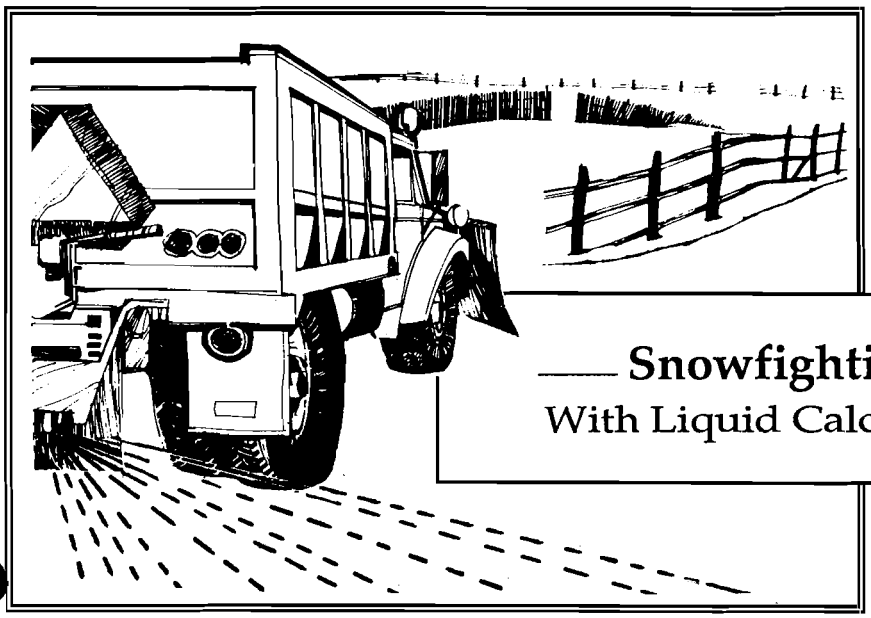
M A S S

INTERCHANGE

VOLUME 5 NUMBER 2 DECEMBER 1990

Safety, the environment, performance, and cost are the reasons why some Massachusetts towns added liquid calcium chloride (CaCl 2) to their arsenal of traditional salt and sand for snow and ice control.

Winter in New England presents an unparalleled challenge to municipal highway personnel. Using a limited number of hard workers, snowplows, and salt and sand material stockpiles, snowfighters face: temperatures that rise and fall precipitously; storms on nights, weekends, and holidays; precipitation that fluctuates from freezing rain to sleet, wet snow, dry snow, and their combinations; and limited budgets for keeping the roads passable and safe. With such unpredictable and often harsh conditions, any method that helps snowfighters do a better job is welcome. Although much can be written about new ideas in all areas of snowfighting, this article will concentrate on the deicing chemicals sodium and calcium chloride. Though other deicing chemicals have been evaluated, the other compounds are not yet competitive due to high cost, poor performance, or other undesirable traits.



Snowfighting
With Liquid Calcium Chloride

Deicers

Both abrasives and deicing chemicals are spread on roadways to help attain winter road safety. Abrasives, most often sand, provide traction for better skid resistance on slick roads. They do not melt snow or prevent ice packs from forming. Deicing chemicals, most commonly sodium chloride (NaCl-common table salt), are used to prevent ice formation, melt ice, and prevent snow pack build-up. Deicers, like an automobile's anti-freeze, work by lowering the freezing point of the precipitation on the pavement surface thus preventing ice packs from forming and pavement slush from refreezing. By keeping the snow in a soft, uncompacted state, the slush can easily be cleared by a snow plow.

Sodium Chloride

Sodium chloride has been the deicing chemical of choice for municipalities because it is both readily available and inexpensive. Common rock salt costs about $30 per ton and is usually applied at a rate of roughly 300 pounds per lane mile. The equipment most often used for application is a hopper body spreader unit with a spinner attachment for material disbursement. Application rates and methods, of course, vary greatly among communities. For

DEP Oil Disposal Update

The Baystate Roads Program received a phone call from the Department of Environmental Protection. On 7 December, 1990, the Department is planning the promulgation of two regulations which will impact several Public Works Departments across the states. These regulations are:

1. "Municipalities (and other public agencies) are allowed to collect waste oil from do-it-yourselfers and very small quantity generators (VSQGs) under 310 CMR 30.393. Often these waste oil collection centers are at public recycling centers or landfills. Our existing regulations require that this waste oil be transported from the collection point by a licensed transporter. These new regulations would allow municipalities to transport the waste oil from the collection center to a municipally owned and operated space heater at another location in that municipality for energy recovery.

