NEW ENGLAND TRANSPORTATION CONSORTIUM
QUARTERLY PROJECT PROGRESS REPORT

A. PROJECT NUMBER AND TITLE:

NETC 10-3 "Low Temperature and Moisture Susceptibility of RAP Mixtures with Warm Mix Technology"

B. PRINCIPAL INVESTIGATOR(s) & UNIVERSITY(s):

Professor Walaa S. Mogawer, PE, F.ASCE, Highway Sustainability Research Center (HSRC), University of Massachusetts

C. WEB SITE ADDRESS (*If one exists***):**

http://www.uvm.edu/~transctr/?Page=netc/netc_fy/netc_fy2010.php#netc103

D. START DATE (*Per NETC Agreement***):**

9/16/2013

E. END DATE (*Per NETC Agreement***):**

9/15/2015

F. **ANTICIPATED COMPLETION DATE:**
If different from the END DATE in paragraph E., the reason must be given. It is the responsibility of the Principal Investigator to insure that the project, including review of the draft report by the Project Technical Committee and the printing of the Final Report, is completed prior to the Agreement End Date. Costs incurred after the Agreement End Date cannot be reimbursed. ***Requests for extensions of the Agreement End Date must contain the reasons for the request and be submitted so as to arrive in the Coordinator's office at least 90 days prior to the Agreement End Date.***

9/15/2015

G. PROJECT OBJECTIVES:

The research project will evaluate the moisture susceptibility and low temperature cracking properties of RAP mixtures produced with WMA technologies. Plant mixtures produced with varying RAP contents and warm mix technologies will be sampled. Laboratory testing will include an evaluation of mixtures susceptibility to moisture damage using one or more of the following tests: (1) AASHTO T324 "Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)", (2) AASHTO T-283 "Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage", and (3) ratio of wet to dry dynamic modulus measured at 20ºC. The test(s) selection will be based, as described later in the proposal, on the literature review conducted under Task 1. Also, the low temperature cracking susceptibility will be evaluated using the following two tests: (1) AASHTO TP10-93 "Standard Test Method for Thermal Stress Restrained Specimen Tensile Strength (TSRST)" and (2) AASHTO T322 "Standard Method of Test for Determining the Creep Compliance and Strength of Hot Mix Asphalt (HMA) Using the Indirect Tensile Test Device." Additional testing will include evaluating the effect of

the different WMA technologies on the workability of the mixtures and evaluating the degree of blending between the RAP binder and the virgin binder using a procedure developed by Bonaquist.

H. REPORT PERIOD:

2014 Quarter 1 – January through March

I. ACCOMPLISHMENTS THIS PERIOD:

1. UMass Dartmouth hosted the project Kick-Off Meeting on February 7th, 2014. A DRAFT copy of the meeting minutes has been attached to this report. The meeting minutes contain a list of attendees, description of the meeting, and an overview of the discussions.

2. UMass Dartmouth conducted two phone meetings with two contractors (Palmer Paving - MA, & Tilcon - CT) who will produce mixtures for this study. Based on these conversations, UMass Dartmouth developed a production matrix as shown below:

Plant Type	% Binder Replaced	WMA Type								
		Organic			Chemical			Foam		
		WMA Dosage			WMA Dosage			WMA Dosage		
		Typical	Typical+0.25%	Typical-0.25%	Typical	Typical+0.25%	Typical-0.25%	Typical	Typical+0.25%	Typical-0.25%
Drum	0	X	-	-	X	-	-	X	-	-
	1.5	X	X	X	X	X	X	X	X	X
	2.0	X	X	X	X	X	X	X	X	X
	2.5	X	X	X	X	X	X	X	X	X
Batch	0	X	-	-	X	-	-	X	-	-
	1.5	X	X	X	X	X	X	X	X	X
	2.0	X	X	X	X	X	X	X	X	X

Due to plant limitations, the batch plant mixtures may not be produced in 2014, but may be produced in 2015. The remaining mixtures are scheduled to be produced in late April or early May 2014. UMass Dartmouth will be on site during production for sampling and specimen production. A production information sheet was developed (also attached to this report) to be utilized to quantify the critical production parameters related to the mixtures.

