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For Calendar Year 2001**

NEW ENGLAND TRANSPORTATION CONSORTIUM

NETCR40

December 2002

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.

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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. 2001 HIGHLIGHTS

1. FUNDING APPROVED FOR NEW RESEARCH TO ADDRESS EIGHT HIGH PRIORITY REGIONAL TRANSPORTATION RESEARCH NEEDS: The NETC Policy Committee, upon recommendation of the Advisory Committee, approved eight research projects, totaling \$615,000 to address high priority regional transportation research needs. The New York State Department of Transportation is collaborating with NETC on the funding of five of the projects.

- Relating Hot Mix Asphalt Pavement Density to Performance
- Formulate an Approach for 511 Implementation in New England
- Establish Subgrade Support Values (M_r) for Typical Soils in New England
- Real-Time Priority Based Statewide Bridge Scour Assessment System
- Determination of Moisture Content of Deicing Salt at Point of Delivery
- Sealing of Expansion Joints
- Calibrating Traffic Simulation Models to Inclement Weather Conditions with Applications to Arterial Coordinated Signal Systems
- Intelligent Transportation System Applications to Ski Resorts in New England

2. FINDINGS FROM THREE RESEARCH PROJECTS DISTRIBUTED: Final reports for the following projects were published and distributed to New England's State transportation agencies and universities, the Federal Highway Administration, and the AASHTO Region 1 Research Advisory Committee:

- NETC 95-3: "Implementation and Evaluation of Traffic Marking Recesses for the Application of Thermoplastic Pavement Markings on Modified Open-Graded Hot Mix Asphalt Pavement"
- NETC 99-3: "Guidelines for the Development of Priority Based Statewide Scour Monitoring Systems in New England"
- NETC 97-3: "Properties, Standards and Performance of Wood Waste Compost as an Erosion Control Mulch and as a Filter Berm"

3. TECHNOLOGY TRANSFER:

-34 Requests for NETC Research Project Reports were Processed: The requests were received from a variety of sources including the following: the Coalition of Northeast Governors, the California, New York, Louisiana, New Jersey, Maryland, Ohio Departments of Transportation, the US Department of Agriculture Natural Resources Conservation Service, the Ministry of Transport of the Province of Ontario Canada, the Asphalt Institute, Worcester Polytechnic Institute, University of Mining & Metallurgy of Cracow Poland, Erosion Control Magazine, and a number of

consultants.

- **Presentations at Meetings/Conferences:**

- a. **Annual Visit of Transportation Research Board Representative:** the NETC Coordinator made a presentation on the Consortium's mission, organization, project selection procedures and current research projects, at the annual visit of the Transportation Research Board representative to the Connecticut Transportation Institute at the University of Connecticut on June 4, 2001.
- b. **American Association of State Highway Transportation Officials Annual Meeting:** The NETC Coordinator presented an exhibit of NETC research projects at the ASSHTO Annual Meeting held in Fort Worth, Texas in December, 2001.
- c. **Northeast Association of State Transportation Officials Annual Meeting:** The NETC Coordinator presented an exhibit of NETC research projects at the NASTO Annual Meeting held in Portland, Maine in May, 2001.
- d. **Connecticut Joint Highway Research Advisory Council Meeting:** The NETC Coordinator presented a report on the activities of the Consortium to the CT Joint Highway Research Advisory Council at its December 18, 2001 meeting.
- e. **American Association of State Highway Transportation Officials Region One Research Advisory Committee Meeting:** The NETC Coordinator made a power-point presentation entitled "The New England Transportation Consortium" at the AASHTO Region One RAC meeting held in Providence on June 26, 2001. The presentation covered the mission, funding, organization, management, project development procedures and highlights of the Consortium's activities for calendar year 2000.
- f. **Papers Presented at Technical Conferences or Published in Technical Journals:** NETC researchers made 6 presentations at technical conferences and published 1 paper in a technical journal:

1. **International Conference on the Beneficial Use of Recycled Materials in Transportation Applications, Arlington, VA, November 2001:** "Use of Wood Waste Materials for Erosion Control," K. Demars, R. Long, J. R. Ives, University of Connecticut; (NETC Project 97-3)
2. **SPIE Symposium on Complex Adaptive Structures, Hutchinson Island, FL, June 2001:** "Adaptive Sensors and Sensor Networks for Structural Health Monitoring," D. Huston University of Vermont; (NETC Project 94-2)
3. **SPIE Symposium on Smart Systems for Bridges, Structures, and Highways, Newport Beach, CA, March 2001:**
 - a. "Inspection of Bridge Columns and Retaining Walls with Electromagnetic Waves," D. Huston, University of Vermont; (NETC Project 94-2)
 - b. "Wireless Inspection of Structures Aided by Robots," D. Huston, University of Vermont; (NETC Project 94-2)
4. **American Concrete Institute Fall Convention, Toronto, Ontario, Canada, October 2001:** "On the Use of Combinations of Durability

Enhancing Admixtures (Mineral and Chemical) in Structural

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Concrete,” S. Civijan, University of Massachusetts, Amherst; (NETC Project 97-2)

- 5. Northeast Asphalt Users Producer Group Meeting, Albany, NY, October 2001:** Presentation on NETC Project 00-2 “Evaluation of Permeability of Superpave Mixes,” Walaa Mogawer, University of Massachusetts, Dartmouth
- 6. Smart Materials and Structures, April 2001:** “Wireless Electromagnetic Interrogation of Structures,” D. Huston, University of Vermont; (NETC Project 94-2)

4. OTHER:

- The New England Transportation Consortium was selected, along with WindSat (a Department of the Navy R&D program), and the Northern Virginia Regional Partnership (an alliance of counties and municipalities formed to foster technological development), as the subject of a study on “The Interorganizational Dynamics of Technology Partnerships”. The study was published as a doctoral dissertation, by Sujata S. Millick, and presented to the School of Policy, Planning, and Development, University of Southern California, August 2001.

C. PROGRESS OF ACTIVE PROJECTS

PROJECT NUMBER: 94-1

PROJECT TITLE: Structural Analysis of New England Subbase Materials and Structures

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): K. Wayne Lee, Milton T. Huston, Jeffrey S. Davis, and Sekhar Vajjhala, University of Rhode Island, Department of Civil Engineering

STATUS: Completed

INITIAL AGREEMENT DATE: N/A

END DATE: N/A

PROJECT OBJECTIVES: The objectives of this research were: (1) to compile a database of subbase aggregate properties by aggregate types common to New England, (2) collect data from existing analysis of natural aggregates and recycled material/aggregates blends, (3) develop recycled material blends, and (4) recommend appropriate testing for State agencies to develop optimum properties for specific sources and various combinations of blended materials projects.

The objectives were amended to modify the existing Instron testing system for the ASHTO TP46, and to characterize the subbase materials with and without reclaimed asphalt pavement (RAP).

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001:

Upon approval of the Technical Committee, one hundred (100) copies of the final research report were submitted to the NETC Coordinator.

