PRACTICAL METHOD OF CONDUCTING THE INDIRECT TENSILE TEST

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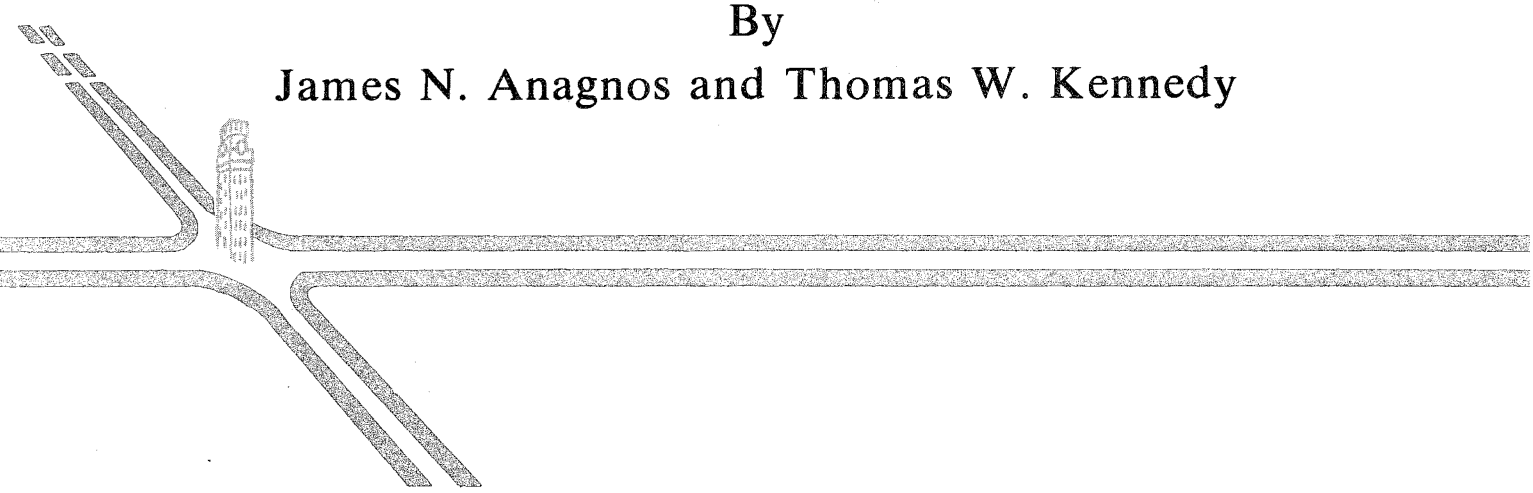

SUMMARY REPORT 98-10 (S)

SUMMARY OF
RESEARCH REPORT 98-10

PROJECT 3-8-66-98

COOPERATIVE HIGHWAY RESEARCH PROGRAM
WITH TEXAS HIGHWAY DEPARTMENT
AND
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

CENTER FOR HIGHWAY RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN
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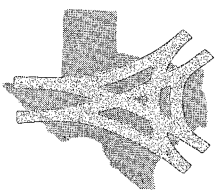

SUMMARY REPORT 98-10 (S)

Foreword

Research Report 98-10 is the tenth in a series of reports dealing with the findings of Research Project 3-8-66-98, concerned with the evaluation of the tensile properties of stabilized subbase materials. The equipment and test procedures involved in conducting the indirect tensile test are described in detail, as is a method of analysis of the test results to determine tensile strength, Poisson's ratio, modulus of elasticity, and total tensile strains.

Introduction

A need has existed for a simple test method which can be used to evaluate the tensile properties of all types of pavement materials and to obtain information which can be used for pavement design. In recognition of the need for information on the tensile characteristics of stabilized subbase materials, Research Project 98, "Evaluation of Tensile Properties of Subbases for Use in Rigid Pavement Design," was conducted by the Center for Highway Research at The University of Texas at Austin for the Texas Highway Department and the Federal Highway Administration.

Several test methods which are currently available to determine the tensile characteristics of highway materials were evaluated, with the indirect tensile test or splitting tensile test being adopted and further developed for use on the project. The portion of Report 98-10 concerned with procedures, equipment, and methods of calculating the various properties has been divided into two sections. The first section deals with the determination of tensile strength, which is relatively simple, requiring only a method of applying and measuring the total compressive load applied to the specimen; the second section deals with the determination of Poisson's ratio, modulus of elasticity, and tensile strains, which is more difficult, requiring accurate measurements of specimen deformations.

Indirect Tensile Test

The indirect tensile test involves loading a cylindrical specimen with compressive loads which act parallel to and along the vertical diametrical plane, as shown in Fig 1. A half-inch-wide stainless steel loading strip with curved interface equal to the radius of the specimen is used to distribute the applied compressive load uniformly along the specimen and causes the specimen to fail in tension along the vertical diameter (Fig 2).

