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NEW ENGLAND TRANSPORTATION CONSORTIUM

NETCR106 April 2018

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NEW ENGLAND TRANSPORTATION CONSORTIUM

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INTRODUCTION

The New England Transportation Consortium (NETC) is a cooperative effort of the transportation agencies of the six New England States, the six New England state land grant universities, and the Federal Highway Administration (FHWA). Through the Consortium, the states pool professional, academic, and financial resources for transportation research leading to the development of improved methods for dealing with common problems associated with the administration, planning, design, construction, rehabilitation, reconstruction, operation, and maintenance of the region’s transportation system. The Consortium’s activities are currently being managed by the University of Vermont Transportation Research Center (UVM TRC), with the Vermont Agency of Transportation (VAOT) acting as the Lead Agency.

The program is intended to supplement, not to replace, ongoing state and federal research activities and other national programs such as the National Cooperative Highway Research Program (NCHRP). To this end, a Memorandum of Understanding (MOU), establishing NETC has been consummated by the six New England state transportation agencies.

The following goals were established for NETC in order to focus the resolve of participating state transportation agencies and universities:
- Implementation of a three-pronged program for the New England region consisting of research and development; technology transfer; and education and training.
- Development of improved methods for dealing with common transportation problems.
- Providing an important source of trained professionals for employment in the Region.

NETC membership now extends to the following agencies: Connecticut Department of Transportation (ConnDOT); Massachusetts Department of Transportation; Maine Department of Transportation; New Hampshire Department of Transportation (NHDOT); Rhode Island Department of Transportation (RIDOT); Vermont Agency of Transportation (VAOT); and, FHWA.

Each of the member state transportation agencies has designated a state university to participate with the state transportation agency in developing and conducting the transportation research program. The following universities have been designated as member universities: University of Connecticut, University of Maine, University of Massachusetts System, University of New Hampshire System, University of Rhode Island, and University of Vermont.

NETC was first established, and work began, in 1986 and, over the years, has undergone a transformative process wherein the management and administrative processes have been under the governance of various governmental and non-governmental organizations. With each change in leadership, the experiential and institutional lessons that have been learned were incorporated into the administration of the program. And so, at the current time, the collective experience of over two decades is now addressed and incorporated in the administration of the NETC program.

In 1984, the Massachusetts Institute of Technology (MIT), the state transportation agencies of five New England states (Maine, Massachusetts, New Hampshire, Rhode Island and Vermont), the American Association of State Highway and Transportation Officials (AASHTO) and FHWA initiated the first transportation pooled fund (TFP) study, administered by RIDOT, to determine the feasibility of establishing a regional consortium. In 1985, the same group of organizations initiated
a second TPF study, again administered by RIDOT, to develop a work program. From 1986 to 1995, various research projects were funded through the NETC program in five funding blocks called “Rounds.”

RIDOT was the Lead Agency for the first two pooled fund studies. For the five Rounds, state funds were transferred to AASHTO, the Lead Agency (i.e., Administrative Agency), through FHWA, and a single contract was effected between AASHTO and MIT, the Coordinator. MIT would then enter into a contract with the selected university for a particular research project.

In 1994, ConnDOT stated its intention to participate in NETC and offered to act as Lead Agency. During Federal Fiscal Year (FFY) 1994, FHWA assumed the Lead Agency designation to facilitate the transition process. MIT and AASHTO exited NETC, effective FFY1994. ConnDOT entered NETC, effective FFY1995, and was the Lead Agency until the Vermont Agency of Transportation assumed the responsibility in March 2010.
2016 HIGHLIGHTS

1. THE FOLLOWING NETC-FUNDED TRANSPORTATION RESEARCH PROJECTS, VALUED AT $2,187,850, WERE ACTIVE AT NEW ENGLAND STATE UNIVERSITIES IN 2016:

   a. University of Massachusetts: $1,329,726
      - Walaa Mogawer (Dartmouth):
        o “Preventative Maintenance and Timing of Applications” (242908.82)
        o “Low Temperature and Moisture Susceptibility of RAP Mixtures with Warm Mix Technology” (150158)
        o “HMA Mixtures Containing Recycled Asphalt Shingles (RAS): Low Temperature and Fatigue Performance of Plant-Produced Mixtures” (249,785)
      - Sergio F. Breña (Amherst): “Development of High-Early Strength Concrete for Accelerated Bridge Construction Closure Pour Connections” (191320)
      - Chris Ahmadjian (Amherst): “Measuring the Effectiveness of Competency Models for Job-Specific Professional Development of Engineers & Engineering Technicians” (100,000)
      - Scott Civjan (Amherst): “Investigation of Northern Long-Eared Bat Roosting Sites on Bridges” (205554)
      - Yuanchang Xie (Lowell): “Optimizing Future Work Zones in New England for Safety and Mobility” (200,000)

   b. University of New Hampshire: $613,124
      - Jo-Sias Daniel: “In-Place Response Mechanisms of Recycled Layers Due to Temperature and Moisture Variations” (198154)
      - Eshan Dave:
        o “Improved Regionalization of Quality Assurance (QA) Functions” (100,000)
        o “Moisture Susceptibility Testing for Hot Mix Asphalt Pavements in New England” (150,000)
      - Jeffrey Foster: “Use of Forested Habitat Adjacent to Highways by Northern Long Ear Bats (and Other Bats)” (164,970)

   c. University of Connecticut: $80,000
      - Julia Kuzovkina: “Effective Establishment of Native Grasses on Roadsides” ($80,000)

   d. University of Maine: $165,000
2. TECHNOLOGY TRANSFER:

a. Requests for Information and Technical Assistance: The NETC Coordinator’s office responded to the following requests: There were no requests received during 2016.

b. Conference Attendance and Exhibiting: The NETC Coordinator’s office attended the following conferences and events:

- Annual New England Materials & Research Engineer’s 27th Annual Meeting: The NETC Coordinator attended this meeting, as per the Advisory Committee’s recommendation, to keep updated on current research in New England. The NETC also provided sponsorship for the event. (June 2016)

c. NETC Research Project Reports, Technical Papers and Presentations:

2. NETC 09-2: “Effective Establishment of Native Grasses on Roadsides,” Kuzovkina, Julia; Schulthess, Cristina P.; Ricard, Robert; Dryer, Glenn, June 2016, NETCR97.

d. Technical Papers and Presentations:

- NETC 09-2: DOT Manual: Effective Establishment of Native Grasses on Roadsides in New England
- NETC 09-2: DOT Workshop and Field Day: Effective Establishment of Native Grasses and Forbs on Roadsides
  Presented at the North American Society for Bat Research (NASBR) conference at San Antonio TX.
  Presented (remotely) at Maine Bat Working Group Annual Meeting.
PROGRESS OF ACTIVE PROJECTS

PROJECT NUMBER: 06-4

PROJECT TITLE: “Preventative Maintenance and Timing of Applications”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Dr. Walaa Mogawer, P.E., University of Massachusetts Dartmouth

STATUS: Open

AGREEMENT TERM: 9/16/2013 – 9/15/2016

ANTICIPATED COMPLETION: 9/15/2016

PROJECT OBJECTIVES: The purpose of this project is to research existing best practices for pavement preventative maintenance strategies and adapt them to the unique variety of road conditions in New England (different traffic volumes, pavement materials, and northern climates). Additionally this research will attempt to outline pavement maintenance techniques and the inter-relationship with the timing of their application in New England. To meet the purpose of this project, the following objectives have been established:

1. Identify the components of a Pavement Preventive Maintenance (PPM) program.
2. Evaluate the state-of-the-practice relative to agencies (both US and worldwide) that have demonstrated successful implementation of a pavement preservation program. Identify both single treatment and multi-treatment strategies.
3. Use current and past projects as appropriate to evaluate techniques that have been successfully used to effectively extend the life of the pavement.
4. Identify and quantify the factors that influenced the successful implementation of a preservation technique, including time of treatment application in the existing pavement life cycle.
5. Validate the treatment parameters and methodologies using available tests for surface treatments as well as those for conventional flexible pavements (Hot Mix Asphalt mixtures) that might be modified to test these treatments.
6. Determine the approximate cost for pavement preservation technique identified.
7. Develop an implementation pavement preservation manual for distribution to the state and local transportation agencies within the New England states.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:
A draft Final Report was submitted to the Technical Committee for review and comments.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:
None.
PROJECT NUMBER: 07-1

PROJECT TITLE: “In-Place Response Mechanisms of Recycled Layers Due to Temperature and Moisture Variations”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Jo Sias Daniel, Ph.D., P.E., Department of Civil Engineering, University of New Hampshire

STATUS: Closed


ANTICIPATED COMPLETION: 3/31/2016

PROJECT OBJECTIVES: The main objective of this research is to determine the in-place properties of pavement cross-sections containing recycled materials common to the New England region, and to relate changes in those properties to variations in temperature and moisture. The study will focus primarily on obtaining field data from base layers (as opposed to asphalt surface layers) that have been constructed with different types of unbound or bound recycled layers such as full depth reclamation (with or without stabilizing additives), plant mix recycled asphalt pavement (PMRAP), or foamed asphalt. The research team will work with the NETC advisory board members to identify appropriate field sites where the pavement design is clearly documented and where pavement performance can be linked to factors such as traffic loadings, moisture regimes and freeze-thaw effects. Laboratory testing will also be included to complement the analysis of in-place test data and instrumentation monitoring.