Before burning the waste oil, it must be tested to determine if it meets certain specifications such as flash point (100 degrees F minimum), PCB content (2 ppm) and halogens (1000 ppm maximum). The transport and testing requirements are found at 310 CMR 30.393(10)."

2. " Amendment (310 CMR 30.353 (7) (a)) allows public or private operations under a single ownership to service VSZGs under their operation with a single vehicle. (e.g. a "milk run") For example, the Massachusetts Department of Public Works would be able to pick up waste oil from several of their VSZG locations and bring it to a Mass. DPW space heater for energy recovery. The shipment would be limited to 55 gallons at any one time and would have to comply with other self-transport requirements for VSZGs. In the current regulations, VSZGs are allowed to transport only their own wastes to another generator or facility."

Once a municipality gets a full barrel or drum, a sample should be taken and the barrel sealed. The sample should be sent off to be analyzed. When testing results have been received and the results are passable, the oil may be burned.

For further information, contact the Department of Environmental Protection Industry Assistance Hotline at (617) 292-5898, 9:00 am to 1:00 pm, Monday to Friday.

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deicers to work, the deicing chemical must be dissolved as a solution in water. NaCl acts by lowering the freezing point of water from 32 degrees F. to about 25 degrees F. When the temperature drops much below 25 degrees F., the NaCl cannot get into its brine state, consequently allowing water to freeze on the pavement surface. The result is slippery, dangerous, and unsafe driving conditions.

A side effect of NaCl use on roadways is the potential contamination of groundwater supplies caused by runoff of high NaCl concentrations. Particularly sensitive areas are municipal water supplies, private wells, and wetlands. Samuel Pollock, Hydrologist for the Massachusetts Department of Public Works, has documented the cost for replacing a contaminated private well at $5,000 to $35,000. Damage can also accrue to such roadside vegetation as red and sugar maple, American elm, white pine and hemlock. Yellowed or dead foliage on roadside trees is a telltale sign of NaCl damage. Yet, the drawbacks associated with NaCl use are offset by the resultant safety improvements. Communities that have tried a "no salt" policy have generally rescinded it due to the resultant unsafe driving conditions.

Calcium Chloride

Calcium chloride, a simple salt found in natural brine deposits, is also commercially manufactured. Its attractive properties are its ability to absorb moisture from the air (deliquescence), its tendency to resist evaporation by holding moisture (hygroscopicity), its lower freezing point (eutectic temperature), and its minimal impact on environmentally sensitive areas. Liquid CaCl2 is usually sprayed onto the salt/sand mixture before it hits the spinner on the back of the spreader. This type of application allows control of chemical spraying by use of an on-off switch inside the truck cab.

The cost for a 32% solution, the standard for snow and ice applications, is about $ .70 per gallon. An associated application rate would be six to ten gallons per ton of salt/sand mix. The CaCl2 acts as a booster to assist the snow melting action of the NaCl/sand mixture by speeding up the transition to brine. Fast melting results because CaCl2 is already in a brine state, and will remain liquid to approximately 5 degrees F. It provides about twenty extra degrees of additional deicing action over NaCl.

Another attraction of CaCl2 is its less harmful effect on the environment. According to George Momberger, senior engineer technician for the New York State Department of Environmental Protection suggest CaCl2 as an effective alternative to NaCl as the sole deicing chemical.

However, if only the above information were available, all municipalities would be using only liquid calcium chloride for winter maintenance. The rest of the story is that CaCl2 is more expensive than sodium chloride, thus there is a trade off between better performance and higher cost. The approach taken by the majority of communities is to compromise between the two. CaCl2 will provide the NaCl with both moisture and heat, thereby helping the rock salt dissolve faster. Additionally, the wetted NaCl will adhere to the road surface better, thereby minimizing scatter. According to the Michigan Technology Transfer Center, 90% of the wetted material will remain on the pavement, whereas only 70% of the dry NaCl will stay put. Consequently, the initial higher cost of the CaCl2 will quickly be offset by the savings in materials not lost to scatter. Another savings results from the lower temperature range of the CaCl2. If the material works at colder temperatures, then crews can go out less often, offering savings in both labor and equipment maintenance. The end result is safer roads, lives saved, and fewer property damage accidents.

Contributed by Meryl Ann Mandell, MSCE
All States Asphalt, Inc., Sunderland, Mass.