REPORTS, PAPERS, AND PRESENTATIONS:

1. A technical paper was presented at the 1998 TRB Annual Meeting based on the findings of original scope, i.e., resilient modulus testing in accordance with the AASHTO T292-91 procedure in January 1998.
2. A technical paper with findings of the original objective, entitled "Structural Properties of New England Subbase Materials of Flexible Pavements," was presented at the 5th International Conference on the Bearing Capacity of Roads, and Airfields on July 8, 1998.
3. Results of the resilient modulus test in accordance with the AASHTO TP-46 procedure were presented at the 11th Rhode Island Transportation and Civil Engineering Forum on 10/21/98.

4. A technical paper was presented at the 1999 World Congress for Korean Scientists and Engineers on July 7, 1999.
5. Results of this study were presented at the 12th Rhode Island Transportation Forum on October 15, 1999.
6. "Structural Analysis of New England Subbase Materials and Structures," Lee, K.W., Huston, M.T., Davis, J., and Vajjhalla, S., June 30, 2001, NETCR 26.

PROJECT NUMBER: 94-2

PROJECT TITLE: Nondestructive Testing of Reinforced Concrete Bridges Using Radar Imaging Techniques

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Dryver R. Huston, Mechanical Engineering Department, University of Vermont; Peter L. Fuhr, Electrical Engineering Department, University of Vermont; Kenneth Maser, Infrasense Inc., Arlington, MA; William Weedon, Applied Radar Analysis, Watertown, MA

STATUS: Continuing

INITIAL AGREEMENT DATE: 10/16/95

END DATE: 9/30/99

PROJECT OBJECTIVES: The overall goal of this project is to advance the state-of-the-art in ground-penetrating-radar (GPR) imaging techniques so that it will become an even more practical and precise tool for assessing the integrity of reinforced concrete bridge decks, with particular attention directed towards the specific problems of the bridges in New England. The plan is to conduct numerical, laboratory and field studies with the ultimate goal of developing a reliable and easy-to-use field technique. **Phase I** involves the numerical modeling of the interactions of defects in concrete bridge decks and GPR through the adaptation of available algorithms, software and dielectric parameter data. **Phase II** involves the laboratory verification of the numerical models through the testing of specimens with known defects. **Phase III** involves the development of radar waveform image processing techniques so that defect conditions can be identified readily. **Phase IV** involves the field-testing of the methods on selected bridge structures in New England. **Phase V** involves the development of the appropriate documentation so the technology developed in this project is capable of being used by the state transportation agencies. This is an interdisciplinary project that has a team of investigators from Vermont and Massachusetts: Prof. Dryver R. Huston and Prof. Peter L. Fuhr from the University of Vermont; Dr. Kenneth Maser of Infrasense, Inc.; and Dr. William Weedon of Applied Radar Analysis, Inc. The project will take three years to complete.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001:

A draft final project report was submitted to the Project Technical Committee for review.

REPORTS, PAPERS, AND PRESENTATIONS:

1. "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.

2. "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.
3. "Wireless Electromagnetic Interrogation of Structures," Huston D., Pelczarski N., Fuhr P., Arms S., and Esser B. (Tentatively accepted) Smart Materials and Structures, April 2001.
4. "Adaptive Sensors and Sensor Networks for Structural Health Monitoring," Huston D. SPIE 4512-24, Symposium on Complex Adaptive Structures, Hutchinson Island, FL, June 2001.
5. "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.
6. "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.
7. "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.
8. "Damage Detection in Roadways with Ground Penetrating Radar," Huston, D.R., Pelczarski N., Esser, B. and Maser, K. GPR 2000, Eighth International Conference on Ground Penetrating Radar, Gold Coast, Australia, May 2000.
9. "Bridge Deck Evaluation with Ground Penetrating Radar," Huston, D., Hu, J., Pelczarski, N., and Esser, B. Proc. Second International Conference on Structural Health Monitoring, Stanford University, September 1999.
10. "Ground Penetrating Radar for Concrete Bridge Health Monitoring Applications," Huston, D, Hu, J., Maser, K., Weedon K., and Adam, C. SPIE 3587-23 Proc. SPIE NDE Techniques for Aging Infrastructure and Manufacturing, Newport Beach, CA, March 1999.
10. "GIMA Antenna Design for Ground Penetrating Radar in Concrete NDE Applications," Hu, J.Q., Huston, D., and Fuhr, P. SPIE 3670-63, SPIE Conf. on Sensory Phenomena and Measurement Instrumentation for Smart Structures and Materials, Newport Beach, CA, March 1999.

12. "Bridge Deck Evaluation with Ground Penetrating Radar," Huston, D., Maser, K., Hu, J.Q., Weedon, W., and Adam, C. Proc. GPR '98 7th International Conference on Ground-Penetrating Radar, The University of Kansas, Lawrence, KS, May 27-30, 1998.
13. "Bridge Deck Evaluation with Ground Penetrating Radar," Huston, D., Maser, K., Weedon, W., Fuhr, P. and Adam C. Structural Health Monitoring, F. Chang, ed., Technomic Publishing, pp. 91-103 Proc. International Workshop on Structural Health Monitoring, Stanford, CA, September 1997.
14. "Ground Penetrating Radar for Nondestructive Evaluation of Concrete Bridge Decks," Adam, C., M.S. Thesis, Department of Mechanical Engineering, University of Vermont, September 1997.

PROJECT NUMBER: 96-2

PROJECT TITLE: Optimizing GPS Use in Transportation Projects

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): John E. Bean,

STATUS: Continuing

INITIAL AGREEMENT DATE: 7/1/97

END DATE: 6/30/99

PROJECT OBJECTIVES: To identify ways to optimize the use of GPS in transportation projects.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001:

Completed draft reports of the summer 1997 individual meetings with each New England State DOT and distributed them to the DOT's for comment, correction, and additional information.

Computer programs have been developed to: a) continuously download, translate, and archive base station data and b) transfer base station data from remote sites to a central location via network or modem. An automated zip drive-based station archiving system was developed and working GPS base stations were established at two locations.

Met with ConnDOT administrators to review status for completion of tasks. Continued working on incorporating GPS base at UCONN into cooperative CORS. Continued working with NH DOT on data distribution plan. Worked to install GPS base station at Springfield Technical Community College. Contacted State reps to get updates on GPS usage.

REPORTS, PAPERS AND PRESENTATIONS: None

PROJECT NUMBER: 96-3

PROJECT TITLE: Effectiveness of Fiber Reinforced Composites as Structural and Protective Coverings for Bridge Elements Exposed to Deicing-Salt Chlorides

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): P. Balaguru, Professor, Rutgers, The State University of New Jersey and Kang-Won W. Lee, Professor, The University of Rhode Island

STATUS: Completed

INITIAL AGREEMENT DATE: N/A

END DATE: N/A

PROJECT OBJECTIVES: The primary objective of the proposed research is to identify a cost-effective composite system that will provide long-term performance under freeze-thaw, wet-dry, and deicing salt environments. The primary tasks are: (i) selecting the promising candidates in terms of materials, combination of fibers and matrices, and application techniques, and (ii) evaluation of the selected materials and systems for long-term performance.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2000:

The final report was completed in May 2001.

