conditions effect of the test box on the measured strength/stiffness values.

Task 3 - Perform large-scale laboratory experiments on crushed stone base course, soil-cement base course, and embankment soils of different plasticities.

Task 4 - Conduct comprehensive analyses of the collected laboratory data.

Task 5 - Conduct field verification experiments on typical pavement sections using DCP, PLT, Geo-gauges, and LFWD.

Task 6 - Conduct comprehensive analysis to correlate the field measurements to laboratory results.

Task 7 - Develop specifications for Q_C/Q_A in evaluating cement base, crushed stone base, and embankment soils.

Implementation Potential

It is anticipated that this research will present a thorough investigation to identify an accurate and reliable assessment of strength properties of soil-cement, crushed stone base courses, and embankment soils. Such measurements will lead to the identification of easy-to-implement procedures for Louisiana DOTD on Q_C/Q_A of soil-cement, crushed stone base courses, and embankment soils. The study could also be expanded to other types of pavement. The outcome of this research will result in huge savings in DOTD manpower and cost.