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.

The contents of this report reflect the views of the author(s) who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Departments of Transportation or the Land Grant Universities of the six New England States, or the U.S. Department of Transportation’s Federal Highway Administration. This report does not constitute a standard, specification, or regulation.
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# TABLE OF CONTENTS

A. INTRODUCTION .............................................................................................................. 1

B. 2001 HIGHLIGHTS ....................................................................................................... 1

C. PROGRESS OF ACTIVE PROJECTS ............................................................................. 4

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>94-2:</td>
<td>Nondestructive Testing of Reinforced Concrete Bridges Using Radar Imaging Techniques</td>
</tr>
<tr>
<td>96-2:</td>
<td>Optimizing GPS in Transportation Projects</td>
</tr>
<tr>
<td>97-1:</td>
<td>A Portable Method to Determine Chloride Concentration on Roadway Pavements</td>
</tr>
<tr>
<td>97-2:</td>
<td>Performance Evaluation and Economic Analysis of Combinations of Durability Enhancing Admixtures (Mineral and Chemical) in Structural Concrete for the Northeast U.S.A.</td>
</tr>
<tr>
<td>99-1:</td>
<td>NETC Bridge Rail Transitions – Development and Crash Testing</td>
</tr>
<tr>
<td>99-4:</td>
<td>Quantifying Roadside Rest Area Usage</td>
</tr>
<tr>
<td>00-1:</td>
<td>Ground-Based Imaging and Data Acquisition Systems for Roadway Inventories in New England – A Synthesis of Practice</td>
</tr>
<tr>
<td>00-2:</td>
<td>Evaluation of Permeability of Superpave Mixes</td>
</tr>
<tr>
<td>00-3:</td>
<td>Design, Fabrication and Preliminary Testing of a Composite Reinforced Timber Guardrail</td>
</tr>
<tr>
<td>00-4:</td>
<td>Portable Falling Weight Deflectometer Study</td>
</tr>
<tr>
<td>00-5:</td>
<td>Guardrail Testing Modified Eccentric Loader Terminal (MELT) at NCHRP 350 TL-2</td>
</tr>
<tr>
<td>00-6:</td>
<td>Effective Visualization Techniques for the Public Presentation of Transportation Projects</td>
</tr>
<tr>
<td>00-7:</td>
<td>A Complete Review of Incident Detection Algorithms and Their Deployment: What Works and What Doesn’t</td>
</tr>
<tr>
<td>00-8:</td>
<td>Performance and Effectiveness of a Thin Pavement Section Using Geogrids and Drainage Geocomposites in a Cold Region Asphalt (HMA)</td>
</tr>
<tr>
<td>01-2:</td>
<td>Development of a Testing Protocol for QC/QA of Hot Mix Asphalt (HMA)</td>
</tr>
<tr>
<td>01-3:</td>
<td>Design of Superpave HMA for Low Volume Roads</td>
</tr>
<tr>
<td>01-6:</td>
<td>Field Evaluation of a New Compaction Monitoring Device</td>
</tr>
<tr>
<td>02-2:</td>
<td>Formulate Approach for 511 Implementation in New England</td>
</tr>
<tr>
<td>02-3:</td>
<td>Establish Subgrade Support Values for Typical Soils in New England</td>
</tr>
</tbody>
</table>

-iii-
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>02-5:</td>
<td>Determination of Moisture Content of Deicing Salt at Point of Delivery</td>
<td>32</td>
</tr>
<tr>
<td>02-7:</td>
<td>Validating Traffic Simulation Models to Inclement Weather Conditions With Applications to Arterial Coordinated Signal Systems</td>
<td>34</td>
</tr>
<tr>
<td>02-8:</td>
<td>Intelligent Transportation Systems Applications to Ski Resorts in New England</td>
<td>35</td>
</tr>
</tbody>
</table>

D. FINANCIAL STATUS ............................................................................. 36
Projects Active During 2002 .................................................................. 36

E. REPORTS, PAPERS AND PRESENTATIONS ........................................... 42
E.1 Policies and Procedures .................................................................. 42
E.2 Annual Reports .................................................................................. 42
E.3 Reports, Papers, and Presentations (1988-1994) ............................. 42
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. 2002 HIGHLIGHTS

1. FUNDING APPROVED FOR NEW RESEARCH TO ADDRESS 7 HIGH PRIORITY REGIONAL TRANSPORTATION RESEARCH NEEDS: The NETC Policy Committee, upon recommendation of the Advisory Committee, approved seven research projects, totaling $560,000, to address the following high priority regional transportation research needs:
   - Ability of Wood Fiber Materials to Attenuate Heavy Metals Associated with Highway Runoff
   - Field Studies of Concrete Containing Salts of Alkenyl-Substituted Succinic Acid
   - Feasibility Study and Design of An Erosion Laboratory in New England
   - Measuring Pollutant Removal Efficiencies of Storm Water Treatment Units
   - Evaluation of Field Permeameter As A Longitudinal Quality Control Indicator
   - New England Land Grant University Consortium Transportation Research Challenge
   - Basalt Fiber Reinforced Polymer Composites

2. FINDINGS FROM 3 RESEARCH PROJECTS PUBLISHED AND DISTRIBUTED: Final reports for the following projects were published and distributed to New England’s State transportation agencies and universities, the Federal Highway Administration, the AASHTO Region 1 Research Advisory Committee, and the National Transportation Library:
   - NETC 99-6: “Analytical and Experimental Investigation of the Effects of Concrete Removal Operations on Adjacent Concrete That Is to Remain”
   - NETC 00-2: “Evaluation of Permeability of Superpave Mixes”
   - NETC 00-5: “Guardrail Testing – Modified Eccentric Loader Terminal (MELT) at NCHRP 350 TL-2”

3. POLICIES AND PROCEDURES UPDATED: An update of the Consortium’s Policies and Procedures was completed. The Policies and Procedures were approved by the Consortium’s Advisory Committee at its April 5, 2002 meeting and recommended to the Consortium’s Policy Committee for approval. The Policy Committee approved the updated Policies and Procedures at its April 15, 2002 meeting.
4. TECHNOLOGY TRANSFER:

- 21 Requests for Information and/or NETC Research Project Reports Were Processed:
The requests were received from a variety of sources including the following: Ohio Department of Transportation; Washington State Department of Transportation; Pennsylvania Department of Environmental Protection; Kentucky Transportation Cabinet; Texas Natural Resources Commission; Yukon Territorial Government, Canada; The Highway Institute, Belgrade Yugoslavia; and a number of consultants and private citizens.

