ANNUAL REPORT

For Calendar Year 2009

NEW ENGLAND TRANSPORTATION CONSORTIUM

NETCR79 **March 2010**

This report was sponsored by the New England Transportation Consortium, a cooperative effort of the Departments of Transportation and the Land Grant Universities of the six New England States, and the U.S. Department of Transportation's Federal Highway Administration.

NEW ENGLAND TRANSPORTATION CONSORTIUM

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Gerald McCarthy
University of Massachusetts Dartmouth

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A. INTRODUCTION

The New England Transportation Consortium (NETC) is a cooperative effort of the transportation agencies of the six New England States. 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.

B. 2009 HIGHLIGHTS

1. **NETC ALLOCATES $500,000 IN ITS FFY2010 RESEARCH PROGRAM FOR RESEARCH IN THE FOLLOWING AREAS:**
   - **Asphalt Pavements: $330,000:**
     - "A Field Evaluation of SuperPave Hot Mix Asphalt Pavement Containing 30% RAP: $180,000"
     - "Low Temperature and Moisture Susceptibility of RAP Mixtures with Warm Mix Technology": $150,000
   - **Bridge Maintenance: $170,000:**
     - "Synthesis of Practice: Electronic Bridge Inspection Document Management Systems": $70,000
     - "Field Evaluation of Corrosion Protection on Bridges with a Spray Application of Disodium Tetrapropenyl Succinate (DSS)": $100,000

2. **NEW YORK STATE DEPARTMENT OF TRANSPORTATION CONTINUES ITS COLLABORATION WITH NETC ON RESEARCH FUNDING:**
   - NYSDOT will provide $50,000 to the NETC pooled fund for NETC's FFY 2010 research program.

3. **FINDINGS FROM THE FOLLOWING RESEARCH PROJECT(S) WERE DISTRIBUTED TO NEW ENGLAND'S STATE TRANSPORTATION AGENCIES, STATE UNIVERSITIES, THE FEDERAL HIGHWAY ADMINISTRATION, THE AMERCIAN ASSOCIATION OF STATE AND HIGHWAY TRANSPORTATION OFFICIALS' REGION 1 RESEARCH ADVISORY COMMITTEE, THE NATIONAL TECHNICAL INFORMATION SERVICE AND THE NATIONAL TRANSPORTATION LIBRARY:**
   - NETC 01-1 (T2 Phase 1) "Advanced Composite Materials in New England's Transportation Infrastructure – Technology Transfer Phase 1: Selection of Prototype," Brena, S. F., Civjan, S. A., November 1, 2009, NETCR77.
   - NETC 04-2 "Driver-Eye Movement-Based Investigation for Improving Work-Zone Safety," Fisher, D. L., Knodler, M., Muttart, J., January 28, 2009, NETCR71.
   - NETC 05-7 "Warrants for Left Turn Lanes at Unsignalized Intersections and Driveways," Ivan, J. N., Sadek, A. W., Zhou, H., Ranade, S., February 12,

2009, NETCR72.

4. TECHNOLOGY TRANSFER:

- **NETC Presented as a Model for the Management of a Multistate Cooperative Research Program at the 2009 Transportation Research Board Meeting.**
  The following paper, presented at the January 2009 Transportation Research Board meeting in Washington, DC was selected for publication in the Transportation Research Record, the Journal of the Transportation Research Board of the National Academies: "New England Transportation Consortium: A Model for Management of a Multistate Cooperative Research Program", Oliveira, D., Sime, J., McCarthy, G., Journal of the Transportation Research Board, No. 2109.

- **Requests for Information and Technical Assistance:**
  The NETC Coordinator's office responded to the following requests for information and technical assistance:
  - **National Center for Freight & Infrastructure Research & Education, University of Wisconsin-Madison:** Copy of the NETC report entitled: "NETC Common Truck Permit Procedures for Non-Divisible Oversize/Overweight Vehicles"
  - **Pennsylvania Department of Transportation:** A request for information on a methodology for determining deicer concentration on road pavements. A copy of the NETC report entitled "A Portable Method to Determine Chloride Concentration on Roadway Pavements" was provided.
  - **FHWA Office of Safety Design, Washington, DC:** Request for copy of the NETC report entitled "Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways"
  - **Stark County Engineer, Toulon, IL:** Information on best practices regarding materials and methods for expansion joints for small bridges.
  - **John Harris, LLC**: A request for information on deicer usage by the six New England State Departments of Transportation
  - **HNTB Consultants:** Technical Information on the NETC 2-bar bridge rail
  - **American University, Beirut Lebanon, Civil Engineering Student:** Information on the NETC project entitled "Development of Supplemental Resistance Method for the Design of Drilled Shaft Rock Sockets"

- **American Association of State Highway and Transportation Officials 95th Annual Meeting:**
  An exhibit highlighting the New England Transportation Consortium and its research projects was presented, by the Coordinator, at the 95th Annual Meeting of AASHTO held at Palm Desert, CA in October 2009.

- **NETC Research Project Technical Papers and Presentations:**
  The following technical papers arising from NETC funded research projects were presented at technical conferences or published in technical journals by NETC researchers:
  - "Evaluation of the Effects of HMA Density on Mixture Fatigue and Rutting Performance," Mogawer, W. S., Northeast Asphalt User/Producer Group (NEAUPG) Annual Meeting, South Portland, Maine, October 8, 2009.
  - "Safety Effects of Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways," Zhou, H., Ivan, J. and Sadek, A., Transportation Research Board Annual Meeting; Paper No. 09-2000, Washington, DC, Jan. 2009.
  - "Sensitivity of MEPDG Level 2 and 3 Inputs Using Statistical Analysis Techniques for New England States," Ayyala, D., Chehab, G. R., and Daniel, J. S., accepted for publication in the Transportation Research Record 2010.
  - "Sensitivity of RAP Binder Grade on Performance Predictions in the MEPDG," Daniel, J. S., Cehab, G. R., and Ayyala, D., Journal of the Association of Asphalt Pavement Technologists, Vol. 78, 2009, pp. 352-376.
  - "Sensitivity of RAP Binder Grade on Performance Predictions in the MEPDG," Presentation by Jo Sias Daniel to the Association of Asphalt Paving Technologists Annual Meeting, March 2009.

C. PROGRESS OF ACTIVE PROJECTS

PROJECT NUMBER: 01-1 (T2 Phase 1)

PROJECT TITLE: Advanced Composite Materials in New England's Transportation Infrastructure - Technology Transfer Phase 1: Selection of Prototype

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Sergio F. Breña, PI, and Scott A. Civjan, Co-PI, University of Massachusetts, Amherst

STATUS: Completed

AGREEMENT TERM: 5/28/2007 – 11/30/2008

ANTICIPATED COMPLETION: N/A

PROJECT OBJECTIVES:
The main objective of this project is to identify a component commonly used in the transportation infrastructure in New England for fabrication using advanced composite materials (ACMs). A related objective will be to collect sufficient details about this component to be able to develop the research problem statement to solicit proposals to fabricate and implement it in demonstration projects in New England. The selected component will likely be one where safety of the transportation network users is not compromised, to alleviate some of the current concerns that engineers have about long-term performance of ACMs and lack of design standards for these materials. Committal from DOT engineers to incorporate the ACM product in a future project will be sought in this phase of the project.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:
Final report submitted and distributed.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009:
"Advanced Composite Materials in New England's Transportation Infrastructure – Technology Transfer Phase 1: Selection of Prototype," Breña, S.F., and Civjan, S.A., November 1, 2009, NETCR77.

PROJECT NUMBER: 02-1

PROJECT TITLE: Relating Hot Mix Asphalt Pavement Density to Performance

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Walaa S. Mogawer, PI, UMass Dartmouth; Rajib Mallick, Co-PI, Worcester Polytechnic Institute; Jo Sias Daniel, Co-PI, University of New Hampshire

STATUS: Continuing

AGREEMENT TERM: 9/1/2003 – 7/31/2007

ANTICIPATED COMPLETION: 3/31/2010

PROJECT OBJECTIVES:
The objective of the proposed study is to determine relationship between pavement density and performance through testing of pavements at different levels of in-place density with accelerated pavement loading equipment and environmental simulation. Another objective is to use the obtained relationship to determine pay adjustments for different densities.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:

1. Fabrication of specimens for Dynamic Modulus (|E*|) testing was completed for both the 9.5mm and 12.5mm mixtures.

2. Dynamic Modulus (|E*|) testing was completed in accordance with AASHTO TP62 and the draft specifications provided by the Principle Investigator (PI) of NCHRP project 9-29 "*Simple Performance Tester for Superpave Mix Design*" in NCHRP Report 629 "*Ruggedness Testing of the Dynamic Modulus and Flow Number Tests with the Simple Performance Tester*." The 9.5mm mixture was tested at average densities of 89.3% (88% target), 91.7% (91.0% target), 94.1% (94.0% target), and 97.9% (97% target). The 12.5mm mixture was tested at average densities of 88.5% (88% target), 91.8% (91.0% target), 93.6% (94.0% target), and 96.2% (97% target). For each mixture, three specimens were tested at each density level at temperatures of 4ºC, 20ºC, and 40ºC and frequencies of 0.01 Hz (40ºC only), 0.1 Hz, 1Hz, and 10 Hz.

3. Based on the Dynamic Modulus (|E*|) data, Master Curves for each mixture (9.5mm and 12.5mm) were constructed for each density level with a reference temperature of 20ºC.

4. The Master Curve data was supplied to Dr. Jo Daniel (Co-PI at the University of New Hampshire) to complete an analysis of the mixture density effect on the performance of each mixture using the Mechanistic-Empirical Pavement Design Guide (MEPDG) software.

5. Rutgers University completed the beam fatigue testing and analysis for the 9.5mm and 12.5mm mixtures at low, moderate and high densities specimens as previously outlined.

6. Additional specimens were fabricated to complete Flow Number (FN) testing in the Asphalt Mixture Performance Tester (AMPT). The FN test was completed in an attempt to provide an indication of the impact of HMA density on the rutting potential of each mixture. Four replicate specimens were prepared at each target density level for both mixtures tested (32 specimens). FN testing was conducted as outlined in NCHRP Project 9-29 "Simple Performance Tester for Superpave Mix Design." The test temperature for the FN testing was selected to be 50ºC based on LTPP data. The 9.5mm mixture was tested at average densities of 88.9% (88% target), 91.1% (91.0% target), 94.2% (94.0% target), and 98.1% (97% target). The 12.5mm mixture was tested at average densities of 88.2% (88% target), 91.5% (91.0% target), 93.7% (94.0% target), and 96.4% (97% target).

7. Additional specimens were fabricated to complete Overlay Tester (OT) testing. The OT test was completed in an attempt to provide, in addition to the beam fatigue test, an indication of the impact of HMA density on the fatigue cracking potential of each mixture. Three replicate specimens were prepared at each target density level for both mixtures tested (24 specimens). OT testing was conducted as outlined in the Texas Department of Transportation Specification Tex-248-F "Test Procedure for Overlay Test." The 9.5mm mixture was tested at average densities of 89.3% (88% target), 91.7% (91.0% target), 94.8% (94.0% target), and 98.5% (97% target). The 12.5mm mixture was tested at average densities of 89.1% (88% target), 92.2% (91.0% target), 94.0% (94.0% target), and 98.0% (97% target).

8. UMass Dartmouth finished analyzing all the test data and authored the DRAFT final report. UMass Dartmouth emailed the DRAFT final report to the technical committee chairperson (Mr. Rick Bradbury – Maine DOT) for review and comments.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009:

"Evaluation of the Effects of HMA Density on Mixture Fatigue and Rutting Performance," Mogawer, W. S., Northeast Asphalt User/Producer Group (NEAUPG) Annual Meeting, South Portland, Maine, October 8, 2009.

PROJECT NUMBER: 02-6 (Phase 2)

PROJECT TITLE: Sealing of Small Movement Bridge Expansion Joints - Phase II: Field Demonstration and Monitoring

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Ramesh B. Malla, PI, and Montgomery Shaw, Co-PI, University of Connecticut

STATUS: Continuing

AGREEMENT TERM: 8/1/2008 – 7/31/2011

ANTICIPATED COMPLETION: 7/31/2011

PROJECT OBJECTIVES:
The main objective of this NETC 02-6 (Phase 2) project is to test the behavior of the silicone foam sealant under various in-field conditions, make any necessary changes, and evaluate its performance while on an operating highway bridge in order to determine its cost effectiveness and durability. The project involves pre-field laboratory testing, field installation, post installation monitoring, report preparation, and specification preparation.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:
The accomplishments of Phase 2 encompass both laboratory testing and field installation/application of the silicone foam sealant developed in Phase 1 of this project in bridge expansion joints. The laboratory tests were performed and data analyzed to assess the sealant's ability to bond to asphalt and steel substrates. In addition to the laboratory tests, the sealant was installed/applied in 5 expansion joints in four (4) bridges (one in each of the following North Eastern states: Connecticut, New Hampshire, Rhode Island, and New York). To install the sealant an application method was used which was developed in the laboratory using a simulated expansion joint. The laboratory tests and field application of the silicone foam sealant are briefly described below.

1. In Phase 1 of the project laboratory tests were performed to analyze the silicone foam sealant's ability to bond to concrete as well as its capability to perform after being exposed to a variety of conditions. In Phase 2 the sealant's bonding capabilities to asphalt and steel substrates was analyzed. Two tests were conducted to evaluate those capabilities:
   - Oven-Aged Bond Test (Temperature conditions range from 70 ^{o}C to -29^{o}C)
   - Salt Water Immersion Test (Samples cured at room temperature then kept at 45^{o}C in saturated salt water for 2 weeks)

   Both tests require the sealant to be pulled apart until it tears internally or separates from the bonding surface of the substrate.

2. The following tests performed in the lab have been completed for both the silicone foam and Wabo solid sealants:
   - Cure Rate Test
   - Modified Cure Rate Test
   - Tack Free Time Test
   - Retrofit Test
   - Freeze Thaw Test

   A cure rate test was performed on the silicone foam sealant and the WABO using asphalt and steel as the substrates. The samples made were pulled to 100 % strain after 3, 6, 18, and 24 hours of curing along with every subsequent day for 42 days. The same samples were used to perform this test. For comparison a modified cure rate test was developed. In this case a set of samples was made for each curing time as opposed to using the same set for every test. The reason for this test was to show how the regular cure rate test will create fatigue within the sealant due to the daily expanding and contracting. The tack free time was used to determine the amount of time it takes the sealant to no longer stick to an object that touches it. Another test, a retrofit test, was developed to see if it would be possible to repair a damaged silicone sealant by combining it with a newly mixed batch of itself. Finally a freeze thaw test was developed which required samples to be submersed in water and then placed in a freezer to evaluate the effects of freezing temperatures on the silicone foam.

3. Using the simulated expansion joint set up in the laboratory (Fig. 1), various types of applicator tools (Fig. 2) were used to try and seal the joint. With each of these tools the sealant material would be pressed out manually into the expansion joint. These application devices required all the materials to be mixed in a separate container and then poured into the applicator. This method created a problem. Once the materials are mixed together to create the sealant the reaction is immediate. To pour the materials into one container, mix them, pour them into an applicator gun, and then apply it to the joint is too long of a process. What was decided on was simply pouring the mixed sealant components into the joint via a bucket that was flexible. The application procedure called for specific measuring of each material needed (WABO white, WABO gray, crosslinker, water, platinum catalyst), which depended on the size of the expansion joint. The materials were put into a bucket, mixed together using a mixer that was attached to a drill, poured into the expansion joint, and leveled off.

4. With the help of the NETC Project Technical Committee members, four bridges one in each of the 4 New England states (Connecticut, New Hampshire, Rhode Island, and New York) were identified for field installation of the silicone foam expansion joint sealant developed in the Phase 1 of this NETC 02-6 project. The expansion joints on these bridges have been sealed using the silicone foam sealant and the WABO, two part solid silicone sealant for comparison. Given below are the bridges where the expansion joints were sealed:

- The bridge on Mansfield Ave. spanning Route 6, west bound in Mansfield, CT (Fig. 3) was sealed on August 17, 2009. Figures 4, 5, and 6 are pictures taken from the joint sealing operation. Figure 7 shows the setup the two sealants used in the expansion joint. Figure 8 shows the dimensions of the bridge
- The bridge on E. Thetford Rd. spanning the Connecticut River in Lyme, CT (Fig. 9) was sealed on September 16, 2009. Figures 10 and 11 are pictures taken from the joint sealing operation. Figure 12 shows the setup the two sealants used in the expansion joint. Figure 13 shows the dimensions of the bridge.
- The Pascoag River Bridge on Route 102 in Burrillville, RI (Fig. 14) was sealed on October 21 & 22, 2009. Figure 15 is a picture taken from joint sealing operation. Figure 16 shows the setup the two sealants used in the expansion joint. Figure 17 shows the dimensions of the bridge.
- The bridge in New York on Route 22 in Dover Plains, NY (Fig. 18) was sealed on November 6, 2009. Figures 19 and 20 are pictures taken from the joint sealing operation. Figure 21 shows the setup the two sealants used in the expansion joint. Figure 22 shows the dimensions of the bridge.