PUBLICATIONS

New Listings

"Manual of Traffic Engineering Studies" (Institute of Transportation Engineers) is a publication which may be borrowed from the Baystate Roads Program. One of the premises of the book is: "Traffic and parking problems that are approached with facts can be rationally solved, and support for these solutions can be developed among the various public interests." The manual concentrates on the commonly occurring traffic and parking situations. It includes chapters as follows: Introduction; Inventories for Traffic Studies; Traffic Volumes; Traffic Accident Studies; Traffic Conflicts; Spot Speeds; Travel Times and Delays; Intersection Delays; Origin-Destination Surveys; Parking Studies; Public Transportation Usage; Public Transportation Speed and Delays; Street Lighting; and Observance of Control Devices. Also included are Appendices on: Statistical Analysis; Before and After Analysis; Written Report; Oral Report; Graphics; Questionnaire Preparation; and Forms for Traffic Studies.

The Baystate Roads Program has recently obtained a copy of ***"Highway Drainage Guidelines"*** (American Association of State Highway and Transportation Officials, Inc., 1987). This publication is composed of the following chapters: Hydraulic Considerations in Highway Planning and Location; Hydrology; Erosion and Sediment; Control in Highway Construction; Hydraulic Design of Culverts; Legal Aspects of Highway Drainage; Hydraulic Analysis and Design of Open Channels; Hydraulic Analyses for Location and Design of Bridges; Hydraulic Aspects in Restoration; and Upgrading of Highways.

"Report of AASHTO Joint Task Force on Rutting" (AASHTO, 1989) is a publication which deals with several aspects of rutting. It discusses ways to prevent rutting, which is a public relations disaster for all segments of the highway building community.

"Guide for Design of Pavement Structures, Volume 2" presents a series of Appendices on: Guidelines for the Design of Highway Internal Drainage Systems; A Position Paper on Pavement Management; Remaining Life Considerations in Overlay; Design; Development of Coefficients for Treatment of Drainage; Development of Reliability; Relationship Between Resilient Modules and Soil Support; Relationships Between Resilient Modules and Layer Coefficients; Development of Effective Roadbed Soil Moduli; Survey of Current Levels of Reliability; Development of Design Nomographs; Determination of J-Factor for Undowelled Pavements; Development of Models for Effects of Subbase and Loss of Support; Extension of Equivalency Factor Tables; Recommendations for the Selection of an AASHTO Overlay Method, Using NDT within the AASHTO Performance Model Framework; Pavement Recycling Fundamentals; and Development of NDT Structural Capacity Relationships.

"Guide for Design of Pavement Structures" (AASHTO, 1986) is a 4 part publication. Part I, Pavement Design and Management Principles, has chapters on: Introduction and Background; Design Related Project Level Pavement Management; Economic Evaluation of Alternative Pavement Design Strategies; Reliability; and Summary. Part II, Pavement Design Procedures for New Construction or Reconstruction, includes the following chapters: Introduction; Design Requirements; Highway Pavement Structural Design; and Low Volume Road Design. Part III, Pavement Design Procedures for Rehabilitation of Existing Pavements, has chapters on: Introduction; Rehabilitation Concepts; Guides for Field Data Collection; Rehabilitation Methods Other Than Overlay; and Rehabilitation Methods with Overlays. Part IV, Mechanistic Empirical Design Procedures, covers: Introduction; Benefits; Framework for Development and Application; Implementation; and Summary.

There are also several Appendices included in this publication. One has a glossary of terms, and another has typical pavement distress type-severity descriptions, among others.

We have received a copy of ***"Geotextile Selection and Installation Manual for Rural Unpaved Roads"*** (FHWA, April, 1989). This 64 page report is available to help guide local officials in selecting and installing geotextiles on rural unpaved roads. It is an excellent reference for personnel who are considering installation of geotextiles. It has details on: Problem Identification; Fabric Installation; Aggregate Selection; and Blading.

Subdivision Street Considerations For Local Road Systems

Introduction

Subdivision activities in many urban and sub-urbanized regions across the nation continue to impact local street/road systems. Five major areas of concern which need to be addressed by local transportation officials are: safety, efficiency, circulation, economy and livability. This article presents an overview of some major considerations in the planning and layout of sub-division street/road systems.

