

**The New England Transportation Consortium (NETC):
A Summary of the Multistate Cooperative Research Program
Between 1994 and 2011**

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Disclaimer

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Preface

The six New England state transportation agencies are cooperating with the six New England state land-grant universities and the Federal Highway Administration in a program of transportation research. This joint venture is called the "New England Transportation Consortium (NETC)". The NETC was formed as a regional approach to address transportation research needs of mutual concern to the New England states. Its purpose is to pool the financial, professional and academic resources of the region and to use them to research and develop improved methods of dealing with common problems in the planning, construction, maintenance, rehabilitation, reconstruction and operation of transportation systems in the participating states.

The Connecticut Department of Transportation was the Lead Agency for NETC, effective October 1, 1994 (Federal Fiscal Year 1995, FFY1995), and was the Lead Agency until December 31, 2011. Since January 1, 2012, the Vermont Agency of Transportation has assumed the Lead Agency designation.

This report discusses the following issues regarding NETC: description; funding; history (from October 1, 1994, to December 31, 2011); establishment and start-up activities; organization and management; project selection process; award of funding; strengths; and, challenges. The report also provides recommendations and guidelines for the establishment, operation and sustained growth of an intergovernmental, multistate cooperative research program.

Metric Conversion Factor Sheet

SI CONVERSION FACTORS				
SYMBOL	GIVEN	MULTIPLY BY	CONVERT TO	SYMBOL
AREA				
mm ²	square millimeters	0.0018	square inches	in ²
m ²	square meters	10.764	square feet	ft ²
m ²	square meters	1.195	square yards	yd ²
ha	hectares	2.47	acres	ac
km ²	square kilometers	0.386	square miles	mi ²
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m ³	cubic meters	35.314	cubic feet	ft ³
m ³	cubic meters	1.307	cubic yards	yd ³
NOTE: volumes greater than 1000L shall be shown in m ³				
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or metric ton)	1.103	short tons (2000 lb)	T
TEMPERATURE				
°C	Celsius	1.8C + 32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m ²	candela/m ²	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in ²

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The New England Transportation Consortium (NETC): A Summary of the Multistate Cooperative Research Program Between 1994 and 2011

Abstract

The six New England state transportation agencies are cooperating with the six New England state land-grant universities and the Federal Highway Administration in a program of transportation research. This joint venture is called the "New England Transportation Consortium (NETC)". The NETC was formed as a regional approach to address transportation research needs of mutual concern to the New England states. Its purpose is to pool the financial, professional and academic resources of the region and to use them to research and develop improved methods of dealing with common problems in the planning, construction, maintenance, rehabilitation, reconstruction and operation of transportation systems in the participating states.

This report discusses the following issues regarding NETC: description; funding; history (from October 1, 1994, to December 31, 2011); establishment and start-up activities; organization and management; project selection process; award of funding; strengths; and, challenges. The report also provides recommendations and guidelines for the establishment, operation and sustained growth of an intergovernmental, multistate cooperative research program.

The New England Transportation Consortium (NETC): A Summary of the Multistate Cooperative Research Program Between 1994 and 2011

Description of NETC Program

The six New England state transportation agencies are cooperating with the six New England state land-grant universities and the Federal Highway Administration (FHWA) in a program of transportation research. This joint venture is called the "New England Transportation Consortium (NETC)."

"The NETC was formed as a regional approach to developing innovative solutions to common transportation problems among the New England states. Its purpose is to pool the financial, professional and academic resources of the region and to use them to research and develop improved methods of dealing with common problems in the planning, construction, maintenance, rehabilitation, reconstruction and operation of transportation systems in the participating states. The program is intended to supplement, not to replace, ongoing state and federal research activities and other national programs such as the National Cooperative Highway Research Program (NCHRP). To this end, a Memorandum of Understanding, establishing NETC has been consummated." (1)

"The following goals were established for NETC in order to focus the resolve of participating state transportation agencies and universities:

- Implementation of a three-pronged program for the New England region consisting of research and development; technology transfer; and, education and training.
- Development of improved methods for dealing with common transportation problems.
- Providing an important source of trained professionals for employment in the Region." (1)

NETC membership now extends to the following agencies:

- Connecticut Department of Transportation (ConnDOT);
- Maine Department of Transportation (MEDOT);
- Massachusetts Department of Transportation (MassDOT);
- New Hampshire Department of Transportation (NHDOT);
- Rhode Island Department of Transportation (RIDOT);
- Vermont Agency of Transportation (VAOT); and,

- Federal Highway Administration (FHWA).

Each of the member state transportation agencies has designated a state university to participate with the state transportation agency in developing and conducting the transportation research program. The following universities have been designated as member universities:

- University of Connecticut (UConn);
- University of Maine (UME);
- University of Massachusetts (UMass);
- University of New Hampshire (UNH);
- University of Rhode Island (URI); and,
- University of Vermont (UVM).

Between CY1995 and CY2005, inclusive, NETC activities were managed by UConn. Subsequently, between CY2006 and CY2011, inclusive, NETC activities were managed by UMass-Dartmouth. ConnDOT was acting as the Lead Agency from October 1, 1994, to December 31, 2011. NETC activities are currently being managed by UVM, with VAOT acting as the Lead Agency.

Program Funding

Current federal-aid highway legislation contains provisions for states to pool resources to address various research and development needs. This authority, Federal Grant and Cooperative Agreement Act (GCA) of 1977, as amended, Section 6300, et seq., of Title 31, United States Code (U.S.C.) is the administrative and legal tool for the establishment and continuation of NETC activities and programs. Each state has similar enabling legislation delineating contracting procedures of the member states.

Funding for NETC is 100% federal [State, Planning and Research (SP&R)]. The mechanism for administering the funds is through the FHWA Transportation Pooled Funds (TPF) program wherein a group of federal, state and local agencies, as well as other organizations, may combine resources to conduct transportation-related research (2).

History

NETC was first established, and work began, in 1986 and, over the years, has undergone a transformative process wherein the management and administrative processes have been under the governance of various governmental and non-governmental organizations. With each change in leadership, the experiential and institutional lessons that have been learned were incorporated into the administration of the program. And so, at the current time, the collective experience of almost 30 years is now addressed and incorporated in the administration of the NETC program, and it is hoped that the wisdom gained will offer guidance to others that may consider establishing cooperative research programs.

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

RIDOT was the Lead Agency for the first two pooled fund studies. For the five Rounds, state funds were transferred to AASHTO, the Lead Agency (i.e., Administrative Agency), through FHWA, and a single contract was effected between AASHTO and MIT, the Coordinator. MIT would then enter into a no-overhead contract with the selected state university for a particular research project (3).

In 1994, ConnDOT stated its intention to participate in NETC and offered to act as Lead Agency. During Federal Fiscal Year (FFY) 1994, FHWA assumed the Lead Agency designation to facilitate the transition process under Pooled Fund Project No. SPR-3(009), "New England Surface Transportation Consortium." MIT and AASHTO exited NETC, effective FFY1994. ConnDOT entered NETC, effective FFY1995, and was the Lead Agency until December 31, 2011. VAOT has assumed the Lead Agency designation, effective January 1, 2012.

In 1995, after MIT and AASHTO exited NETC, Messrs. Thomas F. Humphrey, former Associate Director, MIT Center for Transportation Studies, and Francis B. Francois, former Executive Director of AASHTO, observed "The NETC program has proven to be a cost-effective, simple and fruitful way for a large number of participants to work together on cooperative regional efforts to address and solve transportation infrastructure problems of mutual concern." (4) The statement holds true today.

Establishment and Start-Up Activities

Several tasks were of paramount importance in preparation of ConnDOT assuming the Lead Agency role.

The most important task was the creation of a document called the NETC Standard Format Agreement. As the Lead Agency, one of the primary tasks for ConnDOT was to enter into contracts, known as Personal Service Agreements (PSAs), on behalf of NETC, with the selected universities to conduct the research projects. Individually negotiating each PSA would have been too costly and inefficient. So ConnDOT successfully negotiated a Standard Format Agreement with all six member state universities, with terms that were acceptable to all parties. The negotiations took place over a period of approximately 18 months. The Standard Format Agreement had to satisfy ConnDOT and FHWA contractual requirements whilst recognizing the sovereign authority of the state governments of the six member state universities. The Standard Format Agreement served NETC well over the course of the next fourteen years; the only revisions to it occurred when Connecticut legislation mandated a change in any of its terms.

Another important task was the creation of a financial tracking system within the State of Connecticut and the ConnDOT financial infrastructures to interact with the FHWA financial systems. Because this was a TPF study, a method of properly allocating each state's financial burden for each NETC invoice for each project had to be established. This became particularly important when the New York State Department of Transportation (NYSDOT) became a participant in individual projects of their choosing, starting in 2001.

Finally, ConnDOT had to initiate a TPF project, SPR-3(029), "New England Transportation Consortium." Projects were funded under the auspices of SPR-3(029) from FFY1995 (CY1995) to FFY1999 (CY1999). To accommodate FHWA accounting policies, FHWA requested ConnDOT to initiate a second TPF project, SPR-3(089), "New England Transportation Consortium." Projects were funded under the auspices of SPR-3(089) from FFY2000 (CY2000) to FFY2008 (CY2008). Again, at FHWA's request, ConnDOT initiated a third TPF project, TPF-5(168), "New England Transportation Consortium (IV)." As of December 31, 2011, SPR-3(009) and SPR-3(029) were closed; they remained active while individual projects funded through these projects were active. Refer to Table 1 for a summary of the NETC TPF project numbers. Based on a consensus decision by the member state transportation agencies, each participant provided \$75,000 per year from 1994 to 1999, and \$100,000 per year, thereafter. In addition, NYSDOT has provided a total of \$374,500 to the NETC program on a project-by-project basis.

Table 1: NETC Transportation Pooled Fund (TPF) Project History (as of December 31, 2011)

Calendar Year	TPF Project Number	Programmed Amount ^a	Number of Programmed Projects	Funding Partners	Lead Agency	Coordinator
Pre-1994	N/A	\$132,777 ^b	4	MA - ME - NH - RI - VT - FHWA	AASHTO	MIT
CY94	SPR-3(009)	\$450,000	4	MA - ME - NH - RI - VT - FHWA	FHWA	FHWA
CY95	SPR-3(029)	\$525,000	5	CT - MA - ME - NH - RI - VT - FHWA	ConnDOT	UConn
CY96	SPR-3(029)	\$382,998 ^c	3	CT - MA - ME - NH - RI - VT	ConnDOT	UConn
CY97	SPR-3(029)	\$799,820 ^d	4	CT - MA - ME - NH - RI - VT	ConnDOT	UConn
CY98	SPR-3(029)	\$450,000	0	CT - MA - ME - NH - RI - VT	ConnDOT	UConn
CY99	SPR-3(029)	\$450,000	5	CT - MA - ME - NH - RI - VT	ConnDOT	UConn
CY00	SPR-3(089)	\$600,000	8	CT - MA - ME - NH - RI - VT	ConnDOT	UConn
CY01	SPR-3(089)	\$600,000	7	CT - MA - ME - NH - RI - VT	ConnDOT	UConn
CY02	SPR-3(089)	\$688,500 ^e	7	CT - MA - ME - NH - RI - VT - NY	ConnDOT	UConn
CY03	SPR-3(089)	\$640,000 ^f	8	CT - MA - ME - NH - RI - VT - NY	ConnDOT	UConn
CY04	SPR-3(089)	\$652,000 ^g	6	CT - MA - ME - NH - RI - VT - NY	ConnDOT	UConn
CY05	SPR-3(089)	\$650,000 ^h	9	CT - MA - ME - NH - RI - VT - NY	ConnDOT	UConn
CY06	SPR-3(089)	\$600,000	5	CT - MA - ME - NH - RI - VT	ConnDOT	UConn
CY07	SPR-3(089)	\$610,000 ⁱ	4	CT - MA - ME - NH - RI - VT	ConnDOT	UMass-D
CY08	SPR-3(089) ^q	\$654,000 ^j	6	CT - MA - ME - NH - RI - VT - NY	ConnDOT ^q	UMass-D
CY09	TPF-5(168) ^o	\$660,000 ^k	5	CT - MA - ME - NH - RI - VT - NY	ConnDOT ^o	UMass-D
CY10	TPF-5(201) ^o	\$660,000 ^l	4	CT - MA - ME - NH - RI - VT - NY	FHWA ^o	UMass-D
CY11	TPF-5(201) ^o	\$610,000 ^m	0	CT - MA - ME - NH - RI - VT	FHWA ^o	UMass-D
CY12	TPF-5(222) ^p	\$600,000 ⁿ	0	CT - MA - ME - NH - RI - VT	VAOT ^p	UMass-D

Footnote(s):

^a Each participant, with the exception of NY, provided \$75,000 per year from 1994 to 1999, and \$100,000 per year, thereafter. NY provided funding for specific projects within a program year, starting in 2002.

^b MIT carryover funds.

^c Programmed amount reduced by \$67,002 (6 x \$11,167) for transfer to SPR-3(052). [$\$450,000 - \$67,002 = \$382,998$]

^d Programmed amount increased by \$349,820 [transferred from SPR-2(800)] for DSR laboratory equipment purchase. [$\$450,000 + \$349,820 = \$799,820$]
[(CT - \$ 70,000) + (MA - \$ 55,820) + (ME - \$ 56,000) + (NH - \$ 56,000) + (RI - \$ 56,000) + (VT - \$ 56,000) = \$349,820]

^e NY contributed \$88,500 for CY02.

^f NY contributed \$40,000 for CY03.

^g NY contributed \$52,000 for CY04.

^h NY contributed \$50,000 for CY05.

ⁱ CT and RI contributed an extra \$5,000, each, for NETC-related travel in CY07.

^j NY contributed \$44,000 for CY08. CT and RI contributed an extra \$5,000, each, for NETC-related travel in CY08.

^k NY contributed \$50,000 for CY09. CT and RI anticipate contributing an extra \$5,000, each, for NETC-related travel in CY09.

^l NY contributed \$50,000 for CY10. CT and RI anticipate contributing an extra \$5,000, each, for NETC-related travel in CY10.

^m CT and RI contributed an extra \$5,000, each, for NETC-related travel in CY11.

ⁿ CT and RI contributed an extra \$5,000, each, for NETC-related travel in CY12.

^o CT established TPF-5(168) as a TPF project to continue the NETC program. It remained active as of December 31, 2011.

^p FHWA began the transition process to assume the role of Lead Agency during CY08; a new TPF project, TPF-5(201) was established with FHWA as the Lead Agency. Subsequently, during the spring of 2009, FHWA withdrew its offer to assume the Lead Agency designation because of concerns that management of a regional research consortium was not within the scope of work for an FHWA Division office. TPF-5 (201) remained active as of December 31, 2011.

^q After FHWA declined the Lead Agency designation, VT offered to assume the role of Lead Agency during the spring of 2010; a new TPF project, TPF-5(222) was established with VT as the Lead Agency. VT assumed full responsibility as Lead Agency, effective January 1, 2012. Because of the long transition period in designating the new NETC Lead Agency, there was a lack of uniformity, among the NETC member states, in the transfer of funds to the existing NETC TPF projects that were active as of December 31, 2011: SPR-3(089), TPF-5(168), TPF-5(201) and TPF-5(222). These funding transfer issues will be resolved after December 30, 2011, so that all available NETC funds will be transferred to VT.

^r SPR-3(089) remained active as of December 31, 2011.

Organization and Management

NETC is structured in such a manner that the partners (state transportation agency professionals, federal transportation agency professionals and academicians) each play a vital role in the successful operation of the Consortium.

NETC is comprised of five major components: Policy Committee; Advisory Committee; Lead Agency; Technical Committees; and, Coordinator.

Policy Committee

The Policy Committee is comprised of the chief administrative officers of each member state transportation agency and one ex-officio representative from FHWA, which has been the Division Administrator in Connecticut. The primary functions of the Policy Committee are: to define, in broad terms, the research needs to be addressed by NETC; provide funding for NETC; and, approve the annual Work Program.

Advisory Committee

The Advisory Committee is comprised of one representative from each of the member state transportation agency and each of the member state universities, as well as one ex-officio representative from FHWA. Advisory Committee state transportation agency representatives have full voting rights; state university representatives vote only on the selection of the topics for the research program. The Advisory Committee acts as liaison between the Policy Committee, the Coordinator and the Technical Committees. The functions of the Advisory Committee are: identifying and soliciting research needs; advising the Policy Committee on implementation needs and opportunities; developing and proposing to the Policy Committee the annual work program; monitoring the progress of research studies and implementation; and, carrying out the directives of the Policy Committee.

Lead Agency

By consensus, the Advisory Committee selects an state transportation agency to act as Lead Agency, with approval from the Policy Committee. Functions of the Lead Agency are to administer the pooled funds; conduct financial transactions for NETC; and, administer Agreements on behalf of NETC.

Technical Committees

A Technical Committee is formed for each project. Each Technical Committee is comprised of one representative from each member state transportation agency and FHWA, each of whom is appointed by the Advisory Committee. The Technical Committee Chairperson is the Technical Committee representative from the state transportation agency that submitted the Problem Statement to NETC. The duties of the Technical Committee include: prepare scopes of work; review and evaluate proposals received in response to Requests for Proposals (RFPs); provide recommendations to the Advisory Committee on the research organization selected to conduct a particular study; monitor technical progress of research; review and make recommendations to the

Advisory Committee on acceptability of interim and final work; and, recommend actions appropriate for implementation of findings.

The benefits of having one representative from each member agency on the Technical Committee are:

- Each state transportation agency has a voice in determining the scope of the project, the selection of the contractor and the content/quality of the project deliverables.
- Involvement of state transportation agency technical staff facilitates technology transfer and implementation of the research findings.
- Provides opportunity for professional growth and development of a sense of collegiality among the staff of member agencies.

The drawbacks to the practice of having one representative from each member state transportation agency and FHWA on the Technical Committee are:

- The state transportation agencies' manpower resources may be overstressed. To lessen the burden on the state transportation agencies, a Technical Committee can be formed with a quorum (four of six states represented on the Technical Committee).
- It may be difficult to get volunteers to serve on Technical Committees if the project is not a high priority from an individual state perspective.
- The Technical Committee member may not have the exact expertise for the project topic.

Coordinator

The day-to-day administrative management of NETC resides in a group or person, known as the Coordinator. The Coordinator provides specific administrative, fiscal and technical management services for the NETC program. The Coordinator is selected in an RFP process open to member state universities. The Coordinator serves a four-year term, which can be extended at the discretion of the Advisory Committee. The functions of the Coordinator are to: oversee the procedural aspects of the research; conduct and coordinate the financial interchanges of NETC; and, provide administrative services to the Policy Committee, Advisory Committee and Technical Committees.

The interaction and processes of the five NETC components are illustrated in Figure 1.

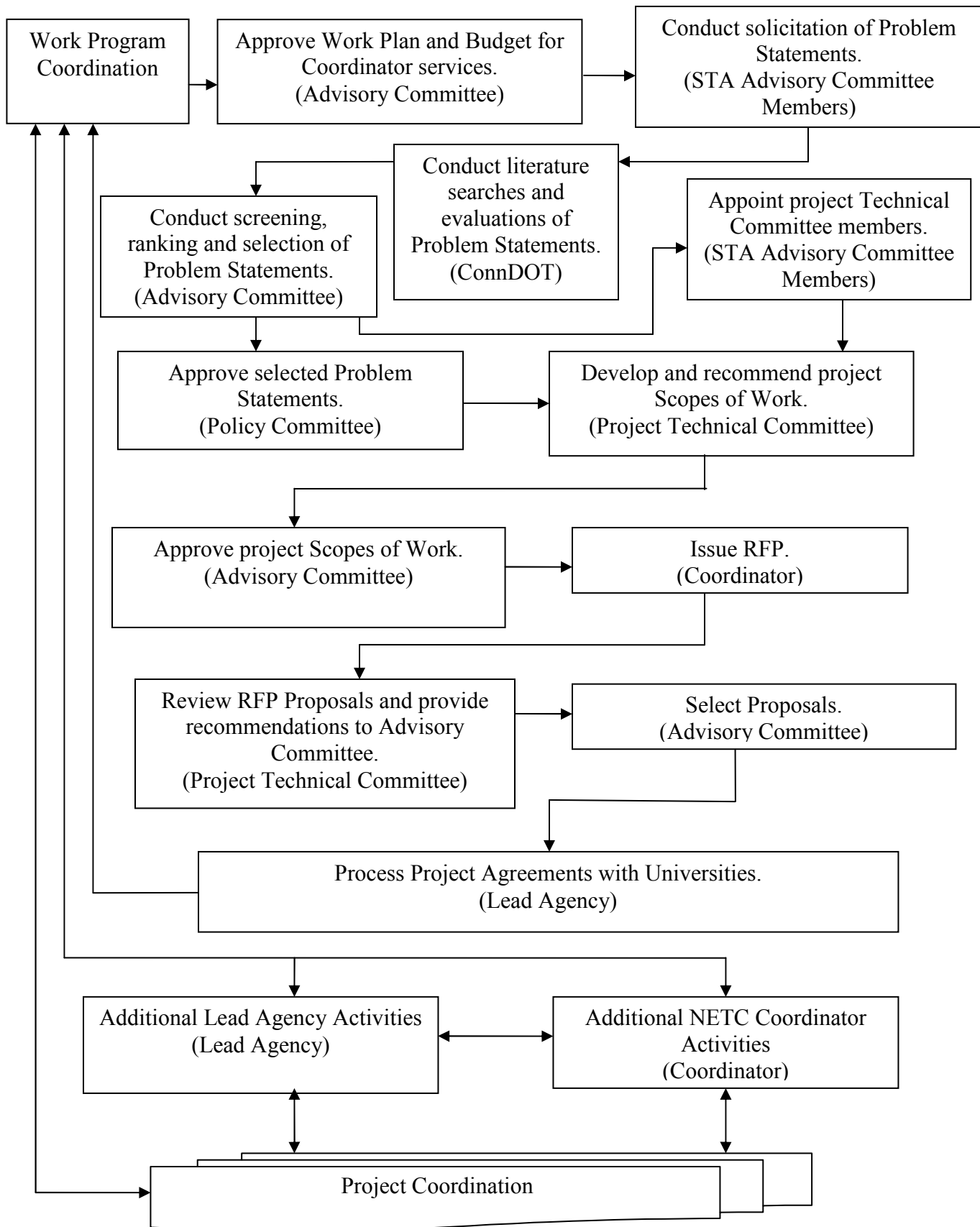


Figure 1: NETC Process

Project Selection Process

Solicitation of Problem Statements

Annually, Advisory Committee state transportation agency representatives solicit Problem Statements from their respective state transportation agencies and member state universities. The Problem Statements are submitted to the Advisory Committee state transportation agency representatives who verify that the Problem Statement has identified a genuine need and is suitable for a regional study. The Advisory Committee state transportation agency representatives then submit the statements to the Coordinator, who assigns a state-specific identifier to each Problem Statement.

Literature Searches and Evaluations of Problem Statements

The Coordinator submits the Problem Statements to ConnDOT. ConnDOT research personnel conduct literature searches. They then review and comment on the merits of each Problem Statement. Results of the literature search and evaluation process are then submitted back to the Coordinator who forwards the results to the Advisory Committee.

Screening, Ranking and Selection of Problem Statements

At its annual springtime meeting, the Advisory Committee first discusses each Problem Statement. By simple majority vote, the Advisory Committee screens the Problem Statements to determine which ones will undergo the formal ranking process. Each Advisory Committee member then assigns a score (0-3, 3 being the highest rank) to each Problem Statement to be ranked; the evaluation criterion is the extent to which the Problem Statement addresses a transportation-related issue that is deemed by the Advisory Committee to be a high-priority regional need. The Problem Statement with the highest score is ranked 1, and so forth. The highest ranked Problem Statement is then selected, and so forth, until the programmed funds have been fully allocated. One or two Problem Statements are also selected as contingency projects in case additional funds become available or there is a problem in developing a particular Problem Statement into a full project.

This stage in the management process is where problem statements transition to projects and are assigned their NETC project numbers.

Policy Committee Approval of Work Program

The Coordinator then prepares and submits the Work Program, developed by the Advisory Committee, to the Policy Committee for consideration. A simple majority of votes is necessary to approve the annual work program. The Policy Committee has the option of approving only selected projects in the recommended work program; in actuality, the Policy Committee has never exercised this right.

Appointment of Technical Committees

The Advisory Committee state transportation agency and FHWA representatives appoint a Technical Committee representative for each project. Once a quorum (minimum of four) has been appointed, the Coordinator convenes a videoconference Technical Committee Organizational Meeting for the project at which work is started to draft the project Scope of Work. The Technical Committee Chairperson coordinates finalization of the recommended Scope of Work and submits it to the Coordinator.

Advisory Committee Approval of Scopes of Work

The Coordinator presents the recommended Scope of Work to the Advisory Committee for approval by majority vote.

Award of Funding

Issuance of Requests for Proposals

Upon approval of the Advisory Committee, the Coordinator issues an RFP to the member state universities and sometimes to other organizations, if recommended by the Technical Committee and approved by the Advisory Committee; the state universities are encouraged to use NETC member state universities as subcontractors, but are free to use non-NETC universities if they so choose. The Coordinator provides the Scope of Work and the required proposal format with the formal RFP.

Evaluation of Proposals by Project Technical Committees

"The proposal should be a well thought-out document that establishes in clear, concise terms the necessity of the research undertaking, definite project objectives, and a systematic work plan designed to attain the project objectives." (1)

The proposals are submitted to the Coordinator who forwards the proposals to the Technical Committee for evaluation. Formal guidelines, with a numerical-based evaluation procedure, similar to that used by NCHRP, have been developed for the evaluation of proposals. The Technical Committee's evaluation results and recommendation for award of funding are submitted to the Coordinator who submits them to the Advisory Committee for consideration and approval.

The Advisory Committee has the option of discussing geographic balance with respect to the award of projects to the state universities. However, the actuality over many programming cycles has been that technical merit is a more persuasive criterion for award selection. As reflected in Table 2, the universities with larger faculties tend to submit more proposals every year for a wider range of subject topics.

