

LTRC Contact:

Harold "Skip" Paul, P.E.

Phone: (504) 767-9131

TECHNICAL SUMMARY

Summary of Report Number 276

PARAMETRIC EVALUATION OF FUNDAMENTAL PROPERTIES OF LOUISIANA HOT MIX

INTRODUCTION

Throughout their lives, pavements are subjected to a continuing state of stress and strain imposed by varying loads of different duration. Repetitive forces over time decrease pavement stiffness and increase deflection thus impacting the serviceability of the roadway. In Louisiana, the reduction in serviceability is generally attributed to such repetitive load cracking or fatigue and pavement distortion.

Historically, asphalt concrete has been designed and constructed using empirically developed criteria which were based on static loading conditions. As loadings increase and stress distributions change due to increased tire pressures static criteria become insufficient to provide durable pavements. Recognizing this design deficiency, AASHTO has incorporated an engineering materials property, resilient modulus, into its pavement design procedure. Many agencies are beginning to examine pavement design procedures based on elastic or viscoelastic theory. These and other time dependent stress-strain relationships will become imperative design parameters to provide cost efficient and durable highway pavements for today's changing conditions.

Many studies have shown that the repeated-load indirect tensile test can be used to evaluate the material properties related to the basic modes of pavement distress (i.e., thermal cracking, fatigue cracking, and permanent deformation).

The Louisiana Transportation Research Center recently completed a study that evaluated the performance and repeatability of an indirect tension test device developed by Baladi at Michigan State University. A new modified indirect tension test device, named the Louisiana Modified test device,

was developed to reduce inconsistencies in the test results.

OBJECTIVE AND SCOPE

The primary objectives of this study were to acquire a dynamic materials testing system, obtain initial familiarization with the equipment, develop necessary software for data acquisition and application, and develop and initiate a maintenance program. A secondary objective was to establish engineering materials properties in both static and dynamic modes for typical Louisiana hot mix.

Two different Louisiana mix types representing both low and high stability mixes (Type 1 and Type 8) were utilized. For each mix type, three air void levels and three asphalt cement sources were used. The indirect tension mode of testing was used to characterize these mixes. Specific tests included the indirect tensile strength and strain test, diametral resilient modulus test and creep test. In addition, Type 1 mixes were tested in the axial mode to determine the dynamic modulus.

APPROACH

A test factorial was developed to establish the engineering materials properties for typical Louisiana hot mix in the indirect tension mode of testing. It incorporated two levels of mix type (low and high stability), three levels of asphalt cement source (Calumet, Exxon, Southland), and three levels of compaction effort. Three replicates were used for each test. Due to the lack of availability of materials, only two specimens per asphalt cement source of Type 1 mixture were used in the axial mode of testing. The test results were statistically analyzed using the analysis of variance (ANOVA) procedure. A multiple comparison procedure with a risk level of

five percent was performed on the means. A REGWF test was selected to control the experimentwise error. The REGWF test was selected because it can detect significant differences between means that might not be detected with other multiple comparison procedures.

CONCLUSION AND RECOMMENDATIONS

A servo-hydraulic MTS test system was acquired and initial familiarization with repetitive load testing has been conducted. Software for data acquisition and equipment control was developed to perform engineering characterization tests (i.e., indirect tensile strength test, indirect tensile resilient modulus, dynamic modulus test, indirect tensile and axial creep test, axial repeated load test, and dynamic modulus test) on asphalt concrete mixtures. In addition, a maintenance program for the MTS and a training program for LADOTD laboratory technicians in the operation of the MTS have been developed. The engineering materials properties, as defined by indirect tensile strength, diametric resilient modulus, and creep characteristics, in both static and dynamic modes for Type 1 and Type 8 mixtures tested have been documented. The range of variations in these engineering properties has been established. Other observations drawn from analysis of the data are as follows:

- The indirect tensile strength (ITS) for samples containing Exxon asphalt cement had a significantly higher mean than those containing Calumet asphalt cement which in turn were higher than those made with Southland asphalt cement. Also, the ITS was not sensitive to the mixture type.
- The resilient moduli for samples made with Southland were significantly different than those made with Calumet and Exxon.
- The resilient modulus and Poisson's ratio were significantly different for samples of Type 1 mix than those containing a Type 8 mix except for the total moduli.
- The creep moduli for samples made with Exxon were significantly higher for the test duration than those made with Calumet and Southland.
- The creep moduli had no significant difference between the mix types except for the first ten seconds of the modulus with computed Poisson's ratio.

- The total axial deformations at 10,000 cycles from the axial repeated load test were not significantly different among the three asphalt cement sources.

NOTICE: This technical summary is disseminated under the sponsorship of the Louisiana Department of Transportation and Development and the Federal Highway Administration in the interest of information exchange. The summary provides a synopsis of the project's final report. The summary does not establish policies or regulations, nor does it imply DOTD or FHWA endorsement of the conclusions or recommendations. These two agencies assume no liability for the contents or its use.