REPORTS, PAPERS AND PRESENTATIONS:

1. "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.
2. "Durability of Carbon Composites made with Inorganic Matrix," Garon, R., and Balaguru, P., SAMPE, November 2000, pp.34-43.
3. "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).
4. "Effectiveness of High Strength Composites as Structural and Protective Coatings for Structural Elements," Balguru, P., and Lee, K.W., May 2001, NETCR28.

PROJECT NUMBER: 97-1

PROJECT TITLE: A Portable Method to Determine Chloride Concentration on Roadway Pavements

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Norman W. Garrick and Nikolaos P. Nikolaidis, University of Connecticut

STATUS: Continuing

INITIAL AGREEMENT DATE: 9/1/98

END DATE: 9/30/01

PROJECT OBJECTIVES: The objective of this work is the development of technology to be used in conjunction with a management framework for effective deicer deployment. The goal is a system that will result in the optimum use of road deicer, thereby, reducing the cost and minimizing the undesirable water quality effects of chlorine, while, at the same time, preserving highway safety.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: Design of the second-generation prototype salinity-measuring device was initiated. The design was guided by the results of both field and laboratory testing of the first prototype. The results were quite promising but they also indicate some shortcomings with the prototype. Specifically it was felt that the original system was not sufficiently precise or responsive. The new design is expected to be much better in this regard because the overall size of the system has been significantly reduced and an improved system for melting snow has been installed.

The old system consists of two major components: the sample collection assembly, and the measurement unit. This system is designed to collect in the storage box any slush that is splashed up by the front vehicle tire. This slush is heated in the box and then flows through appropriate filters to the measurement chamber. The salinity of the water in the chamber is measured using a conductivity meter. The meter is designed to continuously measure and record the salinity of water that is pumped through the measurement chamber. The conductivity meter is connected to a laptop computer that is configured to give instantaneous readings of salinity and other pertinent measures such as the water temperature.



Figure 1: Close-up of Redesigned Prototype

The new prototype is quite similar in principle to the old; however, the retention volume

was significantly decreased from 500 ml to 66 ml. In addition, the heating system was upgraded by increasing the power and by adding a controller to regulate the temperature in the unit. A redesigned system was completed. Testing of the redesigned system was completed and a Draft Final Report was submitted to the Technical Committee for review.

REPORTS, PRESENTATIONS, AND PAPERS: None

PROJECT NUMBER: 97-2

PROJECT TITLE: Performance Evaluation and Economic Analysis of Combination of Durability Enhancing Admixtures (Mineral and Chemical) in Structural Concrete for the Northeast U.S.A.

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

STATUS: Continuing

INITIAL AGREEMENT DATE: 8/30/98

END DATE: 8/30/02

PROJECT OBJECTIVES: To evaluate the performance of chemical and mineral durability enhancing admixtures in structural reinforced concrete mixes typical of those specified by State Highway Departments in New England. Combinations of silica fume, fly ash, ground granulated blast furnace slag, disodium salts, and chemical corrosion inhibitors are being considered. The final report will contain guidelines for the New England State Highway Departments on the specification and use of mineral and chemical admixtures in structural reinforced concrete, including both expected long-term durability enhancement and overall life cycle economic impacts.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: The long term testing protocol continued for all specimens. One “non-cracked” specimen of mixes 1, 3 and 4 (control, silica fume, fly ash) and DSS specimens was initiated at the 6 month period (specimens delayed). The first 1-1/2 years of testing was completed. The evaluation of data is continuing.

Initial Findings;

- Early cracking observed in silica fume mix, however this did not occur when silica fume was used in combination with other admixtures.
- Calcium Nitrite appears to work well as a single admixture in uncracked specimens.
- Combinations of Calcium Nitrite with Slag or Fly Ash showed improvements on cracked specimens as well.
- DSS material appears to eliminate early corrosion potential, even in initially “cracked” specimens.
- To date, 32 of 56 initially non-cracked specimens have negligible macrocell corrosion potential readings (reading approximately zero), while others are well below the expected level to indicate significant corrosion. Negligible readings are present in 12 of 20 single admixture and 20 of 32 admixture combination non-cracked specimens.

REPORTS, PAPERS, AND PRESENTATIONS:

1. "Performance Evaluation of Combinations of Durability Enhancing Admixtures in Concrete – Review and Experimental Program," Lovett, D., Report in Partial Fulfillment of a Master of Science in Civil Engineering Degree, Department of Civil and Environmental Engineering, University of Massachusetts, Amherst. February, 2001.
2. "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.
3. "Performance Evaluation of Durability Enhancing Admixtures (Mineral and Chemical) in Structural Concrete," Sund, D., Report in Partial Fulfillment of a Master of Science in Civil Engineering Degree, Department of Civil and Environmental Engineering, University of Massachusetts, Amherst, September, 1999.

PROJECT NUMBER: NETC 99-1

PROJECT TITLE: NETC Bridge Rail Transitions - Development and Crash Testing

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Jerry Zoller, New Hampshire
Department of Transportation

STATUS: Continuing

INITIAL AGREEMENT DATE: 6/5/98

END DATE: To be determined

PROJECT OBJECTIVES: (1) To design bridge rail transitions for use with the NETC 2-bar curb-mounted and 4-bar sidewalk-mounted steel bridge railings, and (2) to crash test them to meet NCHRP 350 TL-3 criteria.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: The technical committee has submitted the design of the three transition sections to FHWA for comment.

REPORTS, PAPERS, AND PRESENTATIONS: None

PROJECT NUMBER: NETC 99-2

PROJECT TITLE: Evaluation of Asphaltic Expansion Joints

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Prof. Walaa S. Mogawer,
P.E., UMass Dartmouth

STATUS: Continuing

INITIAL AGREEMENT DATE: 8/1/01

END DATE: 7/31/03

PROJECT OBJECTIVES:

1. To evaluate the overall costs including periodic maintenance.
2. To identify its average useful life span.
3. To identify flaws in installation and maintenance methods which could hinder maximum performance.
4. To establish recommendations and limitations regarding expansion, skew, thermal limits, etc.
5. To identify possible reasons for failure, and
6. To develop a specification and design/repair guidelines as well as methods for quality control for use by State Highway Departments.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: A kick-off meeting with the project technical committee was held on October 26, 2001. The technical committee has provided the PI with potential joints to be inspected. The consultant, Dr. Rajib Mallick, developed a draft inspection sheet. A spreadsheet of all potential bridges for inspections was prepared and emailed to the committee members for review.

REPORTS, PAPERS AND PRESENTATIONS: None

PROJECT NUMBER: 99-3

PROJECT TITLE: Guidelines for Development of Statewide Scour Monitoring Systems in New England

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(IES): Carlton.L. Ho, Assistant Professor, University of Massachusetts Amherst, Jeffrey M. Di Stasi, Graduate Research Assistant, University of Massachusetts Amherst

STATUS: Completed

INITIAL AGREEMENT DATE: N/A

END DATE: N/A

PROJECT OBJECTIVES: (1) Create a GIS for each state that catalogs the locations and attributes of scour critical bridges, precipitation gages, stream gages, and in-place scour monitors throughout New England; (2) Identify the procedures taken by states to identify scour critical bridges; (3) Identify and document all sources that provide precipitation data, stream data, storm prediction, flood forecasting, evacuation routing, etc.; (4) Develop a conceptual model of a real-time system that incorporates hazard and risk assessment for bridges jeopardized by scour.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001:

The final report was published and distributed.