Preparation of Project Agreements by Lead Agency

Upon approval by the Advisory Committee, the Coordinator forwards the proposal to the Lead Agency with a request to prepare the Personal Service Agreement to enable the selected state university to conduct the research project.

If a Personal Service Agreement has to be modified to add funding or for a time extension, the contractor submits a modification request to the Coordinator who forwards it to the Technical Committee for review. The Technical Committee's review comments and recommendation are returned to the Coordinator who submits them to the Advisory Committee for consideration and approval.

Program Strengths

Cooperative Effort Between Governmental Agencies

In recent years, the U.S. Department of Transportation (DOT) has encouraged a new perspective in the management of research programs, i.e., emphasizing the need to relate the goals of the various research programs to "the strategic goals for the nation's transportation system: safety, mobility, human and natural environment, economic growth and trade, and national security." (5) "The new approach to research emphasizes cooperation, information-sharing, and development of formal research agendas among the agencies within DOT and across the entire government. It promotes partnerships with state and local governments, academia, and the private sector to accelerate the transformation of new technology, concepts, and ideas into better transportation systems, processes, and services quicker and more cost-effectively." (5)

This intergovernmental cooperation lies at the core of the successful operation of NETC.

Research Needs Solicitation Driven by State Needs

NETC has a process whereby the member state transportation agencies are the determining force behind the collection and submittal of research Problem Statements in any given year, thereby ensuring that needs of the region are met.

Use of Videoconferencing

In partnership with FHWA, NETC pioneered the use of videoconferencing for meetings of its project Technical Committees, thereby eliminating the need for widely dispersed committee members to travel long distances, some of whom would have a 5-hour/230-mile roundtrip. The use of videoconference technology also resulted in improved meeting attendance and shorter meetings.

Opportunities for Professional Growth for State Personnel

Many state transportation agency personnel have benefited from the professional growth associated with their participation in the Consortium's project Technical Committees that develop the Scope of Work, review and evaluate proposals, provide technical oversight and review final reports for NETC research projects.

Strong Framework for Support of Research Projects

NETC has allocated over \$10.5 million between October 1, 1993, and December 31, 2011, to support university research. NETC has funded 89 projects since 1994, three of which are currently active and 19 proposed; the 89 projects do not include the four MIT carryover projects, the Pre-1994 projects, which were completed in 2003. Statistics on the number of research projects are presented in Table 2, Figure 2 and Figure 3.

Table 2: Research Project Statistics (as of December 31, 2011)

Total Number of Projects, Sorted by Project Status	
Status	Number of Projects
Active	3 ^a
Closed	56
Proposed	19
Terminated	4 ^b
Withdrawn	7
TOTAL	89^c

Total Number of Projects, Sorted by University	
	Number of Projects
University of Connecticut	20
University of Massachusetts, Amherst	13
University of Massachusetts, Dartmouth	8
University of Massachusetts, Lowell	1
University of Maine	6
University of New Hampshire	6
University of Rhode Island	7
University of Vermont	6
Cold Regions Research and Engineering Laboratory (CRREL)	1 ^d
Plymouth State University	1
Rutgers, State University of New Jersey	1
Texas Transportation Institute (TTI)	2
N/A ^e	5
TBD ^f	12
TOTAL	89

Total Number of Active Projects, Sorted by University	
	Number of Projects
University of Massachusetts, Dartmouth	1 ^a
University of New Hampshire	1 ^a
University of Rhode Island	1 ^a
TOTAL	3

Footnote(s):

^a These projects were completed, after December 31, 2011, under contract to FHWA.

^b From January 1, 1995, to December 31, 2011, four NETC projects were terminated due to contractual noncompliance. The final products were not completed and NETC did not recover the costs that were incurred as of the termination dates.

^c The 89 projects do not include the four MIT carryover projects, the Pre-1994 projects, which were completed in 2003.

^d NETC 94-3 was performed under Pooled Fund Project No. SPR-3(052), "Procedures for the Evaluation of Sheet Membrane Waterproofing." The Vermont Agency of Transportation was the Lead Agency for Pooled Fund Project No. SPR-3(052). The Contractor was the Cold Regions Research and Engineering Laboratory (CRREL), United States Army Corps of Engineers (USACE).

^e The projects that have an "N/A" designation for the university refer to NETC 01-4 and four projects that were withdrawn from the NETC program. NETC 01-4, "Eliminating Premature Pavement Failure: Creation of a Positive Drainage Layer for Reconstructed and Reclaimed Pavements," is incorporated into NETC 00-8, "Performance and Effectiveness of a Thin Pavement Section Using Geogrids and Drainage Composites in a Cold Region."

^f TBD = To Be Determined.

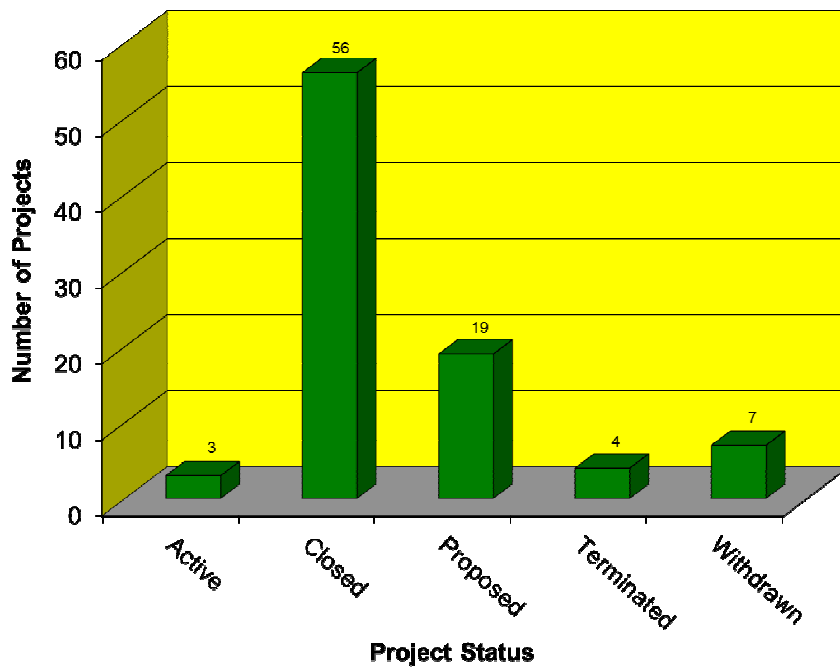


Figure 2: Number of NETC Projects Sorted by Project Status, (as of December 31, 2011)

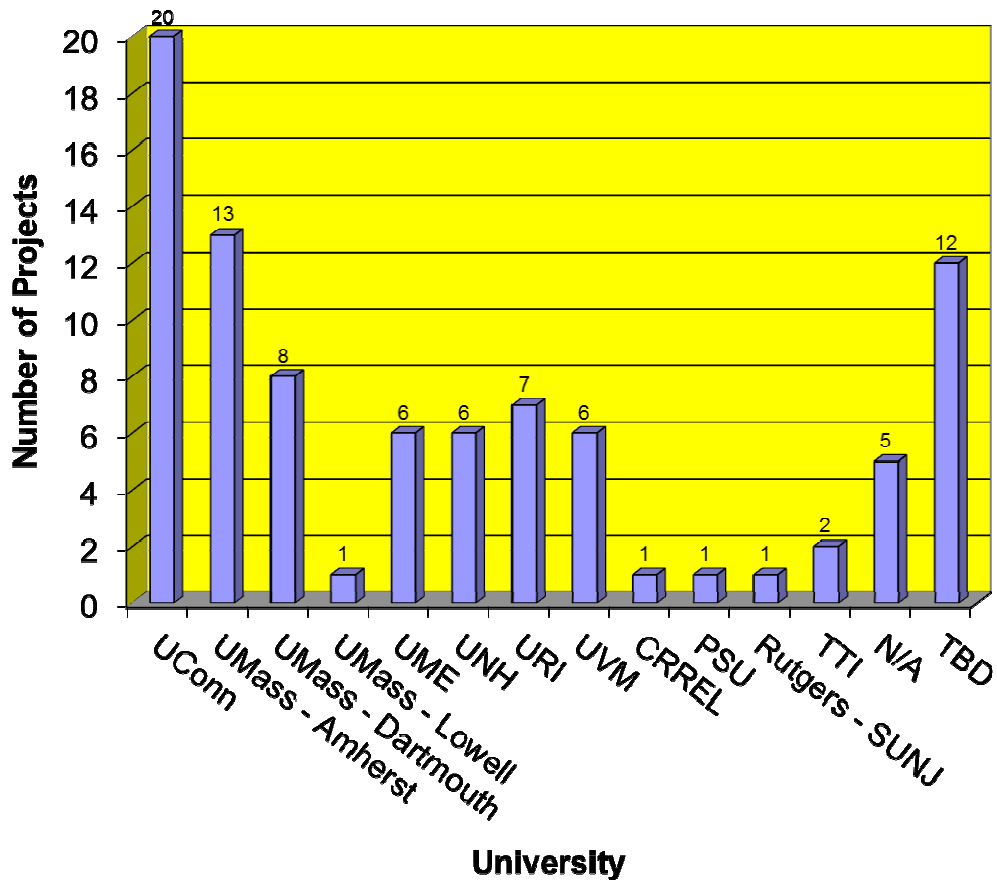


Figure 3: Number of NETC Projects, Sorted by University (as of December 31, 2011)

Unique Capability for Implementation of Research Findings

By being involved in the research project from the development of the Scope of Work through to completion of the final report, NETC's project Technical Committees provide NETC with an inside track for implementation of research findings within the state transportation agencies. Currently, project findings are shared through distribution of the final report, posting of the final report on the consortium's website, workshops, seminars and webinars.

NETC further encourages implementation of research by recognizing that success is more likely when the researchers and user state transportation agencies collaborate and plan. It is for this reason that NETC requires that research proposals include a technology transfer and implementation plan for incorporating the research results/products into practice (1).

In order to more fully understand the extent of the implementation of NETC project results and recommendations, the Advisory Committee approved NETC 08-4, "An Assessment of the Implementation of NETC Research Results." The project is still in a "Proposed" status, but when active, the researcher will evaluate, assess, report on and develop recommendations on the implementation and utilization of research findings from the 85 completed and active NETC projects (6).

Some tasks that are anticipated to be completed in NETC 08-4 include: a review of NETC reports and documents from the 85 completed and active projects, determining sampling requirements; and, conducting interviews, focus groups, or surveys, as needed, with agency staff and customers in the various subject matter fields, such as planning, design, construction, maintenance, rehabilitation, reconstruction and operation of transportation systems. NETC is also interested in the use or implementation of research results by non-NETC institutions or agencies, and if the researcher discovers evidence, through interviews or surveys, of major implementation by non-NETC agencies, a description of that is anticipated to be included in the findings of this project.

From this study, NETC anticipates identifying best practices in research implementation through a literature search among a wide variety of research institutions (e.g., federal, state, provincial and local transportation agencies), giving consideration for organizational and cultural differences among these agencies.

Steady Source for Research Funding and Education and Training of Graduate Students at New England's State Universities

NETC has been a steady source of research funding for the education and training of graduate students at New England's state universities. NETC has funded approximately 300 graduate student semesters since 1995; one graduate student semester equals one graduate student employed for one semester. In addition, NETC has also funded undergraduate student labor for NETC projects.

Partnerships With Entities Outside of Its Funding Members

NETC's procedures for developing and administering transportation research projects have facilitated collaborative funding partnerships with entities outside of its current membership such as NYSDOT and UVM's University Transportation Center.

Collaboration Between Universities and Researchers

Participating in the NETC process is an opportunity for state university researchers to establish professional contacts and working relationships with researchers from other state universities. NETC is the reason that state university researchers have pursued multi-university partnerships and collaborated on proposals submitted to other organizations.

Value in Regional Nature of Consortium

The regional nature of NETC increases the resources available to address critical regional transportation issues. The consortium's procedure for selecting projects to be funded avoids duplication of research efforts by the consortium's individual member agencies.

Without the consortium, regional transportation issues would be neglected until a crisis point is reached. The regional approach allows the leveraging of funds for research projects that address mutual needs and priorities.

The consortium's Technical Committees provide an opportunity for professional growth, professional networking and a sense of commonality and collegiality among the staff of its member agencies that would not otherwise occur.

Establishment of Successful Partnership

The NETC partnership has been successful because it has three common characteristics of a successful partnership:

- "An environment of trust, based on communication, integrity, having the right people at the table, and an authorizing environment;
- Commitment to the relationship, based on a common interest in agreed outcomes, and identifiable clearly perceived benefits in a win/win environment;
- Commitment to the process, including project and process champions, and an agreement (usually written)." (7)

The paragraphs that follow illustrate how NETC satisfies the requirements of the characteristics stated above.

Consortium's Environment of Trust

"Communication, integrity, getting the right people to the table, and empowering staff were all identified as aspects of an effective partnering environment." (7)

NETC promotes trust by fostering open communication by regular meetings, videoconferencing and written communications.

All five major components of NETC (Policy Committee, Advisory Committee, Lead Agency, Technical Committees and Coordinator), as well as the state university researchers, have proved their integrity over the years by faithfully fulfilling the responsibilities expected of them.

The Advisory Committee state transportation agency representatives are decision-makers for the research programs in their respective state transportation agencies and are authorized to speak on behalf of their state transportation agencies. The Advisory Committee state university representatives provide technical advice and guidance for the projects at all phases (evaluation, selection, monitoring and implementation).

In addition, the fact that approval of the Work Program is obtained from the state transportation agencies' chief administrative officers, in the body of the Policy Committee, ensures that the chief administrative officers are aware of and endorse the concept and value of NETC, on an annual basis.

Partners' Commitment to Relationship

"Commitment to the relationship depends largely on whether an environment of trust exists. But two other things also influence the degree to which participants in a partnership are willing to stay committed to the relationship: common interest in the outcomes and identifiable benefits." (7)

Since NETC research needs are driven by the needs of the state transportation agencies, all parties have similar objectives, i.e., addressing transportation research needs of the region by pooling funds, academic resources and professional resources.

The partners see benefits to participating in the Consortium. However, admittedly, there is no formal process for measuring the effectiveness of the NETC program.

An additional benefit to the state transportation agencies is that participation in NETC can raise awareness of the state transportation agency's individual research programs. For example, the state transportation agency that acts as Lead Agency will benefit by having its state transportation agency research program become more visible within the region and the state transportation agency itself.

Partners' Commitment to Process

"Among the factors that keep processes on track are champions and written agreements. Other tools used by DOTs to keep the partners with broad interests at the table include more relationship building at the front end of the process and use of a consensus process for decision-making." (7)

The Coordinator's role serves as a "Program Champion" in that the Coordinator prompts the key players to take action at critical times in the Work Program Cycles and keeps communication open between all concerned parties. The Lead Agency and the Advisory Committee Chairperson serve as "Partnering Champions" to keep the partnering process going.

NETC was established by a Memorandum of Understanding, signed by the Policy Committee. In addition, the Advisory Committee and the Coordinator developed a Policies and Procedures Manual for NETC.

As previously discussed in the "Organization and Management" and "Project Selection Process" Sections, a consensus process is used at every decision-making point in the operation of NETC.

Program Challenges

On-Going Need to Demonstrate Program Value and Review Long-Term Goals

A multistate cooperative effort, such as NETC, needs processes to ensure it serves the needs of, and have relevance to, the states involved.

In an effort to assess program performance and process, a three-day program review was held at the University of Connecticut in 2004. At that time the Advisory Committee concurred that, since the NETC program had been functioning for approximately ten years in its present mode, there was a need to examine the NETC mission, business processes and procedures and policies for relevance and effectiveness.

The following issues were discussed during the Program Review (8):

- Timely appointment of Technical Committee representatives and membership.
- Participation of state universities representatives in the Advisory Committee's meetings.
- Timely progression and completion of research projects.
- The relationship of the NETC research program to the state transportation agency research programs, NCHRP and other transportation research programs throughout the nation.
- Development and execution of project Personal Service Agreements.
- Solicitation of Problem Statements.

- Extent of NETC-funded research implementation and technology transfer activities.
- Allocation of resources for NETC management.
- Solicitation of research proposals.
- Participation of non-Consortium state transportation agencies in NETC.
- Policy Committee membership.

The recommendations developed at the Program Review are being implemented over time.

NETC found the format of a three-day program review, led by a trained moderator, to be a successful format for strategic planning and periodic long-term goal setting.

Bureaucratic Barriers to Timely Actions

Governmental agencies, in general, are bureaucratic in nature, with some flaws inherent to such an organizational structure. A difficult hurdle to the smooth functioning of a consortium of states is the issue of timely decision making. Documentation requirements for written approvals and the number of individuals required to make decisions through a committee structure imposes time requirements on program and project life cycles. All of the due-diligence, communication, deliberation and decision-making processes are put into place in an attempt not only to safeguard against non-priority research and duplication, but also that of the integrity of the governmental process and workforce. In practice, however, the emphasis on documentation and risk avoidance must be balanced against priorities, urgencies and the opportunities made possible through successful NETC research that addresses the needs held in common with the partnering states.

Contracting Issues

Contracting with the member state universities to conduct research was one of the most problematic activities for NETC. In 1995, when ConnDOT first became the NETC Lead Agency, ConnDOT had a streamlined process for entering into Personal Service Agreements. In recent years, modification of the contracting requirements at ConnDOT has changed the contracting environment for NETC. The changes have resulted in longer periods of time from selection of a researcher to the start of the research. As a result, ConnDOT can no longer serve as the contracting body for NETC. VAOT has assumed the role of Lead Agency, effective January 1, 2012.

Between 1995, and December 31, 2011, ConnDOT entered into 153 contracts for NETC research projects and 18 contracts for NETC management (i.e., Coordinator) services. ConnDOT has utilized three contracting mechanisms, including Personal Service Agreements (PSAs), Memoranda of Understanding (MOUs) with the University of Connecticut, and Purchase Orders (POs) for the crash testing services conducted by the Texas Transportation Institute (TTI). Beginning in 1997, at the direction of the Connecticut Office of the Attorney General, MOUs, instead of PSAs, have been used between ConnDOT and UConn since both are state agencies. . Personal Service Agreements continued to be used between ConnDOT and the other State Land Grant universities.

Because of contractual procedural difficulties that arose within the State of Connecticut, ConnDOT was unable to amend and complete its contracts for seven NETC projects. Therefore, beginning in 2009, FHWA entered into contracts with the universities to allow for the completion of the projects. The unexpended project funds were used to fund the FHWA contracts. The SOWs for the seven projects consisted of the tasks remaining to be completed. FHWA contractual information for the seven projects is provided in Table 3.

Table 3: FHWA Contractual Information (as of December 31, 2011)

Project No.	Project Title	Project Status	Contractor	FHWA Contract No.
NETC 03-6	Fix it First: Utilizing the Seismic Property Analyzer and MMLS to Develop Guidelines for the Use of Polymer Modified Thin Lift HMA vs. Surface Treatments	Active	UMass-D	DTFH61-09-H-00009
NETC 04-3	Estimating the Magnitude of Peak Flows for Steep Gradient Streams in New England	Closed	UNH	DTFH61-09-H-00010 ^a
NETC 05-1	Development of Supplemental Resistance Method for the Design of Drilled Shaft Rock Sockets	Closed	UME	DTFH61-09-H-00015 ^a
NETC 05-5	Measurement of Adhesion Properties Between Topcoat Paint and Metallized/Galvanized Steel with 'Surface Energy' Measurement Equipment	Active	URI	DTFH61-10-H-00007
NETC 05-6	Employing Graphic-Aided DMS to Assist Elder Drivers' Message Comprehension	Closed	URI	DTFH61-10-H-00011 ^a
NETC 05-8	Evaluation and Implementation of Traffic Simulation Models for Work Zones	Closed	UMass-A	DTFH61-09-P-00150
NETC 06-1	New England Verification of NCHRP 1-37A Mechanistic-Empirical Pavement Design Guide with Level 2 & 3 Inputs	Active	UNH	DTFH61-09-H-00008

Footnote(s):

^a The FHWA Contract required one no-cost time extension.

Contract statistics are presented in Table 4 and Figure 4. The MIT carryover projects, the Pre-1994 projects, are not included in the contract statistics. As depicted in Figure 4, the number of Original Personal Service Agreements declined after 2005, as a result of changes to the contracting process within Connecticut state government. When the base annual funding level for NETC increased from \$75,000 to \$100,000 per state transportation agency in 2000, the number of agreements increased from 4-5 to 6-7 per year.

For purposes of this discussion, the period 2000-2005 represents a "steady state" period (i.e., between the start-up phase of the initial years and the problematic years, in terms of contracting, starting in 2006) at the higher level of funding.

One specific NETC project was conducted under the auspices of a Transportation Pooled Fund (TPF) program. NETC 94-3 was performed under Pooled Fund Project No. SPR-3(052), "Procedures for the Evaluation of Sheet Membrane Waterproofing." The Vermont Agency of Transportation was the Lead Agency for Pooled Fund Project No. SPR-3(052). The Contractor was the Cold Regions Research and Engineering Laboratory (CRREL), United States Army Corps of Engineers (USACE). CRREL requires payment in advance, which is not allowable under ConnDOT contracting procedures. NETC 94-3 is not included in the contract statistics.

The majority of Personal Service Agreement Amendments are no-cost time extensions because of challenges faced by state universities (e.g., difficulty in recruiting/retaining graduate students and coordinating the academic year/project cycle timing).

Referring to Table 1 and Figure 5, from CY1995 to CY2011, inclusive, a total of 89 projects were programmed, with the average per year of 5. The number of programmed projects increased from an average of 4 to 6 per year with the 2000 increase in the base funding level. The "steady-state" period average is 7 research projects per year.

Table 4: Number of Contractual Mechanisms in the NETC Program (as of December 31, 2011)

Contracting Mechanism for Individual NETC Projects														
CY [A]	Personal Service Agreement (PSA)			Memorandum of Understanding (MOU)			Purchase Order (PO)			FHWA Contract			TBD [C]	Total Number of Contractual Mechanisms
	Original PSA	PSA Amendment		Original MOU	MOU Amendment		Original PO	PO Amendment		Original FHWA Contract	FHWA Contract Amendment			
		NCTE [B]	Other		NCTE [B]	Other		NCTE [B]	Other		NCTE [B]	Other		
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	0	0	0	0	0	0	0	0	0	0	0	0	7
1996	2	0	1	0	0	0	0	0	0	0	0	0	0	3
1997	5	1	0	0	0	0	0	0	0	0	0	0	0	6
1998	4	3	1	0	0	0	0	0	0	0	0	0	0	8
1999	3	3	0	0	0	0	0	0	0	0	0	0	0	6
2000	7	1	0	0	0	0	1	0	0	0	0	0	0	9
2001	6	4	0	0	0	0	1	0	0	0	0	0	0	11
2002	6	4	0	0	0	0	0	0	0	0	0	0	0	10
2003	8	5	0	0	0	0	0	0	0	0	0	0	0	13
2004	5	6	0	0	0	0	0	0	0	0	0	0	0	11
2005	7	4	0	0	0	0	0	0	0	0	0	0	0	11
2006	4	3	0	0	0	0	0	0	0	0	0	0	0	7
2007	3	9	0	2	0	0	0	0	0	0	0	0	0	14
2008	2	0	0	1	2	1	0	0	0	0	0	0	0	6
2009	0	0	0	0	1	0	0	0	0	5	0	0	0	6
2010	0	0	0	0	0	0	0	0	0	2	2	0	0	4
2011	0	0	0	0	0	0	0	0	0	0	1	0	0	1
TBD	0	0	0	0	0	0	0	0	0	0	0	0	20	20
Total	69	43	2	3	3	1	2	0	0	7	3	0	20	153

Contracting Mechanism for NETC Management														
CY [A]	Personal Service Agreement (PSA)			Memorandum of Understanding (MOU)			Purchase Order (PO)			FHWA Contract			TBD [C]	Total Number of Contractual Mechanisms
	Original PSA	PSA Amendment		Original MOU	MOU Amendment		Original PO	PO Amendment		Original FHWA Contract	FHWA Contract Amendment			
		NCTE [B]	Other		NCTE [B]	Other		NCTE [B]	Other		NCTE [B]	Other		
1994	0	0	3	0	0	0	0	0	0	0	0	0	0	3
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	1	0	0	0	0	0	0	0	0	0	0	1
1998	0	0	1	0	0	0	0	0	0	0	0	0	0	1
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	3	0	0	0	0	0	0	0	0	0	0	3
2001	0	0	1	0	0	0	0	0	0	0	0	0	0	1
2002	0	0	1	0	0	0	0	0	0	0	0	0	0	1
2003	0	0	1	0	0	0	0	0	0	0	0	0	0	1
2004	0	0	1	0	0	0	0	0	0	0	0	0	0	1
2005	1	0	0	0	0	0	0	0	0	0	0	0	0	1
2006	0	0	1	0	0	0	0	0	0	0	0	0	0	1
2007	0	0	1	0	0	0	0	0	0	0	0	0	0	1
2008	0	0	1	0	0	0	0	0	0	0	0	0	0	1
2009	0	0	1	0	0	0	0	0	0	0	0	0	0	1
2010	0	0	1	0	0	0	0	0	0	0	0	0	0	1
2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	17	0	0	0	0	0	0	0	0	0	0	18

Footnote(s):

