NEW ENGLAND TRANSPORTATION CONSORTIUM
QUARTERLY PROJECT PROGRESS REPORT

A. PROJECT NUMBER AND TITLE: NETC 15-3

B. PRINCIPAL INVESTIGATOR(s) & UNIVERSITY(s): Eshan V. Dave, University of New Hampshire

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

D. START DATE (*Per NETC Agreement***): 8/1/2016**

E. END DATE (*Per NETC Agreement***): 7/31/2018**

F. **ANTICIPATED COMPLETION DATE: 7/31/2018**

G. PROJECT OBJECTIVES:

1. Evaluate good and poor performing asphalt mixtures in New England and determine mechanisms responsible for poor performing mixtures
2. Determine impacts of remedial measures (anti-stripping additives and hydrated lime) in reducing moisture susceptibility of poor performing mixtures
3. Assess impacts of moisture induced-damage on pavement performance and service life
4. Recommend an evaluation framework consisting of appropriate test procedure(s), specification, analysis procedure verified with field performance data that is reliable and suitable for moisture susceptibility testing of asphalt mixtures used in New England

H. REPORT PERIOD: 7/1/2017 – 9/30/2017

I. ACCOMPLISHMENTS THIS PERIOD:

The main focus of work in this quarter was on conducting laboratory testing and sampling the final mixtures for the project. As of the writing of this report, nine out of the ten mixtures have been sampled and delivered to University of New Hampshire (UNH) and Worcester Polytechnic Institute (WPI). The tenth and final mix will be sampled in the coming weeks from NHDOT. Out of the ten mixtures, six are historically poor performers with three of these having some form of anti-stripping additives while the other three have no such modifiers. The six poor performers are made up of two mixtures sampled from Vermont, three mixtures sampled from Maine, and one mixture sampled from Connecticut. The four remaining mixtures are all considered historically good performers where one of the mixtures is from Vermont, two from Maine, and one from New Hampshire. These ten mixtures cover a broad spectrum of performance, mix designs, binder grades, modifiers, aggregate types, and geographical locations, giving the research team many potential parameters to investigate in terms of moisture susceptibility.

Significant progress was made on the laboratory testing plan this quarter. For a majority of the sampled mixtures, all of the indirect tensile strength (ITS) testing has been completed on specimens in the unconditioned state and specimens conditioned using methods in AASHTO T-283. MiST conditioning has also begun on ITS specimens, with three of the mixes being tested for ITS with MiST conditioning. It is expected that all of the ITS testing will be completed in the next quarter. A plot summarizing the current ITS results can be seen in Figure 1. As can be seen, the current results suggest that using a simple ratio, such as the case in AASHTO T-283, may not be effective in differentiating good (VTG1, MEG1, MEW1)

from poor (VTP1, VTP2, MEM1, MEP1, CTG1) mixtures. More analysis will be performed in the upcoming quarter as more test data is accumulated.

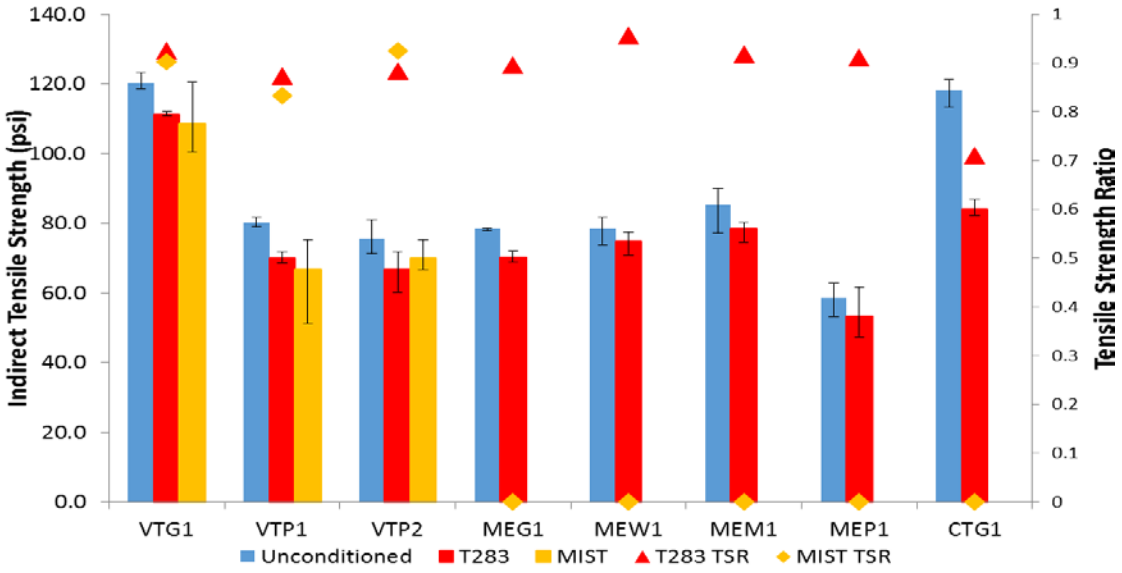

Figure 1: Indirect Tensile Strength (ITS) and Tensile Strength Ratio (TSR)

In addition to ITS, limited amounts of semi-circular bend (SCB) and dynamic modulus testing has been conducted. This includes unconditioned and MiST conditioned specimens for SCB testing, while dynamic modulus testing has only been conducted on unconditioned specimens. Significant progress is expected on SCB and dynamic modulus testing this upcoming quarter as most of the specimens have been produced. Also, Hamburg wheel track test specimens have been fabricated for the nine sampled mixtures. Five of these mixtures have been delivered to MaineDOT for testing, while the other five will be delivered in the coming weeks. Hamburg testing is expected to occur throughout the next quarter. A table summarizing the laboratory testing effort can be seen below.