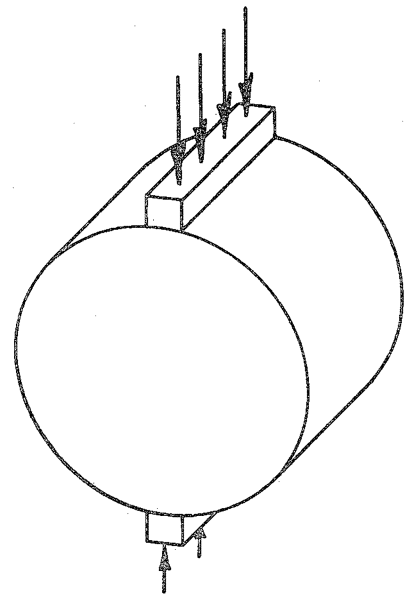

Fig 1. Cylindrical specimen with compressive load being applied.

Determination of Indirect Tensile Strength

Any loading equipment with some provision for attaching half-inch-wide curved face loading strips of the proper radius and capable of applying compressive loads at a controlled deformation rate of two inches per

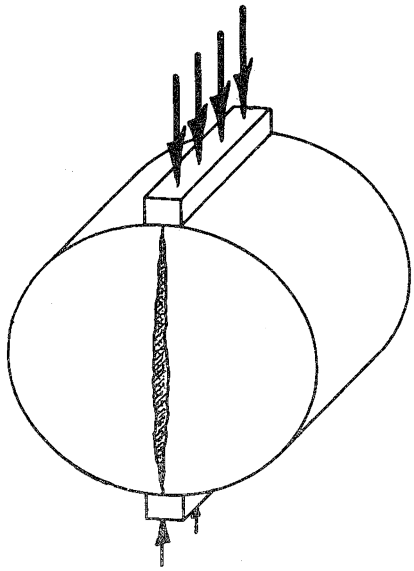

Fig 2. Specimen failing under compressive load.

minute can be used. With some necessary modifications the large Texas Highway Department motorized gyratory press is suitable for use.

The tensile strength of the specimen can be calculated using the following equation:

$$S_T = \frac{2P_{Fail}}{\pi ah} \left(\sin 2\alpha - \frac{a}{D}\right)$$

where

S_T = indirect tensile strength;
P = total vertical load applied to specimen at failure, in pounds;
a = width of loading strip, in inches;
h = height of specimen at beginning of test, in inches;
D = diameter of specimen, in inches; and
2α = angle at the origin subtended by the width of loading strip (Fig 3).

Determination of Poisson's Ratio, Modulus of Elasticity, and Tensile Strain at Failure

Estimates of Poisson's ratio, modulus of elasticity, and tensile strain at failure can be made using theoretical relationships which

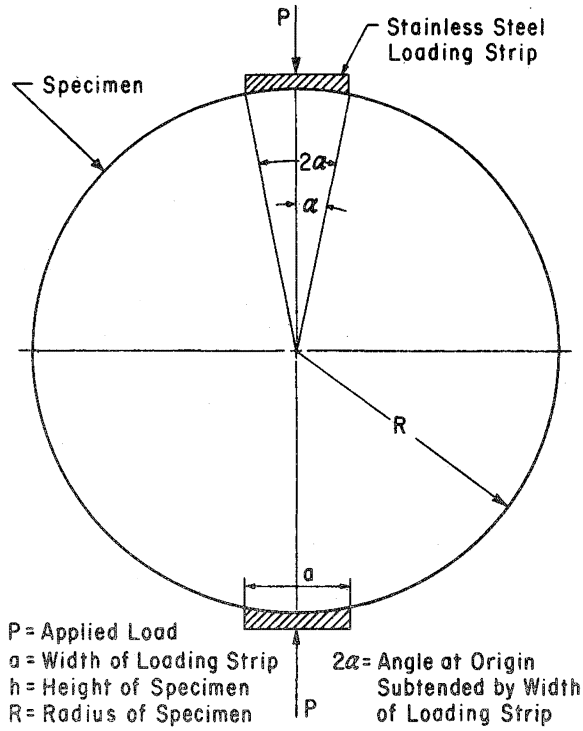

Fig 3. Indirect tensile test.

require rather complex integration of various mathematical functions. However, by assuming a specimen diameter and using a half-inch-wide loading strip the required integrations can be simplified.

In order to determine these additional properties, continuous measurements of vertical and horizontal deformations as well as the applied load must be made. The equipment currently being used at the Center for Highway Research consists of

(1) a guided loading head with parallel platens,
(2) a linear variable differential transformer to measure vertical deformations,
(3) a device to measure horizontal deformations,
(4) a load cell to measure the applied load, and
(5) two x-y plotters to record continuously the load-deformation measurements.

In addition, a step-by-step method of analysis to determine Poisson's ratio, modulus

of elasticity, and tensile strains is contained in Report 98-10.

Utilization of Results

This test can be used to evaluate all stabilized materials and, hopefully, also to evaluate all pavement materials except cohesionless materials, thus comparing the behavioral characteristics of these materials on the same basis using the same test. The tensile properties obtained from this test are expressed in terms of standard engineering units and can be used in theoretical design procedures requiring the elastic constants of the materials involved.

KEY WORDS: tensile strength, Poisson's ratio, modulus of elasticity, tensile strains, test equipment, method of analysis.

The full text of Research Report 98-10 can be obtained from R. L. Lewis, Chairman Research and Development Committee, Texas Highway Department, File D-8 Research, 11th and Brazos Streets, Austin, Texas 78701 (512/475-2971).