REPORTS, PAPERS, AND PRESENTATIONS:

1. "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.
2. "Development of Priority Based Statewide Scour Monitoring Systems in New England," Ho, C.L., and Di Stasi, J.M., August 2, 2001, NETCR24.

PROJECT NUMBER: 99-4

PROJECT TITLE: Quantifying Roadside Rest Area Usage

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Per Garder, University of Maine, Orono

STATUS: Continuing

INITIAL AGREEMENT DATE: 9/1/99

END DATE: 2/28/01

PROJECT OBJECTIVES: To use public input in determining the need for and spacing between roadside rest area along different types of highway.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: The third draft of the final report was completed.

REPORTS, PAPERS, AND PRESENTATIONS: None

PROJECT NUMBER: 99-6

PROJECT TITLE: Analytical and Experimental Investigation of the Effects of Concrete Removal Operations on Adjacent Concrete That is to Remain

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Rusk Masih, University of Connecticut

STATUS: Completed

INITIAL AGREEMENT DATE: N/A

END DATE: N/A

PROJECT OBJECTIVES: To develop simplified guidelines, indicating the effect of powerful demolition equipment on the adjacent concrete that is to remain.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: The Draft Final Report was approved.

REPORTS, PAPERS, AND PRESENTATIONS:

1. "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.
2. "The Effect Of The Powerful Demolishing Equipment On The Remaining Parts Of The Concrete Bridge," Presented and published in the proceedings of the Second International Conference on Computational Methods for Smart Structures and Material. Madrid, June 2000.
3. "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 Architektur and Bauwesen, Germany, June 2000.
4. "The Effect Of Bridge Rehabilitation On The Remaining Structural Parts," Presented and published in the ASCE conference in Stanford University, August 2000.

PROJECT NUMBER: NETC 00-1

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

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Kathleen Hancock, University of Massachusetts Amherst

STATUS: Continuing

INITIAL AGREEMENT DATE: 9/1/00

END DATE: 8/31/01

PROJECT OBJECTIVES: The primary objective of this research is to develop a synthesis of practice for ground-based imaging and data acquisition systems for roadway inventories in New England.

This project will also:

1. Provide insight into the different locational referencing schemes that are being used,
2. Determine how states in the region are coordinating those schemes, and
3. Identify how states are incorporating inventory data into geographic information systems (GIS) for transportation analysis activities.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: The draft final report has been completed, submitted, and sent to the committee for review and comment.

REPORTS, PAPERS, AND PRESENTATIONS: None

PROJECT NUMBER: NETC 00-2

PROJECT TITLE: Evaluation of Permeability of Superpave Mixes

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Walaa S. Mogawer, University of Massachusetts Dartmouth; Rajib B. Mallick, Worcester Polytechnic Institute

STATUS: Continuing

INITIAL AGREEMENT DATE: 9/1/00

END DATE: 12/15/01

PROJECT OBJECTIVES:

1. Evaluate the permeability of hot mix asphalt mixes with fine and coarse gradations.
2. Evaluate the permeability of hot asphalt mixes with different nominal maximum aggregate size.
3. Evaluate the effect of different types of aggregates on permeability of HMA.
4. Prepare recommendations for design criteria of permeability values, and in-place and laboratory testing.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: A draft report has been prepared. A major accomplishment of this study was the design and fabrication of a Field Permeameter.

REPORTS, PAPERS, AND PRESENTATIONS:

1. Presentation: Northeast Asphalt User Producer Group Meeting, October 18, 2001, Albany, New York
2. "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.

PROJECT NUMBER: NETC 00-3

PROJECT TITLE: Design, Fabrication, and Preliminary Testing of a Composite Reinforced Timber Guardrail

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): W. Davids, H. Dagher, University of Maine

STATUS: New

INITIAL AGREEMENT DATE: 5/1/01

END DATE: 5/31/03

PROJECT OBJECTIVES: The primary objective of the proposed research is to develop a timber guardrail reinforced with fiber-reinforced polymers (FRP) and having the potential to meet TL-3 crash test performance criteria. This timber guardrail will take advantage of glued-laminated timber technology, allowing the use of more readily available smaller sections of dimensioned lumber. The FRP reinforcement will permit the use of lower grade lumber, making native New England species (such as red maple and Eastern hemlock) competitive with non-native timber.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001:

1. We have wrapped up the literature review, which included reviewing both reports and technical papers pertinent to the analysis and testing of timber guardrails and posts. The literature review resulted in two important conclusions: a) relatively little is known about the structural response of timber guardrails under vehicular impact; and b) the most reliable and feasible alternative for analyzing the guardrail system under vehicular impact to determine rail design values is the existing program BARRIER VII. We note that BARRIER VII is recommended for use in NCHRP Report 350, which specifies guardrail crash-test requirements.
2. BARRIER VII has been used to analyze timber guardrail systems assuming average soil-structure interaction properties reported in the literature and conventional steel W-beam posts. In addition, a series of parametric studies have been run using BARRIER VII where guardrail stiffness and strength properties were varied within the range expected for an FRP-reinforced timber guardrail. This has provided us with the design moments, shears, and axial forces that must be carried by an FRP-reinforced timber guardrail under a TL-3 crash test scenario. Perhaps more importantly, however, this has allowed us to quantify the ductility required for the guardrail. The FRP reinforcing is crucial in providing this ductility, which cannot be achieved with a guardrail made from only glulam or solid-sawn timber.

3. A nonlinear, deterministic moment-curvature analysis program has been written that allows the guardrail layup and reinforcement level to be optimized to meet the expected strength and ductility requirements.
4. Material selection has been studied in detail. At this point, it appears that red maple is the most likely candidate for FRP-reinforced guardrail construction due to its low cost and high strength. An independent study currently underway at the University of Maine AEWG has indicated that affordable, 1" thick red maple laminations can achieve mean tensile strengths of up to 9 ksi, and lower-cost laminations can easily achieve mean tensile strengths of 5-6 ksi. FRP reinforcing will likely be an E-glass epoxy plate manufactured by Gordon Composites, which has proven durable in bond studies with southern yellow pine.
3. A design cross-section approximately 10" high and 5" deep has been selected based on moment-curvature and BARRIER VII analyses. This will require a brickwork-type layup, since the red maple laminating stock is most affordable in widths of 4" – 5".
4. Options for the splicing of rail sections are being developed. A critical issue that has been identified through the analyses performed in Task 1 is whether the required tensile strength can be developed in the rail system without the use of a continuous steel plate running along the guardrail such as that used on the Merritt Parkway. A viable alternative may be an FRP dowel or plate embedded in and bonded to spliced rail sections. We plan to study this alternative in detail. One critical issue is the embedment length of the dowel required to develop the tensile strength of the FRP dowel. Second, constructability of the spliced section is an issue, since installation and repairs will require field splicing.