- Meetings/Conferences:
  a. American Association of State Highway Transportation Officials Washington Briefing: At the invitation of AASHTO, the NETC Coordinator attended the AASHTO Washington Briefing held in Washington, DC in February 2002. The briefing provided transportation officials with an opportunity to hear about current transportation issues and discuss them with personnel and staff of transportation-related Senate and Congressional committees.
  b. Connecticut Transportation Research Showcase: The NETC Coordinator made a presentation on the Consortium’s mission, organization, project selection procedures and current research projects at the Connecticut Transportation Research Showcase held at the University of Connecticut on March 19, 2002.
  c. Association of General Contractors/American Road Transportation Builders Association/American Association of State Highway Transportation Officials Task Force 13: Dean Alberson, Texas Transportation Institute, Principal Investigator for NETC Project 00-5 “Guardrail Testing – Modified Eccentric Loader Terminal (MELT) at NCHRP 350 TL-2,” presented the results of the crash tests conducted on the MELT guardrail terminal to the AGC/ARTBA/AASHTO Task Force 13 meeting in Seattle, Washington in April 2002.
  d. 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 May 21, 2002.
  e. American Association of State Highway Transportation Officials Annual Meeting: The NETC Coordinator presented an exhibit of NETC research projects at the AASHTO Annual Meeting held in Anchorage, Alaska in October 2002.
  f. 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 Newport Rhode Island, in April 2002.
  g. Northeast States Materials Engineers Association: The NETC Coordinator presented an exhibit of NETC research projects at the NESMEA Annual Meeting held in Newport, Rhode Island in October 2002.

- Papers Presented at Technical Conferences or Published in Technical Journals:
  b. Results from the rest area research were included in a presentation entitled: “The Efficacy and Use of Continuous Shoulder Rumble Strips: Engineering a Solution.” Presented by Dr. Per Garder, University of Maine, Orono at the November 20-21, 2002 National Summit to Prevent Drowsy Driving, National Academy of Sciences, Washington, DC. Dr. Garder based his presentation partly on the results from the research he conducted for NETC project 99-4 “Quantifying Roadside Rest Area Usage.” The Summit was 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.
  c. “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) held in Boston in August 2002.

5. OTHER:
- NETC Begins Utilizing Video Conferencing for Technical Committee Meetings: NETC, in cooperation with the FHWA Division Offices in New England, is now encouraging its Project Technical Committees to utilize the FHWA Division Offices’ video conferencing facilities for meetings. After completing several pilot meetings utilizing video conferencing, NETC concluded that the use of video conferencing not only saved travel time and related expenses but also resulted in more effective meetings.
C. PROGRESS OF ACTIVE PROJECTS

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: Completed

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, 2002:
The final report was completed.

REPORTS, PAPERS, AND PRESENTATIONS:


PROJECT NUMBER: 96-2

PROJECT TITLE: Optimizing GPS Use in Transportation Projects

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

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, 2002:
Work continues on the development of the following interim reports: 1) documentation of the current state of the art of GPS at the six New England State DOTs 2) summarization of several GIS/GPS studies as indicated in Task 5 of the proposal.

Work continues on the final report.

Worked with individuals from the six states to update GPS status reports. Continued dealing with logistics of running a GPS base station and base station data server. Have received updates from New Hampshire, Rhode Island, Vermont and Massachusetts.

REPORTS, PAPERS AND PRESENTATIONS: None
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: Completed

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, 2002: The final report was completed.

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, 2002: 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 were initiated at the 6-month period (specimens delayed). The first 1-1/2 years of testing was completed. The Draft Final Report was completed and distributed to the Project Technical Committee for review.

REPORTS, PAPERS, AND PRESENTATIONS:
PROJECT NUMBER: 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, 2002: The technical committee has submitted the design of the three transition sections to FHWA for comment and received approval for two of the three designs. The Massachusetts design is still awaiting official FHWA response.

REPORTS, PAPERS, AND PRESENTATIONS: None
PROJECT NUMBER: 99-4

PROJECT TITLE: Quantifying Roadside Rest Area Usage

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

STATUS: Completed

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 areas along different types of highway

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2002:
Final report submitted and approved for printing. Printed in early January 2003

REPORTS, PAPERS AND PRESENTATIONS:
1. 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).

PROJECT NUMBER: 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: Completed

INITIAL AGREEMENT DATE: 9/1/00

END DATE: 8/31/01

PROJECT OBJECTIVES: The primary objectives of this research are:
1. To develop a synthesis of practice for ground-based imaging and data acquisition systems for roadway inventories in New England.
2. Provide insight into the different locational referencing schemes that are being used,
3. Determine how states in the region are coordinating those schemes, and
4. Identify how states are incorporating inventory data into geographic information systems (GIS) for transportation analysis activities.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2002:
The final report was completed.

REPORTS, PAPERS, AND PRESENTATIONS:
PROJECT NUMBER: 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: Completed

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, 2002:
The final report was completed.

REPORTS, PAPERS, AND PRESENTATIONS:
PROJECT NUMBER: 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: Continuing

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, 2002:

A. The guardrail design cross-section was finalized to a 10-1/4" wide by 3" deep glulam consisting of a brickwork layup of mixed hardwoods (primarily red maple). Two 5” wide by 1/8” thick pieces of E-glass/epoxy FRP produced by Gordon Composites were selected for tension reinforcement.

B. We purchased 560 board-feet of soft maple from O&R lumber in Milo, Maine and fourteen 5” wide pieces of e-glass/epoxy FRP from Gordon Composites for use in guardrail fabrication. The random-width lumber was ripped into consistent widths suitable for use in a 10-1/4” wide guardrail layup, and was also planed and graded into three grades (#6, #3, and #2) according to the AITC 119-96 Standard Specifications For Structural Glued Laminated Timber of Hardwood Species for red maple.

C. Josh Botting (project graduate student) and Chad Gibson (undergraduate student funded by the NSF REU program) completed finger jointing and planing the mixed hardwoods to be used for rail specimen. 12'-long rail specimens were fabricated for the testing program at the AEWC Center Laboratory (see Figure 1).

D. An effective field splice design was finalized for connecting individual 12’ rail sections at alternate post locations. The unique splice relies on a steel-to-steel single shear connection utilizing ¾”-diameter, field-installed bolts. One steel plate is pre-bonded to the rail section with an inexpensive off-the-shelf epoxy, which eliminates the need for the use of any adhesive in the field. This splice is critical to guardrail performance, as it must transfer the entire tensile force developed during impact between each 12’ section of guardrail. We note that other timber guardrail systems rely on a continuous steel backing plate or rolled section to carry tension in the guardrail system.

E. Six tension-shear tests of the bolted splice connections were completed that mimicked actual eccentricities of the actual splice (see Figure 2). To determine the effect of bolt pretension on connection performance, tests were performed with bolt torques of 100 ft-lbs, 40 ft-lbs, and 20 ft-lbs. (two nominally identical specimens at each torque level). As expected, the 100 ft-lb. specimens performed best, with a splice capacity near 100 kips. However, even when the torque was reduced to 20 ft-lbs., the connection still sustained approximately 80 kips of
tension. We note that the expected tension during a TL-3 rail impact was estimated at 40 kips using the Barrier VII computer program. These test results indicate that the bolted splice connection will continue to perform well in the field after initially high bolt pretension load is lost due to creep and rail dimensional changes under moisture cycling. In all cases, the steel-FRP epoxy bond performed very well.

F. ASTM D1101 moisture cycling tests were conducted to evaluate the efficacy of the steel-FRP-wood bond lines at the splice connection. It is critical to qualify these bonds for an exterior application: the steel undergoes essentially no dimensional changes with moisture cycling, while the wood swells significantly, inducing large tensile and peeling stresses at the wood-FRP and FRP-steel interface. The specimens performed very well, with no delamination noted at the wood-FRP or FRP-steel interface.