The Subdivision System

The total system consists of individual systems. These are streets, roads, homes, shops, schools, recreational facilities -- i.e. playgrounds, parks, entertainment centers, and so on. For the system to operate, a major traffic objective has to be achieved. That is, a transportation system that would yield a traffic circulation system which is safe, efficient, economical and livable should be provided to link these individual system components. The final transportation product is therefore a street/road network providing access and links.

Type of Road/Street Systems

The pattern of the road/street system in any subdivision yields roads/streets serving different functions. The point of focus in this article concerns local residential street systems providing access to and serving abutting properties, and collector road/street systems which basically intercept traffic from the local and transfer them to the arterial systems.

Type of Traffic to be Handled

The basic traffic type found on local and collector street/road systems is the private car. Other types include service vans and trucks. In localities where a public transportation system operates, buses would have to be handled. An accurate estimate of the expected traffic and detailed analysis should be a primary concern of the engineer and/or official involved. Basic questions should address, among others, expected traffic volume, generated trips, class of vehicles, allowable vehicular speed.

Expected Design Outputs

Based on the goals, objectives, and design inputs adopted in the planning phase, the final transportation product should give the street/pedestrian system layout, considering the projected land use pattern, and the corresponding detailed plan, specifying numerical descriptions of pavement widths, turn radii and angles, intersection dimensions, etc.

Major Considerations

Safety issues:

▲ Vehicular access, in terms of street patterns, widths, junctions and/or intersections, should be adequate.

▲ Pedestrian facilities, in terms of sidewalks: placement pattern should be adequate, with minimum conflict with the street system.

▲ Residents should be protected from potential accidents by discouraging through traffic on the local road/street system and excessive speeds.

▲ Avoid direct access to collector street systems.

Efficiency issues:

▲ Provide adequate access with minimum street pattern, which reduces excessive vehicular travel. As much as possible, the street pattern should conform with the existing topography.

▲ Efficiency of service is improved through logical design of street numbering and direction.

▲ Transit vehicles should be considered in deciding on directional and routing pattern.

Circulation issues:

▲ Interruption of traffic circulation should be minimized through driveway access control, on-street parking control, and provision of adequate access for major traffic generators within the subdivision, such as shops, schools, religious centers, recreational facilities, etc.

▲ Adequate geometric provision for transit and other service vehicles should be considered.

Economic issues:

▲ Street patterns should conform as much as possible with existing topography to avoid excessive capital cost.

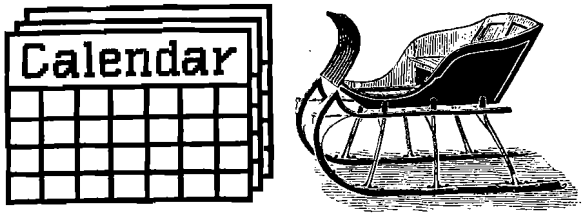
▲ Encourage a minimum travel path for the overall network design to avoid excessive traffic delays and subsequent user costs , in terms of fuel and social costs in areas of air and noise pollution control.

Conclusion

This article has been brief in its discussion of the broad planning issues involved in subdivision transportation systems. However, local officials should recognize that safety, efficiency of service gained through an effective circulation system, livability, and economy to users of the transportation system have a major impact on the final design output.

Readers are encouraged to consult detailed engineering discussions presented by the Institute of Transportation Engineers on this basic but important transportation activity.

Contributed by Emmanuel Ofori-Darko
Research Assistant, University of Massachusetts



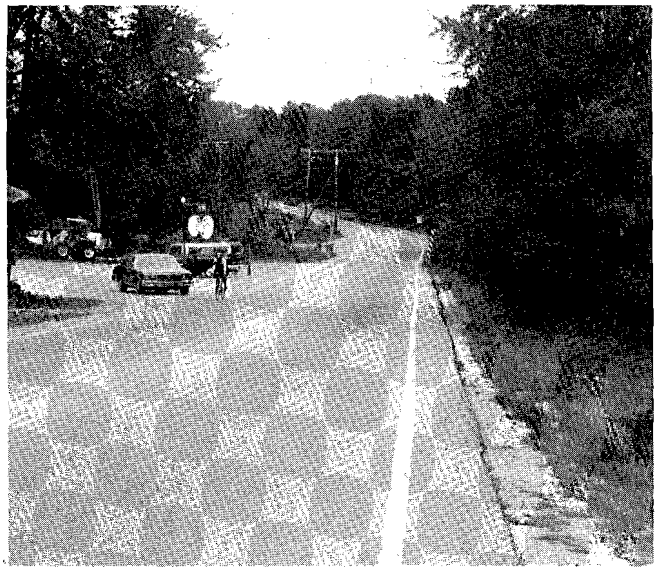
Transportation Research Board - 70th Annual Meeting
13-17 January, 1991
Washington, D. C.
Information: Angela Arrington (202) 334-2382

