Research Project

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Capsule

Technology Transfer Program

LTRC

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Investigation of the Applicability of Intrusion Technology to Estimate Resilient Modulus of Subgrade Soil

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LTRC

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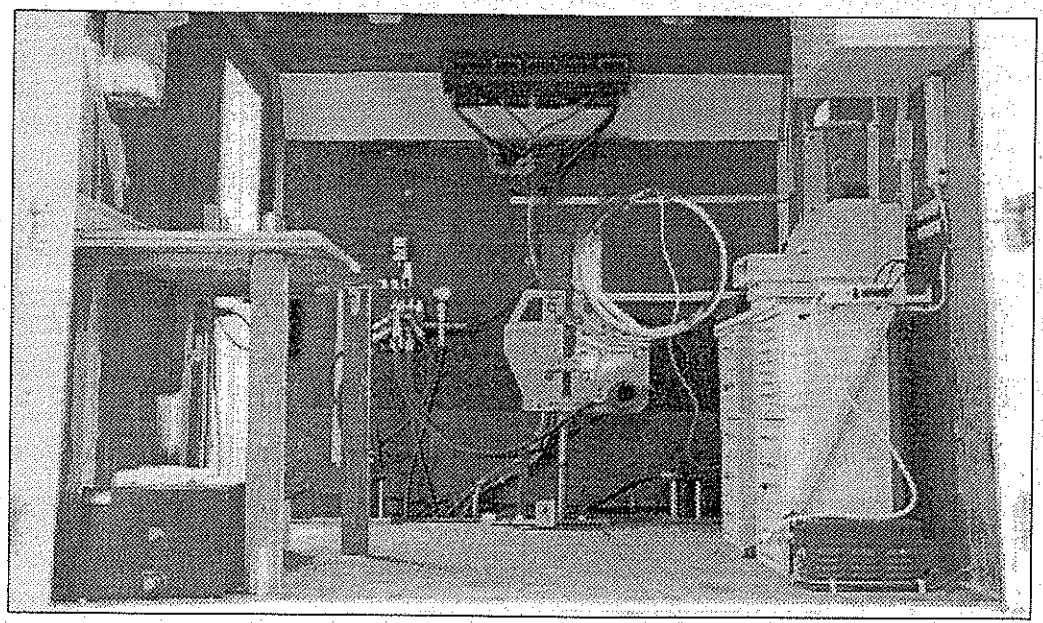
Problem

Many transportation agencies have adapted the design of pavements to reflect the resilient modulus of subgrade soils. Laboratory tests or nondestructive test methods generally used to determine the dynamic resilient properties of subsoils have their drawbacks. The laboratory procedures are considered laborious, time consuming, and highly expensive while the field nondestructive test procedures are limited with respect to repeatability of test results and the identification of layer properties underlaid by soft layers. All these problems can be averted through the use of the in situ cone penetration test method. The cone penetration testing (CPT) is a fast, reliable, repeatable, and cheaper procedure.

The CPT method has been successfully used to determine the static strength and deformation properties of soils. However, its applications in determining the resilient modulus properties have not been fully investigated. This study will research the potential of the CPT method in pavement material characterization, pavement management, pavement construction and rehabilitation, and underground infrastructure development.



In situ cone penetration testing is done with a fully-equipped mobile research vehicle known as a "cone truck."

Objectives

The primary objective of this research is to investigate the applicability of intrusion technology to determine the resilient properties of subgrade soils.

The research work will investigate the applicability of in situ cone testing procedures for evaluating the resilient moduli of subgrade soils. Four locations with distinct soil types will be selected for cone testing. The effect of subgrade soil type, cone size, and overburden depth and their influence on cone test results will also be examined.

The research will also include an investigation of the influence of soil type and soil characteristics on resilient behavior of core samples obtained from the site near the cone test locations. Laboratory resilient modulus tests will be conducted on the core samples to examine this aspect.

The study seeks to draw correlations between cone resistance parameters and laboratory determined resilient moduli. Applicability of theoretical and statistical methods for preparing these correlations will also be examined. Correlations or simplified design charts will be constructed to determine the resilient modulus of soils from the in situ cone testing procedure.

Description

Project sites with four different types of subgrade soils will be selected for field investigations. Cone penetration tests will be conducted at selected locations of these sites.

An in situ research vehicle and a friction cone penetrometer will be used for testing. Various sizes of cones and cross-sectional areas will be considered. Tip and friction resistance will be recorded in the cone tests along the depth of the section. The experimental phase will also include laboratory resilient modulus tests on the undisturbed core samples taken from various depths near cone test locations.

After completion of the testing program, empirical and semi-empirical approaches will be used to analyze the test results and to develop correlations between the laboratory measured resilient moduli and the cone test results. Theoretical methods will be employed in semi-empirical approaches and statistical procedures will be used in the empirical schemes.

Implementation Potential

The successful completion of the proposed CPT study will provide a significant contribution to pavement engineering by providing an innovative and rapid procedure for fundamental characterization of subsoils.

This procedure can be used as an alternative to the expensive sampling and laboratory testing and nondestructive methods generally used to determine the resilient stiffness properties of subsoils. The subsoil resilient stiffness properties are needed for the mechanistic design of flexible pavement systems.

In addition, the CPT technique can be used to determine resilient moduli of subsoils of in-service pavements which will aid in determining the remaining service life of pavements or the need for pavement rehabilitation.

A quick and effective assessment of pavement subsoil properties with this method will enable rapid maintenance of pavements. Since the method is fast, it also reduces the customary delays in pavement construction, thereby reducing traffic congestion and productivity losses. In brief, CPT could save the millions of dollars of new construction and rehabilitation costs which would otherwise be spent on sampling and laboratory testing.