The importance of testing reclaimed layers with Falling Weight Deflectometer, evaluating the response at the different times of the year, and utilizing good practices during mix design and construction have been emphasized by multiple researchers. In order to accomplish this research, five tasks have been established and are broken into two Phases.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:
The Final Report was completed November 2016.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:

“In-Place Response Mechanisms of Recycled Layers Due to Temperature and Moisture Variations,” Daniel, J.S.; Mallick, Rajib B.; Kestler, Maureen A.; Miller, Heather J.
PROJECT NUMBER: 09-2

PROJECT TITLE: “Effective Establishment of Native Grasses on Roadsides in New England”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Julia Kuzovkina, Department of Plant Science and Landscape Architecture, University of Connecticut, Storrs, CT

STATUS: Closed


ANTICIPATED COMPLETION: 2/28/2016

PROJECT OBJECTIVES: To build a comprehensive knowledgebase for a gradual transition toward sustainable native roadside vegetation cover which will support transportation goals for safety and infrastructure reinforcement while providing economic, ecological and aesthetic advantages. The direct deliverables to the New England Departments of Transportation include the Manual with guidelines for the effective establishment of native grasses on roadsides in New England and a model for an accelerated adoption and commercialization of this novel ecological restoration approach.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:

- Preparation of the Manual was completed. A draft version of the Manual was submitted to the three members of the Technical Committee for their feedback.
- The final version of the Manual, consisting of 283 pages, was submitted to the Technical Committee on June 7, 2016.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:

“Effective Establishment of Native Grasses on Roadsides,” Kuzovkina, Julia; Schulthess, Cristina P.; Ricard, Robert; Dryer, Glenn.
PROJECT NUMBER: 09-3

PROJECT TITLE: “Advanced Composite Materials in New England’s Transportation Infrastructure: Design, Fabrication and Installation of ACM Bridge Drain System”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Dr. Roberto Lopez-Anido P.E. University of Maine’s Advanced Structures and Composites Center

STATUS: Closed

AGREEMENT TERM: 9/1/2013 – 12/31/2015
ANTICIPATED COMPLETION: 12/31/2015

PROJECT OBJECTIVES:
1. Design and fabricate a standard FRP drain that can be produced economically for use throughout New England bridges; and
2. Install the fabricated drain system in two to three representative bridge applications in New England to provide information on its performance, ease of construction, and cost.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:
• The Final Report was finalized and submitted August 2016.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:
PROJECT NUMBER: 10-3

PROJECT TITLE: “Low Temperature and Moisture Susceptibility of RAP Mixtures with Warm Mix Technology”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Professor Walaa S. Mogawer, PE, F.ASCE, Highway Sustainability Research Center (HSRC), University of Massachusetts

STATUS: Open

AGREEMENT TERM: 9/16/2013 – 5/31/2017

ANTICIPATED COMPLETION: 5/31/2017

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 20°C. The test(s) selection will be based 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.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:
- The survey results distributed for Task 2 were compiled. Responses were analyzed and respective tables and charts of the results were made.
- Laboratory verification and testing of the plant produced mixtures from the first contractor (Aggregate Industries Wrentham, MA) continued. The following 12.5mm SSC (100 gyration) mixtures were produced using the contractors drum plant and a PG64-28 binder:
  - 12.5mm with 15% RAP (typical mixture) + 0.5% SonneWarmix (Liquid) WMA
  - 12.5mm with 27.8% RAP (1.5% binder replaced) + 0.5% SonneWarmix (Liquid) WMA
  - 12.5mm with 46.3% RAP (2.5% binder replaced) + 0.5% SonneWarmix (Liquid) WMA
- The following tests were completed on each mixture using multiple replicates:
  - Binder content verification using the ignition oven.
  - JMF verification by wet wash sieve analysis
  - Volumetric verification (density, VMA. VFA, etc.)
  - Moisture susceptibility testing using the Hamburg wheel tracking device (HWTD) in accordance with AASHTO T324 at 45°C
  - Low temperature cracking using the disk-shaped compact tension (DCT) test at -18°C
  - Constructed performance space diagram (HWTD vs. DCT) for each mixture
  - Moisture susceptibility (TSR) in accordance with AASHTO T283
  - Low temperature cracking using the thermal stress restrained specimen test (TSRST)
• Mixture dynamic modulus and subsequent construction of mixture master curve
• Dynamic modulus (E*) ratio evaluation of moisture susceptibility
• Mixture workability in the asphalt workability device.
• Summary sheets of results were constructed and data was analyzed.
• Another contractor has committed to producing mixtures for this study in the early summer of 2016.
• A second contractor (Palmer Paving, Springfield MA) began producing mixtures for this study in June 2106. More mixtures will be produced as the contractor schedule allows.
• UMass Dartmouth received the following plant produced mixtures from the second contractor this month:
  • SSC 12.5mm 75 Gyration WMA with 29% RAP (1.5% Binder Replacement)
  • SCC 12.5mm 75 Gyration WMA with 39% RAP (2.0% Binder Replacement)
  • The contractor is using Evotherm as the WMA additive.
• UMass Dartmouth began verification and performance testing of these mixtures.
• Due to delays in producing the mixtures, UMass Dartmouth requested a no-cost extension until 12/31/17 so that the remainder of mixtures can be produced, tested and analyzed. No response to this request has been received and the project ends this quarter June 30th, 2016.
• UMass Dartmouth conducted additional meetings with the two contractors, (Palmer Paving - MA, & Tilcon - CT) who committed to produce mixtures for this study to determine when the mixtures will be produced. Each responded they will be produced in the fall of 2014.
• In September 2014, UMass Dartmouth formally requested a no additional cost time extension for this project of twelve month (new end date 9/15/2016). The basis of the request is that the contractors have not produced or provided the mixtures required for this study. Therefore, an extension is needed as the testing will require sixteen months for completion (as listed in the proposal). UMass Dartmouth is waiting for a response on this time extension request.
• On October 14th, 2016; UMass Dartmouth received a no-cost extension for the project until 5/31/17. This agreement for this project expired on 6/30/16. The extension time was so that the remainder of mixtures can be produced, tested and analyzed.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:
A Transportation Research Board (TRB) paper was submitted in August of 2016 related to this research work for this project. The paper was accepted for presentation at the Transportation Research Board 96th Annual Meeting in Washington DC on January 10th, 2017. The paper entitled “Understanding Influence of Moisture on Performance of Plant-Produced High Reclaimed Asphalt Pavement Conten Mixtures Incorporating Warm-Mix Asphalt Technologies” will be presented in TRB session 636 “Reclaimed Asphalt Pavement and Recycled Asphalt Shingles in Asphalt Mixtures.”
PROJECT NUMBER: 13-1

PROJECT TITLE: “Development of High Early-Strength Concrete for Accelerated Bridge Construction Closure Pour Connections”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Sergio F. Brena – University of Massachusetts Amherst

STATUS: Open

AGREEMENT TERM: 9/1/2014 – 1/14/2017

ANTICIPATED COMPLETION: 1/14/2017

PROJECT OBJECTIVES: To develop and validate concrete mixtures capable of developing high early strength without detrimentally affecting their long-term durability. The mixtures are for use in projects using accelerated bridge construction methods.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:

1. Performed literature review as necessary to obtain research reports and technical papers to assist in further development of mix design trial batches.
2. Remixed multiple trial batches numerous times to understand the variability of properties of the trial batch mix designs.
3. The set time test (AASHTO T197 / ASTM C403) was performed on each trial batch.
4. The slump test (AASHTO T119 / ASTM C143) or the spread test (ASTM C1611) was performed on each trial batch depending on the workability of the concrete mixture.
5. The air content test, pressure method (AASHTO T152 / ASTM C231), was performed on concrete mixtures developed through trial batches.
6. Running ring shrinkage tests to understand behavior of mix designs; will modify based on results.
7. A mix design typically used for precast/prestressed bulb-tee girders was mixed to compare concrete properties.
8. The compressive strength was tested for each trial batch at 12 hours and 24 hours (ASTM C39).
9. Progression of the design of the bar pullout test (ASTM A944) setup.
10. The volume of paste to volume of voids ratio was adjusted to improve the consistency of trial batches.
11. A pilot study was performed to understand the effects of high range water reducer addition rates.
12. Aggregate sizes were blended at specified ratios to reduce the gap grading of the coarse and fine aggregates.
13. The curing temperature was increased, and the compressive strength was measured to quantify the effects.
14. The shrinkage test (AASHTO PP 34-99) was performed on selected concrete mixtures developed through trial batches. These tests are conducted on batches reaching target strength gain and workability.
15. Design of the setup for the bar pullout test (ASTM A944) is still progressing, and fabrication.
16. Completed the literature review and summarized findings.
17. Created a mixture design specification based on the development procedure used in this research project.
18. No further development was required of the mixture design. The two selected concrete mixtures were used for final testing.
19. Completed the shrinkage testing (AASHTO PP 34-99). A minimum of three tests were performed on each of the final selected concrete mixtures.
20. Completed the design and fabrication for the bar pullout test setup, including strength analysis of members within the setup (ASTM A944)
21. Design and fabrication of steel reinforcement used within each bar pullout test concrete specimen completed
22. Completed fabrication of formwork used for the bar pullout test concrete specimens for No.4 and No.6 test bars, including tying of steel reinforcement within each specimen
23. Performed bar pullout test on two selected concrete mixtures developed through trial batches on No. 4 and No. 6 epoxy coated test bars
24. Gradation of aggregates used for the selected mixes was modified as required to conduct alkali-silica reactivity test (ASTM C1567) using fine aggregates and a crushed coarse aggregates
25. Mixed the sodium hydroxide solution required for the alkali-silica reactivity testing
26. Performed alkali-silica reactivity aggregate tests on two mortar mix designs compatible with the selected concrete mixtures, one using coarse aggregates and the other using fine aggregates

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016: None thus far.
PROJECT NUMBER: 13-2
PROJECT TITLE: “HMA Mixtures Containing Recycled Asphalt Shingles (RAS): Low Temperature and Fatigue Performance of Plant-Produced Mixtures”
PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Professor Walaa S. Mogawer, PE, F.ASCE, Highway Sustainability Research Center (HSRC), University of Massachusetts
STATUS: Open
AGREEMENT TERM: 6/1/2014 – 12/1/2017
ANTICIPATED COMPLETION: 12/1/2017

PROJECT OBJECTIVES: The goal of this research is to evaluate plant-produced HMA mixtures that contain RAS to identify the critical material properties and plant operations needed to produce RAS mixtures with fatigue and low temperature cracking properties equivalent (or better than) typical mixtures that are produced. Research objectives:

1. Determine the current state-of-practice for recycled shingle usage in paving mixtures.
2. Locate regional asphalt mixture producers in New England with capabilities and willingness to produce mixtures incorporating RAS for this study. From this list of producers, select producers so that both batch and drum plant are utilized for production.
3. Assist the selected producers in evaluating the properties of the RAS and RAP to be used in production.
4. Construct a matrix of mixtures that will be produced. An all-virgin material control mixture, 5% RAS mixture and a 5% RAS + RAP mixture will be designed.
5. Assist the selected producers in developing laboratory mixture designs utilizing RAS that meet the required volumetric criteria.
6. Produce the mixtures using a batch plant and drum plant. Produce mixtures assuming 100% blending of the RAS and virgin binder and at the calculated actual RAS binder contribution.
7. Sample the mixture at the plant and verify volumetric properties. Mixtures not meeting the volumetric properties should be produced again with alteration to the production parameters (use higher temperatures, longer silo storage or increased mixing times).
8. Construct a matrix for evaluating the performance of the mixtures with emphasis of low temperature and fatigue cracking. The matrix should contain a component to evaluate the effect of aging on the degree of blending between aged and virgin binders.
9. Identify critical material properties and plant operations that yield RAS mixtures with performance properties equivalent to typical all-virgin material mixtures.
10. Develop a guideline for the use of RAS in virgin and RAP mixtures.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:
1. The approved survey for Task 3 was distributed to a list of regional contacts consisting of both agency and industry members for solicitation of responses. Responses were tabulated.
2. Four 12.5mm mixtures were previously developed with similar gradations (Task 6) in the laboratory. The mixtures were:
   ▪ Control mixture using all virgin materials
   ▪ Control mixture incorporating 15% RAP (Typical)
   ▪ Control mixture incorporating 5% RAS (Using the MSW RAS Source)
   ▪ Control mixture incorporating 5% RAS and 15% RAP (Using the MSW RAS Source)
3. For each of these mixtures, the following testing was completed on replicate specimens this quarter:
- Mixture dynamic modulus and subsequent construction of mixture master curve
- Fatigue testing using the flexural beam fatigue in accordance with AASHTO T321
- Moisture susceptibility testing using the Hamburg wheel tracking device (HWTD) in accordance with AASHTO T324
- Low temperature cracking using the disk-shaped compact tension (DCT) test at -18°C
- Low temperature cracking using the thermal stress restrained specimen test (TSRST)
- Fatigue cracking using the Semi Circular Bend (SCB) Illinois Flexibility Index Test (IFIT) test at 25°C

4. UMass Dartmouth met with the contractor to discuss production of the mixtures. A meeting with the plant operations manager will be held in April to discuss these items further.
5. Due to time delays in finding a contractor willing to produce mixtures for this study, UMass Dartmouth requested a no-cost time extension for this project in January 2016 until December 2017. To date no response has been received for this request. The project ended this quarter on 5/31/16.
6. UMass Dartmouth met with the contractor plant operations manager to discuss production of the mixtures in April 29th, 2016. The contractor stated they would attempt to produce the mixtures in early summer 2016, schedule permitting.
7. UMass Dartmouth finished reducing and compiling the survey results obtained for Task 2.
8. UMass Dartmouth has consistently contacted and met with the contractor during the last quarter to discuss production of the mixtures for this study. The contractor stated they would attempt to produce the mixtures as soon their schedule permits but no mixtures were delivered to date.
9. On October 14th, 2016; UMass Dartmouth received a no-cost extension for the project until 12/01/17. This agreement for this project expired on 5/31/16. The extension time was so that the mixtures can be produced, tested and analyzed.
10. In September, since no plant produced mixtures had been received, UMass Dartmouth obtained Post Consumer Asphalt Shingles (PCAS) to begin development of the mixtures designs with this new source of RAS. Previous mixture work had been completed with Manufactures Shingle Waste (MSW).
11. The PCAS source material was tested to determine its properties (binder content, gradation, etc.).
12. Mixture design using 5% PCAS and 15% RAP + 5% PCAS were developed using the same source of aggregates as the previous MSW RAS testing.
13. Performance testing of the two mixtures developed with PCAS commenced. Specifically dynamic modulus testing, flexural beam fatigue, Thermal Stress Restrained Specimen Test (TSRST), Illinois Flexibility Index Test (IFIT), and Disk Shaped Compact Tension Test (DC(T)) were undertaken.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:
A Transportation Research Board (TRB) paper was submitted in August of 2016 related to this research work for this project. The paper was accepted for presentation at the Transportation Research Board 96th Annual Meeting in Washington DC on January 10th, 2017. The paper entitled “Performance Characterization of Asphalt Mixtures Incorporating Recycled Asphalt Shingles: Mechanical Approach to Asphalt Binder Degree of Blending” will be presented in TRB session 636 “Reclaimed Asphalt Pavement and Recycled Asphalt Shingles in Asphalt Mixtures.”
PROJECT NUMBER: 13-3

PROJECT TITLE: “Improved Regionalization of Quality Assurance (QA) Functions”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Eshan Dave, University of New Hampshire

STATUS: Open

AGREEMENT TERM: 12/1/2014 – 4/2/2017

ANTICIPATED COMPLETION: 4/30/2017

PROJECT OBJECTIVES:

2. Review of QA specifications for PCE/PSE.
3. On the basis of the review and through working with the technical review committee of the project, develop common acceptance standards for PCE/PSE to be used by NETC constituents.
4. Develop a cost-sharing mechanism to accompany the common acceptance standards.
5. Identify agencies and contractors to conduct pilot implementation of the common acceptance standards.
6. Develop a list of additional materials and services for which common acceptance standards might be beneficial and feasible.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:

In the first quarter of 2016, a major research effort was on Task-2 of the project that deals with developing first version of the regionalized QA process for precast and prestressed elements used in highway construction. The regionalized QA process is being developed for elements in three primary categories: non-structural precast elements (examples: catch basins, drop inlets, guard barriers), structural pre-cast elements (examples: precast bearing piles, MSE wall, precast gravity walls) and prestressed elements. The specifications are being developed in form of series of tables (spreadsheets) for plant inspection and certifications, and agency inspection and testing.