REPORTS, PAPERS AND PRESENTATIONS: None

PROJECT NUMBER: 00-6

PROJECT TITLE: Effective Visualization Techniques for the Public Presentation of Transportation Projects

PRINCIPAL INVESTIGATORS: Norman W. Garrick, Peter Miniutti and Mark Westa, University of Connecticut

STATUS: New

INITIAL AGREEMENT DATE: 6/01/01

END DATE: 6/30/03

PROJECT OBJECTIVES: The objective of this work is to develop an effective approach that area DOT's can use for presenting transportation projects to the public.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2000: One field trip was made to Connecticut Department of Transportation and a mail-in survey of the six New England DOTs was conducted to develop a baseline for the state-of-the-art in New England including equipment use, personnel availability and methodology. The results of the survey are being compiled. The recommended package of presentation elements and techniques is being refined.

REPORTS, PAPERS AND PRESENTATIONS: None

PROJECT NUMBER: NETC 00-7

PROJECT TITLE: A Complete Review of Incident Detection Algorithms and their Deployment: What Works and What Doesn't

PRINCIPAL INVESTIGATOR(s) & UNIVERSITY(s): Dr. Emily Parkany, Assistant Professor, University of Massachusetts, Amherst

STATUS: New

INITIAL AGREEMENT DATE: 9/1/00

END DATE: 6/30/02

PROJECT OBJECTIVES: This study focuses on a comprehensive evaluation and comparison on all available sensor technologies and processing algorithms for incident detection. There is an emphasis on implemented algorithms, arterial algorithms and algorithms that utilize section data other than point data.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001:

1. All academically recognized incident detection algorithms were reviewed and compared and the algorithms used for arterials and based on probe-based and drive based data were emphasized. Previous literature reviews were also investigated, but the focus of this review is distinguished from previous reviews.
2. A new classification system for current incident detection approaches was defined and identified.
3. A review on procedures for calibration of incident detection algorithms was conducted.
4. The first draft of the final report has been finished. However, newly available findings and progress will further be incorporated into this study. Hence the report draft is being revised and improved.
5. A set of recommendations of incident detection implementation approaches based on the previous evaluations and comparisons were made.

REPORTS, PAPERS, AND PRESENTATIONS:

1. "Use of Driver-Based Data for Incident Detection," Parkany, E. Submitted to the 7th International Conference on Applications of Advanced Technologies in Transportation Engineering (AATT) to be held in Boston in August 2002.

PROJECT NUMBER: 00-8

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

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Dana Humphrey, University of Maine, Orono

STATUS: New

INITIAL AGREEMENT DATE: 7/1/01

END DATE: 6/30/05

PROJECT OBJECTIVES: To evaluate the performance and effectiveness of several alternative cold regions pavement designs that utilize geogrids and/or drainage geocomposites as an integral member in a thin pavement section. Test sections will be constructed a part of a Federal/State, Maine Department of Transportation highway reconstruction project and evaluated for: (1)the influence of the location of a geogrid in a relatively thin pavement section on pavement performance; (2)the influence of a drainage geocomposite in a relatively thin pavement section on pavement performance; (3) the influence of a drainage geocomposite in a pavement reclamation application on pavement performance; (4)the influence of using both a geogrid and drainage geocomposite in a relatively thin pavement section on pavement performance; (5)comparing the performance of a geogrid and/or drainage geocomposite in a relatively thin pavement section to a typical standard thick pavement section.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: The instrumentation for seven test sections were fabricated and installed as part of reconstruction of Route 9/126 in Monmouth-Litchfield, Maine. Installation occurred in September 2001. Instrumentation will be installed in an additional five sections in 2002.

Instrumentation installed in the 2001 construction season included 60 strain gages attached to geogrid to monitor the in-place deformation of the grid, 10 vibrating wire piezometers to measure pore water pressures in the subbase course and subgrade soils in sections with drainage geocomposite, and 7 thermocouple strings with twelve individual thermocouples in each string to monitor the depth of frost penetration. The strain gages were attached directly to the ribs of the geogrid. They were installed in pairs-one on top and one on bottom of the rib. This allows the elongation of the rib to be separated from bending. They were protected by an epoxy coating. As of December 31, 2001, 58 out of 60 strain gages are operating, which demonstrates the effectiveness of the protective system. The piezometers have a measurement range of 0 to 34 kPa (0 to 5 psi) and an accuracy of +/- 0.17 kPa (+/-0.025 psi). This allows heads as low as 1.5mm (0.06 in.) to be measured. Weekly readings were generally taken on the instrumentation.

Preparations were made to connect the instrumentation to an automatic data acquisition system. Instrumentation to be installed in the 2002 construction season was fabricated.

REPORTS, PAPERS, AND PRESENTATIONS: None

PROJECT NUMBER: NETC 01-2

PROJECT TITLE: Development of a Testing Protocol for QC/QA of Hot Mix Asphalt

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Walaa S. Mogawer, P.E., UMass Dartmouth, and Rajib Mallick, Worcester Polytechnic Institute

STATUS: New

INITIAL AGREEMENT DATE: 9/1/02

END DATE: 12/31/02

PROJECT OBJECTIVES:

1. Evaluate the sensitivity, accuracy and repeatability of the rapid triaxial testing equipment.
2. Develop criteria for using the results from these tests for identifying poor and good performing mixes during production and construction.
2. Develop quality control and quality assurance specification limits based on the Results from the triaxial testing equipment.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: The research team obtained a gradation from New Hampshire for a 12.5 mm mix. Samples are being prepared using aggregates from Aggregate Industries (Wrentham, MA quarry). The rapid triaxial equipment is being upgraded to include an environmental chamber and a higher load capacity module.

REPORTS, PAPERS, AND PRESENTATIONS: None

PROJECT NUMBER: 01-3

PROJECT TITLE: Design of Superpave HMA for Low Volume Roads

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Prof. Walaa S. Mogawer, P.E., UMass Dartmouth, and Prof. Rajib Mallick, Worcester Polytechnic Institute

STATUS: New

INITIAL AGREEMENT DATE: 9/1/01

END DATE: 8/31/03

PROJECT OBJECTIVES:

1. Develop compaction and volumetric (mix design) criteria for designing asphalt mixes for low volume roads.
2. Evaluate the performance of mixes designed according to these criteria.
3. Provide recommendations for proper implementation of the new mix design system by the state DOTs.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001:

Mix design was conducted with three different 9.5 mm NMAS aggregate gradations - two fine gradations from ME and one from NH. Aggregate from Aggregate Industries (Wrentham, MA) quarry was used.

A review of the mix design data and a comparison of the data with the data provided by NH and ME DOT showed that the aggregate that is being used is very much different from the ones used by NH and ME DOT. Also, in the laboratory the aggregates were separated into different fractions and reblended (as opposed to getting different percentages from different stockpiles).

Therefore, a decision was taken to get aggregates from different stockpiles from NH and ME (different means the ones from which the gradations have been suggested for this study), and blend them in the same proportion as done by the NH and ME DOT in their mix designs. Both ME and NH DOT have agreed to provide aggregates.

These aggregates will be procured shortly. It is expected that the time required for mix design will be very short, since mix design information (using the very same aggregates) is already available from NH and ME DOT. However, some time will be required to determine the asphalt contents for designing the mixes at different number of gyrations.