3. UMass Dartmouth updated the internet survey based on the comments obtained during the Kick-Off Meeting. Subsequently, UMass Dartmouth began the process of loading the surveys onto the internet system for solicitation of responses.

J. PROBLEMS ENCOUNTERED (If any):

None

K. TECHNOLOGY TRANSFER ACTIVITIES:

List any reports, papers, presentations published/presented during the report period or anticipated for the next quarter.

None during the current period.

L. STATUS BY TASK:

Show Work Task Number, description and % complete for each task including those completed, those underway, and those not started.

Task 1: Literature Review (25%)
Task 2: Determine Critical Information (50%)
Task 3: WMA Technologies Selection Process (15%)

Task 4: Identify Moisture Susceptibility Test (0%)
Task 5: Development of a Testing Matrix (50%)
Task 6: Obtain Plant Produced Samples (5%)
Task 7: Laboratory Testing of Plant Produced Samples (0%)
Task 8: Prepare a Final Report (0%)
Task 9: Execute Implementation Plan (0%)

M. PERCENT COMPLETION OF TOTAL PROJECT: 20%

N. ACTIVITIES PLANNED FOR NEXT QUARTER:

Complete Literature Review. Determine Critical Information.

O. FINANCIAL STATUS:
As of: *03/31/14*
Total Project Budget: $ 150,157.70
Total Expenditures : $ 0

Note: This report should not require more than 2-3 pages & should be e-mailed to the NETC Coordinator so as to arrive no later than three (3) working days after the end of each calendar quarter.

New England Transportation Consortium (NETC)

Project 10-3
"Low Temperature and Moisture Susceptibility of RAP Mixtures with Warm Mix Technology"

Meeting Minutes – Kick-Off Meeting
February 7th, 2014 @ 10:00am
UMass Highway Sustainability Research Center (HSRC) Fall River MA

Attendees:
Dr. Walaa S. Mogawer, P.E. UMass HSRC – Project PI
Mr. Denis M. Boisvert, New Hampshire Department of Transportation (NHDOT)
Mr. Bryan Engstrom, Massachusetts Department of Transportation (MassDOT)
Mr. David J. Kilpatrick, Connecticut Department of Transportation (ConnDOT)
Mr. Richard Bradbury, Maine Department of Transportation (MaineDOT)

Committee Members Unable to Attend:
Mr. Mike Byrne, Rhode Island Department of Transportation

Meeting Minutes:
The meeting began with a brief welcoming and introduction by Dr. Walaa Mogawer (Principal Investigator for NETC 10-3). Dr. Mogawer then conducted a presentation for the technical committee outlining the project on a task-by-task basis as outlined in the proposal. Dr. Mogawer also supplied the technical committee with a draft copy of questions to be included in the State DOT and Contractor surveys to be conducted in Task 2 "Determine Critical RAP & WMA Information" for the approval. General discussions of the project and action plan items then ensued. The following outlines these discussions:

- It was asked what is considered a high amount of RAP. Dr. Mogawer suggested this would be a RAP content relating to 2.5% binder replaced (approximately 40% RAP). ConnDOT suggested defining what is considered a high amount of RAP on the surveys. The UMass HSRC will adjust the survey language accordingly.

- ConnDOT asked if both contractors will utilize the same WMA technologies. Dr. Mogawer replied that the contractors will utilize the WMA technologies that they are familiar with as long as they are on the approved NEAUPG list. Dr. Mogawer further reiterated that the aggregate sources between the two contractors will be different and an attempt will be made to keep the WMA utilized between the two contractors the same if the plant capabilities allow for it. This will be done in an effort to minimize the project variables.