[A] CY = Calendar Year

[B] NCTE = No-Cost Time Extension

[C] TBD = To be Determined

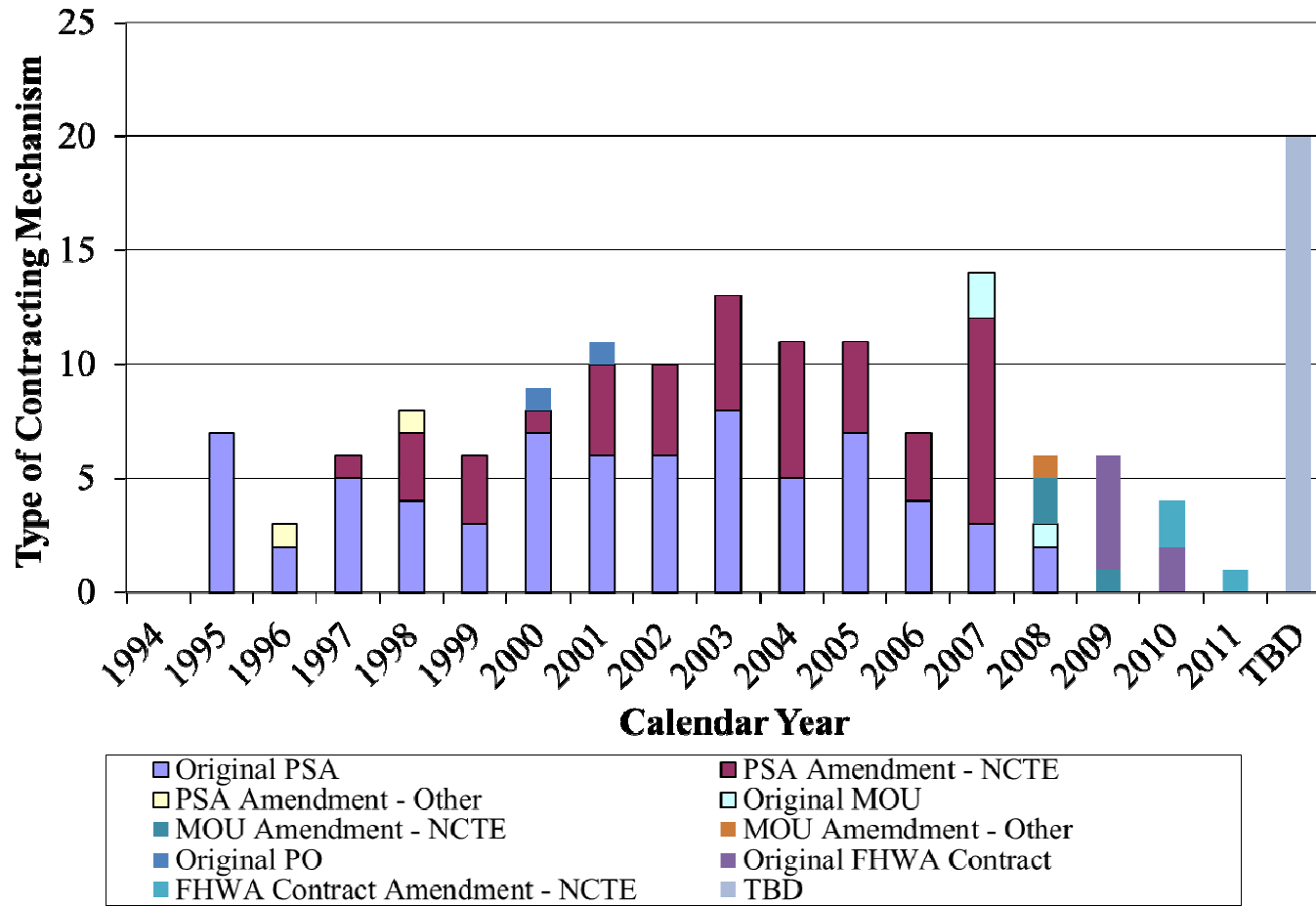


Figure 4: Number of Contracting Mechanisms for Individual NETC Projects, Sorted by Year (as of December 31, 2011)

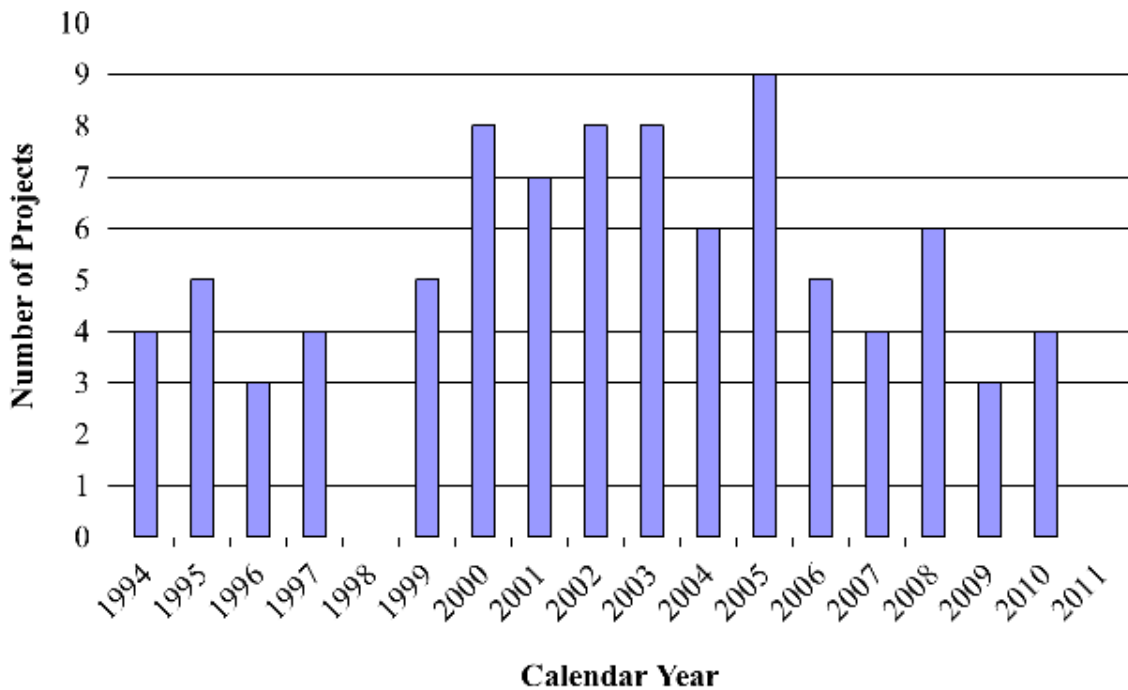


Figure 5: Number of NETC Programmed Projects, Sorted by Year (as of December 31, 2011)

Adequacy of Funding Level

Costs associated with research activities (e.g., labor, fringe rates, supplies, utility/service rates, etc.) have been rising with each passing year. In recognition of this reality, in 2000, the state transportation agencies increased the annual funding level for each state transportation agency from \$75,000 to \$100,000. The New England states received only minor increases in funding for research (i.e., SP&R funds) under SAFETEA-LU.

Conclusions and Recommendations

NETC has proven to be an effective financial, professional and academic collaboration to research and develop improved methods of dealing with common problems in the planning, construction, maintenance, rehabilitation, reconstruction and operation of transportation systems in the participating states.

Based upon lessons learned through the 22-year history of NETC, there are certain principles and guidelines that, if followed, would facilitate the successful establishment and growth of a multistate cooperative research program in other regions of the country.

Principle #1: Identify Key Players in Partnership

During the planning stage for the establishment of the program, identify the following key individuals within each state transportation agency (or organization) of the partnership:

- the administrators (usually the chief administrative officers), the individuals who make the policy and financial decisions for the state transportation agency (or organization);
- the decision makers, the individuals who can make the final decisions for any activity the partnership approves;
- the agencies, organizations and individuals who have the resources, capability and/or authority for making a positive contribution to the partnership; and,
- the agencies, organizations and individuals who have the resources, capability and/or authority for assisting the partnership in overcoming any legal/institutional barriers.

Principle #2: Communicate With Partners

Open communication with all the partners fosters a sense of trust and cooperation between the partners. Past experience has demonstrated that one individual usually assumes this important function to further the interests of the partnership. Open communication and discussion also benefits each member of the partnership by introducing new ideas, that if acted upon by consensus, strengthens the operation of the partnership.

Principle #3: Obtain Consensus on Contracting Mechanism

Because contracting procedures vary from state-to-state, the various contracting options available to the partnerships should be discussed and the "best available" option selected; the "best available" option being a contracting procedure that enables a timely, streamlined development of the contract. Since current federal guidelines permit "home rule" (i.e., the contracting mechanism allowed by state law in a particular state is allowable under federal guidelines) any partner state transportation agency can use its state transportation agency contracting mechanism to contract for the partnership. In the case of ConnDOT, over the years, but especially since 2005, the Connecticut contracting requirements became too burdensome, infringed upon the sovereignty of other states, and, therefore, no longer met the needs of NETC.

Principle #4: Allow for Flexibility in Process and Focus to Accommodate Changing Research Needs and Policies Over Time

Governmental policies, regulations and needs change over time. The partnership process should be robust enough to meet these needs and challenges as they arise. NETC retains flexibility by allowing the Advisory Committee to discuss and revise the focus of the projects selected in any given program year.

Through quarterly progress reports and recommendations from the Technical Committees, the Advisory Committee is kept apprised of the progress of the research projects and any problems encountered. The Advisory Committee can, if it deems necessary, intervene in the conduct of a project.

Principle #5: Emphasize the Research Needs Solicitation Process

The success of any research program begins with the research needs solicitation process. If the process is properly formulated, the research needs solicited will be meritorious and worthy of consideration. NETC continually emphasizes the fact that the program is in place to meet the needs of the member state transportation agencies. Any person considering responding to the NETC needs solicitation is encouraged to contact his/her operational state transportation agency to fully understand the needs of the state transportation agency in terms of that particular issue. NETC also has developed a standard format for the research needs statement to assist the submitter in considering all pertinent factors related to the development of a well-formulated research need. Finally, NETC requires its state transportation agency representatives to the Advisory Committee to review and confirm the merit and relevance of every research need. With these steps, NETC has assured that its process introduces relevant and timely research needs into the program.

Principle #6: Plan for Stability in Funding and Management

One of the contributing factors to the success of NETC has been the relative stability experienced in both the designation of the Lead Agency and the entity providing the coordination services, and funding. Since 1995, there has been only one Lead Agency and two entities providing the coordination services, and funding has increased from \$450,000/yr to \$600,000/yr.

Recommendation #1: Consider Developing an Implementation Metrication Process

The United States Department of Transportation (USDOT), in recent years, has been encouraging, and in some instances requiring, state transportation agencies to develop and implement organizational and program performance measures (9).

The use of performance measures can assist a state transportation agency in six ways:

- justify an outlay of funds for a particular program;
- request additional funds for a particular program;
- substantiate that a particular program is fulfilling its objective;
- allocate resources to a portion of the program that has the best "results";
- market the program's value and products; and,
- attract other funding partners.

Recommendation #2: Consider Developing a Program and Project Performance Measurement Process

NCHRP Project 20-63, "Development of a Manual for State Transportation Research," was recently completed, and a final report issued that offered guidelines and toolbox resources to assist state transportation agencies in developing performance measures for state transportation agency research programs and projects; as emphasized or mandated by recent federal transportation agency policies. "While research performance measurement is important for common management purposes such as program justification and early identification of weakening program areas, there is a heightened need for communication of research program performance and value in the current era of frequent turnover in transportation agency administrators. There is also a growing need at the national level for aggregated research program performance information." (10)

As of December 31, 2011, NETC did not have a process to measure program or project performance measures. A research project to undertake the development of such a process, using the NCHRP 20-63 guidelines and toolboxes, would be an excellent project for NETC to consider as it moves forward.

References

1. *Policies and Procedures: New England Transportation Consortium*. Approved by the New England Transportation Consortium, April 5, 2002.
2. Transportation Pooled Fund Website, Federal Highway Administration. <http://www.pooledfund.org>. Accessed October 29, 2014.
3. Humphrey, T. F. *The New England Transportation Consortium (NETC): Final Report of Activities*. Publication NETC Final Report (1983-1993), Massachusetts Institute of Technology Center for Transportation Studies, October 19, 1994.

4. Humphrey, T. F., and Francois, F. B. The New England Transportation Consortium: A Unique Example of Regional Cooperation. In *Transportation Research Record: TR News, No. 179*, Transportation Research Board of the National Academies, Washington, D.C., July-August 1995, pp. 20-22.
5. Smallen, D. DOT's Vision for Transportation Research. *Public Roads*, Vol. 63, No. 4, January/February 2000, pp. 19-25.
6. *An Assessment of the Implementation of NETC Research Results*. Publication NETC 08-4 Request for Qualification (RFQ), New England Transportation Consortium, November 27, 2007.
7. Ford, M. L. *Managing Change in State Departments of Transportation: Scan 7 of 8: Innovations in Public Partnering and Relationship Building in State DOTs*. Publication NCHRP Web Document 39 (Project SP20-24 [14]): Contractor's Final Report, National Cooperative Highway Research Program, Transportation Research Board, May 2001.
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w39-7.pdf. Accessed October 29, 2014.
8. Oliveira, D.F. *NETC 10-Year Program Review Retreat - November 29, 2004 - December 1, 2004 - Final Report*. New England Transportation Consortium, December 15, 2004.
9. Baird, M. E., and Stammer, Jr., R. E. Measuring the Performance of State Transportation Agencies: Three Perspectives. In *Transportation Research Record: Journal of the Transportation Research Board, No. 1729*, Transportation Research Board of the National Academies, Washington, D.C., 2000, pp. 26-34.
10. Krugler, P, Walden, M. N., Hoover, B., Lin, Y. D., and Tucker, S. *Performance Measurement Tool Box and Reporting System for Research Programs and Projects - Final Report*. CD-ROM. Publication Project No. 20-63. National Cooperative Highway Research Program, April 2006.

Appendix A: Listing of NETC Projects

Project Number: Pre-1994 Project

Project Title: Construction Costs of New England Bridges - Phase II

Project Status: Closed

Contractor: University of Maine

Principal Investigator(s): John A. Alexander, University of Maine
Habib J. Dagher, University of Maine

Report Number: NETCR1

Report Title: Construction Costs of New England Bridges

Author(s): John A. Alexander, University of Maine
Habib J. Dagher, University of Maine
Sean James, University of Maine

Report Publication Date: November 4, 1996

Report URL: <http://www.uvm.edu/~transctr/pdf/netc/netcr01.pdf>

Streaming Media URL(s): N/A

Abstract:

The annual Federal Highway Administration (FHWA) survey of bridge costs indicates that between 1988 and 1993 construction costs of New England bridges averaged \$108 per square foot. This is 74 percent greater than the national average of \$62 per square foot for the same period. The objectives of this study were:

1. to determine the validity of the FHWA survey results, and if they are valid;
2. to identify the cause(s) for this large difference in unit costs; and,
3. to recommend ways to reduce New England bridge construction costs.

Seventeen factors that influence bridge costs were identified and examined, nine of these factors were found to have the most effect on high bridge costs in New England. The remaining factors, while significantly affecting bridge costs in general, do not cause appreciably higher bride costs in New England.

The study quantifies potential cost reductions represented by these factors and makes recommendations for reducing the cost of New England bridges.

Project Number: Pre-1994 Project

Project Title: Tire Chips as Lightweight Backfill - Phase II: Full-Scale Testing

Project Status: Closed

Contractor: University of Maine

Principal Investigator(s): Dana N. Humphrey, University of Maine
Thomas C. Sandford, University of Maine

Report Number: NETCR8

Report Title: Tire Chips as Lightweight Backfill for Retaining Walls - Phase II

Author(s): Jeffrey J. Tweedie, University of Maine
Dana N. Humphrey, University of Maine
Thomas C. Sandford, University of Maine

Report Publication Date: March 11, 1998

Report URL: <http://www.uvm.edu/~transctr/pdf/netc/netcr08.pdf>

Streaming Media URL(s): N/A

Abstract:

Waste tires cut into 25 to 305-mm (1 to 12-in.) pieces yield a material that is coarse grained, free draining and has a low unit weight, thus offering significant advantages for use as retaining wall backfill. This project is a continuation of Phase I, in which the engineering properties of tire shreds were determined. The purpose of this project was to determine design criteria for using tire shreds as retaining wall backfill. This was done by testing a granular control fill and tire shreds from three suppliers in a full scale retaining wall test facility. Tests were performed for at-rest and active conditions. For the at-rest condition, the horizontal earth pressure, interface shear, and compressibility were measured, at surcharges up to 35.9 kPa (750 psf). As much as 7% strain occurred during surcharge application with an additional 3% occurring due to time-dependent settlement. The majority of time-dependent settlement was completed in 50 days. For the active condition, the horizontal earth pressure and deformation within the backfill were measured; tests were performed at the 35.9 kPa (750 psf) surcharge. The horizontal earth pressure for tire shreds was 35% to 45% less than expected from conventional granular fill. The coefficients of lateral earth pressure (K_0 , K_a) were found. K_0 for tire shreds decreased with depth and fell within a small range. At the maximum surcharge and a depth of 2 m (6.5 ft), K_0 ranged from 0.32 to 0.33. K_a for tire shreds was constant with depth and fell within a small range. At 0.01H of outward wall movement, K_a ranged from 0.22 to 0.25. The interface shear strength between tire shreds and a concrete faced wall ranged from 30° to 2°.

Project Number: Pre-1994 Project

Project Title: Bridge Rail Crash Test - Phase II: NETC 4-Bar Sidewalk-Mounted Bridge Rail

Initiated in 1988, Phase I of this project developed and crash tested the NETC 2-Bar Curb-Mounted Bridge Rail.

Based on a recommendation from the Bridge Rail Crash Test Technical Committee, funds were allocated in February 1995 to develop and crash test the NETC 4-Bar Sidewalk-Mounted Bridge Rail.

Phase I: NETC 2-Bar Curb-Mounted Bridge Rail

Project Title: Bridge Rail Crash Test - Phase I: 2-Bar Curb-Mounted Bridge Rail

Project Status: Closed

Contractor: Texas Transportation Institute

Principal Investigator(s):

1995 - James E. Tukey, Maine Department of Transportation
1997 - Eric C. Lohrey, Connecticut Department of Transportation

Report Number: NETCR10

Report Title: Crash Testing and Evaluation of the NETC 2-Bar Curb-Mounted Bridge Rail

Author(s): King J. Mak, Texas Transportation Institute
Wanda L. Menges, Texas Transportation Institute

Report Publication Date: February 1998

Report URL: <http://www.uvm.edu/~transctr/pdf/netc/netcr10.pdf>

Streaming Media URL(s): N/A

Abstract:

The NETC 2-Bar bridge rail design was evaluated in accordance with guidelines set forth in both the 1989 AASHTO Guide Specifications for Bridge Railings Performance Level 2 (PL-2) and Test Level 4 (TL-4) conditions in NCHRP Report 350.

Three crash tests were conducted:

1. Small Car Redirection Test (Test No. 471470-18);
2. Pickup Truck Redirection Test (Test No. 71470-19); and,
3. Single-Unit Truck Redirection Test (Test No. 71470-29).

The bridge rail successfully met all evaluation criteria set forth in both the 1989 AASHTO Guide Specifications for Bridge Railings NCHRP Report 350 for the Small Car Redirection Test (Test No. 471470-18).

The bridge rail also successfully met all evaluation criteria set forth in both the 1989 AASHTO Guide Specifications for Bridge Railings NCHRP Report 350 for the Pickup Truck Redirection Test (Test No. 71470-19). The bridge railing received only minor damage; however, the curb section and bridge deck sustained structural damage at the two post immediately upstream and downstream of the point of impact in the Pickup Truck Redirection Test (Test No. 71470-19). Consequently, the design details for the bridge deck, curb section and steel reinforcement were revised to provide more anchorage capacity.

The redesigned bridge rail and deck design successfully met all evaluation criteria set forth in both the 1989 AASHTO Guide Specifications for Bridge Railings NCHRP Report 350 for the Single-Unit Truck Redirection Test (Test No. 71470-29).

In summary, the redesigned bridge rail and deck design met all evaluation criteria for a Performance Level 2 (PL-2) bridge railing set forth in the 1989 AASHTO Guide Specifications for Bridge Railings and Test Level 4 (TL-4) conditions in NCHRP Report 350.

FHWA approved the NETC 2-Bar Curb-Mounted Bridge Rail for use on the National Highway System (NHS) as a Tl-4 railing.

Phase II - NETC 4-Bar Sidewalk-Mounted Bridge Rail

Project Title: Bridge Rail Crash Test - Phase II: NETC 4-Bar Sidewalk Mounted Bridge Rail

Project Status: Closed

Contractor: Southwest Research Institute

Principal Investigator(s):

- 1995 - James E. Tukey, Maine Department of Transportation
- 1997 - Eric C. Lohrey, Connecticut Department of Transportation
- 1998 - Charles F. McDevitt, Federal Highway Administration
- 1998 - Joseph B. Mayer, Southwest Research Institute

Report Number: NETCR14

Report Title: Full-Scale Crash Evaluation of the NETC 4-Bar Sidewalk-Mounted Steel Bridge Railing

Author(s): C.E. Kimball, Southwest Research Institute
J.B. Mayer, Southwest Research Institute

Report Publication Date: March 1999

Report URL: <http://www.uvm.edu/~transctr/pdf/netc/netcr14.pdf>

Streaming Media URL(s): N/A

Abstract:

This report presents the results of three (3) NCHRP Report 350 Test Level 4 (TL-4) crash tests conducted on a sidewalk-mounted steel bridge railing designed by the New England Transportation Consortium (NETX). The test vehicles included an 820-kg small car, a 2,000-kg pickup truck, and an 8,000-kg single-unit van truck. Barrier performance was determined to be acceptable for the Test Level 4 (TL-4) Longitudinal Barrier category outlined in NCHRP Report 350.

FHWA approved the NETC 4-Bar Sidewalk-Mounted Bridge Rail for use on the National Highway System (NHS) as a Tl-4 railing.

Project Number: Pre-1994 Project

Project Title: New England Vehicle Classification and Truck Weight Program

Project Status: Closed

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): John Collura, University of Massachusetts, Amherst

Report Number: NETCR2

Report Title: New England Vehicle Classification and Truck Weight Program

Author(s): John Collura, University of Massachusetts, Amherst
David Chan, University of Massachusetts, Amherst
Edward Evans, University of Massachusetts, Amherst
Shaun Kelly, University of Massachusetts, Amherst
Trina Hosmer, University of Massachusetts, Amherst
Paul Shuldiner, University of Massachusetts, Amherst

Report Publication Date: April 1996

Report URL: <http://www.uvm.edu/~transctr/pdf/netc/netcr02.pdf>

Streaming Media URL(s): N/A

Abstract:

Recognizing state fiscal problems, personnel shortages and other factors, federal and state highway officials in the region have raised questions regarding the collection of vehicle classification and truck weight data required by the Federal Highway Administration in the Traffic Monitoring Guide. One major question centers around the possibility of coordinating the collection and analysis efforts so that existing staff, funds, equipment and other resources can be used more efficiently. More specifically, this project intends to examine the appropriateness and workability of combining the vehicle classification and truck weight data collection procedures of the six states so that a minimal number of classification and weight locations are required.

This project consists of two phases. The purpose of this report is to present the results of the three major tasks of Phase One, including: 1) a review of vehicle classification and truck weight data collection procedure in each state; 2) an analysis of vehicle classification and truck weight data in each state; and, 3) a formulation of a regional vehicle classification and truck weight program.

The results of Phase One provide a basis for the detailed design of the scope of work in Phase Two which has been proposed to focus on the definition of appropriate data reporting procedures and the development of an associated software to implement a coordinated, regional vehicle classification and truck weight program.

Project Number: NETC 94-1

Project Title: Structural Analysis of New England Subbase Materials and Structures

Project Status: Closed

Contractor: University of Rhode Island

Principal Investigator(s): Kang-Won Wayne Lee, University of Rhode Island
Milton T. Huston, University of Rhode Island
Jeffrey S. Davis, University of Rhode Island

Report Number: NETCR26

Report Title: Structural Analysis of New England Subbase Materials and Structures

Author(s): Kang-Won Wayne Lee, University of Rhode Island
Milton T. Huston, University of Rhode Island
Jeffrey S. Davis, University of Rhode Island
Sekhar Vajjhalla, University of Rhode Island

Report Publication Date: June 30, 2001

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr26_94-1.pdf

Streaming Media URL(s): N/A

Abstract:

Properties of subbase materials used in New England have been compiled and a diversity of materials and practices has been catalogued. Most New England states have specifications for reclaimed materials, but Connecticut and Massachusetts are the only states routinely using reclaimed materials in the construction of the subbase layer. Connecticut allows stockpiles of reclaimed materials maintained at inspected private sites and blended there to meet specifications. Massachusetts specifies full depth in place milling of the entire pavement structure down to the subgrade, and the addition of virgin materials may be required to meet specifications.

The resilient modulus of subbase materials (E_{SB}) had been selected as the primary parameter for structural analysis of New England subbase materials, and the AASHTO T292-91 procedure had initially been used. However, the AASHTO TP46-94 procedure was finally selected to determine moduli of subbase materials with and without reclaimed asphalt pavement (RAP), since it uses larger specimens (150 mm dia. x 300 mm ht.) which represent the field samples better, a servo-hydraulic actuator, and more appropriate equipment configuration, including LVDT location, which leads to less testing error. Virgin aggregate and reclaimed subbase materials provided by the participating state transportation agencies had been tested. Fundamental properties, coefficients of permeability, resilient moduli and layer coefficients for ten subbase materials have been determined in the present study. In addition, milled asphalt pavements have been blended for optimization of layer

coefficient. All blends have coefficients better than the virgin aggregates. Based on results of the study, procedures for State agencies to develop optimum properties have been recommended.

Project Number: NETC 94-2

Project Title: Nondestructive Testing of Reinforced Concrete Bridges
Using Radar Imaging Techniques

Project Status: Closed

Contractor: University of Vermont

Principal Investigator(s): Dryver R. Huston, University of Vermont

Report Number: NETCR19

Report Title: Nondestructive Testing of Reinforced Concrete Bridges
Using Radar Imaging Techniques

Author(s): Dryver R. Huston, University of Vermont
Peter Fuhr, University of Vermont
Kenneth Maser, University of Vermont
William Weedon, University of Vermont

Report Publication Date: July 1, 2002

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr19_94-2.pdf

Streaming Media URL(s): N/A

Abstract:

The goal of this project was to examine the critical issues related to the use of ground penetrating radar (GPR) in the inspection of concrete bridge deck roadways. The project involved numerical, laboratory and field studies of GPR interactions with reinforced concrete roadways. Some of the key results are:

1. ***The state of the art in GPR inspection of concrete roadways was examined.*** - This included an identification of damage mechanisms in concrete, and the various associated evaluation techniques. The conclusion of the survey was that GPR is a potentially powerful method of bridge deck inspection, but that the technology needs some more development before it can be used.
2. ***Numerical Modeling*** - Numerical 1-D and 2-D models indicated that GPR waves can potentially reflect subsurface cracks and air-filled delaminations.
3. ***Laboratory Tests*** - The results of the laboratory tests were that subsurface air-filled delaminations could be identified with a 0.5 - 6 GHz system, and that a 0.5 - 20 GHz system would work even better, when the penetration depth was sufficient.
4. ***Field Tests*** - Various versions of the system was tested several times on local bridges, retaining walls and columns. Subsurface rebars could be identified. Delaminations were identified based on weak rebar reflections and were correlated with hammer tap results.