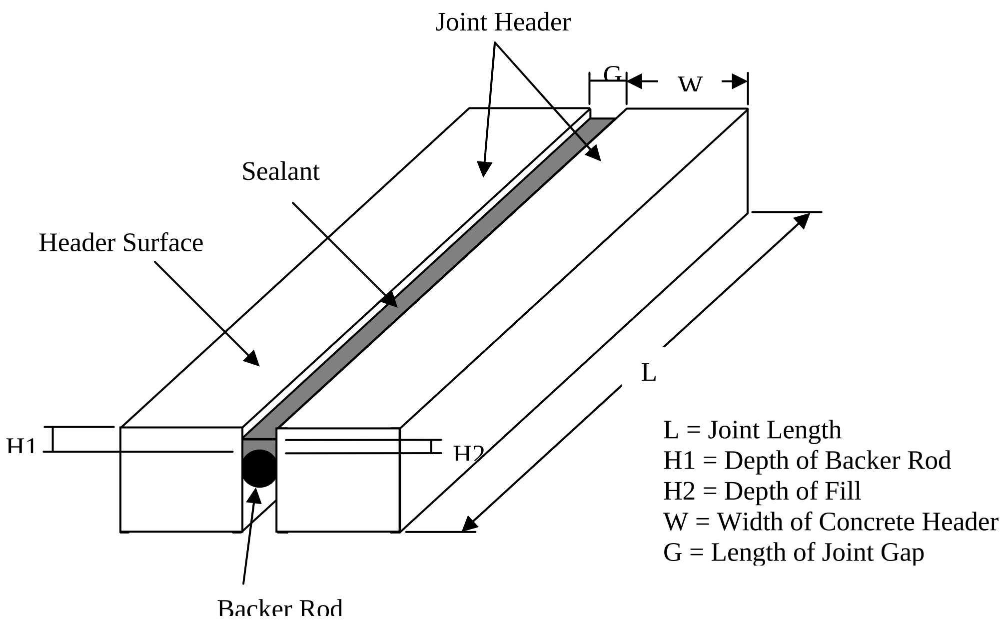

Figure 1. Three- dimensional schematic of the sealed simulated expansion joint

Figure 2. **Applicators**

Figure 3. Candidate Bridge in Mansfield, Connecticut

Figure 4. Placement of Backer Rod into Joint in CT

Figure 5. Sealing of the Bridge Joint in CT

Figure 6. Sealant in the Connecticut Bridge Joint

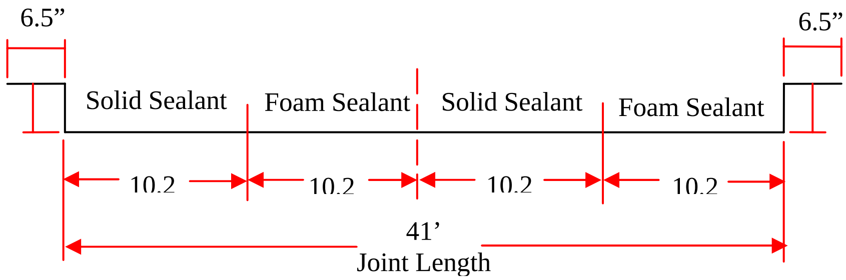

Figure 7. Schematic of Elevation showing the staggering of the joint sealant on the Connecticut Bridge

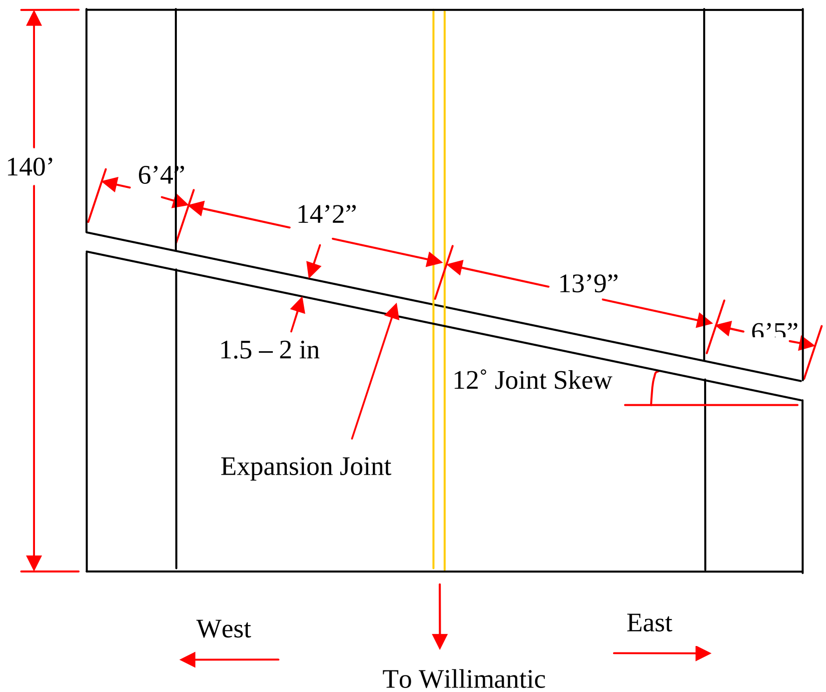

Figure 8. Top schematic view of the expansion joint on the Connecticut Bridge along with the joint and bridge dimensions

Figure 9 Candidate Bridge in Lyme, New Hampshire

Figure 10. Candidate Bridge in NH

Figure 11. Sealed Expansion Joint in NH

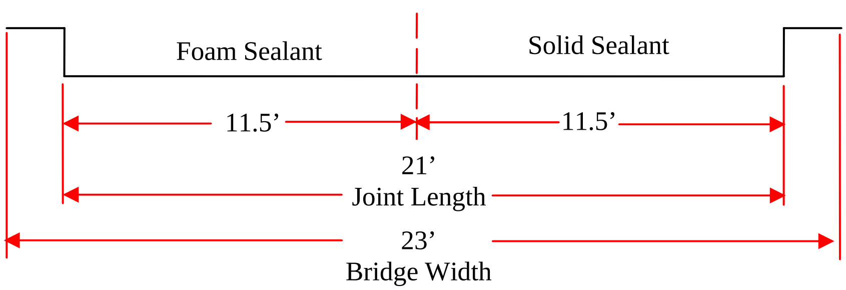

Figure 12. Schematic of Elevation showing the staggering of the joint sealant on the New Hampshire Bridge.

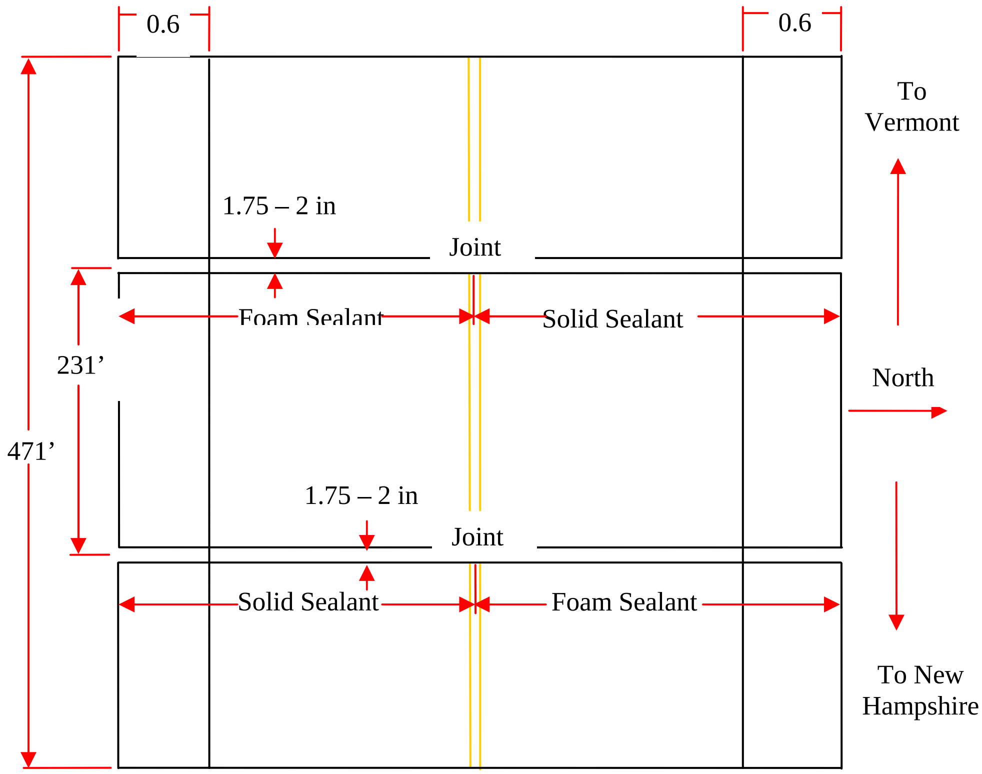

Figure 13. Top view schematic of the expansion joint on the New Hampshire Bridge along with the joint and bridge dimensions

Figure 14. Candidate Bridge in Burrillville, Rhode Island

Figure 15. Sealant in the Rhode Island Bridge Joint

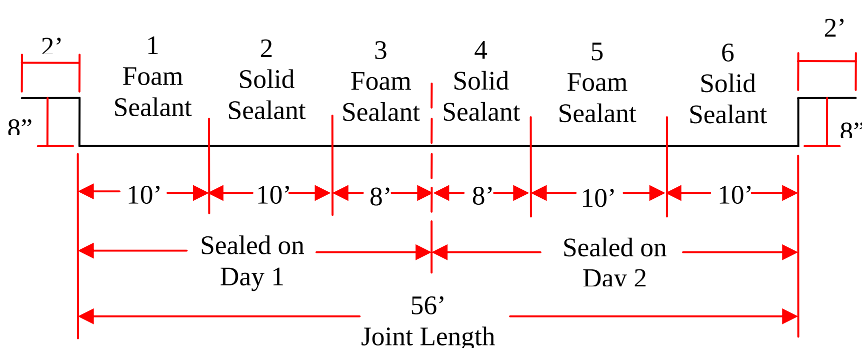

Figure 16. Schematic showing the staggering of the joint sealant on the Rhode Island

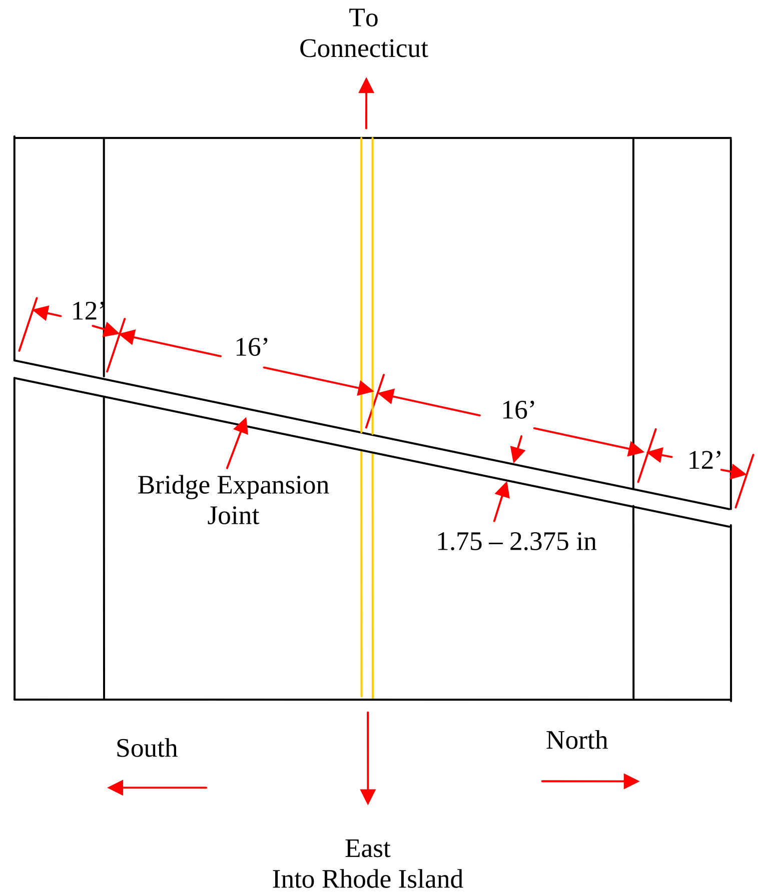

Figure 17. Top schematic view of the expansion joint on the Rhode Island Bridge along with the joint and bridge dimensions

Figure 18. Candidate Bridge in Dover Plains, NY

Figure 19. Cleaning of New York Expansion Joint

Figure 20. Sealing of New York Expansion Joint

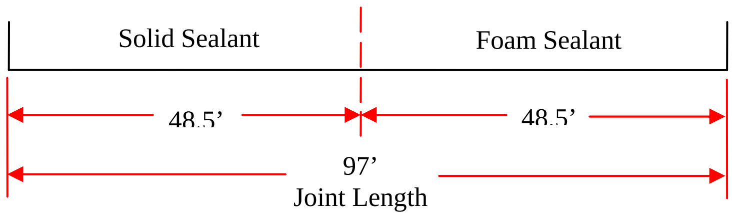

Figure 21. Schematic of Elevation showing the staggering of the joint sealant on the New York bridge.

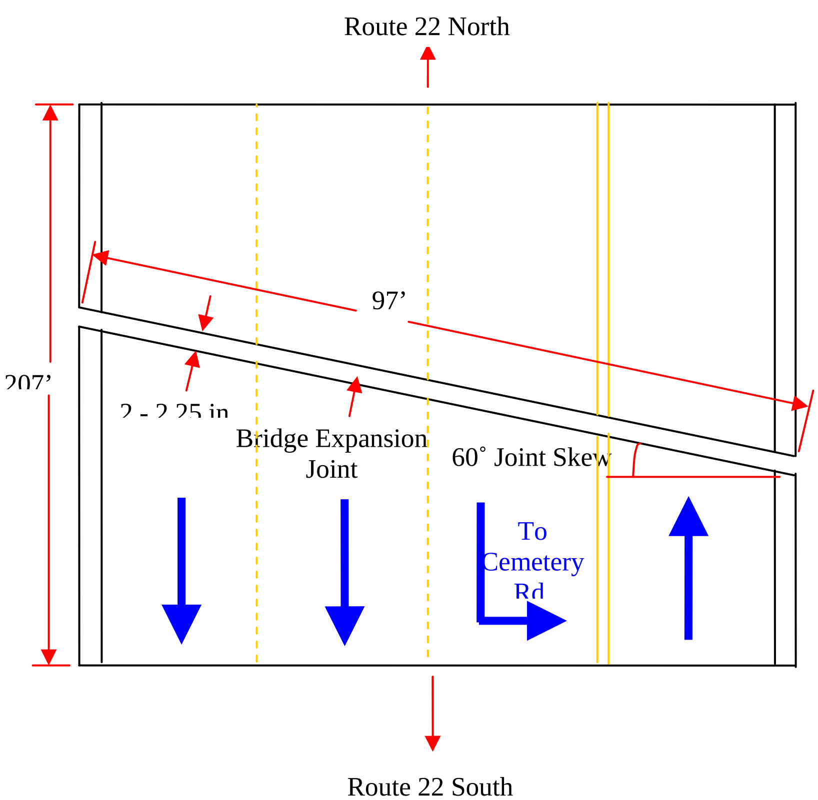

Figure 22. Top view schematic of the expansion joint on the New York Bridge along with the joint and bridge dimensions

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009: None

PROJECT NUMBER: 03-6

PROJECT TITLE: 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

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Walaa S. Mogawer, PI, UMass Dartmouth; Jo Sias Daniel, Co-PI, University of New Hampshire

STATUS: Continuing

AGREEMENT TERM: 10/1/2009 – 9/30/2011

ANTICIPATED COMPLETION: 9/30/2011

PROJECT OBJECTIVES:

- Define and compare thin lift overlay maintenance mixes and surface treatments currently used in the New England States.
- Evaluate the thin lift overlay maintenance mixes and surface treatments currently used in the New England States and compare to those currently used worldwide.
- Determine the current New England DOT procedures for picking rehabilitation methodologies.
- Perform and evaluate non-destructive testing to better determine the optimum time to apply surface treatments or thin lift overlay mixes to the existing pavements in order to properly prioritize rehabilitation projects.
- Evaluate the benefits and drawbacks of using PMA thin lift mixes versus surface treatments with lab testing.
- Evaluate the cost comparisons between PMA thin lift mixes and surface treatments.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:

1. No significant accomplishments were made for the majority of 2009 as the project agreement expired on November 31st, 2008. UMass Dartmouth had previously requested an extension for this project in February 2008.

