Period Covered: Through September 30, 2005 (Quarterly Report)

ALDOT Progress Report
for the

State Planning and Research Program

PROJECT TITLE: Mix Design Criteria for 4.75mm Superpave Mixes		
PROJECT MANAGER: Dr. Randy C. West (334) 844-6857	**SPR Project No:** TPF-5(107) ALDOT Research Project No. 930-615P	**Project is:** ____ PLANNING __X__ RESEARCH & DEVELOPMENT
Annual Budget	**Multi Year Project** Total Budget for Project 240,000.00 Total Cost to Date for Project 34,489.20	

Research Objectives

The objectives of this pooled-fund study are to:

- Refine and field validate mix design criteria for 4.75 mm NMAS Superpave mixtures
- Provide guidelines for appropriate application of 4.75 mm Superpave mixes
- Provide guidelines for production and construction of 4.75 mm mixes

Activities During This Reporting Period

The laboratory work is slightly behind schedule but still making progress. Aggregate tests, mix designs, and performance tests have been completed for four states and are nearly complete for a fifth state. Materials for study mixes have been slow to arrive from a few states. A summary of the aggregate blends for the mix designs are shown in Table 1 and results for the completed testing is shown in Table 2. From this preliminary set of data, it appears that increasing from 50 to 75 gyrations provides about the same change in optimum asphalt content as designing 4.75 mm mixes at 6.0% air voids instead of 4.0% air voids.

A change being considered in the testing plan is to drop the resilient modulus ratio testing in favor of a fracture energy ratio. Figure 1 shows results of the resilient modulus testing that was done for several mixes. This bar chart shows the results of a series of tests on six sets of samples. For each set, three samples compacted to 9.0±0.5% air voids were tested to determine the resilient moduli at 25ºC. The samples were then aged on an oven at 85ºC for different time periods as shown in the legend. After each aging period, the resilient modulus test was performed. The expected trend was that resilient modulus would increase as the binder in the mixtures aged. Although most of the mixtures showed this trend, a few did not. The Mississippi baseline mix has a polymer modified binder, which explains why its M_R was initially higher than other mixes, but the decrease in M_R with aging was counterintuitive. This observation may be either due to microdamage of the samples or due to a loss of elastic effect from the polymer due to oven aging. One issue with using the resilient modulus test to evaluate aging is the large variability associated with this test. The standard deviation of M_R for each set is illustrated on the bar graphs as the whisker lines. Another question is whether or not an increase in stiffness (i.e. resilient modulus) is an appropriate way to evaluate durability.

As a possible alternate to the resilient modulus ratio for evaluating mixture durability, it was decided to consider using fracture energy ratio. Fracture energy is determined using an indirect tensile strength test. Fracture energy is the area below the stress strain plot up to the point of fracture as shown in Figure 2. The point of fracture is determined using the technique developed by Roque and Drakos in Florida (*1*). Kim and Wen showed that fracture energy correlated with fatigue cracking at Westrack (*2*). A preliminary set of tests were run with the Maryland baseline mix to evaluate the equipment and procedure for determining fracture energy. One of the questions that needed to be answered was what duration of oven aging should be used. The results of this preliminary round of fracture energy testing are shown in Figure 3. This data shows that the average fracture energy decreased as the specimens aged due to a decrease in the strain to fracture. It is the opinion of the principal investigator that the embrittlement of the thin film of asphalt in the mixture is captured better in the fracture test. For this data, it appears that a plateau in fracture energy is reached with just three days of ageing. Only two specimens were made for each aging period and for these preliminary evaluation tests. Three specimens would be used in further testing if fracture energy is used. High variability is also a concern with using the fracture energy test. Further fracture energy tests are planned to provide more information on which test to select for the durability evaluation.

References

1. Roque, Reynaldo, and Christos Drakos, "Superpave IDT and Energy Ratio Workshop", University of Florida and Florida DOT, Gainesville, FL, July 27-29, 2004.
2. Kim, Y. Richard, and Haifang Wen, "Fracture Energy from Indirect Tension Testing". Journal of the Association of Asphalt Paving Technologists, Vol. 71, 2002.

Activities Planned For Next Quarter

- Mix designs and performance testing with materials from the participating states.
- Selection and testing of Alternate Blends.
- Analysis of results

Problems Encountered or Anticipated:

The schedule for the project has been delayed by not having materials from some participating states. Approximately 71% of the scheduled time for Phase 1 has elapsed. However, only about 42% of the lab work has been completed with the 4.75mm mixtures to date. We are expecting the materials from the remaining states to arrive soon. If further delays occur, it may be necessary to request a time extension for the completion of the study.

STATUS AND COMPLETION DATE

Percentage of work completed to date for total project 10.9

Project is: 100.0 percent
X on schedule _____ behind schedule, explain:

Expected Completion Date: 1/31/2007