Massachusetts Municipal Association
Twelvth Annual Meeting and Trade Show
24-27 January, 1991
Boston Marriott Hotel/Copley Place
Information: (617) 426-7272 (800) 882-1498

Massachusetts Highway Association Meeting
Thursday, 7 February, 1991 - Lantana's in Randolph
Thursday, 9 May, 1991 - Wachusett Country Club
Information: Gerard L. Daigle, MHA Secretary (508) 966-0203

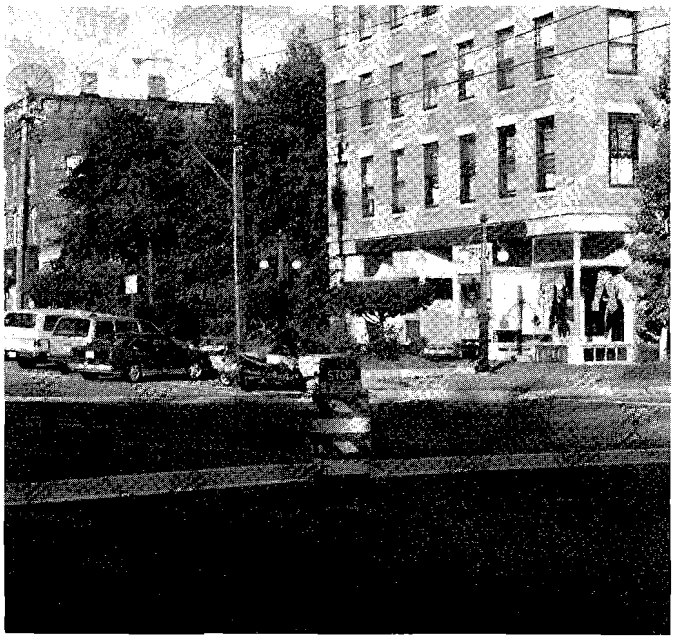
The 1988 Edition of the Manual on Uniform Traffic Control Devices describes a Type 3 Object Marker as a: ("Striped marker consisting of a vertical rectangle approximately 1 foot X 3 feet in size with alternating black and reflectorized yellow stripes, sloping downward at an angle of 45 degrees toward the side of the obstruction on which traffic is to pass.") (A 3C-1).

This sign is either installed on the wrong side of the bridge, or this is a new and exciting method to save wear and tear on the State's bridges.



Both of these traffic signs are meant to convey the same meaning, that vehicles should stop for pedestrians in the cross walk. At the "Traffic Signs and Markings" workshop sponsored by the Baystate Roads Program and conducted by Robert Shea, Charles Sterling, and Richard Gilmartin, these signs were discussed.

One sign is very desirable, and one is a liability problem waiting to happen. Can you tell which one is which? If not, call (413) 545-2848 and request the video tape on the "Traffic Signs and Markings" workshop.



We are offering several publications (of which we have a limited supply). To receive a copy of any of the following: **Please check the appropriate box and mail this form** to: **Baystate Roads Program**, 214 Marston, Dept. of Civil Engineering, University of Massachusetts, Amherst, MA 01003 -- or call **Patricia Miller (413) 545-2848.**

- ❑ ***Communications with your Board and the Public***
  Kate Skelton, Cornell Local Roads Program, 1988
  (Working with elected officials, the public, the media, and the crew)

- ❑ ***Gravel Paser Manual***
  University of Wisconsin, Madison, CE Dept., FHWA, 1989
  (Pavement surface evaluation and rating)

- ❑ ***Municipal Liability in Wisconsin***
  Fred A. Wileman and Rosemarie A. Rhines
  University of Wisconsin, 1989
  (Highway problems)

- ❑ ***The Vermont Backroads***
  Robert F. Longfield, Jr., 1974
  (A guide for the protection, conservation and enhancement of scenic quality)

- ❑ ***Techniques for Reducing Construction and Maintenance Costs***
  H. R. Thomas, D. Sweeney, E. D. Johnson
  PA DOT/FHWA, 1987
  (Value Engineering, drainage, road maintenance, shoulder maintenance)