2. UMass Dartmouth received and processed the new extension agreement in late October 2009.

3. UMass Dartmouth began organizing and coordinating the remaining work to be completed for this project.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009: None

PROJECT NUMBER: 04-1 (Phase 2)

PROJECT TITLE: Recycling Asphalt Pavements Containing Modified Binders - Phase 2

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): James Mahoney, Connecticut Transportation Institute, University of Connecticut

STATUS: Continuing

AGREEMENT TERM: 8/23/2007 – 9/30/2009

ANTICIPATED COMPLETION: 3/31/2010

PROJECT OBJECTIVES:

Phase 2

The objectives of the second Phase of this project will attempt to address incompatibilities that may arise when RAP is used in a new HMA pavement that contains a virgin modified asphalt binder. This Phase of the project will also provide guidance as to the proper amount of RAP that can be added to the HMA without causing problems. In addition, the interaction of polyphosphoric acid modified virgin asphalts and the aggregates in the RAP will also be tested to determine if there is a negative impact on the HMA mixes performance.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:

The research team has acquired modified asphalt binders from NuStar Asphalt (Formerly Citgo Asphalt) as well as Irving. The material from Irving is a PPA modified asphalt. The virgin binder material came from Hudson Liquid Asphalts. The research team has also acquired RAP samples containing granite from Vermont as well as RAP with schist as a its primary aggregate from a milling project in Connecticut, RAP with basalt as its primary aggregate from Connecticut and RAP with limestone as its primary aggregate from a source in Maine.

The research team has acquired the software required for the dynamic shear rheometer in order to conduct the testing of asphalt binders using multiple stress creep recovery (MSCR) test for asphalt binders.

The research team has characterized the aggregate properties for the different types of RAP used on this project. The research team has also designed a Superpave mix design for use with the different sources of RAP utilizing basalt aggregates as the source of coarse aggregates and manufactured stone sand. The aggregate was deemed by the research team to be the least likely to interact with the different asphalt binders as it does not have any known interactions with the asphalt.

The research team has prepared all samples for testing.

The research team has completed all performance testing of the different RAP/Binder combinations in the Asphalt Pavement Analyzer (APA).

The research team has begun data analysis and comparison of the rut testing performance.

The research team has begun MSCR testing of the binders.

The research team has begun assembly of the draft final report.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009: None

PROJECT NUMBER: 04-2

PROJECT TITLE: Driver-Eye-Movement-Based Investigation for Improving Work-Zone Safety

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Donald L. Fisher, PI, Mike Knodler, Co-PI, and Alexander Pollatsek, Co-PI, University of Massachusetts, Amherst

STATUS: Completed

AGREEMENT TERM: 3/1/2005 – 1/31/2007

ANTICIPATED COMPLETION: N/A

PROJECT OBJECTIVES:

1. Determine how driver eye movements vary with different work zone designs
2. Develop recommendation for more effective use of existing work zone traffic control devices.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:
Final report submitted and distributed.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009:
"Human Factors: Understanding & Evaluating Driver Response," Muttart, J.W., Anne Arundel County Police Special Operations Building, Sponsored by the Maryland Association of Traffic Accident Investigators, Hanover, MD. March 20 - 23, 2006.

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

"Using Event Data Recorder Information for Driver Response Research and Intelligent Transportation Systems in Rear End Collision," Muttart, J.W., CDR Users Conference, Dallas, TX. February 13, 2006.

"Human Factors: Understanding & Evaluating Driver Response," Muttart, J.W., Canadian Association of Traffic Accident Investigators & Reconstructionists, Fredericton, NB, Canada. July 10 - 13, 2006.

"Driving Simulator Evaluation of Situational Awareness during Hands-Free Communication," Muttart, J.W., New England Institute of Transportation Engineers Technology Day, Amherst, MA. July 20, 2006.

"Accounting for Moderate Driver Distractions in Work Zones," Muttart, J.W., Factors, Formulae, Forensic, Technology, & Training Conference, Houston, TX. September 17, 2006.

"Driving Simulator Evaluation of Driver Performance during Hands-Free Cell Phone Operation in a Work Zone: Driving without a Clue," Muttart, J., Fisher, D. L., and Pollatsek, A., (January 2007), Presentation given at the 86th Transportation Research Board Annual Meeting, TRB, National Research Council, Washington, D.C.

"Driving Simulator Evaluation of Driver Performance during Hands-Free Cell Phone Operation in a Work Zone: Driving without a Clue," Muttart, J., Fisher, D. L., Knodler, M. and Pollatsek, A., (2007), Transportation Research Record, 2018, pp 9-14.

"Driver-Eye-Movement-Based Investigation for Improving Work-Zone Safety," Fisher, D.L., Knodler, M., and Muttart, J., January 28, 2009, NETCR71.

PROJECT NUMBER: 04-3

PROJECT TITLE: Estimating the Magnitude of Peak Flows for Steep Gradient Streams in New England

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Jennifer Jacobs, PI, Thomas Ballestero, Co-PI, University of New Hampshire and Richard Vogel, Co-PI, Tufts University

STATUS: Continuing

AGREEMENT TERM: 10/1/2009 – 9/30/2010

ANTICIPATED COMPLETION: 9/30/2010

PROJECT OBJECTIVES:
The main objective of this research is to develop a set of regional regression relationships to predict flood flows for steep slope watersheds from basin characteristics. The regression relationships will be developed using standard USGS regional hydrologic methods. We propose to identify target watersheds in the New England region and to develop a database of physical basin parameters and historical streamflow necessary for the statistical analysis. Regression analyses will be conducted to identify explanatory variables and to develop regression relationships for average daily flow and 2-, 10-, 25-, 50-, and 100-year peak flow recurrence interval events. As appropriate, the New England states will be divided into subregions.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:
The final regression analysis and documentation can continue once the contract extension request is approved. The majority of the progress was accomplished prior to 2007 with the project being in hiatus for much of 2008 and 2009 due to pending contract extension request. A new contract is now in place and will allow work to proceed in 2010.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009:
2006 Maine Water Conference, Augusta, ME, March 22, 2006. Poster presentation.

PROJECT NUMBER: 04-4

PROJECT TITLE: Determining the Effective PG Grade of Binder in RAP Mixes

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): PI: Jo Daniel, University of New Hampshire; Co-PI: Walaa Mogawer, UMass Dartmouth

STATUS: Continuing

AGREEMENT TERM: 10/1/2004 – 3/31/2008

ANTICIPATED COMPLETION: 2/28/2010

PROJECT OBJECTIVES:
The main objective of this research is to develop a method to determine or estimate the binder grade in mixtures designed with RAP from the properties of the mixture itself.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:
This project was completed and the final report submitted in 2009.

The objective of this research project was to develop a method to determine or estimate the binder grade in mixtures designed with RAP from the properties of the mixture itself. Three different RAP percentages (10%, 25%, 40%) were evaluated for a 12.5 mm Superpave mixture. A PG 64-28 virgin binder was used. Additionally, testing was done on virgin mixtures with PG 58-28, PG 70-22, and PG 76-22 binders. Dynamic modulus, creep compliance, and strength tests were run in the indirect tensile mode for the various mixtures. The Hirsch model was used to back calculate the binder |G*| values from the measured mixture dynamic modulus values. Partial |G*| master curves were measured on the extracted binder from each mixture and the recovered binder was also PG graded.

Several methods of estimating the effective PG grade of the binder were evaluated. Empirically based methods of interpolating values of measured mixture properties are straightforward, but require an extensive amount of testing in the laboratory. The relationship between material properties and PG grade must be established for each type of mixture (gradation, asphalt content).

The most promising methods for determining the effective PG grade of the mixture use the Hirsch model to back calculate binder |G*| from the measured mixture dynamic modulus. Some difficulties exist in determining the high temperature PG grade because of the large difference in temperatures between the dynamic modulus testing and PG grading temperatures. However, recovered and virgin binder information can be used to compare with the back calculated |G*| from the mix to estimate the effective high temperature PG grade. The low temperature PG grade can be estimated from mixture testing only because the range of temperatures for PG grading corresponds to the dynamic modulus testing temperatures.

Recommended Procedure for Estimating PG Grade

Based on the results of the research conducted in this project, the research team recommends the following procedure for estimating the PG grade of mixtures containing RAP:

1. Perform complex modulus testing on at least three replicate specimens. Recommend that temperatures from -20^{o}C to 30^{o}C be used to develop master curves and obtain desired shift factors. This may require modification of current AMPT devices to test at lower temperatures.
2. To estimate high temperature PG grade:
    a. Obtain |G*| master curve for virgin binder
    b. Obtain |G*| master curve for extracted and recovered mixture binder
    c. Back calculate |G*| using the measured dynamic modulus and the Hirsch model
    d. Compare back calculated |G*| to virgin and recovered values to estimate the effective high temperature PG grade
3. To estimate low temperature PG grade for fatigue:
    a. Back calculate |G*| using the measured dynamic modulus and the Hirsch model
    b. Use the Rowe method to determine the phase angles from the back calculated |G*| master curve
    c. Shift master curves to determine temperature at which |G*| sinδ = 5000 kPa
4. To estimate low temperature PG grade for thermal cracking:
    a. Use linear viscoelastic theory to convert complex modulus to creep compliance
    b. Calculate creep stiffness of mixture
    c. Use Hirsch relationship to calculate creep stiffness of binder
    d. Calculate S-value and m-value for each mixture as a function of temperature
    e. Calculate temperature at which S=300 MPa and m=0.300
    f. Determine effective low temperature PG grade

Recommendations for Further Research

Further research is required on different types of RAP mixtures and different virgin PG grades to verify and refine the procedures developed as part of this research project. In particular, it is important to perform testing on plant produced mixtures to capture what truly happens to these mixtures in the field. Future testing should focus on the low to intermediate temperature testing as this is the biggest concern with the addition of aged RAP binder in the mix.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009: None

PROJECT NUMBER: 05-1

PROJECT TITLE: Development of Supplemental Resistance Method for the Design of Drilled Shaft Rock Sockets

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Thomas C. Sanford, University of Maine

STATUS: Continuing

AGREEMENT TERM: 1/1/2010 – 12/31/2010

ANTICIPATED COMPLETION: 12/31/2010

PROJECT OBJECTIVES:
The objective of this study is to produce a drilled shaft design method for evaluating the now unused side shear or end bearing to supplement the AASHTO allowable load. The magnitude of unused side shear or end bearing corresponding to the AASHTO allowable load will be the magnitude that occurs at the same shaft movement as the allowable load. This method should reflect different rock socket geometry and different rock properties typical of New England. The method should be based on past load tests and be robust and easy-to-use.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:
The University was notified in September 2009 that the agreement providing funding to complete the project has been fully executed. The term of the agreement is January 1, 2010 thru December 31, 2010.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009: None

PROJECT NUMBER: 05-5

PROJECT TITLE: Measurement of Adhesion Properties Between Topcoat Paint and Metallized/Galvanized Steel with Surface Energy Measurement Equipment

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Sze C. Yang, PI, and K. Wayne Lee, Co-PI, University of Rhode Island

STATUS: Continuing

AGREEMENT TERM: Agreement Extension Pending

ANTICIPATED COMPLETION: Agreement Extension Pending

PROJECT OBJECTIVES:

1. Compare the adhesion properties of NEPCOAT-approved topcoat paint over metallizing to topcoat paint over galvanizing using specialized “surface-energy” measuring lab methods.
2. Investigate various factors affecting the adhesion of topcoat paint over galvanizing.
3. Report and recommend practices which produce the best adhesion of NEPCOAT-approved topcoat paints over metallized and particularly galvanized steel surfaces. Examine surface cleaning, phosphating vs. wash primer.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:

Summary: We have obtained the coating of zinc and then the organic coatings on steel test panels supplied by KTA. We performed the pull-off strength adhesion tests (ASTM D4541) and the tape test (ASTM D3359). The compatibility and the wetting properties at the interface between the liquid paint and the profiled zinc surface were studied with the aid of contact angle measurements.

1. Galvanizing, surface profiling and Metalizing steel test panels:

A total of 52 panels with channel attachment were coated with zinc for coating with organic paints. A total of 13 zinc coated panels without channel attachment were used for surface contact angle and paint wetting measurements.

The panels with channel attachment were subdivided into 3 groups based on either the difference in the methods for coating zinc on the steel surface (e.g., hot-dip galvanizing vs. zinc metalizing), or the difference in the methods for surface profiling of the galvanized zinc surface. The 3 groups of test panels are:

(1) Type GM test panels are zinc galvanized surfaces abraded by mechanical grinding. 16 test panels of this type were prepared by Duncan Group, Everett, MA.

(2) Type GB test panels are zinc galvanized surfaces are galvanized surfaces abraded by blast profiling. 16 panels of type Gb panels were prepared by V&S galvanizing, Taunton, MA.

(3) Type M test panels are zinc metalized panels without any further modification of surface profile. 20 panels of type M were prepared by Falmer Thermal Spray, Salem, MA.

The galvanizers and metalizers recorded the materials, the conditions and the thickness profiles of the zinc coated surface according to the specification of the NETC 5-05 Work Plan previously communicated to the three zinc coating facilities.

2. **Apply organic paints on the test panels**

Each of these three types of panels in part 1 was divided into subgroups for coating with different paint systems. The panels of Types GM and GB zinc surfaces were painted with 4 different paint systems. The panels of group M zinc surface were painted with 5 different paint systems. The coatings of the organic paints were performed by Boyd Coatings Research Inc., Hudson, MA. The organic coating consists two layers: an epoxy intermediate layer and a polyurethane finish coat. The epoxy coating was performed on the same day (within 6 hours) of the galvanizing or the metalizing process. The polyurethane coating was applied at a later date by Boyd in accordance with the paint manufacturer's specification. Boyd followed the paint manufacturer's specifications for the painting process and the solvents used for spray painting. The thickness of the paints were recorded and reported.

In the following is a list of all three types of zinc coatings and the different organic coatings applied to the zinc surfaces.

2A **Group GM** (Total of 16 panels): These panels were prepared by hot-dip galvanizing followed by mechanical grinding to produce a rough surface profile at Duncan Group, Everett, MA. The freshly galvanized panels were transported immediately to Boyd Coatings Research, Hudson, MA for coating of the epoxy "intermediate" paint. After the epoxy coating was completely cured, the "finish" coatings were later applied according to the paint manufacturer's specification.

Sub-groups within the GM group:

a. GMc (4 panels). Galvanize / mechanical abrasion / epoxy and urethane from Carboline
   Primer:Galvanizing followed by mechanical abrasion of surface
   Intermediate: Carboline 888 Epoxy
   Finish: Carboline 133 LH Aliphatic Polyurethane

b. GMi (4 panels). Galvanize / mechanical abrasion / epoxy and urethane from International Protective Coatings.
Primer: Galvanize / mechanical abrasion
Intermediate: Intergard 345 Epoxy
Finish: Interthane 870 UHS

c. GMa (4 panels). Galvanize / mechanical abrasion / epoxy and urethane from Sherwin Williams Company
Primer: Galvanize / mechanical abrasion
Intermediate: Macropoxy 646 Fast Cure Epoxy
Finish: Acrolon 218 HS Acrylic Polyurethane

d. GMh (4 panels). Galvanize / mechanical abrasion / epoxy and urethane from Sherwin Williams Company (www.sherwin-williams.com)
Primer: Galvanize / mechanical abrasion
Intermediate: Recoatable Epoxy Primer Series B67
Finish: High Solids Polyurethane Series B58

2B **Group GB** (16 panels): These panels were prepared by hot-dip galvanizing followed by blasting to produce a rough surface profile at V&S, Taunton, MA. The freshly galvanized panels were immediately transported to Boyd Coatings Research, Hudson, MA for coating with the epoxy "intermediate" paint. After the epoxy coating was completely cured, the "finish" coatings were later applied according to the paint manufacturer's specification

Sub-groups within the GB group:

a. GBc (4 panels). Galvanize / blast abrasion / epoxy and urethane from Carboline
Primer: Galvanize / blast abrasion of surface
Intermediate: Carboline 888 Epoxy
Finish: Carboline 133 LH Aliphatic Polyurethane

b. GBi (4 panels). Galvanize / blast abrasion / epoxy and urethane from International Protective Coatings.
Primer: Galvanize / blast abrasion
Intermediate: Intergard 345 Epoxy
Finish: Interthane 870 UHS

c. GBa646 (4 panels). Galvanize / blast abrasion / epoxy and urethane from Sherwin Williams Company
Primer: Galvanize / blast abrasion
Intermediate: Macropoxy 646 Fast Cure Epoxy
Finish: Acrolon 218 HS Acrylic Polyurethane

d. GBh (4 panels). Galvanize / blast abrasion / epoxy and urethane from Sherwin Williams Company
   Primer: Galvanize / mechanical abrasion
   Intermediate: Recoatable Epoxy Primer Series B67
   Finish: High Solids Polyurethane Series B58

2C **Group M** (Group total 20 panels): These panels were prepared by Zinc Metalizing at Falmer Thermal Spray Inc., Salem MA. There is no further surface roughening process after the metallization. The freshly metalized panels were transported immediately to Boyd Coatings Research, Hudson, MA for coating of the epoxy “intermediate” paint. After the epoxy coating was completely cured, the “finish” coatings were later applied according to the paint manufacturer’s specification.

