RESEARCH PROJECT CAPSULE

May 2012 [12-11P]

TECHNOLOGY TRANSFER PROGRAM

Field Validation of Equivalent Modulus for Stabilized Subgrade Layer

JUST THE FACTS:

Start Date:
May 1, 2012

Duration:
24 Months

End Date:
April 30, 2014

Funding: FHWA

Principal Investigator:
Mark Martinez, P.E.
Pavement Research Engineer

Administrative Contact:
Mark Morvant, P.E.
Associate Director, Research
225-767-9124

Technical Contact:
Zhongjie "Doc" Zhang
Pavement and Geotech
Research Administrator
225-767-9162

Louisiana Transportation Research Center
4101 Gourrier Ave
Baton Rouge, LA 70808

Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Mehodology Used Implementation Potential

WWW.LTRC.LSU.EDU

PROBLEM

In Louisiana, highway construction efforts often encounter field conditions that are so poor conventional site development cannot proceed. In such cases, the structural capacity of the existing subgrade is not sufficient to support the introduction of construction equipment. When this occurs, it is often the practice to treat the existing soil matrix by introducing cement or lime to a depth of six or more inches. The additonal strength that such a treatment brings to a pavement is in no way integrated into that pavement's design. Instead, the augmented strength is usually consigned to the margins of safety. The research being proposed argues that this practice should be changed. Often the added strength that results from subgrade treatment is considerable and its utilization in design would improve project cost-benefit ratios significantly.

OBJECTIVE

The objective of this research is to validate the newly developed Equivalent Modulus Analysis (EMA) spreadsheet that was created by the Louisiana Department of Transportation and Development (LADOTD). This interactive spreadsheet, designed to predict layered design strengths, is to be validated by comparison of its predictions to field collected data. If validation is possible, current pavement design strategies and policies will be updated and modified so as to improve long-term performance and increase benefit-cost ratios on future pavement projects. It is also an objective of this research to develop a guideline with subgrade stabilization (lime and/or cement) for the LADOTD that will allow the Department to take design advantage of the structural improvements that subgrade treatment applications provide.

METHODOLOGY

An attempt will be made to corroborate EMA spreadsheet predictions through a comprehensive series of before and after field evaluations. Falling Weight Deflectometer (FWD), Light Falling Weight Deflectometer (LFWD), and Direct Cone Penetration (DCP) testing will serve to model loading and will be conducted between successive stages of construction and rehabilitation on existing and projected projects so that a dataset of actual performance can be compiled. This dataset will be supplemented by available archival data.

Correlations will be determined by plotting project performance against actual performance. LFWD testing, for example, might be conducted at a prepared

subgrade site prior to a lime or cement treatment so as to determine the site's "before" condition through direct measurement of subgrade properties. A "theoretical after" condition will be determined using the EMA spreadsheet to predict the modulus value that should appear once the project's subgrade layer has been treated. At such time as the subgrade layer is treated, LFWD and or FWD testing will be performed again in order to arrive at an "empirical after" condition. A correlation will be established by plotting the "theoretical after" data against the "empirical after" data. In-situ subgrade modulus and other site characteristics will be explored by other means such as DCP, Shelby tube, plate bearing test, and so on.

The Louisiana Transportation Research Center's (LTRC) Geosynthetic Engineering Research Laboratory (GERL) will conduct a parallel study entitled "In-Situ Evaluation of Design Parameters and Procedures for Cementitiously Treated Weak Subgrades using Cyclic Plate Load Tests." The GERL study also seeks to explore weak subgrades. As such, its findings will be used as support for and to help supplement and steer the proposed research.

The compiled correlation plots will then be analyzed in order to isolate outliers and to parameterize how the theoretical figures deviate from the empirical. The reasons that may underlie why these deviations and outliers became manifest will then be explored and reported on in order to establish a usage adjustment for the EMA spreadsheet.

Methodologies, data, and findings derived from LTRC's project entitled "Accelerated Loading Evaluation of Subbase Layers in Pavement Performance" that was undertaken at Louisiana's Accelerated Loading Facility (ALF) will be integrated into this proposed research effort. The ALF project sought to explore the ramifications of using cement as a subgrade stabilizing agent which makes its findings relevant to the proposed research.

IMPLEMENTATION POTENTIAL

The results of this study are intended to assist the LADOTD to improve the quality of its design and rehabilitation methods. Currently, material and thickness considerations are developed through standardized policy or by tedious trial and error methods using traditional methods. LTRC's newly developed EMA spreadsheet streamlines the calculation process and makes it possible to consider various design elements more efficiently and comprehensively. The supporting field work is expected to verify the theory and comment on those cases where the theory breaks down. The principal advantage expected from this research effort will be to develop a more sophisticated design and rehabilitation approach that will offer the engineer more design options and thereby improve cost-benefit ratios.