

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): New Hampshire DOT

### INSTRUCTIONS:

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(230)</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input checked="" type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31)	
<b>Project Title:</b> <p style="text-align: center;"><b>Evaluation of Plant-Produced High-Percentage RAP Mixtures in the Northeast</b></p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Jo Sias Daniel</p>	<b>Phone Number:</b> <p style="text-align: center;">603-862-3277</p>	<b>E-Mail</b> <p style="text-align: center;">jo.daniel@unh.edu</p>
<b>Lead Agency Project ID:</b>	<b>Other Project ID (i.e., contract #):</b>	<b>Project Start Date:</b> <p style="text-align: center;"><b>8/11/2010</b></p>
<b>Original Project End Date:</b> <p style="text-align: center;"><b>12/31/2013</b></p>	<b>Current Project End Date:</b> <p style="text-align: center;">12/31/2013</p>	<b>Number of Extensions:</b> <p style="text-align: center;">0</p>

Project schedule status:

On schedule    
  On revised schedule    
  Ahead of schedule    
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
781,706	631,287	75%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	25,271	

## **Project Description:**

### Research Objectives

The objectives of this research project are to:

1. Evaluation the performance in terms of low temperature cracking, fatigue cracking, and moisture sensitivity of plant produced RAP mixtures in the laboratory and field.
2. Establish guidelines on when it is necessary to bump binder grades with RAP mixtures.
3. Provides further understanding of the blending that occurs between RAP and virgin binder in plant-produced mixtures.
4. Refine fatigue failure criteria for RAP mixtures that can be used in the simplified Viscoelastic Continuum Damage (S-VECD) model.

### Research Plan

The research plan is broken down into two phases. Phase I will focus on evaluating the effects of binder grade and plant type on the properties of mixtures with various percentages of RAP. Phase II of the study will be geared towards evaluating the fatigue failure criteria in the S-VECD model.

The following tasks will be required to achieve the research objectives for both phases of this project:

1. Producing Plant Mixtures.
2. Testing and Analysis of Asphalt Binders and Mixtures.
3. Construction and Evaluation of Field Test Sections.
4. Reporting.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

Testing of the Phase II 2011 construction season mixtures has continued this quarter. The research team has been conducting weekly web conferences to discuss the Phase I mixtures, prepare the interim report, and plan for the final phase of testing with available FHWA funds.

The research team has developed a survey for states and contractors in the Northeast that will be sent out in May. The results of this survey will help guide additional tasks to be proposed in this pooled fund project.

FHWA has committed to contribute \$100,000 to the project. This is less than the \$150,000 budgeted for the original proposed project objectives and scope. The research team has developed a plan for the \$100,000 that is described below. In addition, the research team is developing suggestions for additional tasks that would require additional funds. These include a new silo storage study, expanded laboratory study, and additional plant mixtures based on the results of the laboratory study. These will be developed in collaboration with the technical committee and will be discussed in future meetings and reports.

**Phase III Testing Plan for the \$100,000 FHWA Contribution**

The testing plan proposed for Phase III consists of a laboratory study of 8-10 mixtures to evaluate the impacts of asphalt binder grade and asphalt content on the mixture properties. The laboratory study is proposed to allow for better control of production variables (temperature, gradation, short term aging). NH Phase I mixtures were selected for comparison with plant produced mixtures tested previously. The conditions to be tested are shown in Table 1. The impact of a combination of changing binder grade and adding additional asphalt cement (conditions in parenthesis) will only be evaluated after examining the results of changing binder grade and increasing asphalt content independently.

Table 2 shows the corresponding binder replacement values and equivalent percent credit given for the RAP binders for the different asphalt contents shown in Table 1.