G. We have finalized the testing program for the rail sections, which will include two pure bending tests of 6’-long sections, and tests of four 6’-long sections under combined bending and tension.

H. We have set up a test rig for flexural testing, and have tested three dummy specimens to verify its adequacy and our instrumentation scheme in anticipation of the flexural tests. In addition, we have arranged with an outside consultant to perform laser-based displacement measurement of the rail sections during two days of testing. These measurements will hopefully allow us to gather information on guardrail strains as well as displacements due to combined tension and bending.

I. We designed a test rig that will allow us to perform simultaneous tension and bending tests on the rail specimens. While the design of the test rig is fairly complex, the importance of producing simultaneous bending and tension warrants attempting to design and fabricate such an innovative test rig. We expect delivery of the apparatus within a week, and plan to begin our combined tension-bending tests of the rails sometime in February.
Figure 1: Guardrail Layup in Progress
Figure 2: Rail Tension Splice Test

REPORTS, PAPERS AND PRESENTATIONS: None
PROJECT NUMBER: 00-4

PROJECT TITLE: Portable Falling Weight Deflectometer Study

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S): Dana N. Humphrey, Department of Civil and Environmental Engineering, University of Maine, Orono, Maine; Maureen A. Kestler, Geotechnical/Pavements Engineer, USDA Forest Service

STATUS: New

INITIAL AGREEMENT DATE: 7/1/02

END DATE: 6/30/04

PROJECT OBJECTIVES:
The objective of this project is to evaluate the effectiveness of portable falling weight deflectometers (PFWD) as a means of monitoring compaction, density, or bearing capacity at construction sites. This will include developing correlations between PFWD results and percent compaction for a range of soils. Guidelines for use of PFWDs will be developed. The guidelines will include acceptance and testing protocols. In addition, the PFWD will be evaluated as a means of optimizing timing for load restriction placement and removal on secondary roads in New England. A comparison will be made of the results from different PFWDs and several alternate devices for measuring the degree of compaction of highway subgrade soils and base/subbase aggregates.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2002:
The fully executed contract from the Connecticut Department of Transportation was mailed to the University of Maine on October 3, 2002. This allowed the project to officially begin. Preliminary work was initiated on Task 1 (Literature Review) and inquiries were made with manufacturers of PFWD equipment.

REPORTS, PAPERS AND PRESENTATIONS: None
PROJECT NUMBER: 00-5

PROJECT TITLE: Guardrail Testing-Modified Eccentric Loader Terminal (MELT) at NCHRP 350 TL-2

PRINCIPAL INVESTIGATOR(S): Dean C. Alberson, Texas Transportation Institute, Texas A&M University

STATUS: Completed

INITIAL AGREEMENT DATE: N/A

END DATE: N/A

PROJECT OBJECTIVES:
To conduct the testing needed for FHWA consideration of the acceptability of the NETC MELT at NCHRP Report 350 Test T2 criteria, and to document the testing and the results of the testing in sufficient detail for FHWA consideration. The ultimate goal is to achieve FHWA approval of the NETC MELT as an approved TL2 guardrail terminal.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2002:
The final report was completed.

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

INITIAL AGREEMENT DATE: 6/01/01

END DATE: June 31, 2003

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, 2002:
The state transportation agencies were surveyed to gain an understanding of how and where visualization is used by DOT personnel. This survey showed that all the DOTs are using visualization for public presentation but few are using these techniques as an integral part of the design. The survey found that the level of training and support for visualization varied significantly from state to state.

A separate survey of private sector firms (in transportation and allied design fields) was also conducted. This survey was useful in illustrating the full range of visualization tools that are being employed in design and the level to which these tools have been integrated into the design process by these firms. Based on these surveys, a workshop and manual for guiding the use of visualization tools in the DOTs is being developed.

REPORTS, PAPERS AND PRESENTATIONS:
PROJECT NUMBER: 00-7


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

STATUS: Continuing

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:
“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 N. Humphrey, Department of Civil and Environmental Engineering, University of Maine, Orono, Maine.

STATUS: Continuing

INITIAL AGREEMENT DATE: 7/1/01

END DATE: 6/30/05

PROJECT OBJECTIVES:
The objective of this project is to construct twelve experimental test sections to evaluate the performance and effectiveness of several alternative cold regions pavement designs. These designs involve the use of geogrids and/or drainage geocomposite as an integral member in a thin pavement section. The test sections will be constructed as part of a Federal/State, Maine Department of Transportation highway reconstruction project. Pavement sections will be 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; and 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, 2002: The instrumentation for twelve test sections were fabricated and installed as part of reconstruction of Route 9/126 in Monmouth-Litchfield, Maine. Installation occurred in September, 2001 and July, 2002.

Instrumentation installed in the 2001 and 2002 construction seasons included 120 strain gages attached to geogrid to monitor the in-place deformation of the grid, 16 vibrating wire piezometers to measure pore water pressures in the subbase course and subgrade soils in sections with drainage geocomposite, and 12 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, 2002, 103 out of 120 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 1.5 mm (0.06 in.) to be measured. Most of the instruments were attached to an automatic datalogger that takes and stores hourly readings. The readings are downloaded weekly via modem. To analyze the data, the 24 hourly readings are averaged. This eliminates most of the electronic noise, or random scatter, in the data, which allows for easier identification of time-dependent trends. For instrumentation not attached to a datalogger, weekly manual readings were generally taken.

A new system to measure flows from sections with drainage geocomposite was investigated. In previous projects tilt buckets were used to measure flow, however, these proved to be unreliable at low flow rates. Preliminary flow rate observations on the Litchfield-Monmouth project showed that the
flow rates would be low. This made it desirable to find an alternative method to measure these low flows. Two flowmeters were investigated. The first was an Omega FP5600, capable of measuring flows ranging from 2 to 45 L/min (0.5 gpm to 12 gpm). The second was a Signet Microflow2000, capable of measuring flows ranging from 0.1 to 3 L/min (0.03 gpm to 0.7 gpm). The device that will be installed at a particular station will depend on the anticipated flow rate.

To speed installation this spring, protective housings have been installed at each station where flow measurements are required. Extension wires fabricated to plug directly into the instrument lead wires have been installed in PVC conduit and extend from the protective housing to the box containing the datalogger. Separate dataloggers assigned only to the flow measurement devices have been programmed to record readings every hour.

**REPORTS, PAPERS AND PRESENTATIONS:** None
PROJECT NUMBER: 01-2

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

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

STATUS: Continuing

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.
3. Develop quality control and quality assurance specification limits based on the results from the triaxial testing equipment.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2002:
All tasks related to this project were completed. Each of the four tasks consisted of procurement of material, compaction of mixes, testing of volumetric properties, testing for dynamic modulus and phase angle and analysis of data. Testing was carried out at two different temperatures and two different frequencies. The specific phases in which the testing and analyses were conducted are as follows:

1. In the first phase, two different mixes (different in nominal maximum aggregate size, asphalt content and gradation) were used for compacting samples and testing. These mixes, labeled as Class 1 and Class 2, were obtained from a HMA plant in Connecticut. The samples were made by taking 2,000 gram mix, and using the required number of gyrations required to produce samples with 6 to 8 percent (construction) VTM. Since the 9.5 mm NMAS mix sample could not stand the seating load (20N) at the beginning of the dynamic modulus test (it fell apart) at 100°C, all tests were run at 60°C.