Researchers had a web conference meeting with the project technical advisory committee on March 3rd 2016. During this meeting researchers presented the findings of the review of QA processes from various New England agencies (Task-1 findings) and also made a proposal for the regionalized QA processes (Task-2 preliminary proposal). During the meeting the agency representatives provided feedback on a number of items for modifying the draft report from Task-1. A revised report has been prepared and is currently under editorial review.

There was limited progress during the second quarter for 2016. During majority of this quarter the project amendment process was underway for obtaining a no-cost extension. Two main activities that occurred during this quarter include: Revision of the task reports on basis of the meeting from March 3rd and continued development of spreadsheets that provides recommendations for various sampling and testing activities undertaken by producers and sampling and testing activities undertaken by agencies.

The project amendment was under administrative processing that required researchers to stop work on the study until amendment contract was executed. During this, primary research effort was spent on developing two spreadsheets that provide recommendations for QA practices to be adopted by state agencies for precast and prestressed concrete elements.
A detailed report to accompany these recommendations is currently being prepared and is expected to be delivered to Technical Committee by end of October.

The research team finalized two spreadsheets with recommendations for (1) plant certification; (2) sampling and testing as part of QA inspection. These spreadsheets are instrumental in adoption of common acceptance standards for precast and prestressed concrete elements for all six New England DOTs. The spreadsheets were emailed to the project technical committee in early November and a conference call between researchers and the technical committee was held on November 18th 2016. During the conference call researchers presented their recommendations and the technical committee provided their feedback. On basis of the technical committee feedback researchers revisied the recommendations.

During the conference call there was discussion of setting up a Share Point site by Vermont Agency of Transportation (VAOT). The Share Point site will be used to share QA data between the states. Since the call, VAOT has obtained necessary approvals for setting of the Share Point data sharing site. MassDOT and ConnDOT staff has already obtained necessary login information to access this site. Once other states also obtain the login information from VAOT, another conference call will be organized to go over the Share Point site as well as to further discuss pilot projects during 2017 construction season where sharing of QA resources will be tried by different states.

The final report for the project was prepared during the previous quarter. The report is currently being revised to incorporate recommendations made by technical committee during the November conference call.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:

A Share Point site has been setup by VAOT as first step in realizing the implementation of the research conducted through this study. As a next step, a series of pilot project will be conducted by various New England agencies to use the unified QA processes developed herein and to share inspection resources.
PROJECT NUMBER: 14-1

PROJECT TITLE: “Measuring the Effectiveness of Competency Models for Job-Specific Professional Development of Engineers and Engineering Technicians”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Chris Ahmadjian, University of Massachusetts, Amherst

STATUS: Open


ANTICIPATED COMPLETION: 4/3/2016

PROJECT OBJECTIVES:

1. To identify and review existing Competency Models (CM) and matrices that can help in the development of a DOT specific competency model
2. To perform a gap analysis on the existing CM’s and matrices to create a DOT specific employee competency matrix
3. To create a CM framework for each of the NETC member states
4. To run a pilot program in one of the NETC member states
5. To determine the financial benefits (return on investment) of having a CM in place
6. To create an implementation plan and technology transfer strategy for the research results
7. To deliver a final report

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:

1. Work on Task 1 is complete. Specific models for DOT’s were not found. We will continue to search for specific models as the research continues
2. The subcontractor Bob LePage has started work on the gap analysis between the standard employment classifications for both technicians and civil engineers and the standard classifications in industry. Bob will also look at strategic plans and see if gaps in needed competencies exists. He will also begin work on the pilot project in Maine.
3. Work was begun on a conceptual process that would create a CM model for each DOT.
5. Work was completed on a conceptual process that would create a CM model for each DOT.
6. The graduate student has completed her thesis work. That work forms the base information for this research project. The literature search and data are directly transferrable and her results and conclusions should transfer as key parts for a model under this research.
7. The PI has brought in two new researchers: Dr. Michael Knodler, Associate Professor at UMass will be providing direction and support for the project; Cole Fitzpatrick, Research Fellow here at UMass will be applying his expertise to move the project forward.
8. The research team met and decided on a revised strategy.
   a. The first step is to get an extension until 12/31/17.
   b. The next step is to give up on the subcontractor, who has not been responsive.
   c. Cole Fitzpatrick will meet with members of the technical committee to brief them on progress.
   d. The team will then pull already developed model parts into a comprehensive model.
   e. The model will be tested in Maine.
   f. The final report will be written.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:
None thus far.
PROJECT NUMBER: 14-2

PROJECT TITLE: “Investigation of Northern Long-Eared Bat Roosting Sites on Bridges”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Dr. Scott Civjan, University of Massachusetts, Amherst

STATUS: Open

AGREEMENT TERM: 2/1/2015 – 4/2/2017

ANTICIPATED COMPLETION: 4/2/2017

PROJECT OBJECTIVES: The main objective of the proposed research project is to develop a screening tool and to demonstrate its accuracy in determining the presence of NLEB roosting in New England bridges. Additional information will be collected and disseminated related to preferred structural types for bat roosting, New England bat population distributions and evaluation of existing public data already collected by State Fish and Wildlife Departments and Transportation Agencies throughout New England.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:

1. Further/more detailed evaluation/analysis of all calls from summer 2015 with SonoBat software
2. Evaluation of all calls from summer 2015 with EchoClass software
3. Initial comparison of call results using SonoBat vs EchoClass
4. Conducted rapid visual screenings in CT
5. Determined final 15 bridges to monitor summer 2016 including replacements and sent out for committee approval
6. Contacted regional personnel for updated Summer 2015 data related to NLEB and bridge use for bat roosts
7. Developed preliminary recommendations related to inspection surveys
8. Obtained approval for borescope use in all New England states and UMass Amherst campus
9. Got verbal commitment from two interns for summer 2016
10. Wrote initial draft of report detailing summer 2015 findings
11. Developed field routes for summer 2016
12. Continued discussions about the implications of the final 4(d) ruling
13. Initial discussions on new protocol survey
14. Presentation at TRB Annual Meeting
15. Presentation at MassDOT Innovation and Tech Transfer Exchange
16. Submitted abstract to Northeastern Transportation and Wildlife Conference
17. Finalized bridge selection for summer 2016 field work.
18. Research team bridge assessment survey form: Developed, distributed and revised based on feedback.
19. Completed detailed schedule for remaining summer field work and shared with TC.
20. Purchased materials required for summer 2016 field work.
22. Completed 1st round (early season) monitoring for summer 2016 (15 bridges)
23. Completed bridge assessments of all 15 monitored bridges including the FHWA/FRA and the research team bridge assessment survey forms
24. Completed emergence studies at 7 bridges
25. Completed call analysis running collected call data through SonoBat and EchoClass for
summer 2015 data.
26. Initiated call analysis running collected call data through SonoBat and EchoClass for first round of 2016 data.
27. Initiated analysis using altered settings in SonoBat to determine influence of non-default settings.
29. Meeting with TC on 06/30/16 by phone conference to discuss progress to date and summer 2016 activities.
30. Determined best conferences for dissemination of research results and requested travel approval from NETC and TC.
31. Concluded the field work component of the project
32. Completed early, mid and late season 2016 field monitoring of bridges
33. Completed rapid inspections of all 15 bridges during both 2016 summer monitoring
34. Completed emergence studies at all bridges
35. Documented all collected data
36. Collected guano samples
37. Completed call analysis running collected call data through SonoBat and EchoClass for summer 2016 data.
38. Continued acoustic monitoring program comparison analyses
39. Presentation at New England Transportation and Wildlife Conference at Lake Placid, NY
40. Contacted guano testing labs for project samples
41. Updating of final project report draft
42. Guano samples sent to 2 labs for species identification.
43. Hand vetting results of MYSE calls received from Sarah Boyden of MaineDOT.
44. Continued evaluation of data.
45. Began compiling inspection and data collection forms into report format.
46. Obtained quotes from consultants for data analysis.
47. Sent acoustic data to two consultants for further acoustic analysis with automated programs and select hand vetting.
49. Modified presentation of research and revised for conferences as appropriate.
50. Presented at the North American Society for Bat Research (NASBR) conference at San Antonio TX.
51. Presented (remotely) at Maine Bat Working Group Annual Meeting.
52. Submitted abstract to the Northeastern Bat Working Group (NEBWG) conference.
54. Conference call to discuss planning of Transportation Research Board Workshop 114: Bats at the Crossroads: Regulatory Compliance for Program and Project Delivery and Approaches to Conserving Imperiled Species.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:

- Presentation at Northeastern Transportation and Wildlife Conference, September 2016.
- Presented at the North American Society for Bat Research (NASBR) conference at San Antonio TX.
- Presented (remotely) at Maine Bat Working Group Annual Meeting.
• Submitted abstract to the Northeastern Bat Working Group (NEBWG) conference.
• Submitted abstract to International Conference on Ecology and Transportation (ICOET) conference.
• Extension granted to project end date to allow presentation at 2017 International Conference on Ecology and Transportation, Salt Lake City, UT, May 2017.
Given the aging infrastructure and the anticipated growing number of work zones in New England, it is of utmost importance to optimize their layouts to improve safety and to mitigate their impact on mobility. This study aims to use the Transportation Research Board’s SHRP2 Naturalistic Driving Study (SNDS) data for investigating driver behavior in work zones under different traffic, lighting, and weather conditions. In addition, data from the smart work zones (SWZs) in Massachusetts (and other New England states if available) to validate the findings obtained from the analysis of the SNDS data is also proposed. Based on the analysis of the SNDS and SWZs data, improved work zone TTCPs will be developed. These TTCPs will be evaluated using an advanced driving simulator and a microscopic traffic simulation tool. The main objectives of this study include:

- **Literature Review**: A focused review on work zone safety will be conducted.
- **SNDS Data Analysis**: Critical factors that may potentially affect (either positively or negatively) driver behavior in work zones under various conditions will be reviewed and analyzed based on the SNDS data. These factors may include traffic signs, variable message signs, law enforcement, work zone layout, etc.
- **Identify and Quantify Strategies**: The identified factors will be further examined and tools will be developed to quantify these factors’ impacts on three key aspects of improving work zone safety: reducing speed, maintaining safe distances, and preventing driver distraction. In addition, the impacts of these factors on reducing near crash events will be studied. Investigating near crash events and driver behavior/maneuvers immediately prior to them will allow us to better understand how work zone crashes occur.
- **Proposed Work Zone Control Plans**: Based on the SNDS data analysis results and a review of work zone control strategies, new and improved work zone TTCPs will be developed.
- **Validate the Results**: Field data collected from smart work zones (SWZs) in Massachusetts (and other New England states if available) will be used to evaluate the performance of certain work zone TTCPs. If there is a match between the SWZs and the work zones in the SNDS data, the corresponding data sets will be compared both quantitatively and qualitatively. In addition, an advanced driving simulator and a microscopic traffic simulator will be used to evaluate the safety and mobility performance of various work zone layouts and controls. Extensive driving simulator studies will be conducted to evaluate how drivers respond to different work zone layouts and controls.

**PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:**

**Task 3 – Development of Methodology for Testing and Analyzing TTCPs**

- The team has finished all the required paperwork/training and has obtained the roadway
information database and some shapefiles for the NDS.

- An agreement must be signed between Virginia Tech and UMass Lowell before the team can obtain the requested NDS data. Virginia Tech sent an agreement to UMass Lowell for signature in January 2016. However, UMass Lowell has a template for such an agreement and asked Virginia Tech to use the UMass Lowell template. Virginia Tech also has certain required languages to be included in the agreement. There have been many email exchanges between Virginia Tech and UMass Lowell. The agreement so far has not been finalized and signed yet. The team is still awaiting the NDS data for the candidate sites.
  - However, Virginia Tech raised additional questions on our data security plan. These new problems were finally solved on June 20, 2016. According to the email response from Virginia Tech, our Naturalistic Driving Study data request is now under review by the Transportation Research Board.

- The Naturalistic Driving Study (NDS) data at the end of August 2016 in two batches. The team are currently working on submitting our second data request to the Virginia Tech Transportation Institute (VTTI). For this data request, we will make sure that scenarios with lane closure and one lane open will be covered.

**Smart Work Zone (SWZ) Data**

- The team has acquired some data for a SWZ in Connecticut from ConnDOT.
- The team is also in the process of obtaining data from two additional SWZs in Massachusetts.
- The team has finished analyzing the data obtained from one SWZ in Massachusetts.

**Safety Data**

- The team has also acquired some work zone crash data from ConnDOT and the University of Connecticut (Connecticut Transportation Safety Research Center).
- Task 3 – Development of Methodology for Testing and Analyzing TTCPs

**Other Data Sources**

- The team is coordinating with MassDOT regarding this data collection effort using a drone.
- The team also explored the possibility of using the emerging VR technology for modeling driver behavior under different work zone scenarios. The driving simulator is much cheaper.

**Task 4 – Development of New TTCPs**

- The team has reviewed about 60 literatures on work zone temporary traffic control strategies. Most of them are on work zone speed and merge control.
- The team attempted to identify innovative traffic control strategies from the NDS data but were unsuccessful. We also checked the SWZ data. It seems that the two SWZs used the MassDOT Standard Traffic Control Plans for work zones. Currently, we are in the process of documenting the reviewed traffic control strategies and will present them at the upcoming project meeting.
- The team reviewed many strategies for speed and merge control for highway work zones.

**Task 5 – Evaluation of New TTCPs**

- For this task, the PI initially proposed to use either VISSIM or Aimsun to evaluate the proposed temporary traffic control strategies. We have now tentatively decided to use VISSIM, since an ongoing FHWA sponsored project is working on developing a new car-following model specifically for work zones. This FHWA project also plans to implement this work zone car-following model as a VISSIM extension. If this extension is successfully
implemented before May 2017, we will adopt in our TTCP evaluation.

- The team plans to finish developing the dynamic merge control strategy by the end of this year. The driving simulator and VISSIM evaluations of this strategy will be concluded before May 2017.

Task 5 – Evaluation of New TTCPs

The team has been working on two strategies to evaluate the proposed TTCPs: 1) virtual reality driving simulator (VRDS) and 2) VISSIM microscopic traffic simulation. The VRDS is mainly for evaluating speed control strategies (i.e., strategies 1~4). The team has coded all four strategies and prepared recruiting materials, and is ready to conduct the driving simulation study once the semester starts and students are back on campus.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:

An abstract entitled “Modelling Highway Work Zone Traffic Safety and Driver Behaviours in the United States Using a Virtual Reality Driving Simulator” has been accepted by the 2017 Road Safety & Simulation Conference to be held in The Hague, Netherland in October 2017.
PROJECT NUMBER: 15-1

PROJECT TITLE: “Use of Forested Habitat Adjacent to Highways by Northern Long Ear Bats (and Other Bats)”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Jeffrey Foster, University of New Hampshire

STATUS: Open

AGREEMENT TERM: 12/1/2016 – 11/30/2018

ANTICIPATED COMPLETION: 11/30/2018

PROJECT OBJECTIVES: The project objectives would be to develop a matrix of disturbance features (sound frequencies and volumes, canopy width, etc.) and an assessment of a barrier effect that would affect foraging and roosting behavior of Northern Long-Eared Bat colonies and other potential listed species. There would be a screening tool and GIS model that would show zones of influence around highways that have noise and disturbance levels that would result in unlikely bat utilization in adjacent habitats. The screening tool could be GIS-linked. It would link with other geocoded information, and databases, and satellite imagery, that could be updated by future researchers if need be as more information is collected.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:

None thus far.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:

None thus far.
PROJECT NUMBER: 15-3

PROJECT TITLE: “Moisture Susceptibility Testing for Hot Mix Asphalt Pavements in New England”

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Eshan Dave, University of New Hampshire

STATUS: Open

AGREEMENT TERM: 08/01/2016 – 07/31/2018

ANTICIPATED COMPLETION: 07/31/2018

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

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2016:

The contract for this project between NETC and University of New Hampshire was set up during the reported quarter. The “notice to proceed” was sent to researchers on December 22nd 2016. Since only one working day was available in the reported quarter between the receipt of the notice to proceed and end of the quarter, insignificant progress has been accomplished. Researchers have started to collect published literature on the topic of moisture-induced damage in asphalt mixtures and have started to also collect standard specifications from various agencies to conduct a state of the practice review.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2016:

None thus far.
## 1. FINANCIAL STATUS OF ACTIVE PROJECTS:

<table>
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<tr>
<th>NO.</th>
<th>PROJECT TITLE</th>
<th>APPROVED BUDGET</th>
<th>INVOICES APPROVED FOR PAYMENT</th>
<th>PROJECT BALANCE</th>
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<td>05-5</td>
<td>Measurement of Adhesion Properties Between Topcoat Paint and Metallized/Galvanized Steel with Surface Energy Measurement Equipment</td>
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<td>Effective Establishment of Native Grasses on Roadsides</td>
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<td>Low Temperature and Moisture Susceptibility of RAP Mixtures with Warm Mix Technology</td>
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<td>HMA Mixtures Containing Recycled Asphalt Shingles (RAS): Low Temperature and Fatigue Performance of Plant-Produced Mixtures</td>
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### 2. FUND BALANCE:

