Research Project

00-3GT

Capsule

LTRC

Technology Transfer Program

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Evaluation of Consolidation Characteristics of Cohesive Soils from Piezocone Penetration Tests

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LTRC

Louisiana Transportation Research Center

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

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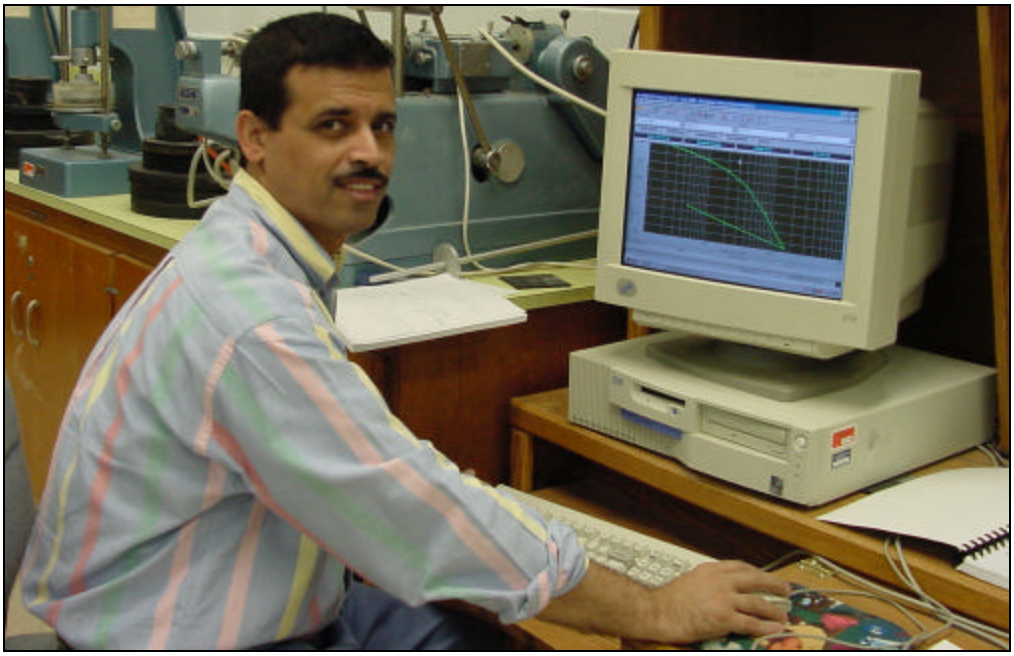
Problem

Much of the geology of Louisiana is dominated with soft compressible soils. Road embankment construction on these soils can produce large settlements. The most noticeable result of such settlement is the "bump" at the end of the bridge. This is caused by differential settlement of a bridge supported on deep piles and a roadway supported on compressible soils. To prevent this bump, DOTD engineers use soil consolidation parameters to predict the amount of settlement that will occur due to the weight of the embankment. Undisturbed samples are taken and sophisticated lab tests are performed to determine these consolidation parameters. Unfortunately, the reliability of these laboratory tests is not very good. These relatively small one-inch samples are used to model large layers of the subgrade profile. The effects of the sampling procedure, release of overburden pressure, and time delays for testing can cause a tremendous variability in the predicted results. Research engineers at LTRC are investigating the prediction capabilities of the piezocone penetration test system (PCPT). This in-



Principal investigator Murad Abu-Farsakh analyzes data in the soils laboratory at the Louisiana Transportation Research Center.

situ system is easier, faster, and more cost effective than conventional laboratory testing.

Objectives

The objective of the proposed research is to use the PCPT system to accurately estimate both the time rate and total magnitude of settlement of fine grained Louiaiana soil subject to embankment loading. The PCPT tip and sleeve data will be used to estimate the constrained modulus of the soil used in determining the magnitude of the total settlement. The pore pressure dissipation data will be used to measure the coefficient of consolidation necessary for predicting the rate of settlement.

Description

The study will include the following tasks:

(1) *Conduct a thorough literature review of existing prediction methods for both total and time rate of settlement using PCPT data.* This search will provide a comprehensive information database on available experimental/ theoretical aspects of utilizing cone penetration test data to evaluate the consolidation characteristics and parameters of cohesive soils.

(2) *Conduct in-situ PCPT and corresponding laboratory testing at a minimum of five different field locations.* LTRC's 20 ton cone truck will be used to push a 15 cm^2 piezocone penetrometer to depths in excess of 100 feet to obtain soil consolidation parameters. The cone will be stopped at different elevations to conduct pore pressure dissipation tests.

(3) *Conduct conventional laboratory consolidation tests on soil samples taken from depths corresponding to the PCPT dissipation tests.* The laboratory tests will be used to determine the coefficient of consolidation, constrained modulus, overconsolidation ratio, compression indexes, and hydraulic conductivity of the soil. Triaxial tests will be performed to determine shear strength, and consistency tests will be conducted to estimate liquid limits and plastic indexes.

(4) *Compare the existing PCPT interpretation methods with the conventional laboratory methods for estimation of pre-consolidation pressure, total settlement and rate of consolidation.* Statistical and reliability analysis will be conducted to evaluate the best prediction methods for obtaining soil consolidation parameters.

(5) *Verify the best prediction method against actual embankment settlements from at least three well documented sites.* The total and rate of settlements at each site will be predicted with the PCPT test method and compared with measured field data.

Implementation Potential

The project researchers anticipate that settlement data acquisition and analysis using the in-situ piezocone penetration tests will be faster, less expensive and more accurate than prediction methods using conventional laboratory data. At the conclusion of this research the PCPT methods will be verified with laboratory and field measurements conducted in Louisiana soils and will therefore be available for practical use by DOTD professionals.