2. In Phase 2, samples were made out of granite aggregate, using a coarse gradation and one asphalt content, and different numbers of gyration (to obtain specific heights), to produce samples with different voids in total mix (VTM). A PG 64-28 asphalt binder was used, at an asphalt content of 5.3 %. Target VTM were 5, 7 and 9 percent.

3. Next, to observe the sensitivity of the test procedure, at different conditions, to mix variables, tests were run with samples compacted with different asphalt contents and percent passing the 0.075 mm sieve. The asphalt content was increased and decreased by 0.5 % from the Phase 2 mixes, and the percent passing the 0.075 mm sieve (P75) was increased and decreased by 2 % from the Phase 2 mixes. The same aggregate and gradations as used in Phase 2 were used. These samples were all compacted to 75 gyrations, using approximately 2,000-gram mix for each sample. The samples were tested at 60°C and 100°C, and using 1 Hz and 5 Hz loading rate. Three samples were made for each cell.

4. In Phase 3, part 2, another aggregate was used for preparing a fine graded mix, with different asphalt contents and percentage passing the 0.075 mm sieve. The sample matrix is shown in Table 2. Tests were conducted for the dark shaded cells only. Five samples were made for each cell. Next, a set of samples was made with mixes with design asphalt content and design, design -2 and design +2 percent P75. Unlike the other samples, these were compacted using 50
gyrations, to obtain higher air voids. The compacted samples were tested at 60°C, at 1 Hz and 5 Hz loading rate. The test parameters and test results were then analyzed to determine whether the test procedure is practical and sensitive to key mix properties.

REPORTS, PAPERS AND PRESENTATIONS:
PROJECT NUMBER: 01-3

PROJECT TITLE: Design of Superpave HMA for Low Volume Roads

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

STATUS: Continuing

INITIAL AGREEMENT DATE: 9/1/01

END DATE: 2/29/04

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, 2002:
All work related to design and testing of three mixes has been completed. First, a set of gyration numbers – 30, 40, 50 and 75 was selected. This selection was based on levels suggested in the literature and levels that are currently being used by many state DOTs. The highest gyration level of 75 was suggested since it is being used by many state DOTs at this time. The lowest number of 30 was suggested since lowering of gyration level below 30 would result in abnormally high asphalt content for most mixes. Next, two commonly used (in the New England states) gradations were selected. The selected gradations were suggested to fall in two broad categories – coarse and fine. It seems that fine mixes are most likely to be used in designing mixes for low volume roads, since they are relatively easy to construct, compared to very coarse graded mixes. The fine graded mixes are easier to compact and also have a “tight” surface. Very coarse graded mixes can have higher permeability, compared to fine graded mixes at similar void level and, hence, are prone to durability problems. In the case of very coarse graded mixes with sufficient asphalt there can be draindown problems. However, coarse graded mixes (gradation lying just below the maximum density line) offer the potential of high resistance against rutting, and are often used in many parts of New England, such as in New Hampshire. Hence a coarse graded mix was selected, along with the fine graded mix, for this study.

Using PG 64-28 asphalt binder, mixes were prepared and compacted with the selected gyration numbers to produce specimens with 4 percent air voids, and the optimum asphalt contents were determined. Samples were then compacted to construction voids (approximately 7 to 8 percent Voids in Total Mix, VTM). Note that the target VTM was between 7 and 8 percent, and that in some cases the samples had higher or lower VTM. The specimens were then tested for bulk specific gravity, and using the theoretical maximum gravity (tested in the laboratory for each mix) volumetric properties, namely, VTM, VMA, VFA and asphalt film thickness were determined.

Samples from each designed mix were tested for resilient modulus in the indirect tensile mode. The samples were then conditioned for long-term aging, using AASHTO TP2 procedure. At the end of conditioning, the samples were again tested for resilient modulus, and then tested for tensile strain at failure. The asphalt binder was extracted from the long-term aged samples and tested for stiffness (using dynamic shear rheometer) at 64°C. Samples at two low asphalt contents were also tested with
the Asphalt pavement Analyzer (APA), for evaluation of rutting potential. Tests were conducted using 4,000 cycles with 690 kPa pressure and temperature of 60°C. Tests were also conducted on samples with different asphalt contents (corresponding to 50, 75 and –1 % of that obtained using 75 gyrations) under water in the APA, using 4,000 cycles at 60°C. The lower number of cycles (4,000) compared to the usual 8,000 cycles was selected to simulate low traffic volume. The results were used to correlate stiffness (of asphalt binder and mix) with volumetric properties such as VMA, VFA and film thickness. This correlation provided the basis for selecting the desired asphalt content for each mix (gradation) and thus helped in determining the most desirable gyration level.

Work is being conducted on extraction and testing of extracted asphalt binder (for dynamic shear rheometer) from the last of the three mixes.

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 (UMD); Rajib Mallick, Co-PI, Worcester Polytechnic Institute (WPI)

STATUS: Continuing

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” (SCM) 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, 2002:
All of the Phase A and Phase B testing was completed during the 2002 calendar year. Under Phase A, 5 different soil and aggregate samples were obtained and transported to the labs at UMD and WPI for testing. At UMD, sieve analyses and Proctor compaction testing on the samples were performed. At WPI, the phase A work involved testing soils compacted with a vibratory roller in a large-scale test frame (mold). The dimensions of the mold are 9-ft. long by 3-ft. wide by 1-ft. deep. For each material, three different moisture contents were selected for testing (less than optimum, optimum moisture, and above optimum). The moisture contents selected were within the range corresponding to 90% - 100% maximum dry unit weight (based upon the Standard or modified Proctor tests, as appropriate). Each material/moisture content combination was placed, compacted, and tested in the load frame at a given moisture content three times.

Each test series at WPI was generally performed as follows. A thin layer of soil (approximately 1 to 3 inches) was placed and compacted in the bottom of the frame, to provide a bedding layer for the SCM sensor. After the sensor was installed, the remaining 8 to 10 inches of soil was placed and compacted at the specified moisture content. After each pass of the vibratory roller, a measurement of soil stiffness was obtained with a GeoGauge (produced by Humboldt Manufacturing Co). The alternating roller passes and GeoGauge testing continued until the signal from the Soil Compaction Meter indicated that the lift had been sufficiently compacted (via a blinking “stop compaction” red light). At that point, the in-place density was determined by a nuclear density test and/or a sand cone test, so that direct correlation could be made between the SCM “stop compaction” signal and the percent compaction (e.g., compared to Standard or Modified Proctor Density). Alternate compaction of the material and GeoGauge measurements continued for at several more passes, and then a final nuclear density test and/or a sand cone test was performed.

Based upon the results obtained during Phase A, several sites were selected for the Phase B work, where materials similar to those tested under Phase A were placed and compacted in full-scale highway construction projects. At those sites, SCM sensors were buried beneath lifts of fill that were
compacted by various types of large vibratory rollers. The general testing scheme was similar to that conducted in Phase A, except that multiple lifts of fill were placed and compacted over the SCM sensors at most of the field sites. By taking measurements on multiple successively placed lifts of fill, it was possible to identify depth limitations of the SCM sensors. The Phase B testing was initiated in March 2002 and was completed by the end of the 2002 calendar year.