#### NETC FUND BALANCE

**As of January 8, 2017**

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<th>ITEM</th>
<th>OBLIGATION FOR PROJECTS</th>
<th>TRAVEL OBLIGATIONS AND EXPENDITURES</th>
<th>BUDGET</th>
<th>EXPENDED</th>
<th>INVOICE</th>
<th>CUMMULATIVE BALANCE</th>
<th>NOTES</th>
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- **Unexpended Balance of NETC funds from AASHTO**
  - as of 6/3/95 (Per AASHTO memo 12/4/95)
  - 132,777.07

- **Member Obligations 1994**
  - 6 X $75,000
  - Coord./Admin. of NETC: Calendar Year 1994 Bdgt. = $730,426
    - 95-1: Use of Tire Chips/Soil Mixtures to Limit Pavement Damage of Paved Roads
    - 95-2: Suitability of Non-Hydric Soils for Wetland Mitigation
    - 95-3: Implementation and Evaluation of Traffic Marking Reecess for Application of Thermoplastic Pavement
    - 95-4: Buried Joints in Short Span Bridges
    - 95-5: Guidelines for Ride Quality Acceptance of Pavements
    - 95-6: Durability of Concrete Crack Repair Systems
  - 450,000.00

- **Member Obligations 1995**
  - 6 X $75,000
  - Coord./Admin. of NETC: Calendar Year 1995 Bdgt. = $75,000
    - 95-7: A Portable Method for Determining Chloride Concentration on Roadway Pavements
    - 95-8: Performance Evaluation & Economic Analysis of Durability Enhancing Admixtures, etc.
    - 95-9: Determining Properties, Standards & Performance of Wood Waste Compost, etc.
    - 95-10: Align. to ComQO7 for Constr. Costs of Test Site (Approved 1/31/99 Ballot)
    - 95-11: Early Distress of Open-Graded Friction Course
  - 525,000.00

- **Member Allocations 1996**
  - 6 X $75,000
  - Coord./Admin. of NETC: Calendar Year 1996 Bdgt. = $75,000
    - 96-1: SUPERPAVE implementation
    - 96-2: Optimizing GPS Use in Transportation Projects
    - 96-3: Effectiveness of Fiber Reinforced Composites as Protective Coverings for Bridge Elements, etc.
  - 450,000.00

- **Member Obligations 1997**
  - 6 X $75,000
  - Coord./Admin. of NETC: Calendar Year 1997 Bdgt. = $82,494
    - 97-1: A Portable Method for Determining Chloride Concentration on Roadway Pavements
    - 97-2: Evaluation of Asphalitic Expansion Joints
    - 97-3: Bridge Scour Monitoring Systems
    - 97-4: Quantifying Roadside Rest Area Usage
    - 97-5: The Effects of Concrete Removal Operations on Adjacent Concrete that is to Remain
  - 450,000.00

- **Member Obligations 1998**
  - 6 X $75,000
  - Coord./Admin. of NETC: Calendar Year 1998 Bdgt. = $71,030
    - 98-1: Bridge Rail Transitions
    - 98-2: Evaluation of Permeability of Superpave Mixes
    - 98-3: Composite Reinforced Timber Guard Rail - Phase I: Design, Fabrication and Testing
    - 98-4: Falling Weight Deflectometer Study
    - 98-5: Guard Rail Testing - Modified eccentric Loading at NCHRP 350 TL2
    - 98-6: Implementation of Visualization Technologies to Create Simplified Presentations Within Highway agencies
    - 99-8: Performance and Effectiveness of A Thin Pavement Section Using Geogrids and Drainage geocomposites in Roadway Pavements
  - 450,000.00

- **Member Obligations 2000**
  - 6 X $500,000
  - Coord./Admin. of NETC: Calendar Year 2000 Bdgt. = $500,524
    - 2000-1: Ground-Based Imaging and Data Acquisition Systems for Roadway Inventories in New England - A Synthesis
    - 2000-2: Evaluation of Permeability of Superpave Mixes
    - 2000-3: Composite Reinforced Timber Guard Rail - Phase I: Design, Fabrication and Testing
    - 2000-4: Falling Weight Deflectometer Study
    - 2000-5: Guard Rail Testing - Modified eccentric Loading at NCHRP 350 TL2
    - 2000-6: Implementation of Visualization Technologies to Create Simplified Presentations Within Highway agencies
    - 2000-8: Performance and Effectiveness of A Thin Pavement Section Using Geogrids and Drainage geocomposites in Roadway Pavements
  - 600,000.00

- **Member Obligations 2001**
  - 6 X $500,000
  - Coord./Admin. of NETC: Calendar Year 2001 Bdgt. = $506,248
    - 2001-1: Advanced Composite Materials for New England’s Transportation Infrastructure
    - 2001-3: Design of Superpave HMA for Low Volume Roads
    - 2001-4: Field Evaluation of A New-Concept Device
  - 600,000.00

- **Member Obligations 2002**
  - 6 X $500,000
  - Coord./Admin. of NETC: Calendar Year 2002 Bdgt. = $516,248
    - 2002-1: Relating Hot Mix Asphalt Pavement Density to Performance
    - 2002-2: Formulate Approach for S11 Implementation in New England Phase 1
    - 2002-3: Establish Subgrade Support Values (Mr) for Typical Soils in New England
    - 2002-4: Determination of Moisture Content of De-Icing Salt at Point of Delivery
    - 2002-5: Determination of Moisture Content of De-Icing Salt at Point of Delivery
    - 2002-6: Design of Superpave HMA for Low Volume Roads
    - 2002-7: Calibrating Traffic Simulation Models to Indentify Weather Conditions with Applications to Arterial
    - 2002-8: Intelligent Transportation Systems Applications to Ski Resorts in New England
  - 600,000.00

- **Member Allocations 2003**
  - 6 X $500,000
  - Coord./Admin. of NETC: Calendar Year 2003 Bdgt. = $516,248
    - 2003-1: Advanced Composite Materials for New England’s Transportation Infrastructure
    - 2003-2: Design of Superpave HMA for Low Volume Roads
    - 2003-3: Field Evaluation of A New-Concept Device
  - 600,000.00

- **NY DOT Obligation**
  - $56,551.38
  - 56,551.38

**Notes:**

- Coord./Admin. of NETC: Calendar Year 2002
  - 2002-1: Relating Hot Mix Asphalt Pavement Density to Performance
  - 2002-2: Formulate Approach for S11 Implementation in New England Phase 1
  - 2002-3: Establish Subgrade Support Values (Mr) for Typical Soils in New England
  - 2002-4: Determination of Moisture Content of De-Icing Salt at Point of Delivery
  - 2002-5: Determination of Moisture Content of De-Icing Salt at Point of Delivery
  - 2002-6: Design of Superpave HMA for Low Volume Roads
  - 2002-7: Calibrating Traffic Simulation Models to Indentify Weather Conditions with Applications to Arterial
  - 2002-8: Intelligent Transportation Systems Applications to Ski Resorts in New England

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**NETC Fund Balance Notes:**

1. Member FFY allocations are obligated between October 1 and December 31
2. A credit of $6,599.70 for NETC's overpayment to UConn for CY 2004 NETC Management was applied, by UConn, to the 'Indirect Cost' for project 02-5. Therefore although the total expenditures of the project were $26,279.69 the amount paid by NETC was $19,679.99.
3. Per minutes of NETC Adv. Comm. Mtg. 5/12/08: "It was agreed that since the encumbered amount for NETC 05-7 was incorrectly shown in the Fund Balance Report (April 30, 2008) as $70,000 and the correct amount is $100,000, the amount of funding to be allocated for the third ranked problem statement for the FFY 09 research program (NETC 09-3) would be set at the amount of the revised unencumbered fund balance remaining (at that time) after the allocation of funds for NETC 09-1 and NETC 09-2, i.e., $48,847." (Note no longer relevant. TAC revised budget. AHC 6/25/2013)

4. Work on project suspended pending resolution of authorization of payment for costs incurred prior to execution of project agreement. VAOT to submit request to FHWA for approval of costs incurred prior to execution of the project agreement in accordance with 23CFR Section 1.9.

5. During the Process to Close out SPR-3(089) and TPF-5(201), it became clear that there was a discrepancy between the NETC Coordinator's Fund Balance Tracking Sheet and what was actually left over in the accounts. The reconciliation is approximately $-450,000. This leads me to believe that an annual contribution from the 1990s might have been canceled, but it is not reflected in the tracking sheet. Unfortunately, SPR-3(009) has been closed for a long time, so the detailed account information cannot be obtained.

6. Contributions for FY 2012 and FY 2013 were canceled in an Advisory Committee ballot dated 1/10/14. Connecticut had already made their contribution. Therefore, they will not need to make a contribution for FY 2014.