Sub-groups within the M group:

a. Mc (4 panels). Galvanize / blast abrasion / epoxy and urethane from Carboline
   Primer: Galvanize / blast abrasion of surface
   Intermediate: Carboline 888 Epoxy
   Finish: Carboline 133 LH Aliphatic Polyurethane

b. Mi (4 panels). Galvanize / blast abrasion / epoxy and urethane from International Protective Coatings.
   Primer: Galvanize / blast abrasion
   Intermediate: Intergard 345 Epoxy
   Finish: Interthane 870 UHS

c. Ma646 (4 panels). Galvanize / blast abrasion / epoxy and urethane from Sherwin Williams Company
   Primer: Galvanize / blast abrasion
   Intermediate: Macropoxy 646 Fast Cure Epoxy
   Finish: Acrolon 218 HS Acrylic Polyurethane

d. Mh (4 panels). Galvanize / blast abrasion / epoxy and urethane from Sherwin Williams Company
   Primer: Galvanize / mechanical abrasion
   Intermediate: Recoatable Epoxy Primer Series B67
   Finish: High Solids Polyurethane Series B58

e. Ma920 (4 panels). Galvanize / blast abrasion / epoxy and urethane from Sherwin Williams Company
   Primer: Galvanize / blast abrasion
   Intermediate: Macropoxy 920 sealant
   Finish: Acrolon 218 HS Acrylic Polyurethane

3. Surface contact angle measurement:

We measured the contact angle of the liquid “intermediate” paint on three types of zinc coated surfaces classified as Gm, Gb, and M surfaces. In order to emulate the wetting property of the liquid paint as close as possible the actual spraying condition, we performed the contact angle measurement on a zinc surface with freshly prepared spray paint. We set up our contact angle measurement equipment (an optical goniometer) in a laboratory adjacent to the spray painting room in Boyd Coatings Research, Hudson, MA. We obtained the fresh spray paints from Boyd's painter. We then performed the measurements of the contact angle of each paint on the 3 types (GM, GB, and M) of zinc surfaces as a function of time.

We have observed a statistically significant difference of the contact angles and the wetting behaviors when we compared the same type of measurement on different pair of epoxy / zinc surface. We are in the process of studying the correlations between the surface contact angle measurement and the mechanical adhesion test data. We believe that we have found some evidence for the correlation between the paint surface energy and the mechanical adhesion test results. We are in the process of a re-evaluation of the correlation and the possible interpretation of the results.

4. Adhesion tests

Adhesion tests of the coatings were performed 3 weeks after the top coat (the "finish" coat) had been applied by Boyd Coatings Research to allow the complete curing of the paint. Two kinds of tests were performed on each test panel: (1) the test for pull-off strength of Coatings according to ASTM D 4541 standard, and (2) the tape test according to the ASTM D 3359 standard method A . Two repeated tests were performed on each panel.

The final analysis of the data has not yet completed. So far our observations are summarized as follows: (1) We found that the pull-off strengths (ASTM D 4541) are generally in the 1000 to 2000 lb/in^2 range for all test panels. These numbers are higher than the threshold strength of 600 lb/in^2 required for NEPCOAT on steel. (2) The tape tests show that the adhesion rating (ASTM D 3359) are mostly in the 4A range. There are some exceptions to this general observation. We are in the process of determining correlations between the measurements and the visual examination of the specific panels.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009: None

PROJECT NUMBER: 05-6

PROJECT TITLE: Employing Graphic-Aided Dynamic Message Signs to Assist Elder Drivers' Message Comprehension

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): J. H. Wang, University of Rhode Island

STATUS: Continuing

AGREEMENT TERM: 10/1/2009 - 9/30/2010

ANTICIPATED COMPLETION: 9/30/2010

PROJECT OBJECTIVES:

- Review and evaluate existing research and literature related to the use of graphic-aided DMSs and the effects of such uses on elder drivers.
- Examine the feasibility of employing graphics in DMS messaging to assist drivers' comprehension of the message with a particular focus on elder drivers.
- Compile and or develop a library of graphic-aided text messages if such use were determined to be both feasible and beneficial.
- Make recommendations to identify, re-design, or create elderly friendly dynamic message signs that are effective for the driving population as a whole.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:

- Currently working on the final report of this project including preparing a summary, conclusions and recommendations regarding the feasibility of employing graphic-aided DMS messages to reduce confusion and enhance reaction time for older drivers.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009:

A presentation was given to the Rhode Island DOT on November 16, 2006.

"Assisting Elder Drivers' Comprehension of Dynamic Message Signs," Clark, A.T., Wang, J.H., Maier-Speredelozzi, V., Collyer, C.E., Proceedings of the 87th Annual Meeting of Transportation Research Board, Paper No. 08-2276, p.1-16, CD-ROM, 2008.

"Age Effect on Driver Comprehension of Messages Displayed on Dynamic Message Signs", Wang, J.H., Clark, A. Y., and Maier-Speredelozzi, V., Proceedings of IIE Research Conference, Paper No. 307, p.1-6, CD-ROM, 2008.

PROJECT NUMBER: 05-7

PROJECT TITLE: Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways - Phase 2

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): John N. Ivan, University of Connecticut and Adel E. Sadek, University at Buffalo, The State University of New York

STATUS: Completed

AGREEMENT TERM: 5/23/2006 – 7/31/2008

ANTICIPATED COMPLETION: N/A

PROJECT OBJECTIVES:

The primary objective of this project is to consider accident and operational experience to develop a set of warrants prescribing conditions under which it is and is not appropriate to install exclusive left turn lanes at unsignalized intersections and driveways. The resulting warrants will balance both safety and operational considerations. Empirical Bayes analysis and negative binomial modeling will be used to compare the accident experience at unsignalized intersections with and without exclusive left turn lanes, especially noting the contributions of other conditions (e.g., volume level, land use, driveway density, and roadway geometry). Traffic simulation will be used to estimate delay to through and left-turning vehicles at these same intersections, again noting the contributions of these other conditions. The resulting warrants will then consider not only traffic volumes, but also observed safety experience and other pertinent characteristics of the intersection or driveway.

A secondary objective is to examine the safety experience at unsignalized intersections and driveways with existing exclusive left turn lanes to see what can be learned about how to design them to be safer. This will involve observing all of the geometric characteristics of the sites studied, along with the precise application of traffic control devices used, including pavement markings and signage, as well as lane and pavement width. Then, in addition to the warrants developed, we will also prepare guidelines for how to physically design and control exclusive left turn lanes to maximize safety for all road users.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:

- Volume-based warrants for left turn lanes were developed based on delay and number of stops for rural two-lane roads and urban two- and four-lane roads.
- A safety comparison between intersections with and without left turn lanes was conducted for three- and four-leg intersection on rural two-lane and urban two- and four-lane roads. Strong evidence was found that left turn lanes reduce same-direction crashes on rural two lane roads at four-leg intersections and on urban four-lane roads at three-leg intersections. Some evidence was found that left turn lanes reduce same-direction crashes on rural two-lane roads at three-leg intersections and on urban four-lane roads at four-leg intersections. However,

there is no evidence that left turn lanes reduce same direction crashes on urban two-lane roads at either three or four leg intersections.

- A design analysis was also conducted of the intersections with left turn lanes that experienced higher than expected crash counts. These intersections tend to have one of the following conditions:
    - Very short taper and/or storage lengths
    - Multiple driveways using the same left turn lane
    - Other geometric conditions that increase the crash risk, such as horizontal curves
- Consequently, the recommendations of the report are the following:
    - Left turn lanes should strongly be considered on rural two-lane roads at four-leg intersections and on urban four-lane roads at three-leg intersections on the basis of safety, irrespective of whether or not the volume warrants are met. Otherwise, the volume warrants should be followed to determine when left turn lanes should be installed.
    - When designing left turn lanes, use the AASHTO recommended taper and storage lengths, avoid multiple driveways sharing the same left turn lane near a significant intersection, and consider the presence of other geometric features, such as horizontal curves, when designing a left turn lane. For example, do not begin the left turn lane in the middle of a curve where it cannot be seen by drivers approaching from behind. Sample photos and plan views of intersections with these conditions are attached at the end of the report.
- The final report has been completed with comments from the Technical Committee. A videoconference workshop was given to demonstrate use of the warrants to the New England state highway agencies.

Example location with very short left turn lane taper and storage length

Example location with numerous driveways sharing a left turn lane

Example location with left turn lane on a horizontal curve

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009:

"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.

"Safety Effects of Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways," Zhou, H., Ivan, J., and Sadek, A., Transportation Research Board Annual Meeting; Paper No. 09-2000, Washington, DC, Jan. 2009.

"Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways," Ivan, J.N., Sadek, A.W., Hongmei, Z., and Surang, R., February 12, 2009, NETCR72.

PROJECT NUMBER: 05-8

PROJECT TITLE: Evaluation and Implementation of Traffic Simulation Models for Work Zones

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): John Collura, University of Massachusetts Amherst

STATUS: Continuing

AGREEMENT TERM: 9/22/2009 – 3/21/2010

ANTICIPATED COMPLETION: 3/21/2010

PROJECT OBJECTIVES:
1) assess the strengths and limitations of readily available computer based simulation models designed to evaluate the impacts of alternative work zone strategies; 2) make recommendations for the use of such simulation models on roadway reconstruction and rehabilitation projects in New England and New York State; and 3) conduct the necessary technology transfer activities in order to ensure that the results of this project are disseminated and provided directly to potential simulation model users, including transportation engineers and planners in New England and New York State.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:

Literature Review

A literature review has been conducted to enhance the knowledge of the project team in the area of driver behavior in work zones and simulation modeling. The research team drew from the past research in both work zones by Collura and Heaslip and in simulation by Collura and Louisell. The knowledge gained by the literature review added to the knowledge gained in practice by the project team to ensure that well informed decisions are made. These well informed decisions will ensure the best evaluation of the work zone simulation packages.

Determine Data Requirements

The Principal Investigator along with project team members has determined the minimum inputs and desired outputs for selection of software as specified in the proposal. The following software has been evaluated to date: Caltrans' CA2PRS; Texas Transportation Institute's QUEWZ (Queue and User Cost Evaluation of Work Zones); QuickZone supported by FHWA; and CORSIM. A survey of State DOTs showed that QUEWZ and QUICKZONE were the most widely used software packages for estimation of queue lengths and delays in work zones.

Validation/Calibration of Simulation Software

The Principal Investigator along with the project team members has identified work zone sites on which software stated above have been applied, as specified in Tasks 3b to 3h. These sites are as follows: Interstate 91 in Greenfield, MA; Interstate 91 in Windsor, CT; Interstate 95 in West Greenwich, RI; Interstate 95 in Bangor, ME; Interstate 93 in Manchester, NH; State Route 9 in Hadley, MA; State Route 116 in Sunderland, MA; and State Route 125 in Andover, MA.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009:

"Using Simulation Models to Assess the Impacts of Highway Work Zone Strategies: Case Studies Along Interstate Highways in Massachusetts and Rhode Island," Moriarty, K.D., Collura, J., Knodler Jr., M.A., Daiheng, N., and Heaslip, K., Paper presented at the TRB Annual Meeting in January 2008.

PROJECT NUMBER: 06-1

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

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Jo Sias Daniel, PI, University of New Hampshire; Ghassan R. Chehab, Co-PI, Pennsylvania State University

STATUS: Continuing

AGREEMENT TERM: 10/1/2009 - 9/30/2011

ANTICIPATED COMPLETION: 9/30/2011

PROJECT OBJECTIVES:

- Determine the design and data collection methods, material tests, and testing equipment currently in use by each state.
- Identify the Level 2 and Level 3 design guide inputs for which regional or local values are required.
- Provide state specific recommendations on implementation of the MEPDG including changes in data collection & measurement, equipment needs, training, and anticipated benefits.
- Provide specific recommendations for regional and local calibration of the MEPDG by identifying appropriate field test & monitoring sites, data to be collected, and perform local calibrations if appropriate field data is available.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:
No progress was made on this project during 2009. Project was stopped waiting for lead agency change to take place so the no-cost extension could be processed. A new contract was set up in October 2009 and a graduate student was recruited to start work on the project in 2010.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009:
"Sensitivity of MEPDG Level 2 and 3 Inputs Using Statistical Analysis Techniques for New England States," Ayyala, D., Chehab, G. R., and Daniel, J. S., accepted for publication in the Transportation Research Record 2010.

"Sensitivity of RAP Binder Grade on Performance Predictions in the MEPDG," Daniel, J. S., Cehab, G. R., and Ayyala, D., Journal of the Association of Asphalt Pavement Technologists, Vol. 78, 2009, pp. 352-376.

"Sensitivity of RAP Binder Grade on Performance Predictions in the MEPDG," Presentation by Jo Sias Daniel to the Association of Asphalt Paving Technologists Annual Meeting, March 2009.

PROJECT NUMBER: 06-3

PROJECT TITLE: Establishing Default Dynamic Modulus Values for New England

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): James Mahoney, PI, University of Connecticut

STATUS: Continuing

INITIAL AGREEMENT DATE: 7/1/2008 – 4/30/2010

ANTICIPATED COMPLETION: 4/30/2010

PROJECT OBJECTIVES: RESEARCH OBJECTIVE:
The objective of this research is to test commonly used HMA mixtures throughout New England to determine their respective moduli. The results of this testing will be:

- Used to determine if there is a significant difference between dynamic modulus values for materials from throughout the region.
- Used to compare the dynamic modulus of lab produced mixes and plant produced mixes.
- Compared against the master curves derived by performing the reduced testing as outlined by Bonaquist and Christensen. This will reduce the number of temperatures as well as the number of frequencies tested. If this process correlates well with the full set testing master curves, it will reduce the amount of time required to conduct the testing.
- Compared against the predicted moduli obtained by using the Witczak Predictive Model and the Hirsh Model. If there is a strong correlation between the tested and predicted values then this would provide a reasonable value for the dynamic modulus for most HMA designs in the 2002 Pavement Design Guide.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:
The research team has conducted an on going literature review of hot mix asphalt dynamic modulus. The great deal of research published in this area over the last couple of years may require some deviation from the models and methods proposed to ensure state-of-the-art practice. Any changes to the work plan would be coordinated with the technical committee.

This year the research team fabricated, tested and analyzed asphalt samples for 4 of the 6 states in the proposal. To date dynamic modulus values have been obtained for CT, VT, NH and ME for all 4 lab mixes and plant mixes. The research team was also able to generate master curves for the plant and laboratory mixes for each of these 4 states. At the end of the December the remaining material requested from RI was dropped off at the CAP Lab. Fabrication and testing of the RI samples has started. The research team is awaiting batch designs for 3 of the 4 mixes supplied by RI. Once received the remaining 3 mixes will be fabricated and tested. The sixth and final state, Massachusetts has not responded to requests for materials and will not be included in the study.

The PI for this project requested, and was granted, a no additional cost extension due to the recent arrival of materials from RI. The development of binder master curves in the near future will allow for the final analysis to be conducted and the final report to be written by the project end date.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009: None

PROJECT NUMBER: 06-5

PROJECT TITLE: The New England Winter Severity Index

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Samuel Miller, PI, Plymouth State University; Brendon Hoch, Co-PI, Plymouth State University

STATUS: Continuing

AGREEMENT TERM: Agreement Extension Pending

ANTICIPATED COMPLETION: Agreement Extension Pending

PROJECT OBJECTIVES: RESEARCH OBJECTIVE: The objective of this study is to develop winter severity indices for the New England region. Anticipated tasks include identifying appropriate and manageable number of weather regions within New England, developing winter severity indices using statistical concepts, developing standard methods to utilize the indices and provide recommendations on maintaining and improving indices.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2009:

Task 1: Literature review – *complete.*

Task 2: Define climate zones – *complete.*

Task 3: Develop a NEWSI for each climate zone – *complete.*

Task 4: Validate NEWSI for each climate zone with historical dataset – *complete.*

Note: We upgraded this task to include five separate NEWSI's for each transportation district. The purpose of this was to achieve higher correlation coefficients between costs and winter weather variables. The first is a general index that calculates all costs associated with winter road maintenance. The other four separately predict costs associated with labor, vehicles and equipment, and chemicals.

Using historical cost data provided by the state transportation department, we have completed this for the state of Maine. The other five New England states did not respond to our request for cost data, so we have not been able to develop a cost predictor for them. All they will receive is a classification of their respective climate zones.

Task 5: Develop a GIS program that computes a NEWSI for zones as defined in task 2 – modified. Following our change of personnel, and in consultation with the Maine transportation department, we decided to create a web-based application that computes the NEWSI(s) for each of the Maine transportation districts, and presents the results in both graphical and numerical form. The webpage will automatically update itself once/month, and be housed on the Plymouth State University/Judd

Gregg Meteorology Institute server.

Task 6: Develop and conduct one-day training workshops for each New England state – under construction. Given the lack of responsiveness from New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island, all we will be able to provide them is a demonstration of how we determined their respective climate zones. Since this is not likely to be of interest to most transportation professionals, we have not begun work on this yet. We are currently focusing our attention on developing demonstrations for the five Maine transportation maintenance districts, since these are the only regions that will have a cost prediction algorithm.