5. ***Recommended Specifications*** - Recommended specifications for a field test system have been formulated. New FCC regulations on ultrawideband instruments will have to be incorporated in all new systems.

Project Number: NETC 94-3

Project Title: Procedures for the Evaluation of Sheet Membrane Waterproofing [1]

Project Status: Closed

Contractor: Cold Regions Research and Engineering Laboratory (CRREL),
United States Army Corps of Engineers (USACE)

Principal Investigator(s): Charles J. Korhonen, Cold Regions Research
and Engineering Laboratory (CRREL),
United States Army Corps of Engineers
(USACE)

Report Number: NETCR13

Report Title: Procedures for the Evaluation of Sheet Membrane
Waterproofing

Author(s): Charles J. Korhonen, Cold Regions Research and Engineering
Laboratory (CRREL), United States Army Corps of Engineers
(USACE)
James S. Buska, Cold Regions Research and Engineering
Laboratory (CRREL), United States Army Corps of
Engineers (USACE)
Edel R. Cotez, Cold Regions Research and Engineering
Laboratory (CRREL), United States Army Corps of
Engineers (USACE)
Alan R. Greatorex, Cold Regions Research and Engineering
Laboratory (CRREL), United States Army Corps of
Engineers (USACE)

Report Publication Date: August 12, 1999

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr13_94-3.pdf

Streaming Media URL(s): N/A

Abstract:

Sheet membrane waterproofing had been used to protect bridge decks against water and deicing salts by transportation agencies in New England for more than two decades. Though such membranes have proven useful at extending the useful life of bridge decks, there are no convenient methods to evaluate one membrane against another. This report details the genesis of blisters, a major problem for membranes, and defines test procedures to evaluate sheet membranes based on their ability to adhere to concrete, accommodate strain, resist puncturing and pass water vapor. The results of these tests allow an engineer to compare sheet membranes based on materials properties but they, alone, cannot be used to predict how well a membrane will perform in practice. Because a laboratory environment does not reflect the complex combination of forces and deterioration mechanisms a membrane is exposed to in the field, a follow-up study of the installation/design process and long-term performance of membranes in actual bridges needs

to be conducted. This report provides a needed step toward the ability to predict sheet membrane service life.

Note(s):

- [1] The work for NETC 94-3 was performed under Pooled Fund Project No. SPR-3(052), "Procedures for the Evaluation of Sheet Membrane Waterproofing." Vermont was the Lead State.

Project Number: NETC 94-4

Project Title: Durability of Concrete Crack Repair Systems

Project Status: Terminated [1]

Contractor: University of Rhode Island

Principal Investigator(s): George Tsiatas, University of Rhode Island

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objectives of this study were to determine the fatigue life, durability and effectiveness of the intrusion prevention characteristics of various structural concrete crack repair systems when subjected to dynamic flexural and compressive stresses and freezing and thawing.

Note(s):

[1] NETC 94-4 was terminated on April 9, 2001.

Project Number: NETC 95-1

Project Title: Use of Tire/Chips/Soil Mixtures to Limit Frost Heave and Pavement Damage of Paved Roads

Project Status: Closed

Contractor: University of Maine

Principal Investigator(s): Dana N. Humphrey, University of Maine

Report Number: NETCR12

Report Title: Use of Tire/Chips/Soil Mixtures to Limit Frost Heave and Pavement Damage of Paved Roads

Author(s): Brian K. Larewnce, University of Maine
Lihue Chen, University of Maine
Dana N. Humphrey, University of Maine

Report Publication Date: June 2000

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr12_95-1.pdf

Streaming Media URL(s): N/A

Abstract:

This research study investigated the use of tire chips and tire chip/soil mixtures as subgrade insulation on secondary paved roads. Insulating properties of tire chips can reduce frost heave-induced damage to paved roads. The free-draining properties of tire chips can strengthen the subgrade and subbase during the spring thaw by allowing excess water to drain. The use of tire chips would also remove large quantities of whole tires from stockpiles.

Project Number: NETC 95-2

Project Title: Suitability of Non-Hydric Soils for Wetland Mitigation

Project Status: Closed

Contractor: University of New Hampshire

Principal Investigator(s): Larry K. Brannaka, University of New Hampshire
Christine V. Evans, University of New Hampshire

Report Number: NETCR5

Report Title: Suitability of Non-Hydric Soils for Wetland Mitigation

Author(s): Larry K. Brannaka, University of New Hampshire
Christine V. Evans, University of New Hampshire

Report Publication Date: February 28, 1997

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr05_95-2.pdf

Streaming Media URL(s): N/A

Abstract:

This project looked at the suitability of non-hydric soils for wetland mitigation by reviewing the literature, and by investigating sites at which non-hydric soils were successfully used in wetland mitigation projects. Five sites were selected for field study. They included the Pine Road Wetland Mitigation Site in Brentwood, New Hampshire; the Bangor Hydroelectric Graham Lake Dam remediation wetland mitigation site in Ellsworth, Maine; the Maine Department of Transportation wetland mitigation site at the old Maine Turnpike southbound exit 6 in Scarborough, Maine; the cloverleaf exit from I-691 to Route 10 in Cheshire, Connecticut; and, the Michelle Memorial Park wetland mitigation in Salem, New Hampshire. Each site was visited, and characterizations were made of the soils and hydrologic conditions.

Conclusions were drawn from the data analyses and the information gathered in the first phase of the project. The literature indicated hydrologic conditions are the controlling factor governing the formation of hydric soils. The soils should be saturated for at least 7-21 days of the growing season in order to form the characteristic hydric morphological features. Organic matter also influences the formation of redoximorphic features characteristic of wetlands. Redoximorphic features did not form in soils with less than 1.5% organics, while soils with 3% or greater were most effective in producing redox depletion in flooded plots. A small laboratory experiment using upland site soils indicated that the site soils supported this conclusion. Each site was considered a functioning site, and the soils used in the construction of all but one site were classified as hydric. The site investigations corroborated the findings of literature review. Guidelines were developed to match appropriate soils to the wetland type and the site hydrology.

Project Number: NETC 95-3

Project Title: Implementation and Evaluation of Traffic Marking
Recesses for Application of Thermoplastic Pavement
Markings on Modified Open Graded Mixes

Project Status: Closed

Contractor: University of Rhode Island

Principal Investigator(s): Kang-Won Wayne Lee, University of Rhode
Island
Stephen A. Cardi, II, University of Rhode
Island
Sean Corrigan, University of Rhode Island

Report Number: NETCR23

Report Title: Implementation and Evaluation of Traffic Marking
Recesses for Application of Thermoplastic Pavement
Markings on Modified Open Graded Mixes

Author(s): Kang-Won Wayne Lee, University of Rhode Island
Stephen A. Cardi, II, University of Rhode Island
Sean Corrigan, University of Rhode Island

Report Publication Date: July 2000

Report URL: <http://ntl.bts.gov/lib/17000/17400/17426/PB2001101582.pdf>

Streaming Media URL(s): N/A

Abstract:

Snow plow blade abrasion is the most noticeable mechanism of damage to all types of pavement marking materials, with the worst effect occurring with thermoplastic skip stripes on open graded friction course (OPFC). Unfortunately, the thermoplastic markings are extruded onto the OGFC at a 1/8 inch thickness, which becomes a substantial target for snow plow blade damage during the winter maintenance season. In some cases the scraping action of the snow plow blades shear off the thermoplastic markings or pull out pieces of the OGFC layers, penetrated by the thermoplastic.

If thermoplastic markings are applied to a constructed recess in the pavement surface, the snow plow blades would pass over without damaging either the marking and/or the pavement surface. Therefore, this study explored the best means of creating traffic marking recesses on modified OGFC mixes and the cost effectiveness of this method.

A trial field installation of this method was carried out with the cooperation of a contractor. Detailed construction specifications were developed and included application methods and equipment, for use by any state highway agency (SHA). The installation consisted of a 1,000 ft tangent section, a 500 ft exit ramp section, and a 500 ft curved section. Three types of recesses and a non recessed control section were constructed within each test section. A new pavement marking

product, permanent inlaid tape, used by the Rhode Island Department of Transportation just outside the limits of the three test sections was also incorporated into the present study.

Project Number: NETC 95-5

Project Title: Buried Joints in Short Span Bridges

Project Status: Terminated [1]

Contractor: University of Rhode Island

Principal Investigator(s): George Tsiatas, University of Rhode Island
Kang-Won Wayne Lee, University of Rhode
Island

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objectives of this study were to determine the viability of buried joints in short span steel and concrete bridges in New England states.

Note(s):

[1] NETC 95-5 was terminated on April 9, 2001.

Project Number: NETC 95-6

Project Title: Guidelines for Ride Quality Acceptance for Pavements

Project Status: Closed

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): John Collura, University of Massachusetts,
Amherst
Tahar El-Korchy, Worcester Polytechnic
Institute

Report Number: NETCR6

Report Title: Guidelines for Ride Quality Acceptance for Pavements

Author(s): John Collura, University of Massachusetts, Amherst
Tahar El-Korchy, Worcester Polytechnic Institute
Kenneth Black
Matthew Chase
Li Jin

Report Publication Date: April 1997

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr06_95-6.pdf

Streaming Media URL(s): N/A

Abstract:

An intent of this project is to assist State Highway Agencies (SHAs) in New England in resolving issues and questions associated with the design and use of an initial ride quality specification. To this end, a literature synthesis was conducted to review such issues and questions surrounding the use of current paving practices and the application of different ride quality parameters, measuring devices, and bonus and penalty schedules. In addition, a survey of current ride quality and paving practices of SHAs in New England and in several other states was performed and a field study to examine the ride quality measuring devices being used in New England was also carried out. Finally, a product of this project is a proposed ride quality specification for SHAs in New England.

Project Number: NETC 96-1

Project Title: SUPERPAVE Implementation

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Jack E. Stephens, University of Connecticut

Report Number: NETCR18

Report Title: SUPERPAVE Implementation

Author(s): James Mahoney, University of Connecticut
Jack E. Stephens, University of Connecticut

Report Publication Date: September 1999

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr18_96-1.pdf

Streaming Media URL(s): N/A

Abstract:

The conversion from viscosity grading asphalt binders to Superpave Performance Graded Asphalt Binders (PGAB) has required a major change in the testing equipment and protocols. The test results from the PGAB showed large variations between laboratories. These variations could result in disputes between PGAB suppliers and state highway agencies. This study looked at possible causes for the test result variations as well as possible remedies. The project also conducted Asphalt Binder Technician Workshops to convey the interim findings of the project as well as to learn where potential problems may exist based upon feedback from the technicians conducting these tests.

Project Number: NETC 96-2

Project Title: Buried Joints in Short Span Bridges

Project Status: Terminated [1]

Contractor: University of Connecticut

Principal Investigator(s): C. Roger Ferguson, University of
Connecticut
John E. Bean, Central Connecticut State
University

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objectives of this study were to:

1. investigate the factors which drive the use of GPS within transportation departments in New England;
2. analyze the conditions which determine base station spacing and develop objective guidelines to be used when selecting multiple base station sites;
3. examine the parameters which affect data collection, processing, dissemination and storage both in the field and at base stations; and,
4. Explore new and innovative uses of GPS in the transportation arena, including terrestrial and airborne mapping applications.

Note(s):

[1] NETC 96-2 was terminated on September 2, 2004.

Project Number: NETC 96-3

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

Project Status: Closed

Contractor: University of Rhode Island

Principal Investigator(s): Kang-Won Wayne Lee, University of Rhode Island
Perumalsamy Balaguru, Rutgers, State University of New Jersey

Report Number: NETCR28

Report Title: Effectiveness of High Strength Composites as Structural and Protective Coatings for Structural Elements

Author(s): Perumalsamy Balaguru, Rutgers, State University of New Jersey
Kang-Won Wayne Lee, University of Rhode Island

Report Publication Date: May 2001

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr28_96-3.pdf

Streaming Media URL(s): N/A

Abstract:

The primary objective of the study is to identify a cost-efficient composite system that will provide protection and strengthening of transportation structures under wet-dry, freeze-thaw and deicing salt environments.

Project Number: NETC 97-1

Project Title: Portable Method to Determine Chloride Concentration on Roadway Pavements

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Nikolaos P. Nikolaidis, University of Connecticut
Norman W. Garrick, University of Connecticut

Report Number: NETCR17

Report Title: A Portable Method to Determine Chloride Concentration on Roadway Pavements

Author(s): Norman W. Garrick, University of Connecticut
Nikolaos P. Nikolaidis, University of Connecticut
Jianhui Luo, University of Connecticut

Report Publication Date: September 2002

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr17_97-1.pdf

Streaming Media URL(s): N/A

Abstract:

Sodium chloride (NaCl) is by far the most commonly used deicing chemical. More effective use of deicer chemical could result in significant economical and environmental benefits. Studies have shown that the ability to measure the salt concentration on the roadway surface would bring dramatic advances in the effective use of deicer. Concentration measurement devices currently in use are only for point measurement and are dangerous for field measurement personnel because they require manual on site measurement. Our new portable concentration system in this project which is mounted on a truck enables safe and continuous measurement of salt concentration.

This study adopts the principle of collecting the tire splash to measure the residual salt concentration on the road surface. A conductivity probe is used to detect salt concentration because it is simple to use and is suitable for rugged field applications. Field test results show that the system was able to continuously detect the salt concentration and distinguish the difference between two areas of different salt concentration under field conditions. A delay in the salt concentration detection, due to the inflow fluid detained in the snow collection box, was observed. However, an analytical method to model this delay and to predict the inflow concentration was developed.

Project Number: NETC 97-2

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

Project Status: Closed

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): James M. LaFave, University of Massachusetts, Amherst

Report Number: NETCR36

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

Author(s): Scott A. Civjan, University of Massachusetts, Amherst
James M. LaFave, University of Massachusetts, Amherst
Daniel Lovett, University of Massachusetts, Amherst
Daniel J. Sund, University of Massachusetts, Amherst
Joanna Trybulski, University of Massachusetts, Amherst

Report Publication Date: February 2003

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr36_97-2.pdf

Streaming Media URL(s): N/A

Abstract:

The performance of single, double, and triple combinations of corrosion preventing admixtures was investigated. An extensive literature review, a survey of New England States mix design procedures, and 108 weeks of accelerated corrosion study results are presented. The experimental study included slab specimens subjected to severe salt water ponding conditions to evaluate corrosion inhibiting performance of each mix design. Both non-cracked and pre-cracked specimens were evaluated for fourteen mix designs (42 specimens). Admixtures studied were; calcium nitrite, silica fume, fly ash, ground blast furnace slag, and DSS. Corrosion was monitored through half-cell and macrocell potential readings, visual observation, and autopsies of specimens at the end of testing. Based on these results, mix designs including a triple combination of calcium nitrite, silica fume, and fly ash, or a double combination of calcium nitrite and slag are currently recommended. DSS alone or in combination with calcium nitrite provided the best performance of all mixes studied, but requires further study prior to widespread acceptance.

Project Number: NETC 97-3

Project Title: Determining Properties, Standards and Performance of Wood Waste Compost as an Erosion Control Mulch and as a Filter Berm

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Richard P. Long, University of Connecticut
Kenneth R. Demars, University of Connecticut

Report Number: NETCR20

Report Title: Use of Wood Waste Materials for Erosion Control

Author(s): Kenneth R. Demars, University of Connecticut
Richard P. Long, University of Connecticut
Jonathan R. Ives, University of Connecticut

Report Publication Date: April 2000

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr20_97-3.pdf

Streaming Media URL(s): N/A

Abstract:

Three wood waste materials were evaluated for use as an erosion control mulch and one of the materials was used as an erosion control filter berm. Samples of the three materials were subjected to laboratory tests to determine their physical and chemical properties for comparison with the CONEG specifications for these erosion control applications. Each of the materials was subjected to large scale erosion control testing at a field site with a slope of 1 vertical to 2 horizontal. Fourteen test cells (5' W x 30' L each) were prepared with different wood waste treatments; nine contained erosion control mulch applications at thicknesses of ¼ to 3 inch. Two cells were left untreated as reference cells and three other cells were untreated but contained erosion control structures including wood waste filter berm, geosynthetic silt fence and hay bale silt barrier. The erosion control performance of each cell treatment was evaluated for eleven storm events of varying rainfall magnitude and intensity. Calibrated tipper buckets were used to measure the runoff from each cell and collection buckets were used to sample runoff and determine the mass of sediment eroded from each cell. Total rainfall and intensity of each storm was measured with an electronic rain gauge. The results show that wood waste material is very effective at reducing erosion when used as an erosion control mulch at a thickness of ¼ inch or greater. Additionally, the wood waste materials, used for an erosion control berm, were more effective at controlling erosion than a geosynthetic silt fence or hay bale berm.

Project Number: NETC 97-4

Project Title: Early Distress of Open-Graded Friction Courses

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Jack E. Stephens, University of Connecticut
James M. Mahoney, University of Connecticut
Charles E. Dougan, University of Connecticut

Report Number: NETCR16

Report Title: Early Distress of Open-Graded Friction Courses

Author(s): Jack E. Stephens, University of Connecticut
James M. Mahoney, University of Connecticut
Charles E. Dougan, University of Connecticut

Report Publication Date: July 1999

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr16_97-4.pdf

Streaming Media URL(s): N/A

Abstract:

Field performance observations and tests were conducted on Open-Graded Friction Courses (OGFC) in four of six New England states. The data obtained included: distress surveys; friction measurements; surface texture values using two methods; air permeability; and, gradation of aggregate recovered from cores. These data were analyzed and the OGFC layer's performance evaluated.

Conclusions regarding performance are set forth based on the data obtained and the results of an extensive literature survey. Recommendations concerning the placement of OGFC and subsequent maintenance are presented.

Project Number: NETC 99-1

Project Title: Bridge Rail Transitions - Development and Crash Testing

Project Status: Closed

Contractor: Texas Transportation Institute

Principal Investigator(s):

1999 - Jerry Zoller - New Hampshire Department of Transportation

2001 - David R. Hall, Federal Highway Administration, New
Hampshire Division

2005 - Dean C. Alberson, Texas Transportation Institute

Report Number: NETCR53

Report Title: NCHRP Report 350 Testing and Evaluation of NETC Bridge
Rail Transitions

Author(s): Dean C. Alberson, Texas Transportation Institute
C. Eugene Buth, Texas Transportation Institute
Wanda L. Menges, Texas Transportation Institute
Rebecca R. Haug, Texas Transportation Institute

Report Publication Date: January 2006

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr53_99-1.pdf

Streaming Media URL(s):

- NCHRP Report 350 Testing and Evaluation of NETC Bridge Rail
Transitions - NETC Project 99-1 (Presentation of Results)
Presented by Dean C. Alberson, Texas Transportation Institute
February 02, 2006

http://www.dotdata.ct.gov/media/mainpsa.aspx?url=mms://159.247.0.209/mediapoint/netc/netc_99-1.wmv?sami=http://www.ct.gov/dot/lib/dot/documents/dConnDot/none.smi&name=%20Dean%20Alberson%20-NETC%20Project%2099-1

mms://159.247.0.209/mediapoint/netc/netc_99-1.wmv?

- NCHRP Report 350 Recommended Procedures for the Safety
Performance Evaluation of Highway Features
Presented by Dean C. Alberson, Texas Transportation Institute
February 02, 2006

<http://www.dotdata.ct.gov/media/mainpsa.aspx?url=mms://159.247.0.209/mediapoint/netc/NCHRP-350.wmv?sami=http://www.ct.gov/dot/lib/dot/documents/dConnDot/none.smi&name=%20Dean%20Alberson%20-NCHRP%20Report%20350>

<mms://159.247.0.209/mediapoint/netc/NCHRP-350.wmv?>

Abstract:

In two previous projects, the New England Transportation Consortium (NETC) developed and crash tested two steel bridge rail systems: a 2-Bar Curb-Mounted system; and, a 4-Bar Sidewalk-Mounted system. The NETC 2-Bar Curb-Mounted Bridge Rail was tested to Performance Level 2 (PL-2), in accordance with the AASHTO Guide Specifications for Bridge Railings, and was effectively accepted as a NCHRP Report 350 Test Level 4 (TL-4) railing by the FHWA Office of Highway Safety. The NETC 4-Bar Sidewalk-Mounted Bridge Rail met evaluation criteria for an NCHRP Report 350 traffic barrier at TL-4. The FHWA Office of Highway Safety Infrastructure has concluded that both bridge rails are acceptable as TL-4 designs and may be used on the National Highway System.

The objective of the proposed research study was to qualify transitions to the two bridge rail systems and to a concrete end wall that is used as a component of several bridge rail systems.

The NETC New Hampshire transition to the two-bar steel bridge rail successfully contained and redirected the pickup for TL-3 test conditions. All occupant risk values were acceptable. The NETC Massachusetts transition to the concrete end wall successfully contained and redirected both the pickup and the single unit truck for TL-4 test conditions. All occupant risk values were acceptable where applicable.

Project Number: NETC 99-2

Project Title: Evaluation of Asphaltic Plug Joints

Project Status: Closed

Contractor: University of Massachusetts, Dartmouth

Principal Investigator(s): Walaa S. Mogawer, University of
Massachusetts, Dartmouth

Report Number: NETCR50

Report Title: Evaluation of Asphaltic Plug Joints

Author(s): Walaa S. Mogawer, University of Massachusetts, Dartmouth
Alexander J. Austerman, University of Massachusetts,
Dartmouth

Report Publication Date: November 30, 2004

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr50_99-2.pdf

Streaming Media URL(s): N/A

Abstract:

Asphaltic expansion joints, commonly referred to as Asphaltic Plug Joints (APJs), provide a relatively low cost joint option for bridges with approximately one-inch of movement. However, failure of these joints can expose the underlying structural bridge components to water and salts that can lead to corrosion. In New England, many of these joints have reached, or are nearing, the end of their anticipated service life. The objectives of the research is to identify reasons of joint failure, identify the useful life span, evaluate the overall costs, identify flaws in installation and maintenance methods, and establish recommendations regarding initial design considerations (skew, expansion, etc.). Field inspections were conducted on 64 in-service APJs in five New England states to determine predominant materials distresses leading to failure. These distresses were determined to be debonding, cracking and rutting. Lab testing was conducted on virgin binder and aggregate as well as cores of in-service APJ material. Each binder was tested to determine its Superpave Performance Grade (PG) and evaluate its resiliency. The aggregates were tested to determine their gradation and amount of fines. The core material was extracted to determine gradation and approximate binder content. This testing information, along with a comprehensive review of existing specifications, was used to develop design guidelines, a design specification, an installation specification, and a repair specification for use in New England.

Project Number: NETC 99-3

Project Title: Development of Priority Based Statewide Scour
Monitoring Systems in New England

Project Status: Closed

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): Carlton L. Ho, University of Massachusetts,
Amherst
Jeffrey M. Di Stasi, University of
Massachusetts, Amherst

Report Number: NETCR24

Report Title: Development of Priority Based Statewide Scour Monitoring
Systems in New England

Author(s): Carlton L. Ho, University of Massachusetts, Amherst
Jeffrey M. Di Stasi, University of Massachusetts, Amherst

Report Publication Date: August 2, 2001

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr24_99-3.pdf

Streaming Media URL(s): N/A

Abstract:

A project was funded by the New England Transportation Consortium (NETC) to research the creation of a scour monitoring system that would assist in the allocation of resources during potentially destructive flood events in New England. Emphasis was placed upon the adoption and use of existing tools and infrastructure to accomplish these tasks. A web-based approach using a spatial decision support system (SDSS) would be adopted for development of the monitoring system. An SDSS is a platform independent software application that can be used as both a decision and research tool. The versatility of the model enables discretion to be used, which emphasizes the importance of engineering judgment with respect to the analytical method used to evaluate scour potential in this system.

Potential components of the system are identified and reviewed, such as existing scour analyses, instrumentation, and automated gages. Internet websites are discussed in detail to familiarize DOTs with sources of available real-time weather products pertinent to the assessment of scour conditions. A GIS is created for each New England state to geographically integrate bridge, dam, and gage infrastructure in order to recognize the relation between them. Various scour models are presented along with methods for determining hydraulic input parameters to be entered into the models. The framework of a conceptual scour monitoring system is outlined and a potential scenario is used to illustrate the operation of the monitoring system for real-time warning and assessment of scour conditions. The sum result of these tasks was the development of a prototype real-time scour

monitoring and assessment tool that integrated web-based assessment tools, geographic information systems, and Internet resources.

Project Number: NETC 99-4

Project Title: Quantifying Roadside Rest Area Usage

Project Status: Closed

Contractor: University of Maine

Principal Investigator(s): Per E. Garder, University of Maine

Report Number: NETCR38

Report Title: Quantifying Roadside Rest Area Usage

Author(s): Per E. Garder, University of Maine
Nicolas Bosonetto, University of Maine

Report Publication Date: November 27, 2002

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr38_99-4.pdf

Streaming Media URL(s): N/A

Abstract:

This study examines issues relevant to the design and operation of Interstate rest areas. The study concentrates on the New England region and is sponsored by the NETC. Usage trends and motorists' preferences were collected through a survey program conducted at eleven sites and with residents of all the New England states. Motorists, in general, see rest areas as a necessity, and favor keeping them, but many have issues with public safety and cleanliness. The results also show that restrooms are the primary demand but the road condition and tourism information services are rated as highly desirable by some rest area users. The report suggests a kiosk system to provide this information to travelers using a GIS interface. Other recommendations include region-wide comprehensive parking development and management, as well as improvements in waste water systems. Rest area improvements are essential to the New England tourism and freight sectors of the economy.