Table 1: Summary of Testing Progress

	Mix:	VTG1	VTP1	VTP2	MEG1	MEW1	MEM1	MEP1	MEP2	CTG1	NHG1
Test Procedure	Performance Description:	Good	Poor w/ AS	Poor w/out AS	Good	Good	Poor	Poor w/out AS	Poor w/ AS	Poor w/ AS	Good
	Sampled?:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Volumetrics and Compaction Char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
ITS	Unconditioned	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	T283	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
	MIST	Yes	Yes	Yes	No	No	No	No	No	No	No
Dynamic Modulus	Unconditioned	Yes	Yes	Yes	No	No	No	No	No	No	No
	MIST @ 60C	Yes	Yes	Yes	No	No	No	No	No	No	No
	MIST @ 25C	No	No	No	No	No	No	No	No	No	No
SCB	Compaction	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	
	Unconditioned	Yes	Yes	Yes	No	No	No	No	No	No	No
	MIST @ 60C	Yes	Yes	Yes	No	No	No	No	No	No	No
	Freeze-Thaw	No	No	No	No	No	No	No	No	No	No
Hamburg	-	No	No	No	No	No	No	No	No	No	No

Green indicates specimens have been prepared and tested
Yellow indicates that specimens have been prepared and possibly conditioned, but not tested
Red indicated specimens have not been produced yet

While analyzing the results from the limited SCB testing conducted so far, unexpected trends of better performance (in terms of fracture energy and flexibility index) were observed from MiST conditioned specimens rather than unconditioned specimens. This is hypothesized to be due to potential softening and healing effects while the specimens are exposed to high temperatures (60˚C) during MiST conditioning. This effect essentially makes the binder more flexible, causing misleading results that suggest MiST conditioned specimens performing better than unconditioned specimens. Since the high temperatures are suspected to be the cause of this problem, limited trials are currently underway to perform MiST conditioning at cooler (25˚C) to see if similar or different trends are observed. With these results in mind, the laboratory testing and conditioning plan may be revised.

J. PROBLEMS ENCOUNTERED (If any):

Minor lab equipment issues delayed lab testing for a few weeks in July, but no other significant problems encountered. Testing is ahead of schedule at this point.

K. TECHNOLOGY TRANSFER ACTIVITIES:

No activity to report.

L. STATUS BY TASK:

Task 1: State of the Practice and Literature Review: All work for Task 1 has been completed. Draft report was submitted at the end of last quarter.

Task 2: Identify and Inspect Moisture Susceptible Mixes and Develop Testing Plan: All of the work for Task 2 has been nearly completed. The finalized testing plan developed during the last quarter has been slightly revised due to unexpected testing results being observed. The sampling plan set forth in the previous quarter is nearly complete as nine out of the ten mixtures proposed for this project have been sampled, while the final mixture will be sampled in the coming weeks. In total, four good performing mixtures as well as six poor performing mixtures (with and without various anti-stripping additives) from four of the six (CT, ME, NH, and VT) New England States were chosen for this project.

Task 3: Laboratory Testing: Significant amounts of laboratory testing was completed during this quarter. For the nine mixtures that have been sampled, compaction characteristics and volumetric testing has been completed. All nine of these mixtures have also been tested for indirect tensile strength with both unconditioned specimens and specimens conditioned using AASHTO T-283. Three of the mixtures have also been tested for indirect tensile strength with MiST conditioning. A few mixtures have had SCB (both unconditioned and MiST conditioned) as well as dynamic modulus (unconditioned only) tests conducted.

Task 4: Final Report and Recommendations: This quarterly report serves as the deliverable for the reported calendar quarter. No other activity is reported.

M. PERCENT COMPLETION OF TOTAL PROJECT: ____45_____%

N. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Sample the last mixture from NHDOT
- Continue the laboratory testing:
    - Conditioning: MiST (at both 25 and 60˚C) and Multi-cycle Freeze-Thaw; Mechanical Characterization: Indirect tensile strength, complex modulus and fracture parameters from semi-circular bend (SCB) test, and Hamburg wheel track test.

- Begin conducting data analysis on laboratory results to assess changes in mechanical characteristics of mixtures due to laboratory moisture conditioning.

O. FINANCIAL STATUS:
As of: 9*/29/2017*
Total Project Budget: $ 150,000
Total Estimated Expenditures: $ 57,000

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.