REPORTS/PAPERS PUBLISHED, PRESENTATIONS MADE RELATING TO THIS PROJECT FROM THE START OF THE PROJECT THROUGH DECEMBER 31, 2009: None

D. FINANCIAL STATUS OF PROJECTS ACTIVE DURING 2009

D.1 FINANCIAL STATUS OF ACTIVE PROJECTS:
Table 1: Financial Status of Projects Active During 2009
(As of December 31, 2009)

NO.	PROJECT TITLE, PI, UNIVERSITY	APPROVED BUDGET	INVOICES APPROVED FOR PAYMENT	PROJECT BALANCE
01-1 T2 Phase 1	Advanced Composite Materials in New England's Transportation Infrastructure - Technology Transfer Phase 1: Selection of Prototype, *S. Brena, University of Massachusetts Amherst*	$25,910.00	$25,286.18	$623.82
02-1	Relating Hot Mix Asphalt Pavement Density to Performance, *W. Mogawer, University of Massachusetts, Dartmouth, R. Mallick, Worcester Polytechnic Institute, J. Daniels, University of New Hampshire*	$103,524.00	$90,721.69	$12,802.31
02-6 Phase 2	Sealing of Small Movement Bridge Expansion Joints - Phase II: Field Demonstration and Monitoring, *R. Malla, M. Shaw, University of Connecticut*	$75,000.00	$28,210.97	$46,789.03
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, *W. Mogawer, University of Massachusetts Dartmouth, J. Daniel, University of New Hampshire*	$45,842.00	$0.00	$45,842.00
04-1 Phase 2	Recycling Asphalt Pavements Containing Modified Binders - Phase 2, *J. Mahoney, University of Connecticut*	$82,751.00	$78,613.45	$4,137.55
04-2	Driver-Eye-Movement-Based Investigation for Improving Work-Zone Safety, *D. Fisher, M. Knodler, University of Massachusetts Amherst*	$74,491.00	$70,387.66	$4,103.34
04-3	Estimating the Magnitude of Peak Flows for Steep Gradient Streams in New England, *J. Jacobs , T. Ballestero, University of New Hampshire, R. Vogel, Tufts University*	$21,978.00	$0.00	$21,978.00
04-4	Determining the Effective PG Grade of Binder in RAP Mixes, *J. Daniel, University of New Hampshire, W. Mogawer, University of Massachusetts Dartmouth*	$130,876.00	$124,332.20	$6,543.80
05-1	Development of Supplemental Resistance Method for the Design of Drilled Shaft Rock Sockets, *T. Sandford, University of Maine*	$47,755.00	$0.00	$47,755.00
05-5	Measurement of Adhesion Properties Between Topcoat Paint and Metallized/Galvanized Steel with Surface Energy Measurement Equipment, *S. Yang, K. W. Lee, University of Rhode Island*	$125,000.00	$104,987.55	$20,012.45

D.1 FINANCIAL STATUS OF ACTIVE PROJECTS:
Table 1: Financial Status of Projects Active During 2009
(As of December 31, 2009)

NO.	PROJECT TITLE, PI, UNIVERSITY	APPROVED BUDGET	INVOICES APPROVED FOR PAYMENT	PROJECT BALANCE
05-6	Employing Graphic-Aided Dynamic Message Signs to Assist Elder Drivers' Message Comprehension, *J. H. Wang, University of Rhode Island*	$13,278.00	$0.00	$13,278.00
05-7 Phase 2	Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways - Phase 2, *J. Ivan, University of Connecticut, A. Sadek, University at Buffalo, New York*	$7,998.00	$7,431.26	$566.74
05-8	Evaluation and Implementation of Traffic Simulation Models for Work Zones, *J. Collura, University of Massachusetts*	$5,035.00	$0.00	$5,035.00
06-1	New England Verification of NCHRP 1-37A Mechanistic-Empirical Pavement Design Guide with Level 2 & 3 Inputs, *J. Daniel, University of New Hampshire*	$68,085.00	$0.00	$68,085.00
06-3	Establishing Default Dynamic Modulus Values for New England, *J. Mahoney, University of Connecticut*	$109,787.00	$67,119.06	$42,667.94
06-5	The New England Winter Severity Index, *S. Miller, Plymouth State University*	$100.000.00	$73,639.62	$26,360.38

D.2 NETC FUND BALANCE				
As of December 31, 2009				
		ENCUMB/		**CUM.**
ITEM	**OBLIGATION**	**EXPEND.**	**INVOICE**	**BALANCE**
Unexpended Balance of NETC funds from AASHTO				
as of 6/5/95 (Per AASHTO memo 12/4/95)				132,777.07
Member Obligations 1994 = 6 X $75,000	450,000.00			582,777.07
Coord./Admin. of NETC: Calendar Year 1995 Bdgt. = $73042		58,761.32	FINAL	524,015.75
Continued Projects:				
- Construction Costs of New England Bridges-Phase II		39,500.00	FINAL/CLOSED	484,515.75
- Tire Chips as Lightweight Backfill-Phase II: Full-Scale Testing				
(Supplemental Funding)		16,000.00	FINAL/CLOSED	468,515.75
- Bridge Rail Crash Test - Phase II:Sidewalk-Mounted Rail		134,127.00	FINAL/CLOSED	334,388.75
- New England Vehicle Classification and Truck Weight Program		6,752.57	FINAL/CLOSED	327,636.18
Member Obligations 1995 = 7 X $75,000	525,000.00			852,636.18
"95" Project Series:				
95-1: Use of Tire Chips/Soil Mixtures to Limit Pavement Damage				
of Paved Roads		75,000.00	FINAL/CLOSED	777,636.18
95-2: Suitability of Non-Hydric Soils for Wetland Mitigation		39,867.70	FINAL/CLOSED	737,768.48
95-3: Implementation and Evaluation of Traffic Marking Recesses				
for Application of Thermoplastic Pavement Markings				
on Modified Open Graded Mixes		120,812.12	FINAL/CLOSED	616,956.36
95-5: Buried Joints in Short Span Bridges		61,705.61	FINAL/TERM.	555,250.75
95-6: Guidelines for Ride Quality Acceptance of Pavements		106,124.00	FINAL/CLOSED	449,126.75
"94" Project Series:				
94-1: Structural Analysis of New England Subbase Materials and				
Structures		110,057.38	FINAL/CLOSED	339,069.37
94-2: Nondestructive Testing of Reinforced Concrete Bridges				
Using Radar Imaging Techniques		224,901.80	FINAL/CLOSED	114,167.57
Member Obligations 1996 = 6 X $75,000	450,000.00			564,167.57
Coord./Admin.of NETC: Calendar Year 1996; Bdgt. = $75,000		69,123.85	FINAL	495,043.72
Member Allocations 1997 = 6 X $75,000	450,000.00			945,043.72
Coord./Admin. of NETC: Calendar Year 1997; Bdgt. = $82,494		77,244.35	FINAL	867,799.37
"94" Project Series:				
94-3: Procedures for The Evaluation of Sheet Membrane Waterproofing		67,002.00	FINAL/CLOSED	800,797.37
Note: Project administered by VAOT under TPF Project No. SPR-3				
94-4: Durability of Concrete Crack Repair Systems		72,036.04	FINAL/TERM.	728,761.33
"96" Project Series:				
96-1: SUPERPAVE Implementation		60,139.25	FINAL/CLOSED	668,622.08
96-2: Optimizing GPS Use in Transportation Projects		27,008.81	FINAL/TERM.	641,613.27
96-3: Effectiveness of Fiber Reinforced Composites as Protective				
Coverings for Bridge Elements, etc.		135,000.00	FINAL/CLOSED	506,613.27
T2 (per 12/2/97 Adv. Committee Mtg.) for 1998 = $10,000		9,551.06	FINAL	497,062.21
Coord./Admin. of NETC: Calendar Year 1998; Bdgt = $73,021		80,422.65	FINAL	416,639.56
Refund Check (No. 15-663337), for CY '98 Management of NETC, from	336.00			416,975.56
UConn OSP; Ref. 7/19/00 letter to J. Sime from J. Devereux, UConn OSP				
Member Obligations 1998 = 6 X $75,000	450,000.00			866,975.56
"97" Project Series:				
97-1: A Portable Method for Determining Chloride Concentration on	*Phase 1*	96,669.50	FINAL/CLOSED	770,306.06
Roadway Pavements	*Phase 2*	90,667.79	FINAL/CLOSED	679,638.27
97-2: Performance Evaluation & Economic Analysis		108,318.73	FINAL/CLOSED	571,319.54
of Durability Enhancing Admixtures, etc.				
97-3: Determining Properties, Standards & Performance	*Phase 1*	27,779.64	FINAL/CLOSED	543,539.90
of Wood Waste Compost, etc.:	*Phase 2*	16,074.30	FINAL/CLOSED	527,465.60
Alloc. to ConnDOT for Constr. Costs of Test Site (Approved 1/21/99 Ballot)		10,700.00		516,765.60
97-4: Early Distress of Open-Graded Friction Course		57,495.71	FINAL/CLOSED	459,269.89
Travel Tech. Comm. (Aug. 98 tel. poll) for 1998 = $5,000		0.00		459,269.89

D.2 NETC FUND BALANCE As of December 31, 2009 (Cont'd)				
		ENCUMB/		CUM.
ITEM	**OBLIGATION**	**EXPEND.**	**INVOICE**	**BALANCE**
Member Obligations 1999 = 6 X $75,000	450,000.00			909,269.89
Coord./Admin. of NETC: Calendar Year 1999:				909,269.89
- Administration = $77,666				
-Technology Transfer & Technical Committee				
Travel = $20,400				
-Total =$98,066		79,101.20	FINAL	830,168.69
"99" Project Series:				
99-1: Bridge Rail Transitions		240,000.00	FINAL/CLOSED	590,168.69
99-2: Evaluation of Asphaltic Expansion Joints		62,234.76	FINAL/CLOSED	527,933.93
99-3: Bridge Scour Monitoring Systems		78,523.32	FINAL/CLOSED	449,410.61
99-4: Quantifying Roadside Rest Area Usage		44,857.00	FINAL/CLOSED	404,553.61
99-6: The Effects of Concrete Removal Operations on Adjacent Concrete				
That Is to Remain		96,008.36	FINAL/CLOSED	308,545.25
Member Obligations 2000 = 6 X $100,000	600,000.00			908,545.25
Coord./Admin. of NETC: Calendar Year 2000:		91,899.37	FINAL	816,645.88
- Administration = $ 85,788				
- Technology Transfer & Technical Committee				
Travel =$ 16,800				
- Total =$102,588				
"00" Project Series:				816,645.88
00-1: Ground-Based Imaging and Data Acquisition Systems for		31,251.92	FINAL/CLOSED	785,393.96
Roadway Inventories in New England - A Synthesis of				
Practice				
00-2: Evaluation of Permeability of Superpave Mixes		95,499.16	FINAL/CLOSED	689,894.80
00-3: Composite Reinforced Timber Guard Rail - Phase I: Design,		81,989.38	FINAL/CLOSED	607,905.42
Fabrication and Testing				
00-4: Falling Weight Deflectometer Study		100,000.00	FINAL/CLOSED	507,905.42
00-5: Guard Rail Testing - Modified eccentric Loading Terminal at		61,287.00	FINAL/CLOSED	446,618.42
NCHRP 350 TL2				
00-6: Implementation of Visualization Technologies to Create		74,914.49	FINAL/CLOSED	371,703.93
Simplified Presentations Within Highway agencies to be Used				
at Public Hearings				
00-7: A Complete Review of Incident Detection Algorithms and		45,369.45	FINAL/CLOSED	326,334.48
Their Deployment: What Works and What Doesn't				
00-8: Performance and Effectiveness of A Thin Pavement Section		150,000.00	FINAL/CLOSED	176,334.48
Using Geogrids and Drainage geocomposites in A Cold				
Region				
Member Obligations 2001 = 6 X $100,000	600,000.00			776,334.48
Coord./Admin. of NETC: Calendar Year 2001:		104,385.35	FINAL	671,949.13
- Administration = $89,448				
- Technology Transfer & Technical Committee				
Travel = $16,800				
- Total = $106,248				
"01" Project Series:				
01-1: Advanced Composite Materials for New England's Transportation Infrastructure		47,559.27	FINAL/CLOSED	624,389.86
01-1: Advanced Composite Materials for New England's Transportation		25,286.18	FINAL	599,103.68
Infrastructure - Technology Transfer Phase I				
01-2: Development of A Testing Protocol for Quality				
Control/Quality Assurance of Hot Mix Asphalt		80,000.00	FINAL/CLOSED	519,103.68
01-3: Design of Superpave HMA for Low Volume Roads		120,324.15	FINAL/CLOSED	398,779.53
01-6: Field Evaluation of A New Compaction Device		49,944.50	FINAL/CLOSED	348,835.03
Member Obligations 2002 = 6 X $100,000	600,000.00			948,835.03
NY DOT Obligation = $52,500	52,500.00			1,001,335.03
Coord./Admin. Of NETC: Calendar Year 2002		109,207.12	FINAL	892,127.91

D.2 NETC FUND BALANCE As of December 31, 2009 (Cont'd)				
		ENCUMB/		CUM.
ITEM	**OBLIGATION**	**EXPEND.**	**INVOICE**	**BALANCE**
"02" Project Series:				
02-1: Relating Hot Mix Asphalt Pavement Density to Performance		103,524.00		788,603.91
02-2: Formulate Approach for 511 Implementation in New England Phase 1		48,158.19	FINAL/CLOSED	740,445.72
02-2: Formulate Approach for 511 Implementation in New England Phase 2		32,813.16	FINAL/CLOSED	707,632.56
02-3: Establish Subgrade Support Values (M_r) for Typical Soils in		79,936.86	FINAL/CLOSED	627,695.70
New England				
02-5: Determination of Moisture Content of De-Icing Salt at Point of Delivery		19,679.99	FINAL[2] /CLOSED	608,015.71
02-6 : Sealing of Expansion Joints - Phase 1		74,982.81	FINAL/CLOSED	533,032.90
02-7: Calibrating Traffic Simulation Models to Inclement Weather Conditions		74,037.57	FINAL/CLOSED	458,995.33
with Applications to Arterial Coordinated Signal Systems				
02-8: Intelligent Transportation Systems Applications to Ski Resorts in		54,724.71	FINAL/CLOSED	404,270.62
New England				
Member Obligations 2003 = 6 X $100,000	600,000.00			1,004,270.62
NY DOT Obligation = $40,000	40,000.00			1,044,270.62
Coord./Admin. Of NETC Calendar Year 2003 = $124,258		118,855.19	FINAL	925,415.43
"03" Project Series:				
03-1: Ability of Wood Fiber Materials to Attenuate Heavy Metals Associated with		70,690.16	FINAL/CLOSED	854,725.27
Highway Runoff				
03-2: Field Studies of Concrete Containing Salts of An Alkenyl-Substituted Succinic		133,385.33	FINAL/	721,339.94
Acid				
03-3: Feasibility Study and Design of An Erosion Control Laboratory in New England		20,682.70	FINAL/CLOSED	700,657.24
03-3: Feasibility Study and Design of An Erosion Control Laboratory in New England		13,135.80	FINAL/CLOSED	687,521.44
Phase 2				
03-4: Measuring Pollutant Removal Efficiencies of Storm Water Treatment Units		80,000.00	FINAL/CLOSED	607,521.44
03-5: Evaluation of Field Permeameter As A Longitudinal Joint Quality Control		77,318.43	FINAL/CLOSED	530,203.01
Indicator				
03-6: Fix It First: Utilizing the Seismic Property Analyzer & MMLS to Develop		99,927.00		430,276.01
Guidelines for the Use of Polymer Modified Thin Lift HMA vs. Surface				
Treatments				
03-7 (Alt.): Basalt Fiber Reinforced Polymer Composites		64,092.29	FINAL/CLOSED	366,183.72
Member Obligations 2004 = 6 X $100,000	600,000.00			966,183.72
NY DOT Obligation = $52,000	52,000.00			1,018,183.72
Coord./Admin. Of NETC Calendar Year 2004 = $126,559		113,012.87	FINAL	905,170.85
"04" Project Series:				
04-1: Recycling Asphalt Pavements Containing Modified Binders - Phase I		27,166.58	FINAL	878,004.27
04-1: Recycling Asphalt Pavements Containing Modified Binders - Phase II		82,751.00		795,253.27
04-2: Driver-Eye-Movement-Based Investigation for Improving Work Zone Safety		70,387.66	FINAL/	724,865.61
04-3: Estimating the Magnitude of Peak Flows For Steep Gradient Streams in		120,000.00		604,865.61
New England				
04-4: Determining the Effective PG Grade of Binder in RAP Mixes		130,876.00		473,989.61
04-5: Network-Based Highway Crash Prediction Using Geographic Information		129,020.04	FINAL/CLOSED	344,969.57
Systems				
Member Obligations 2005 = 6 x $100,000	600,000.00			944,969.57
NY DOT Obligation = $50,000	50,000.00			994,969.57
Coord./Admin. Of NETC Calendar Year 2005 = $130,528		128,934.25	FINAL	866,035.32
"05" Project Series:				
05-1: Develop Base Resistance Load-Displacement Curves for The		100,000.00		766,035.32
Design of Drilled Shaft Rock Sockets				
05-2 Enhancing the Reflectivity of Concrete Barriers Phase 1		48,090.00		717,945.32
05-2: Enhancing the Reflectivity of Concrete Barriers, Phase 2: Full-Scale Barrier		72,000.00		645,945.32
Selection & Evaluation				
05-3: Analysis of Roundabout Operational Characteristics Utilizing Microscopic		75,000.00		570,945.32
Simulation Modeling				
05-5: Measurement of Work of Adhesion Between Paint and Metalized/Galvanized		125,000.00		445,945.32
Steel				