During the course of the project, the SCM was tested in conjunction with the following materials:
- Material #1: Subbase (Dense-Graded)
- Material #2: Gravel Borrow
- Material #3: Ordinary Borrow
- Material #4: Lightweight Aggregate
- Material #5: Hot Mix Asphalt (HMA)

Although statistical analysis of the data is still in progress, the following general statements can be made based upon analyses completed to date:

- The SCM is not an appropriate tool to assess percent compaction with lightweight aggregates (Material #4).

- Although only a limited body of data was obtained with Material #5 (HMA), comparison of SCM data and conventional nuclear density data on compacted Hot Mix Asphalt did not show a consistently good correlation.

- Comparison of SCM data and conventional sand cone and/or nuclear density tests on Materials #1, #2 and #3 (Dense-Graded Subbase, Gravel Borrow, and Ordinary Borrow) is extremely promising. When these materials are compacted at or near optimum moisture content, there is a strong correlation between the SCM “stop compaction” signal and a percent compaction of 95% or greater. For soils compacted significantly wet of optimum, the SCM often gives a “stop compaction” signal at less than 95 percent compaction.

- For Materials #2 and #3 (Gravel Borrow and Ordinary Borrow) a single SCM sensor can be used to monitor compaction of several successively placed lifts. However, when the thickness of fill above the SCM sensors reaches about 4 feet or more, the sensors often fail to transmit a signal for assessing the sufficiency of compaction.

It is anticipated that the statistical analysis of the data will be completed during the next quarter, and then the project report will be prepared. The literature review, field observations and analysis of results will be utilized to provide conclusions and recommendations about applicability of the Soil Compaction Meter, proper test controls and expected variation in results. The report will include a stand-alone easy-to-read document with testing protocols and recommended criteria for quality control limits. As part of the Technology Transfer plan, a hands-on workshop will be provided for New England highway agency personnel near the conclusion of this project.

**REPORTS, PAPERS AND PRESENTATIONS:** None
PROJECT NUMBER: 02-2

PROJECT TITLE: Formulate Approach for 511 Implementation in New England

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S):
Paul Shuldiner, Director, University of Massachusetts Transportation Center, Department of Civil and Environmental Engineering
Jeremy Siviter, Senior Systems Engineer, IBI Group

STATUS: New

INITIAL AGREEMENT DATE: 8/1/02

END DATE: 12/31/03

PROJECT OBJECTIVES:
The overall goal of this project is to develop a multi-faceted regional 511 implementation strategy that will address the following objectives:

- Identify minimum information requirements for a New England regional 511
- Identify the data availability existing within the region to support a minimum level 511 implementation
- Document the regulatory environment and processes that must be implemented for implementation of 511 in each of the New England states
- Identify lessons learned by early 511 adopters and ensure they are integrated in to a regional strategy
- Identify the different options for implementing various system components
- Document business plan approaches that can be used by the New England states to implement a regionally consistent 511 system

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2002:
1. National guidelines, approaches, and case studies for 511 researched and documented
2. Task 1 draft report circulated to committee members for comment
3. Stakeholder survey developed for public and private entities which may participate in a region-wide 511 deployment to identify priorities, data availability, and preferred implementation strategies.
4. A workshop to discuss project objectives and Task 1 activities was conducted in Boston, MA on March 19, 2003.

REPORTS, PAPERS AND PRESENTATIONS: None
PROJECT NUMBER: 02-3

PROJECT TITLE: Establish Subgrade Support Values for Typical Soils in New England

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S):
PI: Ramesh B. Malla, Ph.D., Associate Professor, Department of Civil & Environmental Engineering, University of Connecticut

Co PI: Vincent C. Janoo, Ph.D., Research Civil Engineer, U.S. Army Cold Regions Research and Engineering Laboratory (CRREL)

STATUS: New

INITIAL AGREEMENT DATE: 8/1/02

END DATE: 1/31/05

PROJECT OBJECTIVES: The objective of this research is to collect all relevant data, and based on these findings, develop typical values or a range of typical values for subgrade soils found in New England based on AASHTO soil classification.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2002:
1. Graduate Research Assistant hired: A Ph.D. graduate research assistant (Mr. Balunaini Umashankar) has been recruited and placed on this project from January 13, 2003.
2. Collection of existing soils data in New England States:
   a. Request of Information from NETC Technical Committee:
      A request was submitted to the NETC Technical Committee of this project (NETC 02-3) for any existing published references/literature as pertaining to soil classification and studies on resilient modulus and falling weight deflectometer in the six New England States (CT, MA, ME, NH, RI, and VT).
   b. Soil Survey Reports:
      The soil survey reports published by U.S. Department of Agriculture are collected and the existing soil types in New England States are presented in a Tabular form. The soil data is reported county wise for each state.
      A consolidated summary sheet indicating the soil types state-wise of all the six New England States has been developed.
   c. STATSGO Data:
      State Soil Geographic Database (STATSGO) consists of soil data of all states and is designed for use in Geographic Information Systems (GIS). The data can be accessed through GIS software packages (PCARC and ArcView). We are presently working on ArcView to retrieve the data available in STATSGO database (ftp://ftp.ftw.nrcs.usda.gov/pub/statsgo/dos/arc/data/).
3. Literature on Resilient Modulus and Falling Weight Deflectometer:
   a. Search using TRIS, RIP, and other database:
      A detail literature search using TRIS and RIP is in progress to collect information on resilient modulus and falling weight deflectometer studies done nation-wide. Several recent publications on “Resilient Modulus” and “Falling Weight Deflectometer Tests” are gathered.
b. New England States Studies:

c. LTPP Data:
The Long – Term Pavement Performance (LTPP) Data is obtained from LTPP Customer Service Support Center, Oak Ridge, TN. The data is available in the form of compact disc. It consists of Falling weight Deflectometer (FWD) measurement data and the profile data of selected in-service pavement test sections in North America.

4. Soil-Type Data Table:
The existing soil types in New England States available from the USDA reports have been tabulated. The soil data is reported county-wise for each state. The soils are categorized using AASHTO soil classification as well as under Unified Soil Classification System (USCS). A consolidated summary sheet indicating the soil types state-wise of all the six New England States has been prepared.

REPORTS, PAPERS, AND PRESENTATIONS: None
PROJECT NUMBER: 02-5

PROJECT TITLE: Determination of Moisture Content of Deicing Salt at Point of Delivery

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY:
Richard P. Long and Kenneth R. Demars, University of Connecticut

STATUS: New

INITIAL AGREEMENT DATE: 7/1/02

END DATE: 12/31/03

PROJECT OBJECTIVES:
The object of this research is to find or develop a simple affordable method of device for quickly measuring the moisture content of road salt in the field. The test will be carried out in about five minutes and be capable of measuring moisture contents in the range of 3% to 5% to an accuracy equal to +/- 0.5%.