Project Number: NETC 99-6

Project Title: Analytical and Experimental Investigations of the Effects of Concrete Removal Operations on Adjacent Concrete that is to Remain

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Rusk Masih, University of Connecticut
Tixiang Wang, University of Connecticut

Report Number: NETCR29

Report Title: Analytical and Experimental Investigations of the Effects of Concrete Removal Operations on Adjacent Concrete that is to Remain

Author(s): Rusk Masih, University of Connecticut
Tixiang Wang, University of Connecticut
Andrew Forbes, University of Connecticut

Report Publication Date: January 15, 2002

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr29_99-6.pdf

Streaming Media URL(s): N/A

Abstract:

This report contains both analytical and experimental work, as well as mathematical work, on a concrete bridge, located on Route 89 in Vermont. The bridge was renovated by replacing the deck. The experimental work included monitoring the effect of the Hoe-Ram operation on the remaining concrete, by placing strain gages at different places on the deck, abutments and piers. The gages were connected to strain monitoring equipment, which was connected to a laptop computer to record the strain gage readings. Concrete samples were taken at locations adjacent to the points where the Hoe-Ram operated. They were tested to find if that concrete was affected by the operation. The analytical work included the simulation of the Hoe-Ram operation as static and dynamic load. The concrete elements were modeled in a finite element configuration and special software was used to do the analysis. The software was ANSYS. The analysis showed the contours of stresses in the area adjacent to the points of the Hoe-Ram operation. Both analytical and experimental results were consistent with each other, having some acceptable margin of difference. The mathematical work included the use of the wave equation to predict effect of the Hoe-Ram on the deck by using differential equations, then using special mathematical software to solve those equations, after applying the boundary conditions.

Project Number: NETC 00-1

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

Project Status: Closed

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): Kathleen L. Hancock, University of Massachusetts, Amherst

Report Number: NETCR30

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

Author(s): Jason DeGray, University of Massachusetts, Amherst
Kathleen L. Hancock, University of Massachusetts, Amherst

Report Publication Date: August 2002

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr30_00-1.pdf

Streaming Media URL(s): N/A

Abstract:

Across New England, the use of ground-based imaging technologies ranges from very sophisticated, to very simple, to not used at all. The primary objective of this project is to quantify and summarize the use of ground-based imagery in the six New England states and to provide an overview of the benefits of ground-based imaging technologies. A secondary objective is to determine what kind of linkage exists between roadway databases and GIS systems across the New England states and provide information to the states about the potential benefits of linking these tools.

Project Number: NETC 00-2

Project Title: Evaluation of Permeability of Superpave Mixes

Project Status: Closed

Contractor: University of Massachusetts, Dartmouth

Principal Investigator(s): Walaa S. Mogawer, University of
Massachusetts, Dartmouth
Rajib B. Mallick, Worcester Polytechnic
Institute

Report Number: NETCR34

Report Title: Evaluation of Permeability of Superpave Mixes

Author(s): Walaa S. Mogawer, University of Massachusetts, Dartmouth
Rajib B. Mallick, Worcester Polytechnic Institute
Matthew R. Teto
William C. Crockford

Report Publication Date: July 3, 2002

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr34_00-2.pdf

Streaming Media URL(s): N/A

Abstract:

The objectives of this study were to evaluate permeability of Superpave mixes and develop procedure for permeability testing. The scope included testing of mixes in the laboratory and in the field, determination of relationships between mix properties and permeability, and development and recommendation of new mix design and in-place testing methods. Results from this study indicate that air voids, gradation and nominal maximum aggregate size have significant effects on permeability of HMA mixes. Amounts of interconnected air voids were found to be significantly higher for coarse graded mixes. A critical permeability of 10^{-3} cm/s is suggested for designing HMA mixes. Porosity test by the vacuum sealing method was found to be a good indicator of mix permeability. Porosity was found to be significantly affected by mix gradation, specifically the percent passing the 2.36 mm sieve. Charts were developed to help mix designers avoid mixes with excessive permeability, by selecting appropriate gradation and in-place air voids. Results of field tests indicated that in-place permeability is significantly affected by air voids and aggregate gradation and nominal maximum aggregate size. Permeabilities of coarse graded mixes with larger nominal maximum aggregate size are more sensitive to change in air voids than relatively fine mixes with smaller nominal maximum aggregate size. A laboratory-field permeameter was developed for testing "true" in-place permeability and also for use as a field quality control tool.

Project Number: NETC 00-3

Project Title: Design, Fabrication, and Preliminary Testing of A Composite Reinforced Timber Guardrail

Project Status: Closed

Contractor: University of Maine

Principal Investigator(s): William G. Davids, University of Maine

Report Number: NETCR39

Report Title: Design, Fabrication, and Preliminary Testing of A Composite Reinforced Timber Guardrail

Author(s): William G. Davids, University of Maine
Joshua K. Botting, University of Maine

Report Publication Date: March 31, 2004

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr39_00-3_rev02.pdf

Streaming Media URL(s): N/A

Abstract:

An FRP-reinforced hardwood glulam guardrail was designed and tested for durability and the potential to pass a TL-3 vehicular crash test. The research conducted in this study combined dynamic structural analysis of the guardrail system under vehicular impact with a carefully designed laboratory testing program to establish the adequacy of the guardrail. The results of this research indicate that the guardrail as designed and tested is structurally adequate, and when preservative treated, should be sufficiently durable for exterior use. A unique bolted steel splice connection was developed to transfer tensile forces between 3.65m-long rail sections. This splice is critical to the crashworthiness of the rail, and allows easy installation and replacement of damaged rail sections. The rail section is lighter and easier to install than existing timber guardrail alternatives, and is expected to be cost-competitive for applications where an aesthetically pleasing timber guardrail is required.

Project Number: NETC 00-4

Project Title: Portable Falling Weight Deflectometer (FWD) Study

Project Status: Closed

Contractor: University of Maine

Principal Investigator(s): Dana N. Humphrey, University of Maine
Maureen A. Kestler, USDA Forest Service

Report Number: NETCR52

Report Title: Portable Falling Weight Deflectometer Study

Author(s): Bryan C. Steinert, University of Maine
Dana N. Humphrey, University of Maine
Maureen A. Kestler, USDA Forest Service

Report Publication Date: March 11, 2005

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr52_00-4.pdf

Streaming Media URL(s): N/A

Abstract:

This research investigated the effectiveness of the Portable Falling Weight Deflectometer (PFWD) for evaluating the support capacity of pavements during the spring thaw and evaluating the adequacy of subgrade and base compaction during construction. The performance of ten asphalt and gravel surfaced low volume roads were evaluated through spring thaw and recovery. Comparisons were made to the traditional FWD as well as other portable measuring devices. It was shown that the PFWD was able to follow seasonal stiffness variations and compared well with FWD derived moduli on both asphalt and gravel surfaces. Recommendations were made for using a PFWD to determine when to place and remove load restrictions. Field and laboratory tests were conducted to develop correlations between composite modulus, percent compaction, and water content for a range of aggregate types typical of New England. Comparisons were made between multiple PFWDs. A tentative technique was recommended for using a PFWD for compaction quality control for aggregate base and subbase courses. This is based on a rough equivalency between the PFWD composite modulus and percent compaction for aggregate at optimum water content. Factors are provided to correct the modulus at the field water content to the equivalent value at optimum.

Project Number: NETC 00-5

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

Project Status: Closed

Contractor: Texas Transportation Institute

Principal Investigator(s): Dean C. Alberson, Texas Transportation Institute

Report Number: NETCR35

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

Author(s): Dean C. Alberson, Texas Transportation Institute
Wanda L. Menges, Texas Transportation Institute
Rebecca R. Haug, Texas Transportation Institute

Report Publication Date: July 2002

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr35_00-5.pdf

Streaming Media URL(s): N/A

Abstract:

The objective of this study, as stated in the NETC request for proposal is to "...conduct the testing needed for FHWA consideration of the acceptability of the NETC MELT... at *NCHRP Report 350* Test Level 2 (TL-2) 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 TL-2 guardrail terminal." *NCHRP Report 350* TL-2 evaluates the impact performance of the guardrail terminal when impacted by a vehicle traveling 70 km/h (43.5 mi/h) rather than, as previously tested, the TL-3 impact speed of 100 km/h (62.2 mi/h). NETC contracted to perform *NCHRP Report 350* test designations 2-30 and 2-31. *NCHRP Report 350* test designation 2-30 involves an 820-kg passenger car impacting the terminal end-on at a nominal impact speed and angle of 70 km/h and 0 degree with the quarter point of the vehicle aligned with the centerline of the nose (i.e., end post) of the terminal. This test is intended primarily to evaluate occupant risk and vehicle trajectory criteria. *NCHRP Report 350* test designation 2-31 involves a 2000-kg pickup truck impacting the terminal end-on at a nominal impact speed and angle of 70 km/h and 0 degree with the centerline of the vehicle aligned with the centerline of the nose (i.e., end post) of the terminal. This test is intended primarily to evaluate occupant risk and vehicle trajectory criteria. Reported herein are the details of the NETC MELT installation, description of the two full-scale crash tests performed, and the results and assessment of those tests. The NETC MELT performed acceptably for *NCHRP Report 350* test designations 2-30 and 2-31.

Project Number: NETC 00-6

Project Title: Effective Visualization Techniques for the Public
Presentation of Transportation Projects

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Norman W. Garrick, University of
Connecticut
Peter Miniutti, University of Connecticut
Mark Westa, University of Connecticut

Report Number: NETCR48

Report Title: Effective Visualization Techniques for the Public
Presentation of Transportation Projects

Author(s): Norman W. Garrick, University of Connecticut
Peter Miniutti, University of Connecticut
Mark Westa, University of Connecticut
Jianhui Luo, University of Connecticut
Matt Bishop, University of Connecticut

Report Publication Date: July 2005

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr48_00-6.pdf

Streaming Media URL(s): N/A

Abstract:

The purpose of this project was to look at ways to develop more coherent and effective approaches for presenting transportation projects to the public. A detailed review of recent research on visual perception and visualization was conducted. We also conducted site visits to two consulting firms and one state DOT. In addition to field trips, we conducted mail-in surveys to the six New England DOTs and compared our survey results to a previous nationwide survey conducted in 1998.

The result of the study showed that image composite continue to be the most popular visualization techniques used in both DOTs and consulting firms. Animation, which is the most effective visualization technique, is expected to be used more frequently as the cost and time of production are reduced.

We also found that visualization techniques are mainly used in the public involvement process in the New England DOTs; they are rarely used in design and design development. We expect that this will change as Context Sensitive Design takes hold in the DOTs. As this occurs, we expect that visualization will be more frequently incorporated, not only in the public involvement stage, but also at all stages of design. Because transportation design and public involvement are parallel processes, DOTs will find that the usage of visualization in design

will be invaluable in helping transportation designers evaluate and refine their design.

Project Number: NETC 00-7

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

Project Status: Closed

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): Emily Parkany, University of Massachusetts, Amherst
Chi Xie, University of Massachusetts, Amherst

Report Number: NETCR37

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

Author(s): Emily Parkany, University of Massachusetts, Amherst
Chi Xie, University of Massachusetts, Amherst

Report Publication Date: February 7, 2005

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr37_00-7.pdf

Streaming Media URL(s): N/A

Abstract:

The purpose of this report is to assess the strengths and limitations of available sensor technologies and their corresponding processing algorithms. The performance of an incident detection system is determined on two levels: data collection technologies and data processing algorithms. Variations in sensor-and-algorithm schemes result in a variety of solutions for incident detection. In this report, three categories (roadway-based, probe-based and driver-based) incident detection technologies and their corresponding algorithms are reviewed and evaluated. The capability, accuracy, reliability and cost of available sensor technologies are emphasized. A variety of algorithms associated with these technologies are also investigated in terms of their performance and ease of implementation. Responses to a nationwide online survey of traffic management centers (TMCs) and traffic operations centers TOCs) across the U.S. provide first-hand information regarding experiences and problems of implementation. The report includes consideration of incident detection on arterial roads and the use of section-related data in incident detection.

Project Number: NETC 00-8

Project Title: Performance and Effectiveness of a Thin Pavement Section Using Geogrids and Drainage Geocomposites in a Cold Region [1]

Project Status: Closed

Contractor: University of Maine

Principal Investigator(s): Dana N. Humphrey, University of Maine

Report Number: NETCR60

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

Author(s): Christopher L. Helstrom, University of Maine
Dana N. Humphrey, University of Maine
Jeremy M. Labbe, University of Maine

Report Publication Date: August 2007

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr60_00-8.pdf

Streaming Media URL(s): N/A

Abstract:

Test sections were constructed in two portions of Maine Route 9 to investigate the use of geosynthetics for reinforcement and drainage for subbase courses that were 300 mm (12 in.) and 600 mm (24 in.) thick with 150 mm (6 in.) of flexible pavement. Four types of test sections were constructed: geogrid reinforcement, drainage geocomposite, drainage geocomposite with geogrid reinforcement, and control. Test sections using reinforcement geogrid have strain gages attached to the geogrid to measure induced forces. Some of the reinforcement sections have geogrid on subgrade whereas some have geogrid in the center of the subbase to evaluate the effects of geogrid location. Drainage geocomposite and control sections have vibrating wire piezometers to monitor porewater pressure in the subgrade and subbase course. Thermocouples were used to measure the depth of frost penetration. The results of falling weight deflectometer tests were used to backcalculate the effective structural number for each section. Reinforcement geogrid and drainage geocomposite increased the effective structural number by between 5% and 17% for sections with 300 mm (12 in.) subbase. However, they had no apparent effect for sections with 600 mm (24 in.) of subbase. The increase in backcalculated effective structural number that was produced by geogrid and/or drainage geocomposite in the 300-mm (12-in.) subbase sections could also be obtained by adding between 25 and 75 mm (1 and 3 in.) of subbase aggregate to an unreinforced section.

Note(s):

[1] NETC Project No. 01-4, "Eliminating Premature Pavement Failure: Creation of a Positive Drainage Layer for Reconstructed and Reclaimed Pavements," is incorporated into NETC Project 00-8, "Performance and Effectiveness of a Thin Pavement Section Using Geogrids and Drainage Composites in a Cold Region."

Project Number: NETC 01-1

Project Title: Advanced Composite Materials (Fiber Reinforced Polymers or Polymer Matrix Composites) for New England's Highway Infrastructure: A Synthesis of Technology and Practice

Project Status: Closed

Contractor: University of Massachusetts, Amherst [1]

Principal Investigator(s): Sergio F. Breña, University of Massachusetts, Amherst
Scott A. Civjan, University of Massachusetts, Amherst

Report Number: NETCR62

Report Title: Advanced Composite Materials (Fiber Reinforced Polymers or Polymer Matrix Composites) for New England's Highway Infrastructure: A Synthesis of Technology and Practice

Author(s): Sergio F. Breña, University of Massachusetts, Amherst
Scott A. Civjan, University of Massachusetts, Amherst
Marshall Goodchild, University of Massachusetts, Amherst

Report Publication Date: May 31, 2006

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr62_01-1.pdf

Streaming Media URL(s): N/A

Abstract:

Advanced composite materials (ACMs) have been used to a limited extent in the transportation infrastructure. Their widespread application has been hindered in the past because of lack of design documents and paucity of documented performance under the diverse environmental conditions encountered in the transportation infrastructure. The current research project focused on identifying obstacles and developing a methodology to increase the use of ACMs within the transportation infrastructure in New England. The following activities were undertaken to achieve the goal of the project: (1) creation of development and compilation of questionnaires sent to engineers in transportation agencies, fabricators, and researchers; (2) creation of a web site for information dissemination; (3) conducting meetings at transportation agencies; (4) identification of perceived obstacles for using ACMs in transportation infrastructure projects; and, (5) development of a methodology to expand the use of ACMs in future transportation infrastructure projects in New England.

Note(s):

[1] NETC 01-1 was originally awarded to the University of New Hampshire. The University of New Hampshire terminated the Agreement for NETC 01-1 in a Termination Letter, dated August 14, 2002. NETC 01-1 was then awarded to the University of Massachusetts, Amherst, the bidder ranked second highest in the Screening and Ranking process.

Project Number: NETC 01-1 (T2 Phase 1)

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

Project Status: Closed

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): Sergio F. Breña, University of
Massachusetts, Amherst
Scott A. Civjan, University of
Massachusetts, Amherst

Report Number: NETCR77

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

Author(s): Sergio F. Breña, University of Massachusetts, Amherst
Scott A. Civjan, University of Massachusetts, Amherst

Report Publication Date: November 1, 2009

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr77_01-1_t2.pdf

Streaming Media URL(s): N/A

Abstract:

A wealth of research on the use of advanced composite materials (ACMs) for civil engineering applications has been conducted and published during the last two decades. The use of ACMs in the transportation infrastructure has also been demonstrated through a limited number of trial projects throughout the United States. The use of these materials in civil engineering was originally promoted to solve the problem of an aging and deteriorating transportation infrastructure. To this date, however, the full potential of ACMs has not been realized due to obstacles encountered during the design/construction process of these demonstration projects. In order to further advance the application of ACMs in transportation infrastructure projects this project will identify a component commonly used in the transportation infrastructure in New England and propose its fabrication using advanced composite materials (ACMs). Development of a research problem statement for phase II of the project will allow solicitation of proposals to fabricate and implement the selected component in future transportation projects in New England.

Project Number: NETC 01-2

Project Title: Development of a Testing Protocol for Quality Control/Quality Assurance of Hot Mix Asphalt

Project Status: Closed

Contractor: University of Massachusetts, Dartmouth

Principal Investigator(s): Walaa S. Mogawer, University of Massachusetts, Dartmouth
Rajib B. Mallick, Worcester Polytechnic Institute

Report Number: NETCR43

Report Title: Development of a Testing Protocol for Quality Control/Quality Assurance of Hot Mix Asphalt

Author(s): Walaa S. Mogawer, University of Massachusetts, Dartmouth
Rajib B. Mallick, Worcester Polytechnic Institute
William Crockford

Report Publication Date: February 5, 2004

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr43_01-2.pdf

Streaming Media URL(s): N/A

Abstract:

The objective of this research was to develop a test protocol for the use of the rapid triaxial test method for use in quality control of HMA production. The scope of this study consisted of testing different mixes at two different temperatures and frequencies and evaluating the results. The equipment is rugged and portable, and the hardware and software are easy to handle and do not require extensive technician training. The results from this study show that modulus and phase angle values obtained from testing are sensitive to key mixture components and properties. The coefficients of variation of results obtained from tests conducted at 60°C and 1 Hz are low. Tests with fine graded mixes showed good correlation of dynamic stiffness parameters with rutting, and the stiffness parameters were found to be sensitive to dust to effective binder ratio. One significant advantage of using this test procedure as a regular quality control tool is that decisions can be taken on the basis of performance related parameters rather than on the basis of volumetric properties only. Considering the desirable qualities, it seems that this test method can be considered for regular use for quality control testing. However, before it is used, user agencies must test mixes using the suggested test protocol, and establish target values and allowable variations.

Project Number: NETC 01-3

Project Title: Design of Superpave HMA for Low Volume Roads

Project Status: Closed

Contractor: University of Massachusetts, Dartmouth

Principal Investigator(s): Walaa S. Mogawer, University of
Massachusetts, Dartmouth
Rajib B. Mallick, Worcester Polytechnic
Institute

Report Number: NETCR51

Report Title: Design of Superpave HMA for Low Volume Roads

Author(s): Walaa S. Mogawer, University of Massachusetts, Dartmouth
Rajib B. Mallick, Worcester Polytechnic Institute

Report Publication Date: December 31, 2004

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr51_01-3.pdf

Streaming Media URL(s): N/A

Abstract:

The Superpave mix design system is being adopted by most of the states in the United States. Since the Superpave system was developed on the basis of data mostly obtained from medium to high traffic volume roads, there is a need to develop criteria for mix design for Hot Mix Asphalt (HMA) mixes for low traffic volume roads. In this study, research was carried out to develop a proper mix design system for low volume roads from the standpoint of durability properties. For low volume roads, the performance is primarily affected by the environment and not by traffic. The approach in this study has been to determine the optimum value of a key volumetric property and an optimum number of design gyrations for producing compacted HMA mixes with adequate resistance against aging/high stiffness related durability problems. Three 9.5 mm NMAS and two 12.5 mm NMAS fine graded mixes were tested during this research. Based on the results from performance testing, film thickness of 11 microns in samples compacted to 7 percent voids were found to be desirable from a stability and durability standpoint. A design VMA of 16 percent was determined to be optimum value for producing durable and stable mixes for low volume roads. Results from testing of in-place mixes from good performing 10 to 12 year old low volume roads indicated a design gyration of 50 for obtaining a void content of 4 percent for mixes with gradations close to the maximum density line.

Project Number: NETC 01-4

Project Title: Eliminating Premature Pavement Failure: Creation of a Positive Drainage Layer for Reconstructed and Reclaimed Pavements [1]

Project Status: Withdrawn

Contractor: University of Rhode Island

Principal Investigator(s): George Tsiatas, University of Rhode Island

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objectives of this study were to determine the fatigue life, durability and effectiveness of the intrusion prevention characteristics of various structural concrete crack repair systems when subjected to dynamic flexural and compressive stresses and freezing and thawing.

Note(s):

[1] NETC Project No. 01-4, "Eliminating Premature Pavement Failure: Creation of a Positive Drainage Layer for Reconstructed and Reclaimed Pavements," is incorporated into NETC Project 00-8, "Performance and Effectiveness of a Thin Pavement Section Using Geogrids and Drainage Composites in a Cold Region."

Project Number: NETC 01-5

Project Title: Procedures for the Evaluation of Liquid-Applied
Membrane Waterproofing

Project Status: Withdrawn [1]

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objective of this study was to identify and/or develop a series of tests that can be used to evaluate liquid membranes. The following properties should be considered for this research: adhesion (both to the concrete deck and the overlying bituminous pavement), tensile strength and elongation, puncture resistance, water vapor permeability, aging characteristics and holiday testing.

Note(s):

[1] 01-5 was withdrawn from the NETC program on March 4, 2004, by E-Mail ballot.

Project Number: NETC 01-6

Project Title: Field Evaluation of a New Compaction Device

Project Status: Closed

Contractor: University of Massachusetts, Dartmouth

Principal Investigator(s): Heather J. Miller, University of
Massachusetts, Dartmouth
Rajib Mallick, Worcester Polytechnic
Institute

Report Number: NETCR42

Report Title: Field Evaluation of a New Compaction Device

Author(s): Heather J. Miller, University of Massachusetts, Dartmouth
Rajib B. Mallick, Worcester Polytechnic Institute

Report Publication Date: June 26, 2003

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr42_01-6.pdf

Streaming Media URL(s): N/A

Abstract:

This report documents a research project conducted to verify the effectiveness of the Soil Compaction Supervisor (SCS) as a tool for determining optimum compaction for highway construction applications. The scope of work included testing a number of different materials in a large test frame in a laboratory setting, as well as field testing at several highway construction sites throughout New England. The overall results of this study indicate that the SCS performs well as a QA/QC tool for monitoring compaction of a wide variety of soils, provided that the specifications require a minimum of 95% compaction based upon standard Proctor density (AASHTO T-99, with coarse particle correction). In addition to testing a wide range of soils, use of the SCS with lightweight aggregate and asphalt was also investigated. It was concluded that the SCS is not a viable QA/QC tool for use with lightweight aggregate. A limited amount of testing performed on asphalt indicates that, although the SCS could potentially be used to monitor compaction of that material, it might produce a "stop compaction" signal prematurely in that application. It might be necessary for the manufacturer to make adjustment(s) to the internal data processing in the SCS meter if it is to be used for monitoring asphalt compaction where specifications require a minimum of 98% compaction.

Project Number: NETC 02-1

Project Title: Relating Hot Mix Asphalt Pavement Density to Performance

Project Status: Closed

Contractor: University of Massachusetts, Dartmouth

Principal Investigator(s): Walaa S. Mogawer, University of Massachusetts, Dartmouth
Jo Sias Daniel, University of New Hampshire

Report Number: NETCR76

Report Title: Relating Hot Mix Asphalt Pavement Density to Performance

Author(s): Walaa S. Mogawer, University of Massachusetts, Dartmouth
Jo Sias Daniel, University of New Hampshire
Alexander J. Austerman, University of Massachusetts, Dartmouth

Report Publication Date: April 1, 2010

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr76_02-1.pdf

Streaming Media URL(s): N/A

Abstract:

The purpose of this study was to evaluate the effect of Hot Mix Asphalt (HMA) density on the overall mixture performance in terms of fatigue cracking and rutting. Two plant-produced Superpave mixtures, a 9.5 mm and 12.5 mm, were fabricated to target density levels of 88%, 91%, 94% and 97% of the theoretical maximum specific gravity. These specimens were then used to evaluate the mixtures' stiffness, fatigue cracking characteristics, and rutting potential.

The impact of density on mixture stiffness was evaluated by measuring the complex dynamic modulus ($|E^*|$) of each mixture at varying temperatures and frequencies in the Asphalt Mixture Performance Test (AMPT) device. Fatigue cracking evaluations were completed using the beam fatigue test and the Overlay Test (OT) fatigue cracking analysis based on fracture mechanics theory. Rutting evaluations were completed using the Asphalt Pavement Analyzer (APA) and the flow number test in the AMPT device. Additionally, the Mechanistic-Empirical Design Guide (MEPDG) distress prediction equations were used to predict the mixture performance as function of density by varying the master curve data inputs at each target density level while keeping the remaining inputs constant.

The complex dynamic modulus data, $|E^*|$, showed that increasing the mixtures density increased the measured dynamic modulus, $|E^*|$. Beam fatigue testing provided inconclusive trends relating HMA density to fatigue cracking potential. The OT-based fatigue cracking analysis showed that the number of Equivalent Single Axles Loads (ESALs) required to reach the fatigue cracking failure criteria of 50% area cracked increased as the mixture density increased for both mixture tested. APA and flow number testing indicated that the rutting potential of the mixtures decreased as HMA density increased. The MEPDG Level 1 analysis results showed a fatigue cracking trend similar to the OT fatigue cracking analysis based on fracture mechanics theory. Finally, the MEPDG Level 1 analysis exhibited same rutting trends as the laboratory testing derived trends.