D.2 NETC FUND BALANCE				
As of December 31, 2009				
(Cont'd)				
		ENCUMB/		CUM.
ITEM	**OBLIGATION**	**EXPEND.**	**INVOICE**	**BALANCE**
05-6: Employing Graphic-Aided Dynamic Message Signs to Assist Elder Drivers'		60,000.00		385,945.32
Message Comprehension				
05-7: Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and		92,000.36	FINAL	293,944.96
Driveways Phase I				
05-7: Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and				
Driveways Phase II		7,431.26	FINAL/	286,513.70
05-8: Evaluation of Alternative Traffic Simulation Models, Including CA4PRS for		100,000.00		186,513.70
Analysis of Traffic Impacts of Highway Construction, Reconstruction and				
Rehabilitation				
Member Obligations 2006 = 5 x $100,000 (no ME DOT allocation)	500,000.00			686,513.70
Note: Maine 2006 Obligation as of 11/06/06 per Peabody 11/30/06	100,000.00			786,513.70
email				
Coord./Admin. Of NETC Calendar Year 2006 = 131,814		100,718.92	FINAL	685,794.78
"06" Project Series:				
06-1: New England Verification of NCHRP 1-37A Mechanistic-Empirical Pavement Design Guide With Level 2 & 3 Input		150,295.00		535,499.78
06-2: Infrastructure Management Systems Enhancement and Integration to Support True Integrated Management Decision-Making		100,000.00		435,499.78
06-3 Establish Default Dynamic Modulus Values for New England		110,000.00		325,499.78
06-4 Preventative Maintenance and Timing of Applications		200,000.00		125,499.78
06-5 Winter Severity Indices for New England		100,000.00		25,499.78
Member Obligations 2007 = 600,000	600,000.00			625,499.78
Coord./Admin. Of NETC Calendar Year 2007 = 136,061		122,644.79	FINAL	502,854.99
"07" Project Series:				
07-1 In-Place Response Mechanisms of Recycled Layers Due to Temperature and		150,000.00		352,854.99
Moisture Variations				
07-2 Exploring the Potential of Intelligent Intersections Deployment in New England		100,000.00		252,854.99
07-3 Determining Optimum Distance for a Lane Drop Downstream from a Signalized		100,000.00		152,854.99
Intersection				
07-4 Reliable Travel Time Estimation to Support Real-Time System Management		100,000.00		52,854.99
Information				
Member Obligations 2008 = 600,000	600,000.00			652,854.99
NY DOT Obligation (72,000+8,000)	80,000.00			732,854.99
Coord./Admin. Of NETC Calendar Year 2008 = 134,998		131,509.90	FINAL	601,345.09
08-2 Evacuation Modeling to Assist Hazard Management and Response in Urban		160,000.00		441,345.09
and Rural Areas of New England				
08-3 Best Management Practices for the Invasive Polygonum Cuspidatum (Japanese		140,000.00		301,345.09
Knotweed) Along Transportation Corridors				
08-4 NETC Research Implementation Survey & Synthesis (Rev. from $35,000 to		60,000.00		241,345.09
$60,000 NETC Adv. Comm. Mtg 5/21/09)				
08-5 NETC/UVM-UTC Transportation Research Challenge: Commute Rideshare, etc.		50,000.00		191,345.09
02-6 Phase II Sealing of Small Mvmnt Bridge Expan Joints - Field Inst. & Mntrng		75,000.00		116,345.09
08-6 (Alt.) Interaction Between Salinity, Soil Quality and Amendments in Roadside		75,000.00		41,345.09
Plantings				
Member Obligations 2009 = 600,000	600,000.00			641,345.09
NYSDOT Obligation	50,000.00			691,345.09
Coord./Admin. Of NETC Calendar Year 2009 (Approved) = 139,309		139,309.00		552,036.09
08-1 Applying the Highway Safety Manual in New England		120,000.00		432,036.09
09-1 Active Structural Control of Cantilevered Support Structures:				
Phase 1		150,000.00		282,036.09
Phase 2		100,000.00		182,036.09
09-2 Effective Establishment of Native Grasses on Roadsides		90,000.00		92,036.09
09-3 Advanced Composite Materials: Prototype Development and Demonstration		48,847.00	***See Note 3***	43,189.09

D.2 NETC FUND BALANCE				
As of December 31, 2009				
(Cont'd)				
		ENCUMB/		CUM.
ITEM	OBLIGATION	EXPEND.	INVOICE	BALANCE
Member Obligations 2010 = 600,000	600,000.00			643,189.09
NYSDOT Obligation	50,000.00			693,189.09
Coord./Admin. Of NETC Calendar Year 2010 (Approved) = 134,809		134,809.00		558,380.09
10-1 A Field Evaluation of SuperPave Hot Mix Asphalt Pavement		180,000.00		378,380.09
Containing 30% RAP				
10-2 Synthesis of Practice: Electronic Bridge Inspection Document		70,000.00		308,380.09
Management Systems				
10-3 Field Evaluation of Corrosion Protection on Bridges with A Spray		100,000.00		208,380.09
Application of Disodium Tetrapropenyl Succinate (DSS)				
10-4 Low Temperature and Moisture Susceptibility of RAP Mixtures with		150,000.00		58,380.09
Warm Mix Technology				
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."***				

E. REPORTS, PAPERS AND PRESENTATIONS

E.1 POLICIES AND PROCEDURES:

"Policies and Procedures, New England Transportation Consortium," July 1995.
"Policies and Procedures, New England Transportation Consortium," April 2002.

E.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 2004," December 2005, NETCR59
"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

E.3 REPORTS, PAPERS, AND PRESENTATIONS 1988-1994:

"The Development of a Common Regional System for Issuing Permits for Oversize and Overweight Trucks Engaged in Interstate Travel," Humphrey, T.F., May 1986.

"Agreement to Implement a Common Set of Procedures for Issuing Permits for Nondivisible Oversize and Overweight Trucks Engaged in Interstate Travel," The New England Transportation Consortium, October 1988.

"The New England Transportation Consortium, Round One Activities," Humphrey, T.F., and Maser, K.R., MIT, December 1988.

"New Technology for Bridge Deck Assessment - Phase I Final Report," Vols. I and II, Maser, Kenneth R., MIT Center for Transportation Studies, October 1989.

"Handbook for Use by the Trucking Industry to Implement The NETC Common Truck Permit Procedures for Certain Nondivisible Oversize/Overweight Vehicles Traveling on State Highways," MIT Center for Transportation Studies, January 1989.

"Bridge Rail Design and Crash Worthiness - Final Report," Elgaaly, M., Dagher, H., and Kulendran, S., University of Maine, May 1989.

E.3 <u>NETC REPORTS, PAPERS, AND PRESENTATIONS 1988-1994 (cont'd)</u>:

"New England Transportation Consortium, Operational Procedures," Humphrey, T.F., November 1991.

"Wetlands: Problem & Issues," Shuldiner, P.W., University of Massachusetts, August 1990.

"Development of a Uniform Truck Management System," Vols. I and II, Lee, K.W., and McEwen, E.E., University of Rhode Island. July 1990.

"A Study of STAA Truck Safety In New England - Phases I & II," MIT, November 1991.

"New Technology for Bridge Deck Assessment - Phase II Final Report," MIT, May 1990.

"Rail Service In New England," Martland, C.P. Little, and Alvaro, A.E., MIT Center for Transportation Studies, April 1992.

"CMA Degradation and Trace Metals in Roadside Soil," Ostendorf, D.W., Palaia, T.A., and Zutell, C.A., University of Massachusetts, March 1993.

"Tire Chips as Lightweight Backfill for Retaining Walls - Phase I," Humphrey, D., Sandford, T.C., Cribbs, M.M., Gharegrat, H.G., and Manion, W.P., University of Maine, August 1992.

"Cooperative Regional Transportation Research Programs Underway in New England," Humphrey, T.F., and Sussman, J.M., International Congress on Technology and Technology Exchange, June 1989.

"Uniformity Efforts in Oversize/Overweight Permits," Humphrey, T.F., NCHRP Synthesis, No. 143, Transportation Research Board, 1988.

"Implementation of a Uniform Truck Permit System by the New England Transportation Consortium," Humphrey, T.F., AASHTO 1987 Annual Meeting Proceedings, pp. 84-90, 1987.

"Advantages of Oversize/Overweight Truck Permit Uniformity," AASHTO 1990 Annual Meeting Proceedings, pp. 83-85, 1990.

"Crash Worthiness of Bridge Rails," Dagher, H., Elgaaly, M., and Kulendran, S., Proceedings, Fourth Rail Bridge Centenary Conference, Heriot-Watt University, Edinburgh, Scotland, August 1990.

E.3 NETC REPORTS, PAPERS, AND PRESENTATIONS 1988-1994 (cont'd):

"Principles of Radar and Thermography for Bridge Deck Assessment," Maser, R., and Roddis, W.M.K., ASCE Journal of Transportation Engineering, Vol. 116, No. 5, Sept./Oct. 1990.

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

"CMA Degradation in Roadside Soil: Acetate Microcosms," Ostendorf, D.W., Pollock, S.J., De Cheke, M.E., and Palaia, T.A., Transportation Research Record, No. 1366, pp. 41-43, 1992.

"Aerobic Degradation of CMA in Roadside Soils: Field Simulations from Soil Microcosms," Ostendorf, D.W., Pollock, S.J., De Cheke, M.E., and Palaia, T.A, Journal of Environmental Quality, Vol. 22, pp. 229-304, 1993.

"Shear Strength and Compressibility of Tire Chips for Use as Retaining Wall Backfill," Humphrey, D.N., Sandford, T.C., Cribbs, M.M., and Manion, W.P., Transportation Research Record No. 1422, pp. 29-35, Transportation Research Board, National Research Council Washington, D.C., 1993.

"Tire Chips as Lightweight Subgrade Fill and Retaining Wall Backfill," Humphrey, D.N., and Sandford, T.C., Proceedings of the Symposium on Recovery and Effective Reuse of Discarded Materials and By-Products for Construction of Highway Facilities, pp. 5-87 to 5-99, Federal Highway Administration, Washington, D.C., 1993.

E.4 REPORTS, PAPERS AND PRESENTATIONS 1995-2009:

Project No.	Title
N/A	**Construction Costs Of New England Bridges** Reports: "Construction Costs of New England Bridges," Alexander, J.A., Dagher, H. and James, S., November 1996, NETCR1. Papers and Presentations: "Construction Costs of New England Bridges," Alexander, J., Dagher, H. and James, S. Presented at the Annual Maine Transportation Conference, December 7, 1995.
N/A	**Tire Chips As Lightweight Backfill For Retaining Walls, Phase II: Full-Scale Testing** Reports: "Tire Chips As Lightweight Backfill For Retaining Walls - Phase II," Tweedie, Jeffrey J., Humphrey, Dana N., and Sandford, T.C., March 11, 1998, NETCR8. Papers and Presentations: "Tire Shreds as Lightweight Retaining Wall Backfill-Active Conditions," Humphrey, D. Submitted for publication in the ASCE Journal of Geotechnical and Geoenvironmental Engineering. "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. "Tire Chips as Lightweight Subgrade and Retaining Wall Backfill," by Humphrey, D.N. and Sandford, T.C. Symposium on Recovery and Effective Reuse of Discarded Materials and By-Products for Construction of Highway Facilities, FHWA, Denver, Colorado, October 19-22, 1993. "Use of Tire Chips as Subgrade Insulation and as Lightweight Fill for Highway Construction," Humphrey, D.N. Presented at the 18th Annual Meeting of the Asphalt Recycling and Reclaiming Association, Pompano Beach, Florida, February 23-26, 1994. "Use of Tire Chips in Highway Construction," Humphrey, D.N. Presented to the New England Environmental Expo, Boston, Massachusetts, May 9, 1995.

N/A	**Tire Chips As Lightweight Backfill For Retaining Walls, Phase II: Full-Scale Testing (cont'd):**

Papers and Presentations (cont'd):

"Use of Tire Chips in Highway Construction," Humphrey, D.N. Presented to the AASHTO Region 1 RAC Meeting, Portland, Maine, May 23, 1995.

"Tire Chips for Highway Construction," Humphrey, D.N. Presented to the Northeast Recycling Council in Sturbridge, Massachusetts on December 8, 1995.

"Tire Chips: A New Road Building Geomaterial," Humphrey, D. Presented at the Conference on Waste and Recycled Materials in the Transportation Infrastructure, held in conjunction with the 75th Annual Meeting of the Transportation Research Board, January 7, 1996.

"Use of Tire Chips in Civil Engineering." Presented at the 76th Annual Meeting of the Rubber Association of Canada, March 7, 1996.

"Civil Engineering Uses for Scrap Tires," Humphrey, D. Presented at Scrap Tire '96 held in Chicago, Illinois on August 16, 1996.

"Full Scale Field Trials of Tire Chips as Lightweight Retaining Wall Backfill-At Rest Conditions," Tweedie, J.J., Humphrey, D.N., and Sandford, T.C., Transportation Research Board No. 1619, Transportation Research Board, Washington, D.C., p. 64-71, 1998.

"Tire Shreds as Retaining Wall Backfill, Active Conditions," Tweedie, J.J., Humphrey, D.N., and Sandford, T.C, Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 124, No. 11, Nov., pp.1061-1070, 1998.

"Highway Applications of Tire Shreds," Humphrey, D. A 7-hour short course presented in each of the six New England States, 1998.

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

N/A	**New England Vehicle Classification And Truck Weight Program, Phase I**

Reports:

"New England Vehicle Classification and Truck Weight Program, Technical Report No. 1: Toward the Development of a Vehicle Classification Program for New England," Collura, J., Chan, D., Evans, E., Kelly, S., Hosmer, T., and Shuldiner, P., April 1996.

N/A **New England Vehicle Classification And Truck Weight Program, Phase I (cont'd):**

Reports (cont'd):

"New England Vehicle Classification and Truck Weight Program, Technical Report No. 2: Toward the Development of a Truck Weight Program for New England," Collura, J., Chan, D., Evans, E., Kelly, S., Hosmer, T., and Shuldiner, P., April 1996.

"New England Vehicle Classification and Truck Weight Program, Technical Report No. 3: Supplemental Analysis of Truck Weight Data Collection at SHRP Continuous Count Stations," Collura, J., Chan, D., Evans, E., Kelly, S., Hosmer, T., and Shuldiner, P., April 1996.

"New England Vehicle Classification and Truck Weight Program, Phase I," Collura, J., Chan, D., Evans, E., Kelly, S., Hosmer, T. and Shuldiner, P., April 1996, NETCR2.

"An Analysis of Vehicle Class and Truck Weight Patterns in New England," Collura, J. and Orloski, F. Presented at the 1994 National Traffic Data Acquisition Conference, Rocky Hill, Connecticut, September 18-22, 1994.

"New England Vehicle Classification and Truck Weight Program," Collura, J. and Orloski, F. Presented to the Transportation Research Board's Highway Traffic Monitoring Committee, Annual Meeting of the Transportation Research Board, Washington, D.C., January 1995.

Papers and Presentations: None

N/A **Bridge Rail Crash Test, Phase II: Sidewalk-Mounted Rail**

Reports:

"NETC 2-Bar Curb-Mounted Bridge Rail Design - Plans and Specifications." Revised January 1997.

"NETC 4-Bar Sidewalk-Mounted Bridge Rail Design - Plans and Specifications." January 1997.

"Crash Testing and Evaluation of the NETC 2-Bar Curb-Mounted Bridge Rail," Mak, K.K., and Menges, W.L., February 1998, NETCR10.

"Full-Scale Crash Evaluation of the NETC 4-Bar Sidewalk Steel Bridge Railing," Kimball, C.E., and Mayer, J.B., March 1999, NETCR14.

Papers and Presentations: None

94-1 Structural Analysis Of New England Subbase Materials And Structures

Reports:

"Structural Analysis of New England Subbase Materials and Structures," Lee, K.W., Huston, M.T., Davis, J., Vajjhalla, S., June 30, 2001, NETCR26.

Papers and Presentations:

"Structural Analysis of New England Subbase Materials and Structures," Davis, J. Presented at the Rhode Island Transportation and Civil Engineering Forum, Kingston, Rhode Island, October 23, 1996.

"Structural Analysis of New England Subbase Materials and Structures." Presented at the Northeast Graduate Student Symposium on Applied Mechanics, University of Rhode Island, April 26, 1997.

"Structural Analysis of New England Subbase Materials and Structures." Presented at the Rhode Island Transportation and Civil Engineering Forum, University of Rhode Island, October 15, 1997.

"Structural Analysis of New England Subbase Materials and Structures," Davis, J., Huston, M., and Lee, K.W. Presented at the 1998 Annual Transportation Research Board Meeting.

"Structural Properties of New England Subbase Materials of Flexible Pavements." Presented at the 5th International Conference on the Bearing Capacity of Roads and Airfields, July 8, 1998.

"Structural Properties of New England Subbase Materials of Flexible Pavements." Presented at the 5th International Conference on the Bearing Capacity of Roads and Airfields on July 8, 1998.

"Characterization of Subbase Materials of Flexible Pavements With and Without Reclaimed Asphalt Pavement," Lee, K.W., Davis, J., and Vajjhalla, S. Presented at the 1999 World Congress for Korean Scientists and Engineers, July 7, 1999.