There are several methods of measuring moisture in a material. The analytical and gravimetric methods require substantial time to complete. In the infrared method the material’s particle size, particle shape, particle surface characteristics and color can cause moisture measurement errors. The microwave methods require a large space and tend to be expensive. We are investigating the capacitive, neutron and gamma ray, and conductive methods of measuring moisture content.

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2002:
The literature review continues but there are few studies to identify the different methods used to measure moisture content. Several companies that manufacture equipment to measure moisture content of various materials have been contacted by email. These efforts suggest that the electrical conductivity/ resistivity method offers the most promise for portable, fast and inexpensive moisture measurements on road salt. However, several of the companies we contacted were skeptical that conductivity techniques could be developed for highly conductive materials such as pure salt with some moisture. Yet, conductivity is the method used for determining salt dissolved in water. One company replied that the conductivity method may work for salt and they could design the electronics if we determined the appropriate range of specific conductivity.

Moisture measurements were started with a conductivity cell to measure specific conductance of road salt over the moisture range of 0 to 8%. These measurements were not very repeatable, however, and were not within the stated range of accuracy (+- 0.5%). Additional measurements have shown that conductivity (at constant moisture) is significantly affected by packing density and to a lesser degree by wetting and mixing method, by degree of drying, by particle size distribution and by test technique. Additional testing results with the wood moisture (conductivity) meter, purchased from Tramex, were highly variable because of these factors and additional testing with this device has been discontinued until the factors that affect reproducible conductivity measurements are defined.

Testing with a nuclear moisture-density gauge was also performed in the laboratory and at the Willington, CT salt storage shed. These gauges employ neutrons to measure moisture and gamma rays to measure density but there was no correlation between the values of moisture and density determined from the nuclear gauge and values measured from oven drying and weighing. As a result, we contacted Troxler Electronics lab, the nuclear gauge manufacturer, and were informed that salt is one of 3 or 4 minerals that causes an interference with nuclear density measurements.
REPORTS, PAPERS AND PRESENTATIONS: None
PROJECT NUMBER: 02-7

PROJECT TITLE:
Validating Traffic Simulation Models to Inclement Weather Travel Conditions with Applications to Arterial Coordinated Signal Systems

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S):
Adel W. Sadek, University of Vermont
Wael El-Dessouki, University of Connecticut

STATUS: New

INITIAL AGREEMENT DATE: 9/1/02

END DATE: 8/31/04

PROJECT OBJECTIVES:
The objective of the proposed study is twofold. The first objective is to explore how to best calibrate simulation models to inclement weather conditions in New England. With the simulation models calibrated, the second objective of the study will be to use the calibrated model to investigate the feasibility and benefits of tailoring signal timing to adverse weather conditions along New England arterials. Specifically, the proposed project has the following objectives:

1. To determine the impacts of inclement weather (i.e. snow and ice) on traffic flow parameters such as discharge headway, startup lost times, speeds and speed-density relationships as documented in the literature;
2. To check whether these values apply to New England conditions;
3. To calibrate various traffic simulation models to inclement weather travel conditions;
4. To use the calibrated simulation model to assess whether timing plans could be developed to accommodate inclement weather travel conditions; and to assess the benefits of implementing such tailored plans

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2002:
This project started on September 1, 2003. The accomplishments of the project through December 31, 2002 include:

1. The conduct of a literature review on the impact of inclement weather on traffic flow parameters;
2. The conduct of data collection efforts aimed at quantifying the impact of inclement weather on traffic flow along signalized arterials in New England. Specifically, efforts are underway to assess the impact of inclement weather on traffic flow parameters such as startup lost time, saturation headway, and average headways. Once the impacts are quantified, the study will proceed to examine how to best calibrate simulation models for such conditions, and to assess the benefits of developing special signal timing plans for inclement weather conditions. To the best of our knowledge, this is the first study of that nature in New England.
3. The development of a CORSIM simulation model for a corridor in the State of Vermont for use in assessing the benefits of developing specific signal plans for inclement weather.

REPORTS, PAPERS AND PRESENTATIONS: None
PROJECT NUMBER: 02-8

PROJECT TITLE:
Intelligent Transportation Systems Applications to Ski Resorts in New England

PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S):
Adel W. Sadek, University of Vermont

The IBI Group

STATUS: New

INITIAL AGREEMENT DATE: 9/1/02

END DATE: 3/31/04

PROJECT OBJECTIVES:
The main objective of the proposed research is to conduct a comprehensive study aimed at understanding ski resort travel problems in New England, and the applicability of ITS to address these problems. Specifically, the proposed study has the following objectives:

(1) To define and quantify the transportation problems and challenges associated with ski resorts travel in New England, and to study the implications of such problems with respect to traffic management;
(2) To define and understand the needs of travelers to ski resort areas in New England;
(3) To identify ITS strategies and applications that have the potential to address the problems and needs identified in (1) and (2) above;
(4) To assess the costs and benefits of the ITS strategies identified in (3); and
(5) To explore the opportunity for public-private partnerships to fund the strategies identified in (4)

PROGRESS/ACCOMPLISHMENTS THROUGH DECEMBER 31, 2002:
1. The conduct of a literature review on transportation problems associated with travel to ski resorts, and the needs of travelers;
2. The beginning of data collection aimed at understanding the transportation problems associated with travel to ski resorts in New England, and the needs of the travelers.
3. The development of a preliminary framework for selecting a representative set of ski resorts in New England for the purposes of data collection.

REPORTS, PAPERS AND PRESENTATIONS: None
### D.1 FINANCIAL STATUS OF ACTIVE PROJECTS:

**Table 1: Financial Status of Projects Active During 2002**
*(As of 11/06/02)*

<table>
<thead>
<tr>
<th>NO.</th>
<th>PROJECT TITLE, PI, UNIVERSITY</th>
<th>APPROVED BUDGET</th>
<th>INVOICES PAID TO DATE</th>
<th>PROJECT BALANCE</th>
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</thead>
<tbody>
<tr>
<td>94-2</td>
<td>Nondestructive Testing of Reinforced Concrete Bridges Using Radar Imaging Techniques, <em>D. Huston, University of Vermont</em></td>
<td>$224,902.00</td>
<td>$224,901.80</td>
<td>$0.20</td>
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<td>96-2</td>
<td>Optimizing GPS in Transportation, <em>J. Bean, C. Ferguson, University of Connecticut</em></td>
<td>$120,000.00</td>
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<td>97-1</td>
<td>A Portable Method to Determine Chloride Concentration on Roadway Pavements, <em>N. Garrick, University of Connecticut</em></td>
<td>$107,162.00</td>
<td>$76,997.21</td>
<td>$30,164.79</td>
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<td>97-2</td>
<td>Performance Evaluation and Economic Analysis of Combinations of Durability Enhancing Admixtures (Chemical and Mineral) in Structural Concrete for the Northeast U.S.A., <em>S. Civjan, University of Massachusetts, Amherst</em></td>
<td>$118,473.00</td>
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<td>$14,032.74</td>
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<td>99-1</td>
<td>NETC Bridge Rail Transitions - Development and Crash Testing, <em>J. Zoller, New Hampshire Department of Transportation</em></td>
<td>$240,000.00</td>
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<td>Quantifying Roadside Rest Area Usage, <em>P. Garder, University of Maine, Orono</em></td>
<td>$44,857.00</td>
<td>$17,813.70</td>
<td>$27,043.30</td>
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<td>Ground-Based Imaging and Data Acquisition Systems for Roadway Inventories in New England - A Synthesis of Practice, <em>K. Hancock, University of Massachusetts, Amherst</em></td>
<td>$40,818.00</td>
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<td>Evaluation of Permeability of Superpave Mixes, <em>W. Mogawer, University of Massachusetts, Dartmouth</em></td>
<td>$100,002.00</td>
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<td>00-3</td>
<td>Design, Fabrication and Preliminary Testing of a Composite Reinforced Timber Guardrail, <em>W. Davids, University of Maine, Orono</em></td>
<td>$83,469.00</td>
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<td>00-4</td>
<td>Portable Falling Weight Deflectometer Study, <em>D. Humphrey, University of Maine, Orono</em></td>
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<td>00-5</td>
<td>Guardrail Testing Modified Eccentric Loader Terminal (MELT) at NCHRP 350 TL-2, <em>D. Alberson, Texas Transportation Institute, Texas A&amp;M University</em></td>
<td>$61,287.00</td>
<td>$0.00</td>
<td>See Note 2.</td>
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Table 1: Financial Status of Projects Active During 2002  
(As of 11/06/02)  
(Cont’d)