7. Contributions for FY 2016 have been waived.
1. POLICIES AND PROCEDURES:


2. ANNUAL REPORTS:

“Annual Report For Calendar Year 1995,” March 1996, NETCR3
“Annual Report For Calendar Year 1996,” January 1997, NETCR4
“Annual Report For Calendar Year 1997,” January 1998, NETCR9
“Annual Report For Calendar Year 1998,” January 1999, NETCR10
“Annual Report For Calendar Year 1999,” January 2000, NETCR21
“Annual Report For Calendar Year 2000,” August 2001, NETCR27
“Annual Report For Calendar Year 2001,” December 2002, NETCR40
“Annual Report For Calendar Year 2002,” November 2003, NETCR41
“Annual Report For Calendar Year 2003,” September 2005, NETCR55
“Annual Report For Calendar Year 2005,” August 2006, NETCR61
“Annual Report For Calendar Year 2006,” April 2007, NETCR68
“Annual Report For Calendar Year 2007,” February 2008, NETCR70
“Annual Report For Calendar Year 2008,” April 2009, NETCR75
“Annual Report For Calendar Year 2009,” March 2010, NETCR79
“Annual Report For Calendar Year 2010,” April 2011, NETCR84
“Annual Report For Calendar Year 2011,” December 2011, NETCR90
“Annual Report For Calendar Year 2012,” February 2013, NETCR92
“Annual Report For Calendar Year 2013,” February 2014, NETCR94
“Annual Report For Calendar Year 2014,” February 2015, NETCR95
“Annual Report For Calendar Year 2015,” January 2018, NETCR102
“Annual Report For Calendar Year 2016,” April 2018, NETCR106

3. REPORTS, PAPERS, AND PRESENTATIONS 1988-1995:


“Advantages of Oversize/Overweight Truck Permit Uniformity,” AASHTO 1990


“Regional Rail Planning In New England,” Martland, C.P. Little, and Alvaro, A.E., MIT, August 1993. (Accepted for publication 1994)


4. REPORTS, PAPERS AND PRESENTATIONS 1995-2016:

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
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<tr>
<td>N/A</td>
<td><strong>Construction Costs of New England Bridges</strong></td>
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<td><strong>Reports:</strong></td>
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<td><strong>Papers and Presentations:</strong></td>
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<tr>
<td>N/A</td>
<td><strong>Tire Chips as Lightweight Backfill for Retaining Walls, Phase II: Full-Scale Testing</strong></td>
</tr>
<tr>
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<td><strong>Reports:</strong></td>
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<tr>
<td></td>
<td><strong>Papers and Presentations:</strong></td>
</tr>
<tr>
<td></td>
<td>“Civil Engineering Uses for Tire Chips,” Humphrey D.N. A six-hour short course presented to the Nebraska Department of Environmental Quality, the Maine Dept. of Transportation, the Texas Engineering Extension Service, the Manitoba Tire Stewardship Board, the Alberta Tire Recycling Management Board, and the Arkansas Department of Pollution Control and Ecology.</td>
</tr>
</tbody>
</table>
Tire Chips as Lightweight Backfill for Retaining Walls, Phase II: Full-Scale Testing (cont’d):
Papers and Presentations (cont’d):


“Highway Applications of Tire Shreds,” Humphrey, D. A 7-hour short course presented to the RI DOT, April 1999.

New England Vehicle Classification And Truck Weight Program, Phase I
Reports:
<table>
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<th>N/A</th>
<th><strong>New England Vehicle Classification And Truck Weight Program, Phase I (cont’d):</strong></th>
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<td><strong>Reports (cont’d):</strong></td>
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<td><strong>Papers and Presentations:</strong></td>
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<th>N/A</th>
<th><strong>Bridge Rail Crash Test, Phase II: Sidewalk-Mounted Rail</strong></th>
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<tr>
<td></td>
<td><strong>Reports:</strong></td>
</tr>
<tr>
<td></td>
<td>“Full-Scale Crash Evaluation of the NETC 4-Bar Sidewalk Steel Bridge Railing,” Kimball, C.E., and Mayer, J.B., March 1999, NETCR14. <strong>Papers and Presentations:</strong> None</td>
</tr>
</tbody>
</table>
Structural Analysis of New England Subbase Materials And Structures

Reports:

Papers and Presentations:


Nondestructive Testing of Reinforced Concrete Bridges Using Radar Imaging Techniques

Reports:

Papers and Presentations:


94-2  Nondestructive Testing of Reinforced Concrete Bridges Using Radar Imaging Techniques (cont’d):
Papers and Presentations (cont’d):


94-3  Procedures for the Evaluation of Sheet Membrane Waterproofing:
Reports:

Papers and Presentations: None
94-4 **Durability of Concrete Crack Repair Systems:**

*Reports:* None

*Papers and Presentations:*  

“Durability of Concrete Crack Repair System,” Tsiatas, G. and Robinson, J. Presentation to representatives of the Chemical Grouting Division of Kajima Corporation (Japan), University of Rhode Island, College of Engineering, October 26, 1999.

95-1 **Use of Tire Chip/Soil Mixtures to Limit Frost Heave and Pavement Damage of Paved Road**

*Reports:*  

*Papers and Presentations:*  


"Highway Applications of Tire Shreds,” Humphrey, D. A 7-hour short course presented to the RI DOT, April 1999.

“Field Trial of Tire Shreds as Insulation for Paved Roads,” Humphrey, D., Chen, L.H., Lawrence, B. A paper presented at the 10th International Conference on Cold Regions Engineering: Putting Research into Practice, held in Hanover, NH, August 16-19, 1999.

95-2 **Suitability of Non-Hydric Soils for Wetland Mitigation**

*Reports:*  

*Papers and Presentations:* None
95-3 Implementation and Evaluation of Traffic Marking Recesses for Application of Thermo-Plastic Markings on Modified Open Graded Mixes
Reports:

Papers and Presentations:


95-5 Buried Joints In Short Span Bridges
Reports: None

Papers and Presentations:

95-6 Guidelines for Ride Quality Acceptance of Pavements
Reports:

Papers and Presentations: None

96-1 Implementation of Superpave
Reports:
“Superpave Implementation,” Mahoney, James, Stephens, Jack E., September 1999, NETCR18.
Effectiveness of Fiber Reinforced Composite as Structural and Protective Coverings for Bridge Elements Exposed To Deicing Salt Chlorides

Reports:

Papers and Presentations:


“Recent Advances in Fiber Composites,” Seminar Series, University Catalena, Spain, June 28, 1999.


Effectiveness Of Fiber Reinforced Composite As Structural And Protective Coverings For Bridge Elements Exposed To Deicing Salt Chlorides (cont’d):
Papers and Presentations (cont’d):


A Portable Method to Determine Chloride Concentration on Roadway Pavements
Reports:

Papers and Presentations: None

Performance Evaluation and Economic Analysis of Combinations of Durability Enhancing Admixtures (Mineral and Chemical) In Structural Concrete for the Northeast U.S.A
Reports:

Papers and Presentations:
“Performance Evaluation of Durability Enhancing Admixtures (Mineral and Chemical) in Structural Concrete,” Sund, D., Report in Partial Fulfillment of Master of Science in Civil Engineering Degree, Department of Civil and Environmental Engineering, University of Massachusetts, Amherst, September, 1999.
97-2 Performance Evaluation and Economic Analysis of Combinations of Durability Enhancing Admixtures (Mineral and Chemical) In Structural Concrete for the Northeast U.S.A (cont’d):

Papers and Presentations:


97-3 Determining Properties, Standards and Performance of Wood Material as an Erosion Control Mulch and as a Filter Berm

Reports:

Papers and Presentations:

97-4 Early Distress of Open-Graded Friction Course (OGFC)

Reports:

Papers and Presentations: None

99-1 Bridge Rail Transitions – Development and Crash Testing

Reports:

Note:
Design documents for the NETC 2-Bar Curb-Mounted and 4-Bar Sidewalk-Mounted Bridge Rail Transitions are available from the NETC Coordinator.
99-1  Bridge Rail Transitions – Development and Crash Testing (cont’d):
Papers and Presentations:


99-2  Evaluation of Asphallic Expansion Joints
Reports:

Papers and Presentations:  None

99-3  Development of Priority Based Statewide Scour Monitoring Systems In New England
Reports:

Papers and Presentations:

99-4  Quantifying Roadside Rest Area Usage
Reports:

Papers and Presentations:
Results from the rest-area research were included in a presentation by the PI:
Analytical and Experimental Investigation of the Effects of Concrete Removal Operations on Adjacent Concrete That Is To Remain

Reports:

Papers and Presentations:


“Effect of Demolition on Remaining Part of Concrete Bridge, Numerical Analysis Vs. Experimental Results.” Presented and published in the proceedings of Internationales Kolloquium über die Anwendungen der Informatik in Architektur und Bauwesen, Germany, June 2000.

“The Effect of Bridge Rehabilitation on the Remaining Structural Parts.” Presented and published in the proceedings of the ASCE conference at Stanford University, August 2000.