"Characterization of Subbase Materials of Flexible Pavements With and Without Reclaimed Asphalt Pavement," Lee, K.W., Davis, J. and Vajjhalla, S. Presented at the 12th Rhode Island Transportation Forum, University of Rhode Island, October 15, 1999.

94-2 **Nondestructive Testing of Reinforced Concrete Bridges Using Radar Imaging Techniques**

Reports:

"Nondestructive Testing of Reinforced Concrete Bridges Using Radar Imaging Techniques," Huston, D., Fuhr, P., Maser, K. and Weedon, W., July 1, 2002, NETCR 19.

Papers and Presentations:

"Bridge Deck Structural Monitoring Techniques," Huston, D. Presented at the New England State Materials Engineer Association Conference, Burlington, Vermont, October 9, 1996.

"Bridge Deck Evaluation with Ground Penetrating Radar," Huston, D., Maser, K., Weedon, W., Fuhr, P.L., and Adam, C., Structural Health Monitoring, Chang F., Editor, Technomic Publishing, pp. 91-109, Proceedings of the International Workshop on Structural Health Monitoring, Stanford, California, September 1997.

"Ground Penetrating Radar for Nondestructive Evaluation of Concrete Bridge Decks," Adam, C., M.S. Thesis, Department of Mechanical Engineering University of Vermont, September 1997.

"Bridge Deck Evaluation with Ground Penetrating Radar," Huston, D., Master, K., Hu, J.Q., Weedon, W., and Adam, C., Proceedings of the GPR '98 7th International Conference on Ground-Penetrating Radar, The University of Kansas, Lawrence, KS, May 27-30, 1998.

"Bridge Deck Evaluation with Ground Penetrating Radar," Huston, D., Hu, J.Q, Pelczarski, N, and Esser, B., Proceedings Second International Conference on Structural Health Monitoring, Stanford University, September 1999.

"GIMA Antenna Design for Ground Penetrating Radar in Concrete NDE Application," Hu J.Q., Huston, D. and Fuhr, P. SPIE paper 3670-63, SPIE Conference On Sensory Phenomena and Measurement Instrumentation for Smart Structures and Materials, Newport Beach, CA, March 1999.

"Ground Penetrating Radar for Concrete Bridge Health Monitoring Applications," Huston, D, Hu, J.Q., Maser, K., Weedon, W., and Adam, C. SPIE 3587-23, Proceedings SPIE NDE Techniques for Aging Infrastructure and Manufacturing, Newport Beach, CA, March 1999.

"Electromagnetic Interrogation of Structures," Huston, D. Fourth Army Research Office on Smart Structures, State College, PA, August 1999.

94-2 **Nondestructive Testing of Reinforced Concrete Bridges Using Radar Imaging Techniques (cont'd):**

Papers and Presentations (cont'd):

"GIMA Ground Penetrating Radar System For Infrastructure Health Monitoring," Huston, D.R., Hu, J.Q, Maser, K., Weedon, W., and Adam, C. Journal of Applied Geophysics 43, 2000, pp. 39-146.

"Good Impedance Match Antenna (GIMA) Design and Its Applications for Ground Penetrating Radar In Concrete Structures NDE Applications," Hu, J. M.S. Thesis, Department of Mechanical Engineering, University of Vermont, March, 2000.

"Damage Assessment in Roadways with Ground Penetrating Radar," Huston, D., Pelczarski, N., Esser, B., Maser, K., and Weedon, W. SPIE Conference on Nondestructive Evaluation and Health Monitoring of Aging Infrastructure, 3995A-55, Newport Beach CA, March 2000.

"Damage Detection in Roadways with Ground Penetrating Radar," Huston, D.R., Pelczarski, N., Esser, B., and Master, K. GPR 2000, 8th International Conference on Ground Penetrating Radar," Gold Coast, Australia, May 2000.

"Wireless Inspection of Structures Aided by Robots," Huston D.R., Pelczarski N., Esser B., Gaida G., Arms S. and Townsend C. SPIE Symposium on NDE for Health Monitoring and Diagnostics, 4337-24, Newport Beach CA, March 2001.

"Inspection of Bridge Columns and Retaining Walls with Electromagnetic Waves," Huston D.R., Pelczarski N., and Key C. SPIE Symposium on Smart Systems for Bridges, Structures, and Highways, 4330-09, Newport Beach, CA, March 2001.

"Wireless Electromagnetic Interrogation of Structures," Huston D., Pelczarski N., Fuhr P., Arms S., and Esser B. (Tentatively accepted) Smart Materials and Structures, April 2001.

"Adaptive Sensors and Sensor Networks for Structural Health Monitoring," Huston D. SPIE 4512-24, Symposium on Complex Adaptive Structures, Hutchinson Island, FL, June 2001.

94-3 **Procedures For The Evaluation Of Sheet Membrane Waterproofing:**

Reports:

"Procedures for the Evaluation Sheet Membrane Waterproofing," Korhonen, C.J., Buska, J.S., Cortez, Edel R., and Greatorex, Alan R., August 1999, NETCR13.

Papers and Presentations: None

94-4 **Durability Of Concrete Crack Repair Systems:**

Reports: None

Papers and Presentations:

"Durability of Concrete Crack Repair, Projects," Robinson, J. Presented at the University of Rhode Island Graduate Seminar Series, Kingston, RI, November 19, 1997.

"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:

"Use of Tire Chip/Soil Mixtures to Limit Frost Heave and Pavement Damage of Paved Roads," Brian, K.L., and Humphrey, D. N., June 2000, NETCR12.

Papers and Presentations:

"Laboratory and Field Measurement of the Thermal Conductivity of Tire Chips for Use as Subgrade Insulation," Humphrey, D., Chen, L.H. and Eaton, R. A paper submitted to the Transportation Research Board for presentation at the session on "Properties of Unconventional Aggregates" at the Annual Meeting of the Transportation Research Board, Washington, D.C., January 1997.

"Highway Applications of Tire Shreds," Humphrey, D. A 7-hour short course presented in each of the six New England States, 1998.

"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:

"Suitability of Non-Hydric Soils for Wetland Mitigation," Brannaka, L.K. and Evans, C.V., February 28, 1997, NETCR5.

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:

"Implementation and Evaluation of Traffic Marking Recesses for Application of Thermoplastic Pavement Markings on Modified Open Graded Friction Course," Lee, K.W., Cardi, S.A., and Corrigan, S., July 2000, NETCR23.

Papers and Presentations:

"Implementation and Evaluation of Traffic Marking Recesses for Application of Thermoplastic Pavement Markings on Modified Open Graded Mixes," Lee, K.W. Presented at the Rhode Island Transportation and Civil Engineering Forum, Kingston, Rhode Island, October 23, 1996.

"Implementation and Evaluation of Traffic Marking Recesses for Application of Thermoplastic Pavement Markings on Modified Open-Graded Mixes," Lee, K.W. Presented at the Rhode Island Transportation and Civil Engineering Forum, University of Rhode Island, October 15, 1997.

95-5 **Buried Joints In Short Span Bridges**

Reports: None

Papers and Presentations:

"State of the Art Study of Bridge Joint Systems in New England," Tsiatas, and Chandrasekaran, S. Submitted for presentation at the Annual Meeting of the Transportation Research Board, Washington, D.C., January 1997.

95-6 **Guidelines For Ride Quality Acceptance Of Pavements**

Reports:

"Guidelines for Ride Quality Acceptance of Pavements," Collura, J., El-Korchi, T., Black K., Chase, M. and Li, J., April 1997, NETCR 6.

Papers and Presentations: None

96-1 **Implementation of Superpave**

Reports:

"Superpave Implementation," Mahoney, James, Stephens, Jack E., September 1999, NETCR18.

96-3 **Effectiveness Of Fiber Reinforced Composite As Structural And Protective Coverings For Bridge Elements Exposed To Deicing Salt Chlorides**

Reports:

"Effectiveness of High Strength Composites as Structural and Protective Coatings for Structural Elements," Balaguru, P., and Lee, K.W., May 2001, NETCR28.

Papers and Presentations:

"Inorganic Matrices for Composites," NSF Workshop on Composites, Hanover, NH, March 15, 1998.

"Behavior of Geopolymer Reinforced with Various Types of Fabrics," SAMPE 1998, Anaheim, CA, May 1998.

"Use of Ferrocement Theory for Analysis of High Strength Composites," Ferrocement VI, Ann Arbor, MI, June 1998.

"Advances in Composites," National University of Singapore, July 19, 1998.

"Effectiveness of Fiber Reinforced Composites as Structural and Protective Covering Bridge Elements Exposed to Deicing-Salt Chlorides," Visiting Scholar Lecture, Transportation Forum, University of Rhode Island, October 15, 1999.

"Advanced High Strength Fiber Composites," U.S.-Germany Workshop, Maiz, Germany, May 16-19, 1999.

"Recent Advances in Fiber Composites," Seminar Series, University Cataleuna, Spain, June 28, 1999.

"Inorganic Coatings for Transportation Infrastructures," Geopolymer Conference, St. Quentin, France, July 2, 1999.

"State-of-the-Art: Fiber Reinforced Concrete," NSF Faculty Workshop, Northwestern University, Evanston, IL, July 21, 1999.

"Recent Advances in High Strength Composites and Applications for Repair and Rehabilitation," 6th International Conference on Structural Failure, Durability, and Retrofitting, Singapore, September 15, 2000.

96-3 **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):

"Durability of Carbon Composites Made With Inorganic Matrix," Garon, R., and Balaguru, P., "SAMPE", November 2000, pp. 34-43.

"Inorganic Matrix - High Strength Fiber Composites," University of Missouri, Rolla, July 27, 2000.

"Comparison of Inorganic and Organic Matrices for Strengthening of Reinforced Concrete Beams," Kurtz, S., and Balaguru, P., Journal of Structural Engineering ASCE, V 127, January 2001, pp. 35-42.

"Durability of High Strength Composite Repairs under Scaling Conditions," Garon, R., and Balaguru, P., Proceedings of Third International Conference on Concrete Under Severe Conditions, Vancouver, Canada, June 2001 (in print).

97-1 **A Portable Method To Determine Chloride Concentration On Roadway Pavements**

Reports:

"A Portable Method to Determine Chloride Concenteration on Roadway Pavements," Garrick, N., Nikolaidis, N., P. and Luo, J, September 2002, NETCR17.

Papers and Presentations: None

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**

Reports:

"Performance Evaluation and Economic Analysis of Combinations of Durability Enhancing Admixtures (Mineral and Chemical) in Structural Concrete for the Northeast U.S.A.," Civjan, S.A., LaFave, J.M., Lovett, D., Sund, D.J., Trybulski, J., February 2003, NETCR 36.

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:
"On the Use of Combinations of Durability Enhancing Admixtures (Mineral and Chemical) in Structural Concrete," Lafave, J.M., Lovett, D., and Civjan, S.A., ACI Fall Convention, Toronto, Ontario, Canada, October 15-21, 2000.

"Performance Evaluation of Combinations of Durability Enhancing Admixtures in Concrete - Review and Experimental Program," Report in Partial Fulfillment of Master of Science in Civil Engineering Degree, Lovette, D., Department of Civil and Environmental Engineering, University of Massachusetts, Amherst, February, 2001.

97-3 **Determining Properties, Standards And Performance Of Wood Material As An Erosion Control Mulch And As A Filter Berm**

Reports:
"Performance Specifications for Wood Waste Materials as an Erosion Control Mulch and as a Filter Berm," Demars, K.R., Long, R.P., Ives, J.R. April 2000, NETCR20.

Papers and Presentations:
"Compost Applications for Erosion Control: New and Improved Methods," K. Demars. Presented at the Conference on 'Putting Compost in the Specs: Practical Applications for Erosion Control', Wrentham Development Center, Wrentham, MA, October 8, 2002.

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

Reports:
"Early Distress in Open-Graded Friction Course," Stephens, J.E., Mahoney, J., Dougan, C.E., July 1999, NETCR16.

Papers and Presentations: None

99-1 **Bridge Rail Transitions – Development and Crash Testing**

Reports:
Design documents for the NETC 2-Bar Curb-Mounted and 4-Bar Sidewalk-Mounted Bridge Rail Transitions are available from the NETC Coordinator.

"NCHRP Report 350 Testing and Evaluation of NETC Bridge Rail Transitions," Dean C. Alberson, C. Eugene Buth, Wanda L. Menges, and Rebecca R. Haug, Texas Transportation Institute, Texas A&M University, January 2006, NETCR 53.

99-1 **Bridge Rail Transitions – Development and Crash Testing (cont'd):**

Papers and Presentations:
"NETC Bridge Rail Transitions," by Dean C. Alberson and Wanda L. Menges, Concord, New Hampshire, December 13, 2005.

"Summary of NCHRP Report 350," by Dean C. Alberson, Concord, New Hampshire, December 13, 2005.

99-2 **Evaluation of Asphaltic Expansion Joints**

Reports:
"Evaluation of Asphaltic Expansion Joints," Mogawer, W.S., November 2004, NETCR 50.

Papers and Presentations: None

99-3 **Development Of Priority Based Statewide Scour Monitoring Systems In New England**

Reports:
"Development of Priority Based Statewide Scour Monitoring Systems in New England," Ho, C.T., Di Stasi, J.M., August 2, 2001, NETCR24.

"Real-Time Bridge Scour Assessment and Warning," Di Stasi, J.M. and Ho, C.L., Proceedings of International Symposium: Technical Committee No. 33 on Scour of Foundations. Melbourne, Australia, pp. 337-352.

Papers and Presentations: None

99-4 **Quantifying Roadside Rest Area Usage**

Reports:
"Quantifying Roadside Rest Area Usage," Garder, P. and Bosonetto, N., November 27, 2002, NETCR 38.

Papers and Presentations:
Results from the rest-area research were included in a presentation by the PI: "The Efficacy and Use of Continuous Shoulder Rumble Strips: Engineering a Solution," presented at the November 20-21, 2002 National Summit to Prevent Drowsy Driving, National Academy of Sciences, Washington, DC, November 21, 2002 (taped by C-SPAN. Summit also covered by CNN Live Today, CNN Live on Location, CBS Early Show, National Public Radio's Market Place, and national radio network coverage by ABC, CBS, and AP as well as two stories by nationally syndicated health columnist Jane Brody of The New York Times).

99-6 **Analytical and Experimental Investigation Of The Effects Of Concrete Removal Operations On Adjacent Concrete That Is To Remain**

Reports:

"Analytical and Experimental Investigation of the Effects of Concrete Removal Operations on Adjacent Concrete That is to Remain," Masih, R., Wang, T. and Forbes, A., January 15, 2002, NETCR 29.

Papers and Presentations:

"Enhancing the Students' Learning Process Through Interaction Project Between Academia and Industry." Presented and published in the Abstract of ASEE 2000 at the University of Massachusetts, Lowell, April 2000.

"The Effect of Powerful Demolition Equipment on the Remaining Part of the Concrete Bridge," Masih, R. Presented and published in the proceedings of the Second International Conference on Computational Methods for Smart Structures and Material. Madrid, June 2000.

"Effect of Demolition on Remaining Part of Concrete Bridge, Numerical Analysis Vs. Experimental Results." Presented and published in the proceedings of Internationales Kolloquium uber die Anwedungen der Informatik in Architectur 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.

00-1 **Ground-Based Imaging And Data Acquisition Systems For Roadway Inventories In New England - A Synthesis Of Practice**

Reports:

"Ground-Based Image and Data Acquisition Systems for Roadway Inventories in New England – A Synthesis of Highway Practice," Hancock, K. and Degray, J., August 2002, NETCR 30.

Papers and Presentations: None

00-2 **Evaluation Of Permeability Of Superpave Mixes**

Reports:

"Evaluation of Permeability of Superpave Mixes," Mogawer, W., Mallick, R., Teto, M. and Crockford, C., July 3, 2002, NETCR34.

Papers and Presentations:

"An Alternative Approach to Determination of Bulk Specific Gravity and Permeability of Hot Mix Asphalt (HMA)," Bhattacharjee, S., Mallick, R. and Mogawer, W. Submitted to International Journal of Pavement Engineering.

A Presentation, by W. Mogawer, to the Northeast Asphalt User Producer Group Meeting, October 18, 2001, Albany, New York.

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

Reports:

"Design, Fabrication and Preliminary Testing of a Composite Reinforced Timber Guardrail," Davids, W., Botting, J., March 31, 2004, NETCR 39.

Papers and Presentations: None

00-4 **Portable Falling Weight Deflectometer Study**

Reports:

"Portable Falling Weight Deflectometer Study," Steinert, B., Humphrey, D., Kestler, M., March 11, 2005, NETCR52.

Papers and Presentations: None

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

Reports:

"Guardrail Testing Modified Eccentric Loader Terminal (MELT) at NCHRP 350 TL-2," Alberson, D., Menges, W. and Haug, R., July 2002, NETCR35.

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**

<u>Reports</u>:

"Effective Visualization Techniques for the Public Presentation of Transportation Projects," Luo, J., MS Thesis, University of Connecticut, August 2002.