Project Number: NETC 02-2

Project Title: Formulate an Approach for 511 Implementation in New England

Project Status: Closed

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): Paul Shuldiner, University of Massachusetts, Amherst
Jeremy Siviter, IBI Group, Inc.
Gregg Loane, IBI Group, Inc.
Randy Knapick, IBI Group, Inc.

Report Number: NETCR44

Report Title: Formulate Approach for 511 Implementation in New England

Author(s): Paul Shuldiner, University of Massachusetts, Amherst
Gregg Loane, IBI Group, Inc.
Randy Knapick, IBI Group, Inc.

Report Publication Date: October 13, 2005

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr44_02-2.pdf

Streaming Media URL(s): N/A

Abstract:

This report explores needs and challenges related to the development of an integrated regional 511 telephone traveler information infrastructure for the six New England states (CT, MA, ME, NH, RI, VT). The relatively small scale of individual states, and the significant cross-border economic and transportation integration influences traveler information needs of the general public in New England. Development of a New England-wide vision for 511 deployment is recommended in order to address the traveler information and traffic management needs of this region. The suitability of various technical approaches using call transfers, data transfers, and/or data linking are weighed. The report recommends that the region adopt a hybrid approach incorporating both call transfer capabilities (for misdirected calls) and Voice XML data linking (for information of regional importance). Future 511 integration should be founded on further interstate coordination and a regional vision backed by formalized agreements.

Project Number: NETC 02-3

Project Title: Establish Subgrade Support Values for Typical Soils in New England

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Ramesh B. Malla, University of Connecticut

Report Number: NETCR57

Report Title: Establish Subgrade Support Values for Typical Soils in New England

Author(s): Ramesh B. Malla, University of Connecticut
Shraddha Joshi, University of Connecticut

Report Publication Date: April 10, 2006

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr57_02-3.pdf

Streaming Media URL(s): N/A

Abstract:

The main objective of this research project was to establish prediction models for subgrade support (resilient modulus, MR) values for typical soils in New England. This soil strength property can be measured in the laboratory by means of repeated load triaxial tests. Non-destructive tests like Falling Weight Deflectometer (FWD) can be used to estimate the modulus value using a backcalculation process. The current study used data extracted from Long Term Pavement Performance Information Management System (LTPP IMS) Database for 300 test specimens from 19 states in New England and nearby regions in the U.S. and 2 provinces in Canada. Prediction equations were developed using SAS® for six AASHTO soil types viz. A-1-b, A-3, A-2-4, A-4, A-6, and A-7-6 and USCS soil types Coarse Grained Soils and Fine Grained Soils found in New England region to estimate resilient modulus. To verify the prediction models, MR values for 5 types of soils in New England were determined from laboratory testing using AASHTO standards. The predicted and laboratory measured MR values matched reasonably well for the soils considered. Also an attempt was made to obtain relationship between laboratory MR values and FWD backcalculated modulus from the LTPP test data. No definitive conclusion could be drawn from the analysis. However, in general, FWD backcalculated modulus values were observed to be greater than the laboratory-determined modulus values for the same soil type.

Project Number: NETC 02-5

Project Title: Determination of Moisture Content of Deicing Salt at Point of Delivery

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Richard P. Long, University of Connecticut
Kenneth R. Demars, University of Connecticut

Report Number: NETCR45

Report Title: Determination of Moisture Content of Deicing Salt at Point of Delivery

Author(s): Richard P. Long, University of Connecticut
Kenneth R. Demars, University of Connecticut
U. Balunaini, University of Connecticut

Report Publication Date: March 2004

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr45_02-5.pdf

Streaming Media URL(s): N/A

Abstract:

The object of this research was to find or develop a simple, affordable method or device for quickly measuring the moisture content of road salt in the field. The test should be able to be carried out in about fifteen minutes and be capable of measuring moisture contents up to approximately 5% to an accuracy equal to +/- 0.5%. Of the several methods for moisture measurement, the infrared, nuclear and capacitive methods were eliminated because of high cost, measurement errors or ineffectiveness. The primary focus was electrical conductivity and microwave methods. The electrical conductivity/resistivity properties of moist deicing salt was measured for six salt sources including both solar and mined salt. The electrical properties of a given salt is shown to vary directly with moisture content but is also effected by temperature, packing density and, to a lesser degree, by particle size. Yet, accounting for these variables, it is possible to predict water content using conductivity to +/- 0.4%. For all of the salts combined, the accuracy reduces to +/- 0.8%. Microwave drying is the most accurate method for measurement of salt moisture content. The reduction of data requires a bit of practice. The equipment is inexpensive but requires a power supply.

Project Number: NETC 02-6

Project Title: Sealing of Small Movement Bridge Expansion Joints

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Ramesh B. Malla, University of Connecticut
Montgomery Shaw, University of Connecticut

Report Number: NETCR58

Report Title: Sealing of Small Movement Bridge Expansion Joints

Author(s): Ramesh B. Malla, University of Connecticut
Montgomery T. Shaw, University of Connecticut
Matu R. Shrestha, University of Connecticut
Smita Boob, University of Connecticut

Report Publication Date: June 29, 2006

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr58_02-6.pdf

Streaming Media URL(s): N/A

Abstract:

Sealing of bridge expansion joint systems is important to protect the structural components below the joint from damage due to water, salt, and other roadway debris. A new elastomeric foam-type joint sealant has been developed for sealing small-movement bridge expansion joints. Laboratory tests including tension, compression, shear, bonding, salt water immersion, temperature sensitivity, compression recovery, creep, stress relaxation, cure rate, tack time, and water tightness were performed on this newly developed sealant to assess its mechanical and material characteristics. In addition, loading-unloading behavior in tension and compression and effects of exposure to outdoor condition for 6.5 months period on its engineering properties were investigated. Similar tests were also performed on a currently available commercial bridge joint sealant material for comparison purposes. The new silicone foam sealant showed an increase in volume by about 70 % after the mixing of sealant components. The test results indicated lower stiffness, greater extensibility, and better bonding associated with the foam sealant compared to the commercial sealant. Foam sealant showed more resistant to fatigue with tensile deformation cycles and its stress relaxation rate was greater than that of commercial sealant. The tack and cure time for foam sealant were small and no leakage was observed through the sealant and joint interface. The sealant also did not exhibit any physical deterioration during prolonged exposure to natural weathering elements; however it appeared to stiffen which might be due to oxidation and continuous sealant cure.

Project Number: NETC 02-6 (Phase 2)

Project Title: Sealing of Small Movement Bridge Expansion Joints -
Phase 2: Field Demonstration and Monitoring

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Ramesh B. Malla, University of Connecticut
Montgomery Shaw, University of Connecticut

Report Number: NETCR86

Report Title: Sealing of Small Movement Bridge Expansion Joints -
Phase 2: Field Demonstration and Monitoring

Author(s): Ramesh B. Malla, University of Connecticut
Montgomery T. Shaw, University of Connecticut
Brian Swanson, University of Connecticut
Thomas Gionet, University of Connecticut

Report Publication Date: July 31, 2011

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr86_02-6_phase2.pdf

Streaming Media URL(s): N/A

Abstract:

A silicone foam sealant was developed to provide an easy-to-use and economical joint sealant for small-movement bridge expansion joints. In studies reported in Phase 1, various laboratory tests were conducted to evaluate the performance of the sealant using concrete as the bonding substrate. In the present study (Phase 2), laboratory tests on the sealant were conducted using other substrates found in practice, including steel, asphalt, and polymer concrete. Tension, repair, oven-aged bonding, salt water immersion, freezethaw, and cure rate (modulus vs. time) tests were performed to determine the engineering/mechanical properties of the foam sealant. These tests were also performed on a commercially available silicone sealant for comparison. A method to produce the foam sealant in larger quantity for field application was successfully accomplished. A procedure was developed to apply the foam sealant into bridge expansion joints. This development consisted of determining the proper applicator tools, a step-by-step application process, and the rehearsal of the sealing of a prototype 7-ft long x 2-in wide joint in the laboratory prior to field installation. After successful laboratory experimentation, the newly developed foam sealant along with the commercially available sealant were installed in the expansion joints of four bridges, one each in Connecticut, New Hampshire, Rhode Island, and New York. Over the course of approximately 20 months, post-installation monitoring of the sealants was conducted at the bridge joints to evaluate of the physical condition of the applied sealants. Through the laboratory tests, field installation, and monitoring, it has been observed that the silicone foam sealant has the ability to bond to various substrate materials, can accommodate deformation typical of small-movement expansion joints

in bridges, is easy to install, and has displayed durability over the course of approximately 20 months in the field environment. The silicone foam sealant has been seen to provide as good as or in several cases superior engineering/mechanical properties in laboratory testing and better resiliency and performance in the four bridge expansion joints during the field testing.

Project Number: NETC 02-7

Project Title: Validating Traffic Simulation Models to Inclement Weather Conditions With Applications to Arterial Coordinated Signal Systems

Project Status: Closed

Contractor: University of Vermont

Principal Investigator(s): Adel W. Sadek, University of Vermont
Wael El-Dessouki, University of Connecticut

Report Number: NETCR47

Report Title: Validating Traffic Simulation Models to Inclement Weather Conditions With Applications to Arterial Coordinated Signal Systems

Author(s): Adel W. Sadek, University of Vermont
Seli J. Amison-Agbolosu, University of Vermont

Report Publication Date: November 2004

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr47_02-7.pdf

Streaming Media URL(s): N/A

Abstract:

Congestion along arterial systems in New England is often the result of adverse weather conditions, which typically change the normal traffic flow parameters and render the normal signal plans unsuitable. With recent advances in communications and signals' hardware, there is a need to explore the feasibility and benefits of implementing signal-timing plans, specifically tailored for inclement weather conditions. The current study has two main objectives: (1) to assess the impact of inclement weather on traffic flow parameters at signalized intersections in northern New England; and, (2) to evaluate the likely operational benefits of implementing weather-specific timing plans. To assess inclement weather impact, traffic flow under normal and inclement weather conditions at a signalized intersection were carefully observed over two winter seasons. The weather/road surface conditions were categorized into six different classes, and values for the saturation headways and startup lost times were collected for each weather condition. Statistical analyses reveal that inclement weather does have a significant impact on the values of saturation headways, particularly once slushy conditions start developing or once snow start sticking to the ground. Startup lost time, on the other hand, does not appear to be as significantly impacted. To assess the likely benefits of weather-specific plans, four signalized arterial corridors were selected as case studies: two from the State of Vermont and another two from the State of Connecticut. Optimal signal plans were developed for these corridors for the six different weather/road surface conditions using both TRANSYT-7F and SYNCHRO models. The likely benefits of the "special" timing plans were then determined using the macroscopic models of TRANSYT-7F and SYNCHRO models first, and then

using the more detailed microscopic simulation environment of CORSIM and SIMTRAFFIC models. Results from the study indicate that operational benefits are to be expected from implementing weather-specific timing plans, and that the benefits estimated from the use of macroscopic, deterministic models tend to be higher than those determined by stochastic, microscopic models.

Project Number: NETC 02-8

Project Title: Intelligent Transportation Systems Applications to Ski Resorts in New England

Project Status: Closed

Contractor: University of Vermont

Principal Investigator(s): Adel W. Sadek, University of Vermont
Randy Knapick, IBI Group, Inc.

Report Number: NETCR46

Report Title: Intelligent Transportation Systems Applications to Ski Resorts in New England

Author(s): Adel W. Sadek, University of Vermont
Randy Knapick, IBI Group, Inc.

Report Publication Date: March 2004

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr46_02-8.pdf

Streaming Media URL(s): N/A

Abstract:

Ski areas present transportation professionals with a host of challenging problems, including heavy seasonal peak traffic demands, the rural nature of the surrounding road networks, and the inclement weather conditions under which travel to ski resorts often occurs. The current study was undertaken with the purposes of: (1) understanding winter recreation travel problems in New England; and, (2) assessing the applicability of Intelligent Transportation Systems (ITS) to address these problems. To quantify the transportation challenges, different stakeholders were contacted and interviewed, and site visits were made to a number of ski resorts. With the information compiled, the study proceeded to develop a "toolkit", designed to help select appropriate ITS applications for addressing the transportation challenges associated with ski resort travel. To provide further guidance on ITS applicability, a case study, focused on the Vermont Route 103/100 Corridor which includes a number of ski resorts, was selected and a high-level ITS architecture was developed for the region. The report concludes by summarizing the main conclusions derived from the study and making recommendations for future research.

Project Number: NETC 03-1

Project Title: Ability of Wood Fiber Materials to Attenuate Heavy Metals Associated With Highway Runoff

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Allison MacKay, University of Connecticut

Report Number: NETCR65

Report Title: Ability of Wood Fiber Materials to Attenuate Heavy Metals Associated With Highway Runoff

Author(s): Allison MacKay, University of Connecticut

Report Publication Date: July 16, 2008

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr65_03-1.pdf

Streaming Media URL(s): N/A

Abstract:

Wood chips were evaluated for their ability to attenuate heavy metals in roadway runoff. Column experiments with controlled synthetic runoff composition and flowrate were used to assess effects of flowrate (intercepted sheetflow from a 3-m wide roadway section), runoff salt concentration, wood exposure to alternating wetting and drying cycles, wood aging, competition among dissolved heavy metals, and removal of particle-associated heavy metals. Overall, wood chips damped the 'pulse' of copper in the synthetic runoff such that the effluent was characterized by lower concentrations (3 - 25% of input) over longer periods of time, but with little retention of the total copper mass. The most effective treatment was wood chips aged up to 9 months. Increased aging and chip water content reduced effluent concentrations, relative to no treatment. Flowrate had no effect on effluent concentrations. The presence of salt (> 2 mS/cm) or dissolved lead (500 µg/L) in the runoff caused greater effluent concentrations than the no treatment case. Removal of suspended particles (and associated contaminants) was greater than 85% with an estimated capacity of 0.16 g/gwood. Field evaluation with concentrated flow to a gutter containing a wood chip treatment showed little effect on total or dissolved copper and zinc runoff concentrations and indicated that wood chips may be a source of contaminants in subsequent storm events. Applications of wood chips to treat roadway runoff would not provide a significant decrease in total maximum daily load (TMDL) contributions (e.g., kg/d); however, there may be some scenarios for which wood chip treatments to decrease peak stormwater concentrations of dissolved heavy metals in sheetflow runoff is desirable.

Project Number: NETC 03-2

Project Title: Field Studies of Concrete Containing Salts of an Alkenyl-Substituted Succinic Acid

Project Status: Closed

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): Scott A. Civjan, University of Massachusetts, Amherst

Report Number: NETCR73

Report Title: Field Studies of Concrete Containing Salts of an Alkenyl-Substituted Succinic Acid

Author(s): Scott A. Civjan, University of Massachusetts, Amherst
Benjamin Crellin, University of Massachusetts, Amherst

Report Publication Date: June 30, 2008

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr73_03-2.pdf

Streaming Media URL(s): N/A

Abstract:

The effects of the corrosion inhibitor Hycrete DSS on the physical characteristics of concrete, at full production scale, were evaluated. An extensive literature review, methods for using Hycrete DSS in standard concrete mix designs, results from standardized testing of concrete mixes and implementation projects are presented. Experimental testing included 6 large-scale pours at 3 ready-mixed concrete plants in New England and 1 precast concrete facility. A total of 10 Hycrete DSS mixes and 5 representative control mixes were tested. In these large scale tests it was found Hycrete DSS has no detriment to workability and entrained air at desired levels could be obtained consistently. The absorption of hardened concrete containing Hycrete DSS was less than half of values obtained in the control mixes. If no alterations were made to a mix design, Hycrete DSS was found to reduce the compressive strength of a concrete mix in comparison to the control, with related impact on freeze-thaw durability and bond strength. However, the required design parameters for each mix were met or exceeded. Four applications, including methods for long term corrosion monitoring, were chosen as potential implementation projects. Two projects were completed; major structural components of a ferry terminal (Maine) and a bridge curb (Vermont). Initial ferry terminal concrete batching procedures required modifications to meet specified air content. Other considered implementations included patching of deteriorated overpass bridge bent columns (Massachusetts) and large precast culverts (New York). Highway barriers previously implemented by the Connecticut Department of Transportation (Connecticut) are also described.

Project Number: NETC 03-3 (Phase 1)

Project Title: Feasibility Study and Design of an Erosion Control Laboratory in New England - Phase 1

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Richard P. Long, University of Connecticut
Kenneth R. Demars, University of Connecticut

Report Number: NETCR49

Report Title: Feasibility Study of an Erosion Control Laboratory in New England

Author(s): Richard P. Long, University of Connecticut
Kenneth R. Demars, University of Connecticut

Report Publication Date: December 2004

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr49_03-3.pdf

Streaming Media URL(s): N/A

Abstract:

This study examines the need for a soil erosion control testing facility in New England to evaluate erosion protection products and techniques. The study includes a survey of the 6 New England Departments of Transportation to assess their current approach to erosion control and future erosion control needs. A literature review is performed to identify current erosion testing laboratories, to evaluate capabilities and to determine the economics of testing. Both large-scale and small-scale erosion testing facilities are considered and each testing facility/ method is evaluated considering current soil erosion theories. Several testing laboratories were contacted directly, including site visits, to obtain needed background information. A series of recommendations was prepared for the New England DOTs that considers the economics and quality of results of erosion testing.

Project Number: NETC 03-3 (Phase 2)

Project Title: Design Considerations for a Prototype Erosion Control Testing Plot

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Richard P. Long, University of Connecticut
Kenneth R. Demars, University of Connecticut

Report Number: NETCR56

Report Title: Design Considerations for a Prototype Erosion Control Testing Plot

Author(s): Richard P. Long, University of Connecticut
Kenneth R. Demars, University of Connecticut

Report Publication Date: December 2005

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr56_03-3phase2.pdf

Streaming Media URL(s): N/A

Abstract:

This study examines the design requirements and testing protocol for a soil erosion control testing facility in New England to evaluate erosion protection products and techniques. It is based on a literature review of current and past erosion testing experiences. Only large-scale erosion testing is considered. The testing facility design/ protocol is evaluated considering current soil erosion theories. A series of recommendations was prepared for the New England DOTs that is based on ASTM standard test methods and that considers the economics and quality of results of erosion testing.

Project Number: NETC 03-4

Project Title: Measuring Pollutant Removal Efficiencies of Stormwater Treatment Units

Project Status: Closed

Contractor: University of Massachusetts, Lowell

Principal Investigator(s): Xiaoqi (Jackie) Zhang, University of Massachusetts, Lowell

Report Number: NETCR54

Report Title: Measuring Pollutant Removal Efficiencies of Stormwater Treatment Units

Author(s): Xiaoqi (Jackie) Zhang, University of Massachusetts, Lowell

Report Publication Date: September 27, 2005

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr54_03-4.pdf

Streaming Media URL(s): N/A

Abstract:

This study evaluated the bacteria removal efficiency, and bacteria distribution and survivability within a structural BMP called Vortechs System (manufactured by Stormwater 360, formerly Vortechtechnics, Inc.) installed at two different sites in Providence, Rhode Island. Twelve rain events with precipitations greater than 0.1 inch were sampled over a two year period. Five pathogenic indicator bacteria, *E. coli*, *Enterococci*, Fecal *Streptococci*, Total Coliform, Fecal Coliform, were analyzed. Based on our research results, maintenance strategies such as more frequent sediment removal may be necessary to prevent pathogen-rich washouts to receiving waters. Structural BMPs near busy streets and highway should be cleaned out more frequently.

Project Number: NETC 03-5

Project Title: Evaluation of Field Permeameter as a Longitudinal Joint Quality Control Indicator

Project Status: Closed

Contractor: University of New Hampshire

Principal Investigator(s): Jo Sias Daniel, University of New Hampshire
Rajib B. Mallick, Worcester Polytechnic Institute
Walaa S. Mogawer, University of Massachusetts, Dartmouth

Report Number: NETCR64

Report Title: Evaluation of Field Permeameter as a Longitudinal Joint Quality Control Indicator

Author(s): Jo Sias Daniel, University of New Hampshire
Rajib B. Mallick, Worcester Polytechnic Institute
Walaa S. Mogawer, University of Massachusetts, Dartmouth

Report Publication Date: April 20, 2007

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr64_03-5.pdf

Streaming Media URL(s): N/A

Abstract:

Premature distress along the longitudinal construction joint in asphalt pavements occurs when adequate density or tightness is not achieved during construction. The objective of this research project was to evaluate a field permeameter as a tool to evaluate the quality of longitudinal joints. As part of the study, a field permeameter that can simultaneously test three locations; along the joint and one foot into both mats, was developed. The permeameter was used to test longitudinal construction joints on pavement projects around New England. Pavements that were tested as part of the study had nominal maximum size aggregate (NMSA) ranging from 9.5 mm to 25 mm; base, binder, and surface courses were tested, and various joint construction techniques were used, including infrared heating and various joint sealants. Field cores at most test sites were taken for air void and strength testing in the laboratory and performance of the joints over the course of the project was monitored for several sites. Results of the study show that a permeability or infiltration criterion for longitudinal joint quality is promising. However, more refinements need to be made to the permeameter to reduce the variability in test results. The research team suggests returning to a single standpipe permeameter (air or water) to improve variability. The study also shows that improved construction techniques, such as joint sealants or use of a joint heater, improve the short term performance of the longitudinal joint.

Project Number: NETC 03-6

Project Title: Fix it First: Utilizing the Seismic Property Analyzer and MMLS to Develop Guidelines for the Use of Polymer Modified Thin Lift HMA vs. Surface Treatments [1]

Project Status: Active (as of December 31, 2011) [2]

Contractor: University of Massachusetts, Dartmouth

Principal Investigator(s): Walaa S. Mogawer, University of Massachusetts, Dartmouth
Jo Sias Daniel, University of New Hampshire

Report Number: TBD

Report Title: TBD

Author(s): TBD

Report Publication Date: TBD

Report URL: TBD

Streaming Media URL(s): TBD

Project Objective(s):

The goal of this research is to develop a guideline for industry professionals regarding the use of thin lift overlay mixes with Polymer Modified Asphalt PMA in New England. This guideline will include thorough research into the existing surface treatments and overlays being used in the New England States as well as development of PMA asphalt mixes that can be used in lieu of the conventional surface treatments. Also explored will be a non-destructive testing method (NDT), the seismic property analyzer (SPA), to determine the optimum time to perform resurfacing, cost/benefit analysis of the various resurfacing options as compared with PMA overlays, and the strengths/weaknesses of particular PMA mixes. Also the NDT device can be utilized to diagnose the problems that lead to the surface distresses.

Note(s):

[1] NETC 03-6 was the project selected for the New England Land Grant University Consortium Members Transportation Challenge.

[2] NETC 03-6 was active, as of December 31, 2011, under contract to FHWA.

Project Number: NETC 03-7

Project Title: Basalt Fiber Reinforced Polymer Composites

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): Richard Parnas, University of Connecticut
Montgomery Shaw, University of Connecticut

Report Number: NETCR63

Report Title: Basalt Fiber Reinforced Polymer Composites

Author(s): Richard Parnas, University of Connecticut
Montgomery Shaw, University of Connecticut
Qiang Liu, University of Connecticut

Report Publication Date: August 2007

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr63_03-7.pdf

Streaming Media URL(s): N/A

Abstract:

The objective of the research was to determine if basalt fiber reinforced polymer composites are feasible, practical, and a beneficial material alternative for transportation applications. No significant differences in stiffness and strength were found between basalt fabric reinforced polymer composites and glass composites reinforced by a fabric of similar weave pattern. Aging results indicate that the interfacial region in basalt composites may be more vulnerable to environmental damage than in glass composites. However, the basalt/epoxy interface may also be more durable than the glass/epoxy interface in tension-tension fatigue because the fatigue life of basalt composites is longer. A wide disagreement between the literature properties of basalt fibers and the properties measured in this study renders any further consideration of basalt reinforced composites highly problematical.

Composites manufacturing issues with basalt fabric were also investigated. The measurement results of the in-plane permeability for basalt twill 3x1 fabric material showed that a high correlation exists between the two principal permeability values for this fabric. This is in contrast to the lack of correlation found in other weave patterns, and may point to an important material selection criteria for mass production of composites by liquid molding.

Project Number: NETC 04-1

Project Title: Recycling Asphalt Pavements Containing Modified Binders

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): James Mahoney, University of Connecticut

Report Number: NETCR66

Report Title: Recycling Asphalt Pavements Containing Modified Binders

Author(s): James Mahoney, University of Connecticut
Scott Zinke, University of Connecticut
John DaDalt, University of Connecticut
Adam Zofka, University of Connecticut
Alexander Bernier, University of Connecticut
Ilya Yut, University of Connecticut

Report Publication Date: March 3, 2011

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr66_04-1.pdf

Streaming Media URL(s): N/A

Abstract:

The objective of Phase I of this research was to evaluate the current state of the practice in New England/New York Region regarding the use and specifications of modified binders. Existing literature regarding Modified Binders was reviewed; State Transportation Agencies and their suppliers were surveyed. The purpose of the inquiries was to determine which types of modified asphalt binders are being used in the Northeast currently. The inquiries were intended to define what constitutes modified binder and provide a working definition that is regionally accepted by users of modified binders.

Phase II examines effects of combining RAP with HMA that is composed of different PG binder grades and different types of polymer and acid modification. This research attempts to address whether there is cause for concern with respect to incompatibility when combining RAP with different types of modified asphalt. Asphalt in designed mixes is expected to maintain characteristics such as flexibility at lower temperatures and elasticity to resist deformation at higher temperatures. Once RAP of unknown origin is combined into the mix, there is risk that the chemistry of the virgin binder in the mix could be altered, thus, reducing benefits of the modifier. This would compromise the HMA structure and the length of service life. Several different sources of RAP with differing aggregate bases were collected from different geographic regions in the Northeast as were several different modified binders. One mix design was used with sound virgin aggregates and all combinations of RAP and binder type were fabricated into specimens which were tested for their susceptibility to rutting in the Asphalt Pavement Analyzer (APA). Rutting susceptibility was of interest as a means of investigating if the RAP changed the chemistry

in the modified asphalt such that it would make it softer and more susceptible to permanent deformation. Findings of this research indicate that the RAP increased the rut resistance of the mixes. The binder with the highest level of polymer modification performed the best under both liquid binder testing as well as testing of the mix in the APA.