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<th>NO.</th>
<th>PROJECT TITLE, PI, UNIVERSITY</th>
<th>INVOICES</th>
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<th>PROJECT</th>
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<td>00-6</td>
<td>Effective Visualization Techniques for the Public Presentation of Transportation Projects, N. Garrick, University of Connecticut</td>
<td>APPROVED</td>
<td>74,929.00</td>
<td>$56,105.62</td>
<td>$18,823.38</td>
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<td>00-7</td>
<td>A Complete Review of Incident Detection Algorithms and Their Deployment: What Works and What Doesn’t, E. Parkany, University of Massachusetts, Amherst</td>
<td>PAID TO DATE</td>
<td>45,384.00</td>
<td>$40,558.26</td>
<td>$4,825.74</td>
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<td>00-8</td>
<td>Performance and Effectiveness of a Thin Pavement Section Using Geogrids and Drainage Geocomposites in a Cold Region, D. Humphrey, University of Maine, Orono</td>
<td>BUDGET</td>
<td>150,000.00</td>
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<td>$81,995.00</td>
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<td>01-2</td>
<td>Development of a Testing Protocol for QC/QA of Hot Mix Asphalt (HMA), W. Mogawer, University of Massachusetts, Dartmouth</td>
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<td>80,000.00</td>
<td>$44,242.31</td>
<td>$35,757.69</td>
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<td>01-3</td>
<td>Design of Superpave HMA for Low Volume Roads, W. Mogawer, University of Massachusetts, Dartmouth</td>
<td>BALANCE</td>
<td>99,755.00</td>
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<td>Field Evaluation of a New Compaction Monitoring Device, H. Miller, University of Massachusetts, Dartmouth</td>
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<td>02-2</td>
<td>Formulate Approach for 511 Implementation in New England, P. Shuldiner, University of Massachusetts, Amherst</td>
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<td>Establish Subgrade Support Values for Typical Soils in New England, R. Malla, University of Connecticut</td>
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<td>02-5</td>
<td>Determination of Moisture Content of Deicing Salt at Point of Delivery, K. Demars, University of Connecticut</td>
<td>$59,236.00</td>
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<td>Validating Traffic Simulation Models to Inclement Weather Conditions with Applications to Arterial Coordinated Signal Systems, A. Sadek, University of Vermont</td>
<td>$74,731.00</td>
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<td>Intelligent Transportation Systems Applications to Ski Resorts in New England, A. Sadek, University of Vermont</td>
<td>$60,000.00</td>
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Notes: 1. Retainage is not included in "INVOICES PAID TO DATE"  
2. Project 00-5 was a Purchase Order Agreement project
## D.2 FUND BALANCE:

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<tr>
<th>ITEM</th>
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<td>Continued Projects:</td>
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<td>- Construction Costs of New England Bridges-Phase II</td>
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<td>95-1: Use of Tire Chips/Soil Mixtures to Limit Pavement Damage</td>
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<td>of Paved Roads</td>
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<td>for Application of Thermoplastic Pavement Markings</td>
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<td>on Modified Open Graded Mixes</td>
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<td>T2 (per 12/2/97 Adv. Committee Mtg.) for 1998 = $10,000</td>
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Table 2: NETC Fund Balance

(As of 12/31/02)
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<td>97-1: A Portable Method for Determining Chloride Concentration on Roadway Pavements</td>
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<td>97-2: Performance Evaluation &amp; Economic Analysis of Durability Enhancing Admixtures, etc.</td>
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<td>97-3: Determining Properties, Standards &amp; Performance of Wood Waste Compost, etc. Alloc. to ConnDOT for Constr. Costs of Test Site (Approved 1/21/99 Ballot)</td>
<td>43,853.94</td>
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<td>97-4: Early Distress of Open-Graded Friction Course</td>
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Table 2: NETC Fund Balance
(As of 12/31/02)

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<td>587,475.46</td>
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<tr>
<td>02-2: Formulate Approach for 511 Implementation in New England</td>
<td>84,012.00</td>
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<td>503,463.46</td>
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<td>02-3: Establish Subgrade Support Values (M_i) for Typical Soils in New England</td>
<td>80,000.00</td>
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<td>423,463.46</td>
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<td>02-5: Determination of Moisture Content of De-Icing Salt at Point of Delivery</td>
<td>59,236.00</td>
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<td>364,227.46</td>
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<td>02-6: Sealing of Expansion Joints</td>
<td>75,000.00</td>
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<td>289,227.46</td>
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<td>02-7: Calibrating Traffic Simulation Models to Inclement Weather Conditions with Applications to Arterial Coordinated Signal Systems</td>
<td>74,731.00</td>
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<td>214,496.46</td>
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<td>02-8: Intelligent Transportation Systems Applications to Ski Resorts in New England</td>
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<td>154,496.46</td>
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<td>Projected Allocations &amp; Expenditures:</td>
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<tr>
<td>Member Allocations 2003 = 6 X $100,000</td>
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<tr>
<td>NY DOT Allocation 2003 = $40,000</td>
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<td>Coord./Admin. Of NETC Calendar Year 2003 = $124,258</td>
<td>124,258.00</td>
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Table 2: NETC Fund Balance  
(As of 12/31/02)

<table>
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<tr>
<th>ITEM</th>
<th>ALLOCATION</th>
<th>ENCUMB/EXPEND.</th>
<th>INVOICE</th>
<th>CUM. BALANCE</th>
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<tr>
<td>NY DOT Allocation 2003 = $40,000</td>
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<td>124258</td>
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</table>