Ground-Based Imaging and Data Acquisition Systems for Roadway Inventories in New England - A Synthesis of Practice

Reports:

Papers and Presentations: None

Evaluation of Permeability of Superpave Mixes

Reports:

Papers and Presentations:

00-3  Design, Fabrication and Preliminary Testing of a Composite Reinforced Timber Guardrail

Reports:

Papers and Presentations: None

00-4  Portable Falling Weight Deflectometer Study

Reports:

Papers and Presentations: None

00-5  Guardrail Testing Modified Eccentric Loader Terminal (MELT) at NCHRP 350 TL-2

Reports:

Papers and Presentations:
Dean Alberson, Texas Transportation Institute, Principal Investigator presented the results of the crash tests conducted on the MELT guardrail terminal to the Association of General Contractors/American Road Transportation Builders Association/American Association of State Highway Transportation Officials Task Force 13 meeting in Seattle, Washington, April 2002.

00-6  Effective Visualization Techniques for the Public Presentation of Transportation

Reports:

Papers and Presentations:
A Complete Review of Incident Detection Algorithms and Their Deployment: What Works and What Doesn’t
Reports:

Papers and Presentations:
“Use of Driver-Based Data for Incident Detection,” Parkany, Emily, Submitted to the 7th International Conference on Applications of Advanced Technologies in Transportation Engineering (AATT), Boston, August 2002.

Performance and Effectiveness of a Thin Pavement Section Using Geogrids and Drainage Geocomposites in a Cold Region
Reports:

Papers and Presentations:

Advanced Composite Materials for New England’s Transportation Infrastructure: A Study for Implementation and Synthesis of Technology and Practice
Reports:

Papers and Presentations: None

Advanced Composite Materials in New England’s Transportation Infrastructure - Technology Transfer Phase 1: Selection of Prototype
T2 Phase I
Reports:

Papers and Presentations: None
01-2 Development of a Testing Protocol for QC/QA of Hot Mix Asphalt Reports:

Papers and Presentations:

01-3 Design of Superpave HMA for Low Volume Roads Reports:

Papers and Presentations:

01-6 Field Evaluation of a New Compaction Monitoring Device Reports:

Papers and Presentations: None

02-1 Relating Hot Mix Asphalt Pavement Density to Performance Reports:

Papers and Presentations:

02-2  **Formulate Approach for 511 Implementation in New England Reports:**

**Papers and Presentations:** None

02-3  **Establish Subgrade Support Values for Typical Soils in New England Reports:**

**Papers and Presentations:**


02-5  **Determination of Moisture Content of Deicing Salt at Point of Delivery Reports:**

**Papers and Presentations:** None
Sealing of Small Movement Bridge Expansion Joints

Reports:

Papers and Presentations:


02-6 Phase 2 Sealing of Small Movement Bridge Expansion Joints - Phase II: Field Demonstration and Monitoring

Reports:

Papers and Presentations:


02-7 Validating Traffic Simulation Models to Inclement Weather Travel Conditions with Applications to Arterial Coordinated Signal Systems Reports:

Papers and Presentations:


02-8 Intelligent Transportation Systems Applications to Ski Resorts in New England Reports:

Papers and Presentations:

03-1 Ability of Wood Fiber Materials to Attenuate Heavy Metals Associated with Highway Runoff Reports:

Papers and Presentations: None
03-2 Field Studies of Concrete Containing Salts of an Alkenyl-Substituted Succinic Acid
Reports:

Papers and Presentations:


03-3 Feasibility Study of an Erosion Control Laboratory in New England
Reports:

Papers and Presentations: None

03-3 Phase 2 Design Considerations for a Prototype Erosion Control Laboratory in New England
Reports:

Papers and Presentations: None

03-4 Measuring Pollutant Removal Efficiencies of Stormwater Treatment Units
Reports:

Papers and Presentations:

03-5 Evaluation of a Field Permeameter as a Longitudinal Joint Quality Indicator

Reports:

Papers and Presentations:


03-6 Fix It First: Utilizing the Seismic Property Analyzer and MMLS to Develop Guidelines for the Use of Polymer Modified Thin Lift HMA vs. Surface Treatments

Reports:

Papers and Presentations: None
Basalt Fiber Reinforced Polymer Composites

Reports:

Papers and Presentations:


“Investigation of Basalt Fiber Composite Aging Behavior for Applications in Transportation,” Q. Liu, M. T. Shaw, R. S. Parnas, A.M. McDonnell, Polymer Composites.


Recycling Asphalt Pavements Containing Modified Binders - Phase 2

Reports:

Papers and Presentations:

Driver-Eye-Movement-Based Investigation for Improving Work-Zone Safety

Reports:

Papers and Presentations:

“Understanding and Quantifying Driver Response,” Muttart, J.W., Texas Association of Accident Reconstructionist Specials, Houston, TX, February 17 & 18, 2006.


04-3 Estimating the Magnitude of Peak Flows for Steep Gradient Streams in New England
Reports:

Papers and Presentations:

04-4 Determining the Effective PG Grade of Binder in RAP Mixes
Reports:

Papers and Presentations:

04-5 Network-Based Highway Crash Prediction Using Geographic Information Systems
Reports:

Papers and Presentations:


05-1 Development of Supplemental Resistance Method for the Design of Drilled Shaft Rock Sockets
Reports:

Papers and Presentations: None
05-5 Measurement of Adhesion Properties Between Topcoat Paint and Metalized/Galvanized Steel with Surface Energy Measurement Equipment
Reports:

Papers and Presentations:

05-6 Employing Graphic-Aided Dynamic Message Signs to Assist Elder Drivers’ Message Comprehension
Reports:

Papers and Presentations:


05-7 Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways
Reports:
05-7 Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways (cont’d):

Papers and Presentations:
“A Decision Support System for Predicting the likely Benefits of Left-turn Lane Installation,” Ranade, S., Sadek, A.W. and Ivan, J., 2007, TRB Annual meeting, Paper No. 07-0992; January 2007; Transportation Research Record, 2023:28-36, 2007. This paper received the Best Paper Award from the Committee on Operational Effects of Geometrics at the 2008 Annual Meeting.


05-8 Evaluation and Implementation of Traffic Simulation Models for Work Zones

Reports:

Papers and Presentations:


06-1 New England Verification of NCHRP 1-37A Mechanistic-Empirical Pavement Design Guide with Level 2 & 3 Inputs

Reports:

Papers and Presentations:
06-1 New England Verification of NCHRP 1-37A Mechanistic-Empirical Pavement Design Guide with Level 2 & 3 Inputs (cont’d):

Papers and Presentations:


06-3 Establishing Default Dynamic Modulus Values for New England Reports:

Papers and Presentations: None

06-4 Preventative Maintenance and Timing of Applications

Reports: None

Papers and Presentations: None

07-1 In-Place Response Mechanisms of Recycled Layers Due to Temperature and Moisture Variations

Reports:

Papers and Presentations: None

09-2 Effective Establishment of Native Grasses on Roadsides

Reports:
“Effective Establishment of Native Grasses on Roadsides,” Kuzovkina, Julia; Schulthess, Cristina P.; Ricard, Robert; Dryer, Glenn, June 2016, NETCR97.

Papers and Presentations: None

09-3 Advanced Composite Materials: Prototype Development and Demonstration

Reports:
“Advanced Composite Materials in New England’s Transportation Infrastructure: Design, Fabrication, and Installation of ACM Bridge Drain

Papers and Presentations: None

10-3 Low Temperature and Moisture Susceptibility of RAP Mixtures with Warm Mix Technology
Reports: None

Papers and Presentations: None

3-1 Development of High Early Strength Concrete for Accelerated Bridge Construction Closure Pour Connections
Reports: None

Papers and Presentations: None

13-2 HMA Mixtures Containing Recycled Asphalt Shingles (RAS): Low Temperature and Fatigue Performance of Plant-Produced Mixtures
Reports: None

Papers and Presentations: None

13-3 Improved Regionalization of Quality Assurance (QA) Functions
Reports: None

Papers and Presentations: None

14-1 Measuring the Effectiveness of Competency Models for Job-Specific Professional Development of Engineers & Engineering Technicians
Reports: None

Papers and Presentations: None

14-2 Investigation of Northern Long-Eared Bat Roosting Sites on Bridges
Reports: None

Papers and Presentations:
Presentation at Northeastern Transportation and Wildlife Conference, September 2016.
Presented at the North American Society for Bat Research (NASBR) conference at San Antonio TX.
Presented (remotely) at Maine Bat Working Group Annual Meeting.
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<th>Papers and Presentations</th>
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<td>14-4</td>
<td>Optimizing Future Work Zones in New England for Safety and Mobility</td>
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<td>15-1</td>
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