Project Number: NETC 04-2

Project Title: Driver-Eye-Movement-Based Investigation for Improving Work Zone Safety

Project Status: Closed

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): Donald L. Fisher, University of Massachusetts, Amherst
Michael Knodler, University of Massachusetts, Amherst
Alexander Pollatsek, University of Massachusetts, Amherst

Report Number: NETCR71

Report Title: Driver-Eye-Movement-Based Investigation for Improving Work Zone Safety

Author(s): Donald L. Fisher, University of Massachusetts, Amherst
Michael Knodler, University of Massachusetts, Amherst
Jeffrey Muttart, University of Massachusetts, Amherst

Report Publication Date: January 28, 2009

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr71_04-2.pdf

Streaming Media URL(s): N/A

Abstract:

Crashes continue to be a problem in work zones. Analyses have indicated that rear-end and sideswipe crashes are the most frequent. Investigators have hypothesized that distractions are often the cause of both types of crashes. These distractions will only increase as more and more drivers attend to other tasks, such as cell phone conversations. Three experiments were run to determine whether cell phone use in work zones increased drivers' inattention to the forward roadway. In Experiment 1, drivers were asked to navigate a virtual roadway on a driving simulator which contained a number of work zones. In Experiment 2, drivers were asked to navigate a test track in a real car which contained an actual work zone. And in Experiment 3, drivers were again asked to navigate a virtual roadway with signs warning drivers not to use their cell phones in the work zone. In all experiments, the drivers were asked to engage in a mock cell phone conversation for some portion of the trials. And in all experiments, the drivers' eyes were tracked. Cell phones clearly decreased drivers' ability to respond to events around them as determined both by vehicle and eye behavior. And warning signs were effective at increasing drivers' attention to the roadway.

Project Number: NETC 04-3

Project Title: Estimating the Magnitude of Peak Flows for Steep Gradient Streams in New England

Project Status: Closed [1]

Contractor: University of New Hampshire

Principal Investigator(s): Jennifer Jacobs, University of New Hampshire
Thomas Ballestero, University of New Hampshire
Richard Vogel, Tufts University

Report Number: NETCR81

Report Title: Estimating the Magnitude of Peak Flows for Steep Gradient Streams in New England

Author(s): Jennifer Jacobs, University of New Hampshire

Report Publication Date: November 17, 2010

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr81_04-3.pdf

Streaming Media URL(s): N/A

Abstract:

Estimates of these flood events are used by the Federal, State, regional, and local officials to safely and economically design hydraulic structures as well as for effective floodplain management. The regression relationships developed to predict flows at ungauged sites do not always hold true for steep slope watersheds in New England. This study developed the regression relationships to predict peak flows for ungaged, unregulated steep streams in New England with recurrence intervals of 2, 5, 10, 25, 50, 100, and 500 years. For watersheds having a main channel slope that exceeds 50 ft per mile, peak flows are well estimated by the watershed drainage area and the mean annual precipitation. No metric of watershed steepness provided a statistically significant improvement to prediction capability. For these steep watersheds, the series of regression equations was found to perform as well or better than the individual state regression equations.

Note(s):

[1] NETC 04-3 was completed under contract to FHWA.

Project Number: NETC 04-4

Project Title: Determining the Effective PG Grade of Binder in RAP Mixes

Project Status: Closed

Contractor: University of New Hampshire

Principal Investigator(s): Jo Sias Daniel, University of New Hampshire
Walaa S. Mogawer, University of
Massachusetts, Dartmouth

Report Number: NETCR78

Report Title: Determining the Effective PG Grade of Binder in RAP Mixes

Author(s): Jo Sias Daniel, University of New Hampshire
Walaa S. Mogawer, University of Massachusetts, Dartmouth

Report Publication Date: January 2010

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr78_04-4.pdf

Streaming Media URL(s): N/A

Abstract:

This report presents the results of a research study to develop a method to determine or estimate the binder grade in mixtures designed with RAP from the properties of the mixture itself. A 12.5 mm Superpave mixture was used to evaluate mixtures containing 0% RAP, 10% RAP, 25% RAP, and 40% RAP with a virgin PG 64-28 binder. Virgin mixtures with PG 58-28, PG 70-22, and PG 76-22 binders were also evaluated. Testing included dynamic modulus, creep compliance, and strength tests in the indirect tensile mode. Partial $|G^*|$ master curves were measured on the extracted binder from each mixture and the recovered binder was also PG graded. Several methods of estimating the effective PG grade of the binder were evaluated. Empirically based methods of interpolating values of measured mixture properties are straightforward, but require an extensive amount of testing in the laboratory. The relationship between material properties and PG grade must be established for each type of mixture (gradation, asphalt content). The most promising methods for determining the effective PG grade of the mixture use the Hirsch model to back calculate binder $|G^*|$ from the measured mixture dynamic modulus. This report summarizes the research effort and provides a recommended procedure for estimating the effective PG grade of binders in RAP mixtures.

Project Number: NETC 04-5

Project Title: Network-Based Highway Crash Prediction Using Geographic Information Systems

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): John N. Ivan, University of Connecticut
Per E. Garder, University of Maine

Report Number: NETCR67

Report Title: Network-Based Highway Crash Prediction Using Geographic Information Systems

Author(s): John N. Ivan, University of Connecticut
Per E. Garder, University of Maine
Sumit Bindra
B. Thomas Jonsson
Hyeon-Shic Shin
Zuxuan Deng

Report Publication Date: June 6, 2007

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr67_04-5.pdf

Streaming Media URL(s): N/A

Abstract:

The objectives of this project were to estimate network-based crash prediction models that will predict the expected crash experience in any given geographic area as a function of the highway link, intersection and land use features observed in the area. The result is a system of GIS programs that permit a polygon to be drawn on a map, or a set of links and intersections to be selected, and then predict the number of crashes expected to occur on the selected traffic facilities. These expected values can then be compared with observed values to identify locations with higher than usual crash incidence and may require attention to improve the safety of the location. Alternatively, this tool could be used to estimate the safety impacts of proposed changes in highway facilities or in different land development scenarios.

A network approach was chosen to solve this problem, in which separate models were estimated for crashes at major intersections, and intersection-related and segment-related crashes on road segments. All three sets of models can then be used to predict the number of crashes for an entire highway facility delineated as the user desires - including all intersections. These models also consider all relevant road features, in particular the intensity of traffic at intersections and driveways resulting from the surrounding land use. Gathering traffic volumes at every intersection and driveway on the road network would preclude the feasibility of such an approach, both for estimation and in practice. Instead, the link between land development and trip

generation was exploited to estimate the driveway and minor road volumes. Land development intensity variables were generated from land use inventories organized using Geographic Information Systems (GIS), permitting virtually automatic preparation of the required data sets for model estimation and application and prediction of crash counts on roads. Specifically, population and retail and non-retail employment counts were associated with each analysis segment to represent vehicle exposure to intersection-related crashes.

GIS was used for two purposes in this project: 1) distributing population and employment counts in a traffic analysis zone (TAZ) among all the links in that zone; and, 2) visually comparing the predicted and observed accident counts in order to identify higher than usual crash locations.

Project Number: NETC 04-6

Project Title: Development of Truck Lane Software That Uses a Current Model of Truck Performance

Project Status: Withdrawn [1]

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objective of this study was to develop design software for evaluating the warrant for and design of climbing lanes with consideration for current truck performance . Input parameters for this software would be roadway profile, initial running speed and truck weight to horsepower ratio. Output parameters would include the truck speed profile (i.e., at what point would a climbing lane be warranted).

Note(s):

[1] NETC 04-6 was withdrawn from the NETC program on February 16, 2004, by E-Mail ballot, since it would duplicate the research findings of NCHRP Report 505, "Review of Truck Characteristics as Factors in Roadway Design."

Project Number: NETC 05-1

Project Title: Development of Supplemental Resistance Method for the Design of Drilled Shaft Rock Sockets

Project Status: Closed [1]

Contractor: University of Maine

Principal Investigator(s): Thomas C. Sandford, University of Maine

Report Number: NETCR83

Report Title: Development of Supplemental Resistance Method for the Design of Drilled Shaft Rock Sockets

Author(s): Thomas C. Sandford, University of Maine
James McCarthy, University of Maine
Jonathan Bussiere, University of Maine

Report Publication Date: March 31, 2011

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr83_05-1.pdf

Streaming Media URL(s): N/A

Abstract:

Rock Socketed Drilled Shafts have been used on a variety of projects, especially bridges, in areas with bedrock close to the surface. The large loads that these foundation structures can resist make them more practical than alternatives, such as pile groups, in certain situations. However, the current conservative design practices are based on the performance of Rock Socketed Drilled Shafts in soft rock formations. The current design practice for axial capacity often neglects one of the two resisting forces, usually end bearing. In areas, such as New England, with good quality hard rock, Rock Socketed Drilled Shafts have been found to have ultimate axial capacities 7-25 times the predicted value. The goal of this research is to develop a design method that utilizes the full potential of Rock Socketed Drilled Shafts in hard rock. A finite element model using constitutive relationships and surface interactions was created to replicate Rock Socketed Drilled Shafts in hard rock. The model was calibrated by duplicating results from five Osterberg load tests on shafts in hard rock. For the purpose of this research hard rock is classified as having an unconfined strength greater than 30 MPa. After calibrating the model, the model was used to show performance of shafts of various sizes founded in rock of two different qualities. The performance results were used to develop a design method for Rock Socketed Drilled Shafts based on service limit criteria. This research revealed that portions of both resistance forces, end bearing and side shear, can be used together in the design of Rock Socketed Drilled Shafts if service limit state criteria are considered. This method applies to well cleaned sockets and primarily hard rock. This method can be used with equations for nominal resistance as well as Osterberg tests.

Note(s):

[1] NETC 05-1 was completed under contract to FHWA.

Project Number: NETC 05-2 (Phase 1)

Project Title: Enhancing the Reflectivity of Concrete Barriers [1]

Project Status: Proposed (as of December 31, 2011) [2]

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): Scott A. Civjan, University of
Massachusetts, Amherst
Sergio F. Brena, University of
Massachusetts, Amherst
Michael Knodler, University of
Massachusetts, Amherst

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The overall objective of this research was to identify multiple methods for increasing the long-term visibility of concrete barrier systems. These methods must be effective under poor weather and/or nighttime driving conditions. The resulting concrete barriers must be cost-effective and effectiveness must be long-lasting with minimal deterioration in effectiveness (safety and visibility) through time and weathering.

Note(s):

[1] NETC 05-2 (Phase 1), "Enhancing the Reflectivity of Concrete Barriers," was formerly NETC 05-2, "Safety of Reflective Median Barriers."

[2] NETC 05-2 (Phase 1) was never started due to delays caused by problematic contractual procedures. Therefore, the project status was still considered as "Proposed", as of December 31, 2011.

Project Number: NETC 05-3

Project Title: Practicable Calibration Procedures to Enhance the Accuracy of Analytical and Microsimulation Software for Modern Four-Legged Single-Lane Roundabouts [1]

Project Status: Proposed (as of December 31, 2011) [2]

Contractor: University of Vermont

Principal Investigator(s): Adel W. Sadek, University of Vermont
Mark Smith, University of Vermont
Per E. Garder, University of Maine
Lisa Aultman-Hall, University of Connecticut

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The overall objective of this research was to identify multiple methods for increasing the long-term visibility of concrete barrier systems. These methods must be effective under poor weather and/or nighttime driving conditions. The resulting concrete barriers must be cost-effective and effectiveness must be long-lasting with minimal deterioration in effectiveness (safety and visibility) through time and weathering.

Note(s):

[1] NETC 05-3, "Practicable Calibration Procedures to Enhance the Accuracy of Analytical and Microsimulation Software for Modern Four-Legged Single-Lane Roundabouts," was formerly titled, "Microscopic Simulation for Modeling Modern Roundabouts in New England: Accuracy, Sensitivity and Calibration."

[2] ConnDOT could not put an Agreement into place for UVM to perform the work for NETC 05-3, due to delays caused by problematic contractual procedures. UVM did proceed with the work despite the fact that an Agreement was not in place. As of December 31, 2011, VAOT was preparing a request for authorization from FHWA for reimbursement of costs incurred prior to the award of the Agreement, as provided under 23CFR Section 1.9; if the request is approved, VAOT will identify the best way to contract with UVM to complete the project. Therefore, the project status was still considered as "Proposed", as of December 31, 2011.

Project Number: NETC 05-4

Project Title: Characterization of the Rate Constant of Pozzolan Available Alkalis

Project Status: Withdrawn [1]

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objectives of this study were to determine the fatigue life, durability and effectiveness of the intrusion prevention characteristics of various structural concrete crack repair systems when subjected to dynamic flexural and compressive stresses and freezing and thawing.

Note(s):

[1] At its April 10, 2006, meeting, the NETC Advisory Committee passed a motion that NETC 05-4 be withdrawn from the NETC program.

Project Number: NETC 05-5

Project Title: Measurement of Adhesion Properties Between Topcoat Paint and Metallized/Galvanized Steel with 'Surface Energy' Measurement Equipment [1]

Project Status: Active (as of December 31, 2011) [2]

Contractor: University of Rhode Island

Principal Investigator(s): Sze C. Yang, University of Rhode Island
Kang-Won Wayne Lee, University of Rhode Island

Report Number: TBD

Report Title: TBD

Author(s): TBD

Report Publication Date: TBD

Report URL: TBD

Streaming Media URL(s): TBD

Project Objective(s):

The objectives of this project are to:

1. Compare the adhesion properties of NEPCOAT-approved topcoat paint over metallizing to topcoat paint over galvanizing using specialized "surface-energy" measuring lab methods. As a control the adhesion properties of topcoat paint over zinc primer painted steel substrates will also be measured.
2. Investigate various factors affecting the adhesion of topcoat paint over galvanizing.
3. Report and recommend practices which produce the best adhesion of NEPCOAT-approved topcoat paints over metalized and particularly galvanized steel surfaces.

Note(s):

[1] NETC 05-5, "Measurement of Adhesion Properties Between Topcoat Paint and Metallized/Galvanized Steel with 'Surface Energy' Measurement Equipment," was formerly titled, "Measurement of Work of Adhesion Between Paint and Metallized/Galvanized Steel."

[2] NETC 05-5 was active, as of December 31, 2011, under contract to FHWA.

Project Number: NETC 05-6

Project Title: Employing Graphic-Aided DMS to Assist Elder Drivers' Message Comprehension

Project Status: Closed [1]

Contractor: University of Rhode Island

Principal Investigator(s): Jyh-Hone Wang, University of Rhode Island

Report Number: NETCR82

Report Title: Employing Graphic-Aided DMS to Assist Elder Drivers' Message Comprehension

Author(s): Jyh-Hone Wang, University of Rhode Island
Aaron Clark, University of Rhode Island

Report Publication Date: December 30, 2010

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr82_05-6.pdf

Streaming Media URL(s):

- Employing Graphic-Aided Dynamic Message Signs to Assist Elder Driver's Message Comprehension
An Overview of NETC Project 05-6
Presented by Jyh-Hone Wang, University of Rhode Island
September 27, 2007

http://www.dotdata.ct.gov/media/mainpsa.aspx?url=mms://159.247.0.209/mediapoint/netc/netc_05-6.wmv?sami=http://www.ct.gov/dot/lib/dot/documents/dConnDot/67.smi&name=%20Jay%20Wang%20-NETC%2005-6

mms://159.247.0.209/mediapoint/netc/netc_05-6.wmv?

Abstract:

This report presents a human factors study that was conducted to seek ways to assist elder drivers' understanding of dynamic message sign (DMS) messages. The study employed a computer based questionnaire survey and a driving simulation experiment with a goal to measure drivers' preferences and responses to various DMS displays and formats. The results are included in this report. While the age of the subjects studied ranged between 20 and 94, results for drivers over 60 were of special concern. The survey assessed drivers' preferences toward different types of graphics, use of graphics in messages, color of the message, color of the graphic, message flashing, animation, text alignment, abbreviations, shadowing, and wording sequence. Survey results indicated that drivers preferred text only messages compared with graphic-aided messages, and also preferred animated graphics over stationary ones. Subjects differed on their preferences toward color, however. A driving simulation experiment was conducted to measure subjects' responses to DMS displays in different colors and graphical formats, similar to those shown in the survey to provide a comparison.

Results from the driving simulation experiment show that drivers responded faster to amber-colored messages and graphic-aided messages. Older drivers responded slower and less accurately than younger drivers, but their response time and accuracy were improved with the use of graphics in the DMS messages. Correlations and discrepancies between the results of the survey and simulation are also discussed.

Note(s):

[1] NETC 05-6 was completed under contract to FHWA.

Project Number: NETC 05-7

Project Title: Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): John N. Ivan, University of Connecticut
Adel W. Sadek, University of Vermont

Report Number: NETCR72

Report Title: Warrants for Exclusive Left Turn Lanes at Unsignalized Intersections and Driveways

Author(s): John N. Ivan, University of Connecticut
Adel W. Sadek, University of Vermont
Hongmei Zhou
Surang Ranade

Report Publication Date: February 12, 2009

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr72_05-7.pdf

Streaming Media URL(s): N/A

Abstract:

Accommodating left turns at unsignalized intersections is one of the most challenging problems in traffic engineering. Over the last forty years, a small number of studies developed guidelines for traffic engineers to help in deciding when a left turn lane is warranted for a given situation. Building on these previous attempts, this report describes the development of a refined decision support system (DSS) for assessing the likely benefits of left-turn lane installations as an aid to deciding whether a left-turn lane is warranted. The developed DSS is designed to predict these likely benefits based on several measures including delay savings, reductions in percent stops, increases in fuel efficiency, and reductions in emissions. The first step in developing the DSS was to use microscopic simulation to model several real-world unsignalized intersections with different geometric configurations and located in different area types. After carefully calibrating these models, several scenarios covering a wide range of operational conditions were simulated. The output from these simulation runs was then used to train a set of Multi-layer Perceptron Neural Networks (NNs), and to generalize the results from the models' runs. The NNs were then incorporated into a DSS that can help an analyst quantify the impacts of a proposed new development as well as estimate the benefits of left-turn lane installations.

The report also presents an investigation of the safety effects of exclusive left turn lane installation at unsignalized intersections. Crash prediction models were estimated using crash and volume data from intersections without left turn lanes by intersection category and crash category. Intersections throughout Connecticut were selected, representing six different types of intersections based on rural versus urban location, number of approach legs and number of through lanes on the main road. Negative binomial modeling was used with generalized estimation equations to account for the correlation among the crash counts for an intersection through the years. The expected number of crashes was predicted using the prediction models for intersections with left turn lanes assuming no left turn lanes were present. If the observed crash counts were significantly lower than the predicted, then there was evidence that the left turn lane created a safer condition. The results of comparing the observed and predicted crashes showed that the intersections were safer for same direction crashes when left turn lanes were installed, except for those on urban two lane roads, at which no safety effect is discernable.

Project Number: NETC 05-8

Project Title: Evaluation and Implementation of Traffic Simulation Models for Work Zones

Project Status: Closed [1]

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): John Collura, University of Massachusetts, Amherst

Report Number: NETCR80

Report Title: Evaluation and Implementation of Traffic Simulation Models for Work Zones

Author(s): John Collura, University of Massachusetts, Amherst
Kevin Heaslip, University of Massachusetts, Amherst
Michael Knodler, University of Massachusetts, Amherst
Daiheng Ni, University of Massachusetts, Amherst
William C. Louisell, University of Massachusetts, Amherst
Andrew Berthaume, University of Massachusetts, Amherst
Raju Khanta, University of Massachusetts, Amherst
Kevin Moriarty, University of Massachusetts, Amherst
Francis Wu, University of Massachusetts, Amherst

Report Publication Date: June 18, 2010

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr80_05-8.pdf

Streaming Media URL(s):

- An overview of NETC Project 05-8
Presented by John Collura, University of Massachusetts, Amherst
December 21, 2010.

http://www.dotdata.ct.gov/media/mainpsa.aspx?url=mms://159.247.0.209/mediapoint/netc/netc_05-8.wmv?sami=http://www.ct.gov/dot/lib/dot/documents/dConnDot/none.smi&name=%20Using%20Traffic%20Simulation%20Models%20to%20Assess%20the%20Impacts%20of%20Highway%20Work%20Zone%20Strategies

mms://159.247.0.209/mediapoint/netc/netc_05-8.wmv?

Abstract:

As the National Highway System reaches the end of its serviceable life, transportation agencies increasingly need to focus on the preservation, rehabilitation, and maintenance of these roads. In light of significant increases in the amount of work zone activity, transportation officials and contractors are challenged with finding ways to reduce the negative impacts on driver mobility. The key to addressing this challenge is to recognize potential impacts well in advance. One major tool used for this purpose is computer simulation. There are many simulation models in existence, some of which are designed specifically for work zone analysis. Examples of these models

include QUEWZ, QuickZone, CORSIM, and CA4PRS. The purpose of this paper is to present case studies that illustrate and evaluate these models in terms of their ease of use, data requirements, and ability to simulate and assess work zone strategies, shedding light on the relative reliability and accuracy of these simulation models as well as their user-friendliness and data requirements. This paper compares simulation results to actual work zone conditions in eight locations across New England. The results of this evaluation will be of interest to state and local transportation engineers responsible for planning and designing work zone strategies. This research has shown that some simulation models provide a low-risk, low-cost environment in which to test and analyze a variety of work zone alternatives. For example, QUEWZ and QuickZone were able to provide reasonable order of magnitude queue length estimates on interstate highways comparable to observations made in the field. In addition, such estimates required little data including hourly volume and roadway geometry information.

Note(s):

[1] NETC 05-8 was completed under contract to FHWA.

Project Number: NETC 05-9

Project Title: Eliminating Premature Pavement Failure: Creation of a Positive Drainage Layer for Reconstructed and Reclaimed Pavements [1]

Project Status: Withdrawn [1]

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

Intermodal transportation and connectivity demonstrate the problems associated with how we finance and provide for transportation in the United States, and its negative impacts to New England. The failure to address it is a significant hidden tax on the country. This increased cost is particularly true for New England. The failure of New England states to recognize the criticality of a regional, public-private transportation strategy and their failure to provide a well-connected intermodal system has resulted in the region becoming a *cul de sac* to freight movement and higher freight costs. Aviation and intercity passenger rail have also suffered.

The research will provide the following:

- A clear assessment of the problem and the causes from a public and private sector perspective.
- Recommendations, practical, policy and legislative, to address the problem at both a regional and national level.
- Identification of potential and specific areas where additional federal resources could be leveraged to attack the problem.

Note(s):

[1] At its December 19, 2005, meeting, the NETC Advisory Committee passed a motion that NETC 05-9 be withdrawn from the NETC program.

Project Number: NETC 06-1

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

Project Status: Active (as of December 31, 2011) [1]

Contractor: University of New Hampshire

Principal Investigator(s): Jo Sias Daniel, University of New Hampshire
Ghassan R. Chehab, Pennsylvania State University

Report Number: TBD

Report Title: TBD

Author(s): TBD

Report Publication Date: TBD

Report URL: TBD

Streaming Media URL(s): TBD

Project Objective(s):

The objectives of this project are to:

The main goal of this research was to offer the New England and New York state highway agencies guidelines for the implementation of the MEPDG, with focus on flexible pavements and AC overlays. The research team in this report addressed some of the issues and concerns that arise in the transition from current AASHTO empirical design methodologies, such as those in the 1972, 1986 and 1993 guides, to the new mechanistic-empirical design methodologies incorporated in the MEPDG. Within the scope of this project, the proposal team answered some questions that highway agencies have or will encounter with regard to the MEPDG implementation, as shown in Figure 1 below.

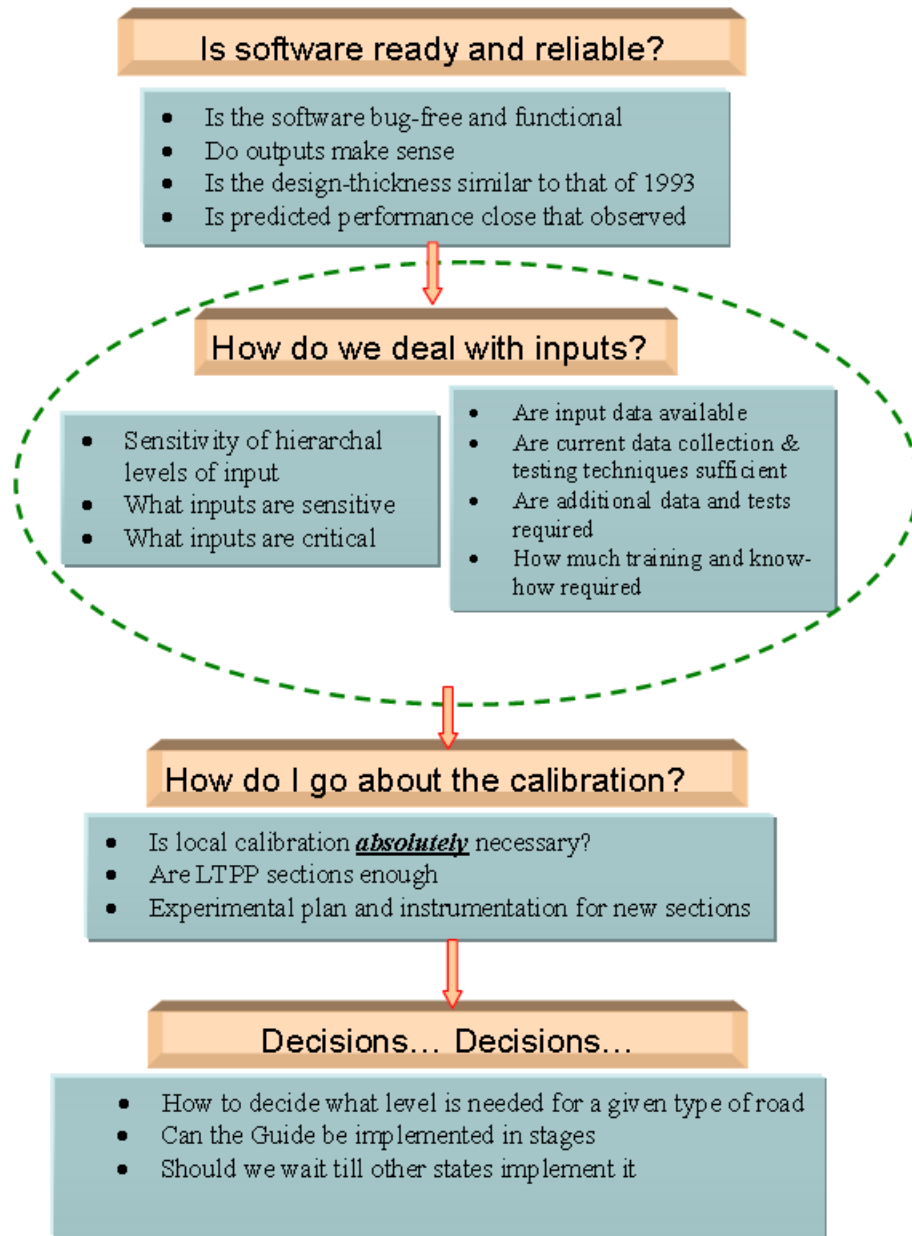


Figure 1: Possible Concerns Regarding the MEPDG Implementation

Specifically, the objectives of this research project were as follows:

- Determine the design and data collection methods, material tests, and testing equipment currently in use by each state.
- Identify the Level 2 and Level 3 design guide inputs for which regional or local values are required.
- Provide state specific recommendations on implementation of the MEPDG including changes in data collection & measurement, equipment needs, training, and anticipated benefits.