REPORTS, PAPERS, AND PRESENTATIONS: None

PROJECT NUMBER: 01-6

PROJECT TITLE: Field Evaluation of a New Compaction Monitoring Device

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Heather J. Miller, PI, University of Massachusetts Dartmouth, and Rajib Mallick, Co-PI, Worcester Polytechnic Institute

STATUS: New

INITIAL AGREEMENT DATE: 8/1/01

END DATE: 7/31/03

PROJECT OBJECTIVES: The primary objective of this study is to verify the effectiveness of the “Soil Compaction Meter” as a tool for determining optimum compaction for highway construction applications. The scope of this project will initially involve performing a literature review of previous research performed on the Compaction Meter in order to identify the operational parameters, current capabilities and limitations of the device. Subsequently, testing will be performed to evaluate the effective uses of the device in a variety of applications and for a variety of materials. Based upon statistical analysis of the data obtained, conclusions and recommendations for use of the device in highway applications will be provided.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2001: The start date for this project was August 1, 2001. The initial work on the project involved contacting key personnel at Foster Miller and MBW. A great deal of published and unpublished data regarding the Compaction Meter (SCM) was obtained. The theory of operation and the results of previous research performed on the SCM were reviewed. To become more familiar with the device, the PI and undergraduate research assistants visited some construction sites where they had the opportunity to try out the device during compaction operations.

Five different soil and aggregate samples were obtained and transported to the labs at UMD and WPI for testing (as outlined under Task 3A). At UMD, sieve analyses and Proctor compaction testing on some of the samples has been completed. At WPI, the largescale test frame has been prepared, and testing will begin on the gravel borrow and on the common borrow in early January.

REPORTS, PAPERS, AND PRESENTATIONS: None

D. FINANCIAL STATUS
Active Projects

Table 1: Financial Status of Projects Active During 2001
(As of 11/23/01)

PROJECT	APPROVED BUDGET	INVOICED TO DATE	PROJECT BALANCE
94-1: Structural Analysis of New England Subbase Materials and Structures <i>P.I.: K.W. Lee</i> <i>University of Rhode Island</i>	111,497.00	110,057.38	1,439.62
94-2: Nondestructive Testing of Reinforced Concrete Bridges Using Radar Imaging <i>P.I.: D. Huston</i> <i>University of Vermont</i>	224,902.00	224,901.80	0.20
94-4: Durability of Concrete Crack Repair Systems <i>P.I.: G. Tsiatas</i> <i>University of Rhode Island</i>	84,850.00	72,036.04	12,813.96 Project Terminated 04/09/01
95-3: Implementation and Evaluation of Traffic Marking Recesses for Application of Thermoplastic Pavement Markings on Modified Open Graded Mixes <i>P.I. K.W. Lee</i> <i>University of Rhode Island</i>	132,313.00	120,812.20	11,500.80 Project Closed 04/11/01
95-5: Buried Joints in Short Span Bridges <i>P.I.s: G. Tsiatas and K.W. Lee</i> <i>University of Rhode Island</i>	64,910.00	61,705.61	3,204.39 Project Terminated 04/09/01

**Table 1: Financial Status of Projects Active During 2001
(As of 11/23/01)
(Cont'd)**

PROJECT	APPROVED BUDGET	INVOICED TO DATE	PROJECT BALANCE
96-1: Superpave Implementation <i>P.I.: J. Stephens University of Connecticut</i>	74,978.00	60,139.25	14,838.75
96-2: Optimizing GPS Use in Transportation Projects <i>P.I.: C. R. Ferguson, J. Bean University of Connecticut</i>	120,000.00	26,670.01	93,329.99
96-3: Effectiveness of Fiber Reinforced Composites as Structural and Protective Coverings for Bridge Elements <i>P.Is.: P.N. Balaguru, Rutgers University; K.W. Lee, University of Rhode Island</i>	135,000	122,534.87	12,465.13
97-1: A Portable Method to Determine Chloride Concentration on Roadway Pavements-Phase I <i>P.I.s: N.W. Garrick, N.P. Nikolaidis; University of Connecticut</i>	97,502.00	96,669.50	832.50 Final Invoice Approved 10/15/01
97-1: A Portable Method to Determine Chloride Concentration on Roadway Pavements-Phase II <i>P.I.s: N.W. Garrick, N.P. Nikolaidis; University of Connecticut</i>	107,162.00	76,997.21	30,164.79

**Table 1: Financial Status of Projects Active During 2001
(As of 11/23/01)
(Cont'd)**

PROJECT	APPROVED BUDGET	INVOICED TO DATE	PROJECT BALANCE
97-2: Performance Evaluation and Economic Analysis of Combinations of Durability Enhancing Admixtures (Mineral and Chemical) in Structural Concrete for the Northeast USA <i>P.I.: S. Civjan University of Massachusetts</i>	118,473.00	98,546.54	19,926.46
97-3: Determining Properties, Standards and Performance of Wood Waste Compost as an Erosion Control Mulch and as a Filter Berm <i>P.I.s: K.R. Demars, R.P. Long University of Connecticut</i>	54,649.00	43,853.94	10,795.06 Project Closed 04/11/01
97-4: Early Distress of Open-Graded Friction Course (OGFC) <i>P.Is.: J. Stephens, J. Mahoney, C. Dougan, University of Connecticut</i>	79,865.00	57,495.71	22,369.29
99-3: Development of Priority Based Statewide Scour Monitoring Systems in New England <i>P.I.: C. Ho University of Massachusetts, Amherst</i>	79,999.00	78,523.32	1,475.68
99-4: Quantifying Roadside Rest Area Usage <i>P.I.s: P. Garder University of Maine</i>	44,857.00	30,864.70	13,992.30

**Table 1: Financial Status of Projects Active During 2001
(As of 11/23/01)
(Cont'd)**

PROJECT	APPROVED BUDGET	INVOICED TO DATE	PROJECT BALANCE
97-2: Performance Evaluation and Economic Analysis of Combinations of Durability Enhancing Admixtures (Mineral and Chemical) in Structural Concrete for the Northeast USA <i>P.I.: S. Civjan University of Massachusetts</i>	118,473.00	98,546.54	119,926.46
97-3: Determining Properties, Standards and Performance of Wood Waste Compost as an Erosion Control Mulch and as a Filter Berm <i>P.I.s: K.R. Demars, R.P. Long University of Connecticut</i>	54,649.00	43,853.94	110,795.06 Project Closed 04/11/01
97-4: Early Distress of Open-Graded Friction Course (OGFC) <i>P.Is.: J. Stephens, J. Mahoney, C. Dougan, University of Connecticut</i>	79,865.00	57,495.71	22,369.29
99-3: Development of Priority Based Statewide Scour Monitoring Systems in New England <i>P.I.: C. Ho University of Massachusetts, Amherst</i>	79,999.00	78,523.32	1,475.68
99-4: Quantifying Roadside Rest Area Usage <i>P.I.s: P. Garder University of Maine</i>	44,857.00	30,864.70	13,992.30