Discussion Points

- All committee members noted that they specify WMA technologies on the NEAUPG approved list. No new WMA technologies for inclusion in the study were presented. NHDOT noted that typically only foaming WMA is utilized in New Hampshire unless otherwise specified. NHDOT will supply the UMass HSRC with the latest version of the NEAUPG list.

- ConnDOT would like a third contractor from the New England states to produce mixtures for this study. The UMass HSRC will follow up with other contractors. Additionally, MaineDOT offered to contact contractors in their area.

- MassDOT would like to limit all foaming WMA to mechanical foaming devices as opposed to foaming based additives like Advera. There was no disagreement from other committee members regarding this proposal.

- Discussion about the specific laboratory moisture and low temperature cracking tests were brief as the final selection will be made in a future meeting. As of this meeting, the moisture tests in consideration were the E* ratio, Hamburg Wheel Tracking Device test, and AASHTO T283. MassDOT noted that they are phasing out AASHTO T283 in lieu of the HWTD. MaineDOT noted that AASHTO AMRL is developing a replacement for AASHTO T283 involving the use of the AMPT. This replacement test may be similar to the E* ratio test proposed. The low temperature tests in consideration were the TSRST and IDT. Dr. Mogawer noted that there is much data to suggest that the IDT does not correlate well with the binder low temperature grade. Thus IDT may only be performed on select mixtures in this study until it is clear if the low temperature cracking predictions using the IDT data correlate well with the binder low temperature grade.

- Either a 9.5mm or 12.5mm mixture was proposed for this study. MassDOT stated that they prefer 12.5mm mixtures. There was no opposition from the other committee members, thus it will be attempted to make all mixtures 12.5mm NMAS.

- NHDOT inquired about how moisture content will be varied and measured. Dr. Mogawer stated that the exact methodology will be determined after discussion with the two contractors (Palmer Paving - MA, & Tilcon - CT) that will take place within the next two weeks. Additionally information collected during the surveys will also be utilized.

- ConnDOT asked if the literature review showed any new test or information related to this project. Dr. Mogawer explained that there is a new method to using Atomic Force Microscopy (AFM) to determine the degree of blending between RAP and virgin binders. This method is in its infancy and will likely not be used for this project.

- MaineDOT asked is sampling of foamed mixtures at the plant and on-site will be done in an effort to quantify the moisture content or moisture susceptibility. Dr. Mogawer explained that mixtures will be sampled at each location to evaluate the moisture susceptibility of the mixture, not moisture content.

- MaineDOT suggested, in addition to normal production information, that bin (batch plant), stack, and bag house temperatures also be documented during production. The UMass HSRC will attempt to get this data as well.

- ConnDOT asked if the produced mixtures will be placed and cataloged for field monitoring purposes. Dr. Mogawer responded that this is unlikely because these mixtures will not likely be placed for DOT projects. However, the location of the mixtures will be documented in case funding is available for monitoring the field performance.

- MaineDOT suggested to start with a typical RAP moisture content in New England as a base value, then adjust moisture content up from that starting point. Also it was suggested to reword the survey to ask what a typical RAP moisture content is rather than allowable moisture content. The UMass HSRC will revise the surveys accordingly.

- NHDOT suggested to ask the contractors if they can produce a dry batch of aggregate and RAP to determine if the elevated temperature of the heated virgin aggregate sufficiently dries out the moisture in the RAP prior to adding the binder. Maine DOT believed this would be feasible at both plant types. NHDOT further suggested that this should be completed first at the highest RAP and moisture content.

The theory being if the RAP is sufficiently dried at the maximum amount and moisture content, there would be no further need to explore the moisture content variable as all the moisture will be removed. This would eliminate some production/experimental work and also further help isolate any moisture effects from foaming WMA processes. The UMass HSRC will explore this idea with the contractors.

Action Plan

- The UMass HSRC will edit the State DOT and Contractor surveys based on the kick-off meeting discussion and then post them for solicitation of responses. Once responses are received, the UMass HSRC will begin tabulation of responses.