- Provide specific recommendations for regional and local calibration of the MEPDG by identifying appropriate field test & monitoring sites, data to be collected, and perform local calibrations if appropriate field data is available.

Note(s):

[1] NETC 06-1 was active, as of December 31, 2011, under contract to FHWA.

Project Number: NETC 06-2

Project Title: Infrastructure Management Systems Enhancement and Integration to Support True Integrated Decision-Making

Project Status: Withdrawn [1]

Contractor: University of Vermont

Principal Investigator(s): Richard Watts, University of Vermont
Adel W. Sadek, University of Vermont
Karen Glitman, University of Vermont

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The maintenance and management of the different components of transportation systems and infrastructure has been an issue of critical importance for many years. In the early 1980's, management systems were developed to aid decision-makers in making sound decisions regarding infrastructure preservation and management (Haas et al., 1994; Hudson et al., 1997). One problem with these systems, however, was that they were developed for managing individual components of the overall transportation system not the system as a whole. In other words, a pavement management system was designed to manage the maintenance and rehabilitation of pavement sections, a bridge management system was developed for bridges, and so on. These individual systems typically did not communicate with one another. This lack of communication and coordination between the individual systems can lead to problems and sub-optimal use of resources.

In recent years, some progress has been made towards integrating these transportation infrastructure management systems (IIMSs) or asset management systems, to better serve the needs of the public. Integrated management systems allow for optimizing budget allocation among the different competing components of the transportation system, as well as for coordinating work schedules for their maintenance and preservation. In addition, comprehensive asset management systems strive to manage the transportation system from both a physical as well as an operational standpoint (i.e., managing the congestion and safety aspects of the system).

While some definite progress had been made, there are still numerous gaps, however, between understanding and implementing the concept. One important area that warrants additional research involves the required enhancements to the decision support capabilities of individual

management systems in order to allow for supporting true integrated decision-making. For asset management, improved decision support is required in at least the following three areas: executive information; tradeoff analysis; and, benefit cost-analysis.

The goal of the proposed research is twofold. First, the research will focus on clearly determining and documenting the current state-of-practice of infrastructure management in New England. Next, the research will focus on identifying and developing some of the additional decision-support functionality and capabilities required of integrated infrastructure management systems.

Note(s):

[1] At its June 30, 2010, meeting, the NETC Advisory Committee passed a motion that NETC 06-2 be withdrawn from the NETC program.

Project Number: NETC 06-3

Project Title: Establishing Default Dynamic Modulus Values for New England

Project Status: Closed

Contractor: University of Connecticut

Principal Investigator(s): James Mahoney, University of Connecticut

Report Number: NETCR85

Report Title: Establishing Default Dynamic Modulus Values for New England

Author(s): Eric D. Jackson, University of Connecticut
Jingcheng Li, University of Connecticut
Adam Zofka, University of Connecticut
Iliya Yut, University of Connecticut
James Mahoney, University of Connecticut

Report Publication Date: April 11, 2011

Report URL: http://www.uvm.edu/~transctr/pdf/netc/netcr85_06-3.pdf

Streaming Media URL(s): N/A

Abstract:

The primary objective of this research is to test commonly used Hot Mix Asphalt (HMA) mixtures throughout New England to determine their respective dynamic modulus master curves. Four mixes were requested from each of the New England states for modulus testing. Physical testing consisted of two replicates of each mix, outfitted with three linear variable differential transformers (LVDTs). AASHTO TP 62 was followed for the testing of these samples. Comparisons of plant produced mix vs. lab produced mix shows no significant difference between the two methods, thus, indicating lab produced samples are analogous to real-world pavements for dynamic modulus testing. Furthermore, the results of physical modulus testing were compared to predicted modulus values from three different theoretical modulus models. Comparisons of Predicted dynamic modulus ($|E^*|$) values from the Mechanistic-Empirical Pavement Design Guide (MEPDG) and physical testing indicates the predicted $|E^*|$ values may be off by as much as 100% for New England Mixes. Through this research scaling factors were developed for all the mixes tested to allow state DOTs to forgo expensive and labor intensive physical testing. Furthermore, the minimal range and standard deviation of scaling factors for the Hirsh and Witczak models indicates there is potentially a constant scaling factor that could be applied to all New England mixes, regardless of aggregate source, and binder type. However, further testing may be required to determine if a uniform scaling factor for our region is truly valid.

Project Number: NETC 06-4

Project Title: Preventative Maintenance and Timing of Applications [1]

Project Status: Proposed (as of December 31/2011)

Contractor: University of Massachusetts, Dartmouth

Principal Investigator(s): Walaa S. Mogawer, University of
Massachusetts, Dartmouth
Jo Sias Daniel, University of New Hampshire

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The purpose of this project is to understand pavement maintenance techniques and the inter-relationship with the timing of their application. In order to meet this, the following objectives have been established:

1. Identify the components of a Pavement Preventive Maintenance (PPM) program.
2. Evaluate the state-of-the-practice relative to agencies (both US and worldwide) that have demonstrated successful implementation of a pavement preservation program. Identify both single treatment and multi-treatment strategies.
3. Use current and past projects as appropriate to evaluate techniques that have been successfully used to effectively extend the life of the pavement.
4. Identify and quantify the factors that influenced the successful implementation of a preservation technique, including **time** of treatment application in the existing pavement life cycle.
5. Validate the treatment parameters and methodologies using Accelerated Pavement Testing (APT).
6. Determine the approximate cost for pavement preservation technique identified.

Develop an implementation pavement preservation manual for distribution to the state and local transportation agencies within the New England states.

Project Number: NETC 06-5

Project Title: The Winter Severity Index for New England [1]

Project Status: Terminated [2]

Contractor: Plymouth State University

Principal Investigator(s): Samuel Miller, Plymouth State University
Brendon Hoch, Plymouth State University

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

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

Note(s):

[1] NETC 06-5, "The Winter Severity Index for New England," was formerly titled, "Winter Severity Indices for New England."

[2] NETC 06-5 was terminated on June 30, 2010.

Project Number: NETC 07-1

Project Title: Effects of In-Place Properties of Recycled Layers Due to Temperature and Moisture Variations

Project Status: Proposed (as of December 31, 2011)

Contractor: University of New Hampshire

Principal Investigator(s): Jo Sias Daniel, University of New Hampshire
Rajib B. Mallick, Worcester Polytechnic Institute
Maureen A. Kestler, USDA Forest Service
Heather J. Miller, University of Massachusetts, Dartmouth

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

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

Project Number: NETC 07-2

Project Title: Exploring the Potential of Intelligent Intersections
Deployment in New England

Project Status: Proposed (as of December 31, 2011)

Contractor: University of Massachusetts, Amherst

Principal Investigator(s): Michael Knodler, University of
Massachusetts, Amherst
John Collura, University of Massachusetts,
Amherst

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The primary objective of this research project is to explore the potential for infrastructure based "Intelligent Intersection" deployments in New England. An underlying aim of this project is to aid state traffic and safety engineers in New England as they consider innovative ways to improve flow and safety at intersections. To this end, the products of this research will include, but not be limited to:

- (1) A list of mobility and safety focus areas, needs and priorities associated with intersections in the participating states based on a survey of New England state traffic and safety engineers.
- (2) An annotated bibliography that documents a comprehensive literature review and synthesis pertaining to existing and proposed "Intelligent Intersections" concepts and applications; a special effort will be made to document the findings and results of field tests that have included "Intelligent Intersection" related concepts and technologies. Each reference in the bibliography will include a full citation and a summary as it relates to the potential use of "Intelligent Intersections" in New England; in addition, complete copies of the most significant references will be printed and made available to the NETC Technical Committee throughout the project.

- (3) An interim report that includes an identification and assessment of ideas, concepts and applications pertaining to "Intelligent Intersections" concepts and technologies with an emphasis on their applicability to the intersections on the list prepared based on the survey of State traffic and safety engineers in New England.
- (4) The design of a multi-phase field test; this test would include an actual demonstration in the field of a number of the technologies identified as part of this project. This design would include: a statement of the objectives of field test; a concept of operations plan; a physical and logical architecture considering the Regional ITS Architecture (if available) and U.S. DOTs National Architecture; an evaluation plan including measures of effectiveness; a budget estimate including capital and operating costs; and, a finance plan suggesting sources of funding including NETC funds and other sources.

Project Number: NETC 07-3

Project Title: Determining Optimum Distance for a Lane Drop Downstream
from a Signalized Intersection

Project Status: Proposed (as of December 31, 2011)

Contractor: University of Vermont

Principal Investigator(s): Adel W. Sadek, University of Vermont
Lisa Aultman-Hall, University of Vermont

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The primary objective of the proposed research is to carefully analyze existing methods and procedures for determining the optimum lane drop distance for auxiliary lanes. Following the review of existing methods, the study will assess their adequacy and if needed will develop refined and updated procedures for determining the optimal lane drop distance.

Project Number: NETC 07-4

Project Title: Estimating and Predicting Traffic Conditions for
Traveler Information and Emergency Response

Project Status: Withdrawn [1]

Contractor: University of Vermont

Principal Investigator(s): Lisa Aultman-Hall, University of Vermont
Adel W. Sadek, University of Vermont

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objective of this research is to develop and validate an efficient framework to estimate reliable travel time from existing traffic surveillance systems to display on variable message signs (VMS) for major highways in both rural and urban areas of New England. The estimated travel time data might also be provided to travelers via websites or phone. Furthermore, this project will evaluate specific methods for some combinations of highway types and sensor networks.

Note(s):

[1] At its June 30, 2010, meeting, the NETC Advisory Committee passed a motion that NETC 07-4 be withdrawn from the NETC program.

Project Number: NETC 08-1

Project Title: Evacuation of the Highway Safety Manual in New England

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

In anticipation of the pending Fall 2008 release of first edition Highway Safety Manual (HSM), the objectives of this project are to address the issues that are most critical for analyzing road safety in New England. It is suggested that this would include the following:

1. Assess and verify the validity of the HSM calibration procedure by applying it to a sample of New England roads and recalibrate, if determined necessary by the NETC Technical Committee in concert with the release of the first edition HSM.
2. Evaluate the accuracy of existing HSM accident modification factors (AMFs) using a sample of New England roads (minimum one urban state and one predominantly rural state). Assess and estimate AMF's that account for interactions with other AMFs and with other road conditions for commonly implemented improvements, including: lane and shoulder widening; curve realignment; signal installation; and, others selected by the Technical Committee.
3. Calculate the effects of applying multiple AMFs (AMFs to be determined by the NETC 08-1 Technical Committee and PI) for commonly implemented improvements.

Project Number: NETC 08-2

Project Title: Evacuation Modeling to Assist Hazard Management and Response in Urban and Rural Areas of New England

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

Recent natural disasters such as Hurricane Katrina and the need for Homeland Security preparedness has mandated that evacuation plans be developed that are coordinated across jurisdictions and modes of travel. These plans should be actionable and adaptable to changing conditions. In addition, drill and exercises should be developed around these plans in order to prepare first responders and transportation managers for the actual event, including the need to exercise and test the validity of the plan itself. To serve the above purposes, this research focuses on the development of evacuation modeling methodologies suited for urban and rural areas of New England.

The objectives of this research include the following:

- incorporate a broad range of hazards into the consideration of evacuation planning;
- develop evacuation simulation models to assist decision makers to evaluate and test evacuation plans;
- develop tools based on the simulation models to assist personnel training during drills and exercises; and,
- emphasize the particular situations and needs in urban and rural areas of New England.

Project Number: NETC 08-3

Project Title: Best Management Practices for the Invasive Polygonum Cuspidatum (Japanese Knotweed) Along Transportation Corridors

Project Status: Proposed (as of December 31, 2011)

Contractor: University of Rhode Island

Principal Investigator(s): Kang-Won Wayne Lee, University of Rhode Island

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The primary objective of this research is two-fold:

- In the first part of the project, the research team will determine the degree to which common maintenance and construction practices in New England play a role in the spread of Japanese Knotweed. The research team will then evaluate methods for controlling and eradicating Japanese Knotweed populations.
- In the second part of the project, the researcher team will determine which of these methods are the most effective to eradicate Japanese Knotweed populations and provide recommendations to the research panel accordingly.

Project Number: NETC 08-4

Project Title: An Assessment of the Implementation of NETC Research Results [1]

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objectives of this study are:

- 1) to conduct a survey of the New England Transportation Consortium's member state transportation agencies to identify the extent to which research findings from NETC funded research projects are being implemented;
- 2) to prepare a synthesis of the implementation activities that are occurring; and,
- 3) to recommend strategies for increasing the implementation of research findings from NETC-funded research.

Note(s):

[1] NETC 08-4, "An Assessment of the Implementation of NETC Research Results," was formerly titled, "NETC Research Implementation Survey and Synthesis."

Project Number: NETC 08-5

Project Title: NETC/UVM-UTC Transportation Research Challenge

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objective of this project is to establish a joint program between NETC and UVM-UTC to collaborate on the funding of transportation research in the theme area of "Sustainable Systems and Advanced Technologies for Northern Communities". This joint program will be called the "NETC/UVM-UTC Transportation Research Challenge".

The New England Transportation Consortium (NETC) is a cooperative effort of the transportation agencies and Land Grant Universities 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.

The University of Vermont Transportation Center (UVM-UTC) is a National University Transportation Center, established by the Safe, Accountable, Flexible, Efficient Transportation Equity Act enacted by the US Congress on August 10, 2005. Its mission is to advance research and education in the transportation disciplines with a focus on "Sustainable Systems and Advanced Technologies for Northern Communities".

The benefits for NETC through this joint program include increased financial resources for research to address the transportation needs of New England's communities through the leveraging of funds from UVM-UTC

The benefits for UVM-UTC include enhanced capabilities for carrying out its research mission through the leveraging of funding and administrative resources of NETC, utilization of the transportation expertise at New England public universities, and generating a contribution to the required USDOT 1:1 match on the UTC grant.

It is envisioned that two research projects will be initiated, one in each of two successive years. NETC will provide its coordination and management resources to administer the projects.

Final reports from the project will be jointly published and include both an NETC and UVM-UTC report number.

This program could potentially be used as an example of DOT UTC cooperation for research.

Project Number: NETC 08-6

Project Title: Interaction Between Salinity, Soil Quality and Amendments in Roadside Plantings

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

This research will investigate the seasonal variation of soil salinity, microbial activity and the decomposition of biosolids in roadside plantings to elucidate whether soil mineralization of biosolids occurs in roadside plantings.

The research questions are:

1. Is the roadside microbial community able to transform organic nitrogen in biosolids into plant available forms of nitrogen during times of plant need?
2. Can biosolids application be timed so that they benefit roadside plantings?

The objective is to generate data that would inform management of organic amendments of roadside plantings.

Project Number: NETC 09-1 (Phase 1)

Project Title: Active Structural Control of Cantilevered Support Structures

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

This research should have four primary objectives:

1. Document the current state-of-the-art in: (i) vibration mitigation of cantilevered signal and sign supports; and, (ii) active control of civil structures.
2. Conduct field instrumentation of cantilevered signal and sign support structures to identify the dynamic characteristics (e.g., natural frequencies and damping ratios) of actual signal and sign structures.
3. Perform analytical studies to examine the feasibility and performance of proposed active control strategies to mitigate wind-induced fatigue in cantilevered signal and sign supports.
4. Conduct full-scale experimental verification of these concepts on cantilevered signal and sign supports to demonstrate the feasibility and performance of the proposed active control strategy.

Project Number: NETC 09-2

Project Title: Effective Establishment of Native Grasses on Roadsides

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The objectives of this research are:

1. Review the literature on establishment of grass species native to Rhode Island and southern New England, particularly warm-season species, and summarize the current knowledge in a form accessible to landscape architects and maintenance personnel at highway departments and construction companies.
2. Test the germination and establishment of ecotypes from the Northeast under controlled conditions to determine the temperature range needed for successful establishment, tolerance to the herbicides commonly used to control crabgrass, and the efficacy of chemical treatments to enhance germination.
3. Examine establishment of native grasses in the field with planting dates, planting method and species mix as variables.

Project Number: NETC 09-3

Project Title: Advanced Composite Materials: Prototype Development and Demonstration

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The New England Transportation Consortium (NETC) funded a research project, NETC 01-1, "Advanced Composite Materials for New England's Transportation Infrastructure: A Study for Implementation and Synthesis of Technology and Practice," to identify obstacles for implementation of Advanced Composite Materials (ACMs) and develop a methodology to improve implementation of these materials in the transportation infrastructure of New England. A methodology to increase usage of ACMs was proposed. The methodology will identify new application areas where composite materials would offer an advantage over materials used traditionally in civil engineering. Phase 1 of a technology transfer follow-up of NETC 01-1, NETC 01-1 (T2 Phase 1), "Advanced Composite Materials in New England's Transportation Infrastructure - Technology Transfer Phase 1: Selection of Prototype," has been funded and will identify a common element of the transportation infrastructure that can be economically fabricated using composite materials. This study will be underway soon and has a six-month duration. One of the deliverables of the technology transfer Phase 1 effort is a research problem statement for prototype development of the yet to be determined composite element.

The objective of this research problem statement is to provide funds in this round of NETC projects to facilitate the prototype and demonstration of the yet to be determined composite element from the Phase 1 effort mentioned above.

Project Number: NETC 10-1

Project Title: Synthesis of Practice: Electronic Bridge Inspection Document Management Systems

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The recent Minneapolis bridge collapse and other related bridge inspection issues have pointed out the necessity for better and more efficient inspection systems. State transportation agency bridge inspection reports are a compilation of various parts, on paper, bound into an inspection report document. Sketches, clearance diagrams, field notes and drawings are generally done on paper for insertion into a report. Inventory sheets are printed for each bridge, filled out by hand by inspectors, and then placed in report folders. Some states work from these paper files to enter data into electronic documents or databases at a later date. A report summary, although electronic, is completed by using field notes to update documents on desktop PCs. Parts of the inspection report elements often reside in different data formats. Because the reports are paper, processing and review, transmittal and storage, are all time-consuming and require a large number of file cabinets for storage for paper. Even though digital photos are taken by inspectors, they are generally included as printed pages in the inspection reports. There is generally no computerized system in place for computer-based retrieval and viewing of the inspection report or related images for later use. In addition, considerable quantities of paper are needed for internal copies. Lastly, there is generally a considerable gap in time between the collection of data in the field and its entry into a state transportation agency database. It would be useful to know what other states are doing in this area and if they have electronic document systems for bridge inspection, then to better understand what is working well, how those states developed and support their systems and what elements and features New England state transportation agencies should consider in the development of electronic document management systems and inspection methods

The objectives of the research would be to conduct a synthesis of practice on the topic of electronic bridge inspection document management systems. The synthesis should gather information on what other states and turnpike companies are doing for electronic data collection related to bridge inspections, and related electronic bridge inspection document management systems.

Project Number: NETC 10-2

Project Title: A Field Evaluation of SuperPave Hot Mix Asphalt Pavement Containing 30% RAP

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

A recent publication in Public Works Magazine stated that over the past year the price of asphalt binder has increased in price more than any other road construction material (1). Many state highway agencies (SHAs) are considering increasing the percentage of recycled asphalt pavement (RAP) in hot mix asphalt (HMA) pavement to help offset this increased price. The Federal Highway Administration (FHWA) is attempting to familiarize SHAs with the benefits of using higher percentages of RAP, and an Expert Task Group (ETG), led by Mr. John D'Angelo, FHWA, was formed to develop best practices for its use.

The practice of using RAP in HMA pavement has potential economic and environmental benefits, which were well documented over 25 years ago when the practice was first introduced (2). Many SHAs are using 10% to 20%. With the cost of oil increasing at a faster rate than that of inflation, some professionals believe it is time to increase these percentages to between 30% and 40% for certain applications (2). The ETG is interested in demonstrating and evaluating its use at 30% with several trial projects throughout the United States.

The cost of HMA has risen steadily with the price of oil, and sources of virgin aggregates are limited. There is an abundance of RAP in New England that is not being used to its full potential. Increasing the allowable percentage of RAP in HMA pavements has potential cost savings and environmental benefits because less virgin material (binder and aggregates) would be required. There are concerns that higher percentages of RAP may be detrimental to the quality of HMA (2). Field evaluations of HMA pavement in New England containing RAP at a higher percentage are needed to address quality-control issues and to demonstrate the viability of HMA with higher RAP content.

The objective of this project is to perform a performance and durability field evaluation of HMA pavement containing higher percentages of RAP, including 20% and 30%, as compared to virgin HMA pavement and HMA with 15% RAP, serving as experimental controls.

Project Number: NETC 10-3

Project Title: Low Temperature and Moisture Susceptibility of RAP Mixtures With Warm Mix Technology

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

As Reclaimed Asphalt Pavement (RAP) is added to hot mix asphalt (HMA) in increasing amounts, many contractors are exploring the use of warm mix technologies to aid in compaction and workability of the RAP mixtures. The lower mixing temperatures associated with the warm mix technologies may not provide adequate drying of the RAP and could potentially increase the moisture susceptibility of the mix. The lower temperatures may also decrease the amount of blending or co-mingling between the RAP binder and the virgin binder. This could result in a mixture that is essentially under asphalted and would then be more prone to low temperature cracking.

This project will evaluate the low temperature cracking properties and moisture susceptibility of RAP mixtures produced with warm mix technologies. Plant mixtures with varying RAP contents and warm mix technologies will be sampled. Laboratory testing will include tensile strength ratio tests to evaluate moisture susceptibility, and TSRST and IDT creep testing to evaluate the low temperature cracking properties of the mixtures.

Project Number: NETC 10-4

Project Title: Field Evaluation of Corrosion Protection on Bridges
With a Spray Application of Disodium Tetrapropenyl
Succinate (DSS) [1]

Project Status: Proposed (as of December 31, 2011)

Contractor: N/A

Principal Investigator(s): N/A

Report Number: N/A

Report Title: N/A

Author(s): N/A

Report Publication Date: N/A

Report URL: N/A

Streaming Media URL(s): N/A

Project Objective(s):

The reinforcing steel (rebar) in existing concrete structures is under constant attack from chloride ions. The widespread use of deicing salts and proximity to saltwater have made these structures susceptible to corrosion induced damage.

Hycrete-DSS has exhibited positive results as a corrosion inhibitor when used as a concrete admixture in new structures. Trial laboratory applications showed that it may also have potential in slowing rates of corrosion when applied as a spray-on application to the surface of concretes containing corroding steel. There is a need to investigate the effects on existing concrete structures in the field to verify the effectiveness of this application procedure. If successful, this could delay the active corrosion rates in deteriorating structures, reducing maintenance costs and extending time until required repair or replacement.

Kansas DOT started to investigate the use of DSS-Hycrete as a corrosion-arresting, spray-on, penetrating solution, addressing the need to halt corrosion on existing steel-reinforced concrete structures.

Kansas DOT never finished its study because the P.I. retired from state service. So the need for additional experimental work is needed to measure and quantify the corrosion arresting properties of DSS-Hycrete as a spray-on, penetrating solution.

The objective is to study the effectiveness of a spray-applied DSS-Hycrete solution at inhibiting new chloride ion penetration and/or reducing active corrosion rates in existing reinforced-concrete structures, which are exhibiting corrosion of reinforcement.

In either approach, the researcher would measure corrosion activity (electrical potential) of the reinforcement in the concrete member before and after the spray application of the penetrative solutions of DSS. The corrosion activity would then be monitored for a period of 2 years, likely at 6-month increments. In addition, samples will be extracted for chloride testing at each time period, along with a baseline sample prior to the Hycrete-DSS application.

ConnDOT has identified a cathodic protection system that is installed on a bridge deck that has been inactive for several years, but has instrumentation installed to monitor corrosion activity; it can be made available to NETC as a test site for this study. Another ideal situation would be an application during patching repairs of corroding bridge piers and bent caps. In these cases, comparison studies would be expected between Hycrete-DSS treated sections and non-treated sections. In the former application, a comparison to cathodic protection demands may be possible.

A second research objective to study the spray application of DSS-Hycrete on new (yet to be poured) concrete structures may be considered. A portion of this research would be to identify appropriate structures in conference with the Advisory Committee and interact with state transportation agencies to aid in the implementation of these projects.

ConnDOT has a 340 square roll (4'W by 86'L) of titanium mesh that can be provided to a NETC researcher to utilize anywhere in New England for this research.

Note(s):

[1] NETC 10-4, "Field Evaluation of Corrosion Protection on Bridges With a Spray Application of Disodium Tetrapropenyl Succinate (DSS)," was formerly titled, "Inhibiting Chloride Ion Penetration in Existing Reinforced Concrete Structures, With a Spray Application of DSS-Hycrete [Disodium Tetrapropenyl Succinate (DSS)]."