**Table 1: Financial Status of Projects Active During 2001
(As of 11/23/01)
(Cont'd)**

PROJECT	APPROVED BUDGET	INVOICED TO DATE	PROJECT BALANCE
99-6: Analytical and Experimental Investigation of the Effects of Concrete Removal Operations on Analytical Concrete That is to Stay <i>P.I.: R. Masih University of Connecticut</i>	99,689.00	73,919.18	25,769.82
00-1: Ground-Based Imaging and Data Acquisition Systems for Roadway Inventories in New England: A Synthesis of Practice <i>P.I.s: K.L. Hancock University of Massachusetts, Amherst</i>	40,818.00	31,251.92	9,566.08
00-2: Evaluation of Permeability of Superpave Mixes <i>P.Is.: W.S. Mogawer University of Massachusetts, Dartmouth</i>	100,002.00	81,134.83	18,867.17
00-3: Design, Fabrication, and Preliminary Testing of a Composite, Reinforced, Timber Guard Rail <i>P.I.: W.G. Davids University of Maine</i>	83,469.00	6,882.12	76,586.88
006: Effective Visualization Techniques for The Public Presentation of Transportation Projects <i>P.I.: N.W. Garrick University of Connecticut</i>	75,929.00	0.00	74,929.00

**Table 1: Financial Status of Projects Active During 2001
(As of 11/23/01)
(Cont'd)**

PROJECT	APPROVED BUDGET	INVOICED TO DATE	PROJECT BALANCE
00-7: A Complete Review of Incident Detection Algorithms and Their Deployment: What Works and What Doesn't <i>P.I.: E. Parkany Villanova University</i>	45,384.00	42,692.91	2,691.09
00-8: Performance and Effectiveness of a Thin Pavement Section Using Geogrids and Drainage Geocomposites in a Cold Region <i>P.I.: D. Humphrey University of Maine</i>	150,000.00	49,173.97	100,826.03
01-2: Development of a Testing Protocol for Quality Control/Quality Assurance of Hot Mix Asphalt <i>P.I.: W.S. Mogawer University of Massachusetts, Dartmouth</i>	80,000.00	2,528.05	77,471.95
01-3: Design of Superpave Hot Mix Asphalt For Low Volume Roads <i>P.I.: W.S. Mogawer University of Massachusetts, Dartmouth</i>	99,755.00	0.00	99,755.00

Table 1: Financial Status of Projects Active During 2001
(As of 11/23/01)
(Cont'd)

PROJECT	APPROVED BUDGET	INVOICED TO DATE	PROJECT BALANCE
01-6: Field Evaluations of a New Compaction Device <i>P.I.: H. Miller</i> <i>University of Massachusetts,</i> <i>Dartmouth</i>	50,000.00	3,886.32	46,113.68

Notes: 1. Although final reports have been published for Projects 96-1 and 97-4 final invoices are outstanding.
2. "Invoiced to Date" excludes retainage.

TABLE 2:NETC Fund Balance

(As Of December 31, 2001)

ITEM	ALLOCATION	ENCUMB/		CUM.
		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 Allocations 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	484,515.75
- Tire Chips as Lightweight Backfill-Phase II: Full-Scale Testing (Supplemental Funding)		16,000.00	FINAL	468,515.75
- Bridge Rail Crash Test - Phase II:Sidewalk-Mounted Rail		134,127.00	FINAL	334,388.75
- New England Vehicle Classification and Truck Weight Program		6,752.57	FINAL	327,636.18
Member Allocations 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	777,636.18
95-2: Suitability of Non-Hydric Soils for Wetland Mitigation		39,867.70	FINAL	737,768.48
95-3: Implementation and Evaluation of Traffic Marking Recesses for Application of Thermoplastic Pavement Markings on Modified Open Graded Mixes		132,313.00		605,455.48
95-5: Buried Joints in Short Span Bridges		61,705.61	FINAL	543,749.87
95-6: Guidelines for Ride Quality Acceptance of Pavements		106,124.00	FINAL	437,625.87
"94" Project Series:				
94-1: Structural Analysis of New England Subbase Materials and Structures		111,497.00		326,128.87
94-2: Nondestructive Testing of Reinforced Concrete Bridges Using Radar Imaging Techniques		224,902.00		101,226.87
Member Allocations 1996 = 6 X \$75,000	450,000.00			551,226.87
Coord./Admin.of NETC: Calendar Year 1996; Bdgt. = \$75,000		69,123.85	FINAL	482,103.02
Member Allocations 1997 = 6 X \$75,000	450,000.00			932,103.02
Coord./Admin. of NETC: Calendar Year 1997; Bdgt. = \$82,494		77,244.35	FINAL	854,858.67
"94" Project Series:				
94-3: Procedures for The Evaluation of Sheet Membrane Waterproofing		67,000.00	FINAL	787,858.67
94-4: Durability of Concrete Crack Repair Systems		72,036.04	FINAL	715,822.63
"96" Project Series:				
96-1: SUPERPAVE Implementation		74,978.00		640,844.63
96-2: Optimizing GPS Use in Transportation Projects		120,000.00		520,844.63

96-3: Effectiveness of Fiber Reinforced Composites as Protective Coverings for Bridge Elements, etc.		135,000.00		385,844.63
T2 (per 12/2/97 Adv. Committee Mtg.) for 1998 = \$10,000		9,551.06	FINAL	376,293.57
Coord./Admin. of NETC: Calendar Year 1998; Bdgt = \$73,021		80,422.65	FINAL	295,870.92
Member Allocations 1998 = 6 X \$75,000	450,000.00			745,870.92

TABLE 2: NETC Fund Balance (Cont'd)
(As Of December 31, 2001)

ITEM	ALLOCATION	ENCUMB/		CUM.
		EXPEND.	INVOICE	BALANCE
"97" Project Series:				
97-1: A Portable Method for Determining Chloride Concentration on Roadway Pavements		96,669.51 107,162.00	Phase 1/FINAL Phase 2	649,201.42 542,039.42
97-2: Performance Evaluation & Economic Analysis of Durability Enhancing Admixtures, etc.		118,473.00		423,566.42
97-3: Determining Properties, Standards & Performance of Wood Waste Compost, etc.		43,853.94	FINAL	379,712.48
Alloc. to ConnDOT for Constr. Costs of Test Site (Approved 1/21/99 Ballot)		11,000.00		368,712.48
97-4: Early Distress of Open-Graded Friction Course		79,865.00		288,847.48
Travel Tech. Comm. (Aug. 98 tel. poll) for 1998 = \$5,000		0.00		288,847.48
Member Allocations 1999 = 6 X \$75,000	450,000.00			738,847.48
Coord./Admin. of NETC: Calendar Year 1999:				
- Administration = \$77,666				
-Technology Transfer & Technical Committee				
Travel = \$20,400				
-Total = \$98,066		79,101.20	FINAL	659,746.28
"99" Project Series:				
99-1: Bridge Rail Transitions		240,000.00		419,746.28
99-2: Evaluation of Asphaltic Expansion Joints		62,236.00		357,510.28
99-3: Bridge Scour Monitoring Systems		79,999.00		277,511.28
99-4: Quantifying Roadside Rest Area Usage		44,857.00		232,654.28
99-6: The Effects of Concrete Removal Operations on Adjacent That Is to Remain		99,689.00		132,965.28
Member Allocations 2000 = 6 X \$100,000	600,000.00			732,965.28
Coord./Admin. of NETC: Calendar Year 2000:				
- Administration = \$ 85,788				
- Technology Transfer & Technical Committee				
Travel = \$ 16,800				
- Total = \$102,588		91,899.37	FINAL	641,065.91