- The UMass HSRC will meet with two contractors (Palmer Paving - MA, & Tilcon - CT) within the next two weeks to discuss production of the mixtures for this study. The dry batch experiment suggested by NHDOT will also be explored.

- The UMass HSRC will send out a DRAFT testing plan in March/April 2014 for committee approval.

The next meeting for this project will be scheduled to discuss the final testing matrix and laboratory testing plan. This meeting will be scheduled after all the details of the plant production are determined.

ENTER Mixture ID Here	**Production Sheet for NETC 10-3**		
	Company:		Date:
	City:		Inspector:

COMPONENT MATERIALS	Plant ID	Stockpile Check	
(d) = Drum Mix Plant Only		Stone: ☐	Fine Agg: ☐	RAP: ☐
(b) = Batch Plant Only			

			Bin Number	Moisture %	Name and City of Aggregate Producer
Coarse Aggregate		inch stone			
		inch stone			
		inch stone			
		inch stone			
Fine Aggregate Blend		% Screenings			
		% Stone Sand			
		% Sand			
RAP:		inch			Mineral Filler % and Kind:
RAP:		inch %PGAB			Special Material:
PGAB:		Refineries &			
WMA Type:					
WMA Dosage:					
ANTI-STRIP:		% of PGAB &	Manufacturer:		Silicone: oz. per gals PGAB

MIX:	ENTER MIX ID	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	PGAB
PLANT: d	PGAB:	50mm	37.5mm	25mm	19mm	12.5mm	9.5mm	4.75mm	2.36mm	1.18mm	0.6mm	0.3mm	0.18mm	75µm	%
JMF DATE:															
RAP%:	Size:														
Time:		lbs. / tph			Batch ☐		Drum ☑			Ran auto. ☐			w / printer ☐		
%Voids:	G_{mm}:	Bin % of mix		1)	0	2)	0	3)	0.00	4)	0.00	5)	0	6)	0

Production Parameters

Lot - Sublot #		Aggregate Temperature:		°F/°C	Stack Temperature:		°F/°C
Weather:		RAP Temperature:		°F/°C	Baghouse Temperature:		°F/°C
Temperature:		RAP Moisture Content:		%	Silo Storage Time:		°F/°C
Time:		Dry Mixing Time:		Sec.	Discharge Temperature:		hrs.
Date:		Wet Mixing Time:		Sec.	Compaction Temperature:		°F/°C
		Bin Temperature (Batch):		°F/°C			

Lot - Sublot #		Aggregate Temperature:		°F/°C	Stack Temperature:		°F/°C
Weather:		RAP Temperature:		°F/°C	Baghouse Temperature:		°F/°C
Temperature:		RAP Moisture Content:		%	Silo Storage Time:		°F/°C
Time:		Dry Mixing Time:		Sec.	Discharge Temperature:		hrs.
Date:		Wet Mixing Time:		Sec.	Compaction Temperature:		°F/°C
		Bin Temperature (Batch):		°F/°C			

Lot - Sublot #		Aggregate Temperature:		°F/°C	Stack Temperature:		°F/°C
Weather:		RAP Temperature:		°F/°C	Baghouse Temperature:		°F/°C
Temperature:		RAP Moisture Content:		%	Silo Storage Time:		°F/°C
Time:		Dry Mixing Time:		Sec.	Discharge Temperature:		hrs.
Date:		Wet Mixing Time:		Sec.	Compaction Temperature:		°F/°C
		Bin Temperature (Batch):		°F/°C			

Lot - Sublot #		Aggregate Temperature:		°F/°C	Stack Temperature:		°F/°C
Weather:		RAP Temperature:		°F/°C	Baghouse Temperature:		°F/°C
Temperature:		RAP Moisture Content:		%	Silo Storage Time:		°F/°C
Time:		Dry Mixing Time:		Sec.	Discharge Temperature:		hrs.
Date:		Wet Mixing Time:		Sec.	Compaction Temperature:		°F/°C
		Bin Temperature (Batch):		°F/°C			