"Effective Visualization Techniques for the Public Presentation of Transportation Projects," Garrick, N.W., Minutti, P., Westa, M., Luo, J., Bishop, M., July 2005, NETCR 48.

<u>Papers and Presentations</u>: None

00-7 **A Complete Review of Incident Detection Algorithms and Their Deployment: What Works and What Doesn't**

<u>Reports</u>:

"A Complete Review of Incident Detection Algorithms & Their Deployment: What Works and What Doesn't," Parkany, E., Xie C., February 7, 2005, NETCR 37.

<u>Papers and Presentations</u>:

"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.

00-8 **Performance and Effectiveness of a Thin Pavement Section Using Geogrids and Drainage Geocomposites in a Cold Region**

<u>Reports</u>:

"Performance and Effectiveness of a Thin Pavement Section Using Geogrids and Drainage Geocomposites in a Cold Region," Helstrom, C.L., Humphrey, D.N., and Labbe, J.M., August 2007, NETCR60.

<u>Papers and Presentations</u>:

"Geogrid Reinforced Pavement Structure in a Cold Region," Helstrom, C.L., Humphrey, D.N., and Hayden, S.A., <u>Proceedings of the 13th International Conference on Cold Regions Engineering</u>, ASCE, Orono, Maine, 12 pp., 2006

01-1 **Advanced Composite Materials for New England's Transportation Infrastructure: A Study for Implementation and Synthesis of Technology and Practice**

Reports:

"Advanced Composite Materials for New England's Transportation Infrastructure: A Study for Implementation and Synthesis of Technology and Practice," Breña, S.F., Civjan, S.A., and Goodchild, M., May 2006, NETCR62.

Papers and Presentations: None

01-1 (T2 Phase I) **Advanced Composite Materials in New England's Transportation Infrastructure - Technology Transfer Phase 1: Selection of Prototype**

Reports:

"Advanced Composite Materials in New England's Transportation Infrastructure – Technology Transfer Phase 1: Selection of Prototype," Breña, S.F., and Civjan, S.A., November 1, 2009, NETCR77.

Papers and Presentations: None

01-2 **Development of a Testing Protocol for QC/QA of Hot Mix Asphalt**

Reports:

"Development of a Testing Protocol for QC/QA of Hot Mix Asphalt (HMA)," Mogawer, W.S., Mallick, R., February 5, 2004, NETCR 43.

Papers and Presentations:

"An Evaluation of Use of Rapid Triaxial Test In Quality Control of Hot Mix Asphalt (HMA)," Mogawer, W. S., Presented at the 82nd Annual Meeting of the Transportation Research Board, January 12-16, 2003, Washington DC.

01-3 **Design of Superpave HMA for Low Volume Roads**

Reports:

"Design of Superpave HMA for Low Volume Roads," Mogawer, W.S., Mallick, R., December 31, 2004, NETCR 51.

Papers and Presentations:

"Development of Mix Design Criteria for Low Traffic Volume Hot Mix Asphalt Roads," Nanagiri, Y.V., Mallick, R., Mogawer, W.S. Proceedings of the Annual Meeting of the Canadian Technical Asphalt Association, November 2003.

01-6 **Field Evaluation of a New Compaction Monitoring Device**

Reports:

"Field Evaluations of A New Compaction Monitoring Device," Miller, H.J., June 26, 2003, NETCR 42.

Papers and Presentations: None

02-1 **Relating Hot Mix Asphalt Pavement Density to Performance**

Reports: None

Papers and Presentations:

"Evaluation of the Effects of HMA Density on Mixture Fatigue and Rutting Performance," Mogawer, W. S., Northeast Asphalt User/Producer Group (NEAUPG) Annual Meeting, South Portland, Maine, October 8, 2009.

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

Reports:

"Formulate Approach for 511 Implementation in New England," Shuldiner, P., Loane, G., and Knapick, R., October 2005, NETCR44.

Papers and Presentations: None

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

Reports:

"Establish Subgrade Support Values for Typical Subs in New England," Malla, R. B., and Joshi, S., April 2006, NETCR57.

Papers and Presentations:

"Resilient Modulus Prediction Models for Some New England Subgrade Soils," Malla, R. and Joshi, S., *Electronic Proceedings* of the 2005 Joint ASCE/ASME/SES Conference on Mechanics and Materials (McMat 2005), Baton Rouge, LA, June 1-3, 2005.

"Resilient Modulus of Subgrade Soils A-1-b, A-3, an A-7-6 using LTPP Data: Prediction Models with Experimental Verification," Joshi, Shraddha, and Malla, R., *Proceedings, ASCE GeoCongress 2006*, (Atlanta, GA, Feb. 26-March 01, 2006), ASCE, Reston, VA; Feb. 2006, 6p (CD ROM).

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

Reports:
"Determination of Moisture Content of Deicing Salt at Point of Delivery," Long, R., Demars, K., March 2004, NETCR 45.

Papers and Presentations: None

02-6 **Sealing of Small Movement Bridge Expansion Joints**

Reports:
"Sealing of Small Movement Bridge Expansion Joints," Malla, R.B., Shaw, M.T., Shrestha, M.R. and Boob, S., June 2006, NETCR58.

Papers and Presentations:
"Silicone Foam Sealant for Bridge Expansion Joints," Malla R. B., Shaw M. T., Shrestha M. R., Boob S., McMat 2005 Mechanics and Materials Conference Baton Rouge, Louisiana, June 1-3, 2005.

"Experimental Evaluation of Mechanical characteristics of Silicone Foam Sealant for Bridge Expansion Joints," Malla R. B., Shaw M. T., Shrestha M. R., Boob S., 2005 Society for Experimental Mechanics Annual Conference Portland, Oregon, June 7-9, 2005.

"Development and Experimental Evaluation of Silicone Foam Sealant For Small Bridge Expansion Joints," Matu Shrestha, M.S. Thesis, Dept. of Civil & Environmental Engineering, University of Connecticut, Storrs, CT, September 2005.

"Laboratory Evaluation of Weathering and Freeze-Thaw Effects on Silicone Foam Bridge Joint Sealant," Shrestha, M.R., Malla, R.B., Boob, S. and Shaw, M.T., Paper #369, *Proceedings, SEM 2006 Annual Conference and Exposition (* St. Louis, MO, June 04-07, 2006), SEM, Bethel, CT, June 2006, 8p (CD ROM).

"Development and Laboratory Analysis of Silicone Foam Sealant for Bridge Expansion Joints," Malla, R., Shaw, M., Shrestha, M., and Brijmohan, S., *Journal of Bridge Engineering*, ASCE, Reston, VA, July 2006.

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

Reports:

"Validating Traffic Simulation Models to Inclement Weather Travel Conditions with Applications to Arterial Coordinated Signal Systems," Sadek, A., El-Dessouki, W., November 2004, NETCR 47.

Papers and Presentations:

"Inclement Weather and Traffic Flow at Signalized Intersections: A Case Study from Northern New England," Agbolosu-Amison, S.J., Sadek, A.W., and El-Dessouki, W., (2003). Tentatively accepted for publication in the *Journal of the Transportation Research Board.*

"Impact of Inclement Weather on Traffic Signal Operations in New England," Agbolosu-Amison, S.J., Sadek, A.W., (2003). Presented to the Vermont Chapter of the Institute of Transportation Engineers, Montpelier, Vermont.

"Inclement Weather and Traffic Flow at Signalized Intersections: A Case Study from Northern New England," Agbolosu-Amison, S.J., Sadek, A.W., and El-Dessouki, W., (2003). Presented at the *83rd Annual Transportation Research Board Meeting*, Washington, D.C.

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

Reports:

"Intelligent Transportation Systems Applications to Ski Resorts in New England," Sadek, A., March 2004, NETCR 46.

Papers and Presentations:

"Addressing Ski Resort Transportation Problems with Intelligent Transportation Systems Applications," Knapick, R.J., and Sadek, A.W., (2003). Abstract submitted to the Institute of Transportation Engineers District One Meeting, Burlington, VT.

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

Reports:

"Ability of Wood Fiber Materials to Attenuate Heavy Metals Associated with Highway Runoff", MacKay, A.A., July 16, 2008, NETCR65.

03-2 **Field Studies of Concrete Containing Salts of an Alkenyl-Substituted Succinic Acid**

Reports:

"Field Studies of Concrete Containing Salts of an Alkenyl-Substituted Succinic Acid," Civjan, Scott A., and Crellin, Benjamin, June 30, 2008, NETCR73.

Papers and Presentations:

"Hycrete – DSS An Innovative Admixture for Concrete: An Update on NETC 03-2," Civjan, Scott A., and Crellin, Benjamin, 16th Annual NE Materials and Research Meeting Concord, NH. June 7, 2005.

"Hycrete Concretes: An Update on NETC 03-2," Civjan, Scott A., and Crellin, Benjamin, Connecticut DOT, November 2, 2005.

"A New Admixture to Mitigate Corrosion Problems," Civjan, S.A., and Crellin, B.J., *Concrete International*, Volume 28, No. 8, Pp. 78-82.

03-3 Phase 1 **Feasibility Study of an Erosion Control Laboratory in New England**

Reports:

"Feasibility Study of an Erosion Control Laboratory in New England," Long, R.P., and Demars, K.R., December 2004, NETCR 49.

Papers and Presentations: None

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

Reports:

"Design Considerations for a Prototype Erosion Control Testing Plot," Long, R.P., and Demars, K.R., December 2005, NETCR 56.

Papers and Presentations: None

03-4 **Measuring Pollutant Removal Efficiencies of Stormwater Treatment Units**

Reports:
"Measuring Pollutant Removal Efficiencies of Stormwater Treatment Units," Zhang, X., September 27, 2005, NETCR54.

Papers and Presentations:
"Evaluation of Pathogenic Indicator Bacteria in Structural BMPs," Zhang, X. and Lulla, M., to be published in the *Journal of Environmental Science and Health, Volume* A41 (November 2006).

"Distribution of Pathogenic Indicator Bacteria in Structural BMPs," Zhang, X. and Lulla, M. to be published in the *Journal of Environmental Science and Health, Volume* A41 (August 2006).

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

Reports:
"Evaluation of a Field Permeameter as a Longitudinal Joint Quality Indicator", Daniel, J.S., Mallick, R.B., and Mogawer, W.S., April 20, 2007, NETCR64.

Papers and Presentations:
"Development of a Longitudinal Joint Permeameter as a QC/QA Tool for HMA Pavements," Daniel, J.S., a Presentation to the Petersen Asphalt Research Conference, Cheyenne, WY, June 2005.

"Longitudinal Joint Permeameter: New Non-Destructive Pavement Joint Test," Daniel, J.S., a Presentation to the North East Asphalt User/Producer Group Meeting, Burlington, VT, October 2005.

"Longitudinal Joint Permeameter: Non-Destructive Test for QC," Daniel, J.S., a presentation to PennDOT Bituminous Technician Certification Program, March 14, 2006.

"Development and Evaluation of a Field Permeameter as a Longitudinal Joint Quality Indicator," Mallick, R.B., and Daniel, J.S., International Journal of Pavement Engineering, Vol. 7, No. 1, March 2006. pp. 11-21.

03-7 **Basalt Fiber Reinforced Polymer Composites**

Reports:

"Basalt Fiber Reinforced Polymer Composites," Parnas, R., Shaw, M., and Liu, Q., August 2007, NETCR63.

Papers and Presentations:

"Preliminary Investigation of Basalt Fiber Composite Properties for Applications in Transportation," Liu, Q., Shaw, M.T., Parnas, R.S., McDonnell, A., Transportation Research Board Annual Meeting, January 2005, Washington, D.C., Paper 05-1117, Session 487.

"Investigation of Basalt Fiber Composite Mechanical Properties for Applications in Transportation," Q. Liu, M.T. Shaw, R.S. Parnas and A.M. McDonnell, Polymer Composites, 27(1), 41-48, 2006.

"Investigation of Basalt Fiber Composite Aging Behavior for Applications in Transportation," Q. Liu, M. T. Shaw, R. S. Parnas, A.M. McDonnell, Polymer Composites *(in press).*

"Basalt Fiber Reinforced Polymer Composites," Q. Liu, R.S. Parnas, M.T. Shaw, A.M. McDonnell, SAMPE, Seattle, WA, November 2005.

"New Set-up for Permeability Measurement," Q. Liu, R.S. Parnas, SAMPE, Seattle, WA, November 2005.

04-2 **Driver-Eye-Movement-Based Investigation for Improving Work-Zone Safety**

Reports:

"Driver-Eye-Movement-Based Investigation for Improving Work-Zone Safety," Fisher, D.L., Knodler, M., and Muttart, J., January 28, 2009, NETCR71.

Papers and Presentations:

"Human Factors: Understanding & Evaluating Driver Response," Muttart, J.W., Anne Arundel County Police Special Operations Building, Sponsored by the Maryland Association of Traffic Accident Investigators, Hanover, MD. March 20 - 23, 2006.

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

"Using Event Data Recorder Information for Driver Response Research and Intelligent Transportation Systems in Rear End Collision," Muttart, J.W., CDR Users Conference, Dallas, TX. February 13, 2006.

04-2 **Driver-Eye-Movement-Based Investigation for Improving Work-Zone Safety (cont'd):**

Papers and Presentations (cont'd):

"Human Factors: Understanding & Evaluating Driver Response," Muttart, J.W., Canadian Association of Traffic Accident Investigators & Reconstructionists, Fredericton, NB, Canada. July 10 - 13, 2006.

"Driving Simulator Evaluation of Situational Awareness during Hands-Free Communication," Muttart, J.W., New England Institute of Transportation Engineers Technology Day, Amherst, MA. July 20, 2006.

"Accounting for Moderate Driver Distractions in Work Zones," Muttart, J.W., Factors, Formulae, Forensic, Technology, & Training Conference, Houston, TX. September 17, 2006.

"Driving Simulator Evaluation of Driver Performance during Hands-Free Cell Phone Operation in a Work Zone: Driving without a Clue," Muttart, J., Fisher, D. L., and Pollatsek, A., (January 2007), Presentation given at the 86th Transportation Research Board Annual Meeting, TRB, National Research Council, Washington, D.C.

"Driving Simulator Evaluation of Driver Performance during Hands-Free Cell Phone Operation in a Work Zone: Driving without a Clue", Muttart, J., Fisher, D. L., Knodler, M. and Pollatsek, A., (2007), Transportation Research Record, 2018, pp 9-14.

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

Reports:

"Network-Based Highway Crash Prediction Using Geographic Information Systems," Ivan, J.N., Gårder, P.E., Bindra, S., Jonsson, B.T., Shin, H., Deng, Z., June 2007, NETCR67.

Papers and Presentations:

"A Procedure for Allocating Zonal Attributes to a Link Network in a GIS Environment," Jonsson, T., Deng, Z., Ivan, J.N., presented at 85th TRB Annual meeting, Jan. 2006, Paper No.: 06-2561.

"Using Land Use Data to Estimate Exposure for Improving Road Accident Prediction," Jonsson, T., Ivan, J.N., Zhang, C., presented at 32nd Annual Traffic Records Forum, Palm Desert CA, Aug. 3, 2006.

05-6 **Employing Graphic-Aided Dynamic Message Signs to Assist Elder Drivers' Message Comprehension**

Reports: None

Papers and Presentations:

"Assisting Elder Drivers' Comprehension of Dynamic Message Signs," Clark, A.T., Wang, J.H., Maier-Speredelozzi, V., Collyer, C.E., Proceedings of the 87th Annual Meeting of Transportation Research Board, Paper No. 08-2276, p.1-16, CD-ROM, 2008.

"Age Effect on Driver Comprehension of Messages Displayed on Dynamic Message Signs," Wang, J.H., Clark, A. Y., and Maier-Speredelozzi, V., Proceedings of IIE Research Conference, Paper No. 307, p.1-6, CD-ROM, 2008.

05-7 **Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways**

Reports:

"Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways," Ivan, J.N., Sadek, A.W., Hongmei, Z., and Surang, R., February 12, 2009, NETCR72.

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.

"Safety Effects of Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways," Zhou, H., Ivan, J. and Sadek, A., Transportation Research Board Annual Meeting; Paper No. 09-2000, Washington, DC, Jan. 2009.

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

Reports: None

Papers and Presentations:

"Using Simulation Models to Assess the Impacts of Highway Work Zone Strategies: Case Studies Along Interstate Highways in Massachusetts and Rhode Island," Moriarty, K.D., Collura, J., Knodler Jr., M.A., Daiheng, N., and Heaslip, K., Paper presented at the TRB Annual Meeting in January 2008.

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

Reports: None

Papers and Presentations:

"Sensitivity of MEPDG Level 2 and 3 Inputs using Statistical Analysis Techniques for New England States," Ayyala, D., Chehab, G. R., and Daniel, J. S., accepted for publication in the Transportation Research Record 2010.

"Sensitivity of RAP Binder Grade on Performance Predictions in the MEPDG," Daniel, J. S., Cehab, G. R., and Ayyala, D., Journal of the Association of Asphalt Pavement Technologists, Vol. 78, 2009, pp. 352-376.

"Sensitivity of RAP Binder Grade on Performance Predictions in the MEPDG," Presentation by Jo Sias Daniel to the Association of Asphalt Paving Technologists Annual Meeting, March 2009.