"00" Project Series:				641,065.9 1
00-1: Ground-Based Imaging and Data Acquisition Systems for Roadway Inventories in New England - A Synthesis of Practice		40,818.0 0		600,247.9 1
00-2: Evaluation of Permeability of Superpave Mixes		100,002.0 00		500,245.9 1
00-3: Composite Reinforced Timber Guard Rail - Phase I: Design, Fabrication and Testing		83,469.0 0		416,776.9 1
00-4: Falling Weight Deflecometer Study		100,000.0 00		316,776.9 1
00-5: Guard Rail Testing - Modified eccentric Loading Terminal at NCHRP 350 TL2		56,887.0 0		259,889.9 1
00-6: Implementation of Visualization Technologies to Create Simplified Presentations Within Highway agencies to be Used At Public Hearings		74,929.0 0		184,960.9 1
TABLE 2: NETC Fund Balance (Cont'd)				
(As Of December 31, 2001)				
		ENCUMB/		CUM.
ITEM	ALLOCATION	EXPEND.	INVOICE	BALANCE
00-7: A Complete Review of Incident Detection Algorithms and Their Deployment: What Works and What Doesn't		45,384.0 0		139,576.9 1
00-8: Performance and Effectiveness of A Thin Pavement Section Using Geogrids and Drainage Geocomposites in A Cold Region		150,000.0 00		- 10,423.09
Member Allocations 2001 = 6 X \$100,000	600,000.00			589,576.9 1
Coord./Admin. of NETC: Calendar Year 2001:		104,385.35	FINAL	485,191.5 6
- 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		50,000.0 0		435,191.5 6
01-2: Development of A Testing Protocol for Quality Control/Quality Assurance of Hot Mix Asphalt		80,000.0 0		355,191.5 6
01-3: Design of Superpave HMA for Low Volume Roads		126,657.0 00		228,534.5 6
<i>Note: Additional funding (\$26,902) approved 11/19/02</i>				
01-5: Procedures for the Evaluation of Liquid-Applied Membrane		75,000.0 0		153,534.5 6
01-6: Field Evaluation of A New Compaction Device		50,000.0 0		103,534.5 6
Member Allocations 2002 = 6 X \$100,000	600,000.00			703,534.5 6
NY DOT Allocation = \$52,500	52,500.00			756,034.5 6
Coord./Admin. Of NETC: Calendar Year 2002		123,967.0 00		632,067.5 6

Note: Member allocations are obligated between October 1 and December 31				

E. NETC REPORTS, PAPERS, AND PRESENTATIONS

E1. POLICIES AND PROCEDURES:

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

E2. 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

E3. 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.

"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.

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

E3. NETC REPORTS, PAPERS, AND PRESENTATIONS 1988-1994 (cont'd):

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

"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.

"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.

E3. NETC REPORTS, PAPERS, AND PRESENTATIONS 1988-1994 (cont'd):

"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.

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001:

Project No.	Title
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N/A	Construction Costs Of New England Bridges
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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:
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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.

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title

N/A Tire Chips As Lightweight Backfill For Retaining Walls, Phase II: Full-Scale Testing:

Papers and Presentations (cont'd):

"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.

"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. N. 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.

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title

N/A Tire Chips As Lightweight Backfill For Retaining Walls, Phase II: Full-Scale Testing:

Papers and Presentations (cont'd):

"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 in each 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.

"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.

Papers and Presentations:

"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.

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title

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

"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.

**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., Houston, 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.

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title

**94-1 Structural Analysis Of New England Subbase Materials And Structures
Papers and Presentations (cont'd):**

"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 on 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: None

Papers and Presentations

"Bridge Deck Structural Monitoring Techniques," Huston, D. Presented at
the New England State Materials Engineers 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.

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title

**94-2 Nondestructive Testing Of Reinforced Concrete Bridges Using Radar
Papers and Presentations (cont'd):**

"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. Proc. 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. Proc. 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 Conf. 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.

"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.

"Wireless Electromagnetic Interrogation of Structures," Huston, D., Pelczarski, N., Fuhr, P, Arms, S., and Esser, B. Accepted pending revision, Smart Materials and Structures, March 2000.

"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.

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title

**94-3 Nondestructive Testing Of Reinforced Concrete Bridges Using Radar
Papers and Presentations (cont'd):**

"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**

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title

94-4 Durability Of Concrete Crack Repair Systems

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 Roads

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

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title

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, G. 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.

Papers and Presentations: None

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title

96.2 Optimizing GPS Use in Transportation Projects

Reports: None

Papers and Presentations: None

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, Mainz, Germany, May 16-19, 1999.

"Recent Advances in Fiber Composites," Seminar Series, University Cataluna, 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.

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title
96-3 Effectiveness Of Fiber Reinforced Composite As Structural And Protective Coverings For Bridge Elements Exposed To Deicing Salt Chlorides

Papers and Presentations (cont'd):

"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.

"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: None.

Papers and Presentations: None.

"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.

"Performance Evaluation and Economic Analysis of Combinations of Durability Enhancing Admixtures (Mineral and Chemical) in Structural Concrete for the Northeast U.S.A.," *Internal Interim Report Prepared for the New England Transportation Consortium*, Lafave, J.M., Civjan, S.A., Lovett, D., and Sund, D.J., July 2000.

E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2001 (cont'd):

Project No. Title

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 (cont'd):

"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.

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.

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.

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

Reports: None

Papers and Presentations: None

99-2 Evaluation of Asphaltic Expansion Joints

Reports: None

Papers and Presentations: None

E4. NETC Reports, Papers and Presentations 1995-2000 (Cont'd):

**Project
Number**
99-3

Title

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.

Papers and Presentations:

"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.

99-4

Quantifying Roadside Rest Area Usage

Reports: None

Papers and Presentations: None

99-6

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

Reports: None

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 Anwendungen der Informatik in Architektur und Bauwesen, Germany, June 2000

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

00-1

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

Reports: None

Papers and Presentations: None

E4. NETC Reports, Papers And Presentations 1995-2000 (cont'd):

**Project
Number**

Title

00-2

Evaluation Of Permeability Of Superpave Mixes

Reports: None

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.

Presentation: 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: None

Papers and Presentations: None

00-6

Effective Visualization Techniques for the Public Presentation of Transportation

Reports: None

Papers and Presentations: None

00-7

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

Reports: None

Papers and Presentations:

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

00-8

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

Reports: None

Papers and Presentations: None

01-2

Development of a Testing Protocol for QC/QA of Hot Mix Asphalt

Reports: None

Papers and Presentations: None

E4. NETC Reports, Papers And Presentations 1995-2000 (cont'd):	
Project	Title
Number	
01-3	Design of Superpave HMA for Low Volume Roads
	<u>Reports:</u> None
	<u>Papers and Presentations:</u> None
01-6	Field Evaluation of a New Compaction Monitoring Device
	<u>Reports:</u> None
	<u>Papers and Presentations:</u> None