Mixture	Asphalt content	RAP Content (total weight)		
		0	20	40
NH Pike Mixture from Phase I, 12.5 mm	optimum	PG 64-28	PG 64-28 PG 58-28	PG 64-28 PG 58-28
	+0.5%	-	PG 64-28	PG 64-28 (PG 58-28)
	+1.0%	-	-	PG 64-28 (PG 58-28)

		Optimum	+0.5%	+1.0%
% binder replacement	20% RAP	16.8	15.5	-
	40% RAP	33.7	31.0	28.7
RAP credit	20% RAP	100%	47.9%	-
	40% RAP	100%	74.0%	47.9%

## Laboratory Specimen Fabrication Procedures

All specimens will be fabricated in the UNH laboratory for consistency and to minimize shipping costs. Laboratory procedures are summarized:

- Aggregate stockpiles will be dried and sieved into individual size components for batching of individual specimen sizes.
- Aggregates will be heated to mixing temperature for at least 4 hours prior to mixing. The mixing temperatures used in the plant production will be used for heating the aggregate (approx. 330 F).
- Asphalt cement will be heated to mixing temperature; it will be discarded after 3 hours at mixing temperature and will not be reheated once it has been heated to mixing temperature.
- RAP will be air dried on a flat sheet for 24 hours prior to mixing.
- RAP will be heated to 60C for 2 hours prior to being mixed with the virgin aggregate and asphalt.
- RAP, virgin aggregate, and asphalt will be mixed together for 2 minutes using a bucket mixer.
- Mixtures will be short-term oven aged for 2 hours at compaction temperature.
- Mixtures will be compacted to create specimens of appropriate geometry and air void content using a Superpave Gyratory Compactor.
- Specimens will be cored to appropriate diameter prior to being shipped.
- Testing labs will trim specimens to appropriate height.

## Testing

**Table 3. Binder Testing (Virgin & Extracted)**

<b>Test/Test Parameter</b>	<b>Test Method/Reference</b>	<b>Title</b>	<b>Lab</b>
Extraction and Recovery			Rutgers
Performance Grade	AASHTO R29 & AASHTO M320	Grading or Verifying the Performance Grade of an Asphalt Binder & Performance-Graded Asphalt Binder	Rutgers
Binder Modulus (G*) & Binder Master Curve			Rutgers
Critical Cracking Temperature	AASHTO R49-09	Determination of Low-Temperature Performance Grade (PG) of Asphalt Binders	Rutgers

**Table 4. Mixture Testing**

<b>Test/Test Parameter</b>	<b>Test Method/Reference</b>	<b>Title</b>	<b>Lab</b>
SGC Compaction Volumetrics		Specimens compacted to design gyration level and measurement of volumetrics	UNH
Dynamic Modulus	AASHTO TP 62	Determining Dynamic Modulus of Hot Mix Asphalt Concrete Specimens	NCSU
Fatigue Test	Push-Pull Fatigue (S-VECD)	Proposed Standard Method of Test for Determining the Damage Characteristic Curve of Asphalt Concrete from Direct Tension Cyclic Fatigue Tests	NCSU
Permanent Deformation		Triaxial Stress Sweep	NCSU
Low Temperature Cracking		Thermal Stress Restrained Specimen Test (TSRST)	UMass

**Anticipated work next quarter:**

1. Interim Report that includes data, analysis, and preliminary conclusions from the Phase I mixtures will be finalized and submitted to the technical committee for review
2. Finalize testing plan for Phase III \$100,000 FHWA contribution
3. Begin acquisition of materials and fabrication of specimens for Phase III
4. Administer and summarize survey to states and contractors
5. Develop scope and budget for future tasks
6. Continue testing remaining Phase II mixtures

**Significant Results:**

None this quarter. Significant results from the Phase I testing will be presented during the technical committee webinar to explain the rationale for the proposed Phase III testing plan.

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

The anticipated \$150,000 contribution from FHWA has not been received. FHWA will be contributing \$100,000 to this project. It is expected that the transfer of these funds will be completed by mid-May. In the interim, the research team has been working with a reduced budget and scope.

**Potential Implementation:**