CAIT
Center for Advanced Infrastructure & Transportation
Rutgers, The State University of New Jersey

NJDOT Bureau of Research
QUARTERLY PROGRESS REPORT

Project Title:	Evaluation of Poisson's Ratio
RFP NUMBER:	NJDOT RESEARCH PROJECT MANAGER: Mr. Anthony Chmiel
TASK ORDER NUMBER/Study Number: Task Order No. 128 / 4-26531	PRINCIPAL INVESTIGATOR: Thomas Bennert
Project Starting Date: 1/01/2004 **Original** Project Ending Date: 12/31/2005 **Modified Completion Date: 12/31/2006**	Period Covered: 4th Quarter 2004

Task	% of Total	% of Task this quarter	% of Task to date	% of Total Complete
Literature Search/Sensitivity Analysis	10%	50%	100%	10%
1. Material Collection	5%	0%	100%	5%
2. Laboratory Testing	70%	5%	50%	35%
3. Calibration	15%	10%	45%	6.75%
4. Reporting	10%	0%	0%	0%
Final Report				
TOTAL	100%			56.75%

Project Objectives:

- Conduct a sensitivity analysis to evaluate how the changing of the Poisson's Ratio affects the stresses and strains determined using elastic layer analysis procedures
- Evaluate the measurement of the Poisson's Ratio for aggregate base materials during the resilient modulus test and compare to available prediction equations
- Evaluate the measurement of the Poisson's Ratio for HMA materials during the dynamic modulus test and compare to available prediction equations

Project Abstract:

For the upcoming AASHTO Mechanistic Design Guide, the two main parameters needed for predicting the pavement stresses and strains are the modulus and the Poisson's Ratio. At the moment, the Poisson's Ratio is estimated based on the modulus of the material (both aggregate and HMA) or by the HMA temperature. However, this was developed using a minimal amount of material that does not represent the commonly used materials of New Jersey. Therefore, a research effort was developed to evaluate the current prediction methods and, if applicable, modify them to provide values that more closely represent materials from New Jersey.

1. Progress this quarter by task:

The dynamic modulus testing of the low (2 +/- 0.5%) and high (7% +/- 0.5%) air void HMA samples were conducted. The samples consisted of a 12.5mm coarse graded Superpave mix using a PG64-22 asphalt binder, called 12H64 by the NJDOT. During the testing, a circumferencial LVDT was attached to the sample and measured the radial strains. The radial strain, along with the axial strain, was then used to compute the Poisson's Ratio of the 12H64 asphalt mix.

Previous results of the high air void mix were shown to compare more favorably to the NCHRP predictive equation than the 4% samples. This may be due to the compacted air voids used in the NCHRP database from where the predictive equation was developed. The test results from the low air void samples showed that the measured Poisson's ratio was almost one-half of last determined by the NCHRP predictive equation. At the low test temperatures (10 and 40 ^{o}F), the measured and predictive values had the best comparison. However, as the test temperature increased, the difference between the measured and predicted increased.

The test data collected up to this point in the research was used to modify the NCHRP predictive equation within the 2002 Mechanistic Design Guide software program. In the software program, the predictive equation for the Poisson's ratio is dependent on the dynamic modulus and is in the form of equation (1).

$$\mu = 0.15 + \frac{0.35}{1 + e^{(a + b \log E^*)}} \qquad (1)$$

where,

a, b = default constants that equal -1.63 and 3.84 x 10^{-6}
E* = dynamic modulus, psi

The equation's default constants were modified using a non-linear least squares optimization method. Because different measured Poisson's ratio values were found for the PG76-22 and the PG64-22 samples, two different sets of "new" constants were used; 1) Material specific (i.e. PG64-22 constants for the HMA materials with a PG64-22 asphalt binder and PG76-22 constants for the HMA materials with a PG76-22 asphalt binder) and 2) "global" constants that were determined using the full set of data (PG64-22 and PG76-22 test results). The software was run for two different traffic conditions, moderate and heavy. The software was also run for two different pavement cross-sections, thick and thin, under both heavy and moderate traffic conditions. This provided a four simulations for each model type (material specific or "global"). These simulation results are to be compared with the results from the default values.

At the time of this report, all of the PG64-22 material specific simulations were completed. The remaining simulations should be completed by the time of the quarterly meeting.

2. Proposed activities for next quarter by task:

As mentioned earlier, up to this point, only a coarse-graded HMA material has been tested. A 12.5mm Superpave mix, with a fine gradation (gradation that goes above the "restricted zone") has been designed in the laboratory and was found to meet all of the Superpave volumetric and moisture sensitivity requirements. Samples are to be compacted, cored, cut, and tested for the dynamic modulus with the radial measurements for evaluation. The mix will be tested under the same parameters as the coarse mix; different asphalt binders and different air void contents.

3. List of deliverables provided in this quarter by task (product date):

N.A.

4. Progress on Implementation and Training Activities:

N.A.

5. Problems/Proposed Solutions:

N.A.

Total Project Budget	$426,111
Modified Contract Amount:	
Total Project Expenditure to date	$244,844
% of Total Project Budget Expended	58%

* These are approximate expended amounts for the project; these estimates are for reference only and should not be used for official accounting purposes. For a more accurate project accounting please review the quarterly invoice for this project.