"03" Project Series:

| 03-1: Enhancing the Chemical Retention Capacity of A Roadway Runoff Retention Pond System Using Wood Filters | | 72000 | | 598,238.46 |
| 03-2: Field Studies of Concrete Containing Salts of An Alkenyl-Substituted Succinic Acid | | 140000 | | 458,238.46 |
| 03-3: Feasibility Study and Design of An Erosion Control Laboratory in New England | | 30000 | | 428,238.46 |
| 03-4: Measuring Pollutant Removal Efficiencies of Storm Water Treatment Units | | 80000 | | 348,238.46 |
| 03-5: Evaluation of Field Permeameter As A Longitudinal Joint Quality Control Indicator | | 75000 | | 273,238.47 |
| 03-6: New England Land Grant University Consortium Members Research Challenge | | 103000 | | 170,238.46 |
| 03-7 (Alt.): Basalt Fiber Reinforced Polymer Composites | | 60000 | | 110,238.46 |

Note: Member FFY allocations are obligated between October 1 and December 31
E. NETC REPORTS, PAPERS, AND PRESENTATIONS

E1. POLICIES AND PROCEDURES:

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
   “Annual Report for Calendar Year 2001,” December 2002, NETCR40

E3. REPORTS, PAPERS, AND PRESENTATIONS 1988-1994:


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


E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2002:

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

Project No. Title

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

Papers and Presentations (cont’d):


### E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2002 (cont’d):

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
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<tbody>
<tr>
<td>N/A</td>
<td>Tire Chips As Lightweight Backfill For Retaining Walls, Phase II: Full-Scale Testing:</td>
</tr>
<tr>
<td></td>
<td>Papers and Presentations (cont’d):</td>
</tr>
<tr>
<td></td>
<td>“Highway Applications of Tire Shreds,” Humphrey, D. A 7-hour short course presented to the RI DOT, April 1999.</td>
</tr>
</tbody>
</table>

| N/A         | New England Vehicle Classification And Truck Weight Program, Phase I Reports: |

| N/A         | Bridge Rail Crash Test, Phase II: Sidewalk-Mounted Rail Reports: |
### E4. REPORTS, PAPERS AND PRESENTATIONS 1995-2002 (cont’d):

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
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<tbody>
<tr>
<td>N/A</td>
<td>Bridge Rail Crash Test, Phase II: Sidewalk-Mounted Rail</td>
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**Reports (cont’d):**


**Papers and Presentations:** None

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>94-1</td>
<td>Structural Analysis Of New England Subbase Materials And Structures</td>
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</tbody>
</table>

**Reports:**


**Papers and Presentations:**

Project No.     Title
94-1 Structural Analysis Of New England Subbase Materials And Structures

Papers and Presentations (cont’d):

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

Reports:

Papers and Presentations


“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 No.  Title
94-2  Nondestructive Testing Of Reinforced Concrete Bridges Using Radar Imaging Techniques

Papers and Presentations (cont’d):


Project No.  Title

94-3 Procedures For The Evaluation Of Sheet Membrane Waterproofing

Reports:
“Procedures for the Evaluation Sheet Membrane Waterproofing,”

Papers and Presentations None

94-4 Durability Of Concrete Crack Repair Systems

Reports: None

Papers and Presentations:

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

95-1 Use Of Tire Chip/Soil Mixtures To Limit Frost Heave And Pavement Damage Of Paved Roads

Reports:

Papers and Presentations:


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

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

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
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<tbody>
<tr>
<td>95-2</td>
<td>Suitability Of Non-Hydric Soils For Wetland Mitigation</td>
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<td>Papers and Presentations: None</td>
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<td>95-3</td>
<td>Implementation And Evaluation Of Traffic Marking Recesses For Application of Thermo-Plastic Markings On Modified Open Graded Mixes</td>
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<tr>
<td>95-5</td>
<td>Buried Joints In Short Span Bridges</td>
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<tr>
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<td>95-6</td>
<td>Guidelines For Ride Quality Acceptance Of Pavements</td>
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<td>Papers and Presentations: None</td>
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<td>96-1</td>
<td>Implementation of Superpave</td>
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<td>Project No.</td>
<td>Title</td>
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<td>96-1</td>
<td>Implementation of Superpave</td>
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<td>96-2</td>
<td>Optimizing GPS Use in Transportation Projects</td>
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</table>

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):


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

Reports:


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 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.


<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
<th>Reports</th>
<th>Papers and Presentations</th>
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<tbody>
<tr>
<td>99-1</td>
<td>Bridge Rail Transitions</td>
<td>None</td>
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<tr>
<td>99-2</td>
<td>Evaluation Of Asphalitic Expansion Joints</td>
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<table>
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<tr>
<th>Project No.</th>
<th>Title</th>
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<tbody>
<tr>
<td>99-3</td>
<td>Development Of Priority Based Statewide Scour Monitoring Systems In New England</td>
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**Papers and Presentations:**


<table>
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<tr>
<th>Project No.</th>
<th>Title</th>
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<tbody>
<tr>
<td>99-4</td>
<td>Quantifying Roadside Rest Area Usage</td>
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**Reports:**

“Quantifying Roadside Rest Area Usage,” Garder, P. and Bosonetto, N., NETCR 38, November 27, 2002.

**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).

<table>
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<tr>
<th>Project No.</th>
<th>Title</th>
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<tbody>
<tr>
<td>99-6</td>
<td>Analytical and Experimental Investigation Of The Effects Of Concrete Removal Operations On Adjacent Concrete That Is To Remain</td>
</tr>
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**Reports:**


**Papers and Presentations:**


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

Project No.    Title
99-6 Analytical and Experimental Investigation Of The Effects Of Concrete Removal Operations On Adjacent Concrete That Is To Remain Papers and Presentations (cont’d):
“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:

Papers and Presentations: None

00-2 Evaluation Of Permeability Of Superpave Mixes
Reports:

Papers and Presentations:


003 Design, Fabrication and Preliminary Testing of a Composite Reinforced Timber Guardrail
Reports: None

Papers and Presentations: None

004 Portable Falling Weight Deflectometer Study
Reports: None

Papers and Presentations: None

005 Guardrail Testing Modified Eccentric Loader Terminal (MELT) at NCHRP 350 TL-2
Reports:
00-5 Guardrail Testing Modified Eccentric Loader Terminal (MELT) at NCHRP 350 TL-2
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 in April 2002.

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

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) 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:

01-3 Design of Superpave HMA for Low Volume Roads
Reports: None

Papers and Presentations: None

01-6 Field Evaluation of a New Compaction Monitoring Device
Reports: None
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<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
<th>Papers and Presentations</th>
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<td>01-6</td>
<td>Field Evaluation of a New Compaction Monitoring Device</td>
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<td>02-2</td>
<td>Formulate Approach for 511 Implementation in New England</td>
<td>Reports: None Papers and Presentations: None</td>
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<tr>
<td>02-3</td>
<td>Establish Subgrade Support Values for Typical Soils in New England</td>
<td>Reports: None Papers and Presentations: None</td>
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<tr>
<td>02-5</td>
<td>Determination of Moisture Content of Deicing Salt at Point of Delivery</td>
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<td>02-7</td>
<td>Validating Traffic Simulation Models to Inclement Weather Travel Conditions with Applications to Arterial Coordinated Signal Systems</td>
<td>Reports: None Papers and Presentations: None</td>
</tr>
<tr>
<td>02-8</td>
<td>Intelligent Transportation Systems Applications to Ski Resorts in New England</td>
<td>Reports: None Papers and Presentations: None</td>
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