- ❑ ***Construction Inspection Techniques for Base Course Construction***
  DOT/FHWA, 1986
  (Base course types, important base characteristics, granular base course construction and compaction, stabilized base courses)

- ❑ ***Local Highway Safety Improvement Program***
  DOT/FHWA,NHI 1986
  (Users guide)

- ❑ ***Improving Operational Safety on Local Roads and Streets***
  DOT/FHWA, 1988

- ❑ ***Understanding Soil Compaction***
  CASE, 1986
  (What is compaction? Soil types, soil properties, moisture content, compaction factors, machine types, testing)

- ❑ ***Highway Drainage***
  DOT/FHWA, 1984
  (Basic culvert hydraulics)

- ❑ ***Installation Manual for Corrugated Steel Drainage Structures***
  NCSPA, 1982
  (Locating, excavating, assembly of pipe culverts and sewers, back filling, subdrainage, skew diagram)

- ❑ ***Drainage***
  Robert E. O'Conner, Ph. D., Donald R. Esmond
  NY DOT
  (Soils disposition, highway structure, negative effects of water on highway structure, drainage facilities)

- ❑ ***Local Highway Safety Studies***
  B. L. Bowman, Ph. D., P.E.
  DOT/FHWA/NHI, 1986
  (User's guide)

- ❑ ***Flagging Handbook***
  American Traffic Safety Services Association, 1987
  (Equipment, flagger's position, advanced flagger, stop traffic, release of traffic, flag carrying)

Please see page 8 for additional publications.

Please fold (on line above) and mail.

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- ❑ ***Rating Unsurfaced Roads***
  R. A. Eaton, S. Gerard and D. W. Cate, US ACE, 1987
  (A field manual for measuring maintenance problems)

- ❑ ***Comparison of 3 Compactors Used in Pothole Repair***
  Michael A. Snelling and Robert A. Eaton, Nov. 1984
  (Asphalt concrete, compactors, potholes, repair, roads)

- ❑ ***Pothole Primer***
  Robert A. Eaton, Robert H. Joubert and Edmund A. Wright, U.S. ACE, 1989
  (A public administrator's guide to understanding and managing the pothole problem)

- ❑ ***Asphalt Paser Manual***
  Donald Walker, Lynn Entine, Susan Kummer, 1989
  (Pavement surface evaluation and rating)

- ❑ ***Uses of Asphalt Rubber***
  ARPG
  (Asphalt rubber, asphalt rubber concrete, three layer system, stress absorbing membrane layer)

- ❑ ***Pavement Maintenance Treatments***
  (Liquid asphalt, sprayed on seals, cold mixes and hot mixes)

- ❑ ***Concrete Paser Manual***
  University of Wisconsin, Madison, CE Dept., FHWA, 1989
  (Surface defects, joints, cracking, pavement deformation, Paser rating system, inventory and field inspection)

- ❑ ***Recycling Asphalt Pavement***
  Roger W. Gose, Baystate Roads Program, 1986
  (Hot mix recycling, cold recycling with chemical options, surface recycling, heater-planer, heater-scarifier, cold planing)

- ❑ ***The Engineer's Pothole Repair Guide***
  Robert A. Eaton, Edmund A. Wright, William E. Mongeon US ACE, 1984
  (Potholes, materials for patching, tacking materials, sealing materials, patching equipment, repair procedures, pavement management)

- ❑ ***Construction Inspection Techniques For Flexible Pavements***
  DOT/FHWA, 1986
  (Preliminary inspection activities, base/grade preparation, plant operations, hauling and laydown, compaction, project acceptance)

Please see page 7 for additional publications, and reply label.

The Baystate Roads Program, which publishes *Mass Interchange* each quarter, is a Technology Transfer (T2) Center created under the Federal Highway Administration's (FHWA) Rural Technical Assistance Program (RTAP). FHWA is joined by the Massachusetts Department of Public Works, the Department of Civil Engineering at the University of Massachusetts/Amherst, and local public works departments in an effort to share and apply the best in transportation technologies.

In addition to publishing *Mass Interchange*, the Baystate Roads Program facilitates information exchange by conducting workshops, providing reports and publications and videotapes on request, and offering one-to-one technical assistance on specific roadway issues. Because the program relies on input from many sources, inquires, articles, and ideas are encouraged.

To contact the Baystate Roads Program, please call Silvio Baruzzi at (413) 545-2604.

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