M A S S

INTERCHANGE

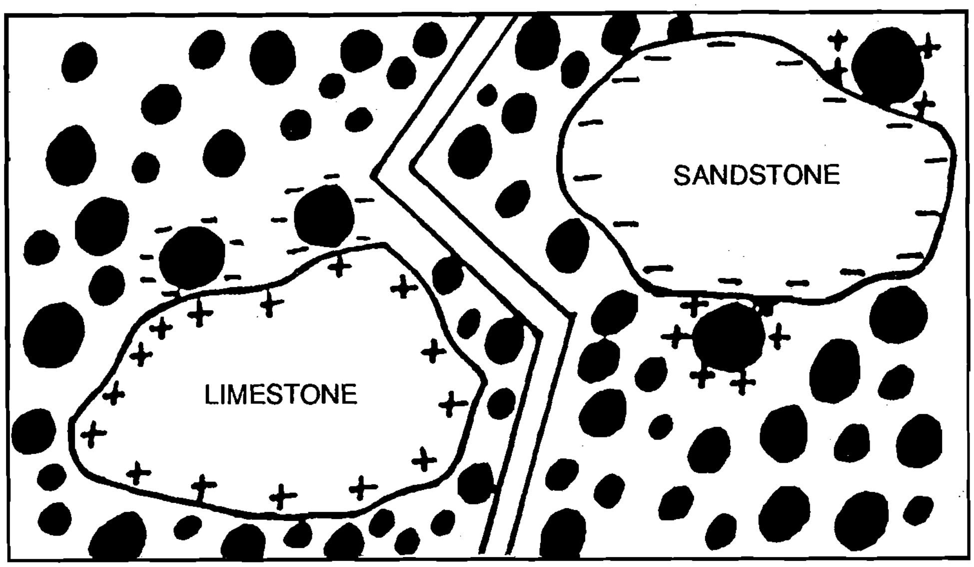
Volume 6, Number 4 Summer 1992

CHIP SEAL MATERIALS

ASPHALT EMULSION

As a highway official you aren't in the business of making asphalt emulsions. However, it helps to know something about construction materials if you are to have control over construction projects that require them. This article will provide some information about the ingredients of asphalt emulsions and how they work.

Asphalt emulsion is a mixture of asphalt cement, water, and an emulsifying agent (very much like a detergent or soap). Sometimes there is a small amount of solvent such as naptha, also. Mixing asphalt with water requires an emulsifier since they do not readily mix. As the three ingredients are blended, a suspension of asphalt droplets in water occurs. The emulsifier creates a surface tension between the asphalt particles and surrounding water that permits the asphalt droplets to remain in suspension until the water evaporates. Emulsifiers create an electrical charge on the surface of the asphalt particles that cause them to repel each other, helping them to stay in suspension. An anionic emulsifier is one that makes a negative charge on the asphalt droplets. A cationic emulsifier creates a positive charge on the droplets. Figure 1 (not to scale) is a drawing of asphalt particles in suspension as an emulsion.



Anionic emulsion Cationic emulsion

Figure 1: Asphalt Droplets in an Emulsion

Most people agree that anionic emulsions work best with aggregates having mostly positive surface charges, such as limestone. Usually a cationic emulsion works best with aggregates having mostly negative surface charges, such as sandstone. However, the risk of severe stripping failure due to mismatched emulsion and stone is not high. Seldom, if ever, is the degree of compatibility so poor that the asphalt emulsion will not coat the stones. Furthermore, once the emulsion has broken, it behaves like an asphalt cement, and the charge on the asphalt film disappears.

Curing of Emulsions

Both anionic and cationic emulsions "cure" when the water evaporates, leaving the asphalt cement residual to bind the aggregate. The type and concentration of emulsifier used determines if the emulsion is rapid setting (RS), medium setting (MS), or slow setting (SS). Cationics tend to give up their water a little faster than anionics. There are several factors which affect the curing rate of all emulsions. These factors affect how fast a chip seal will take to cure:

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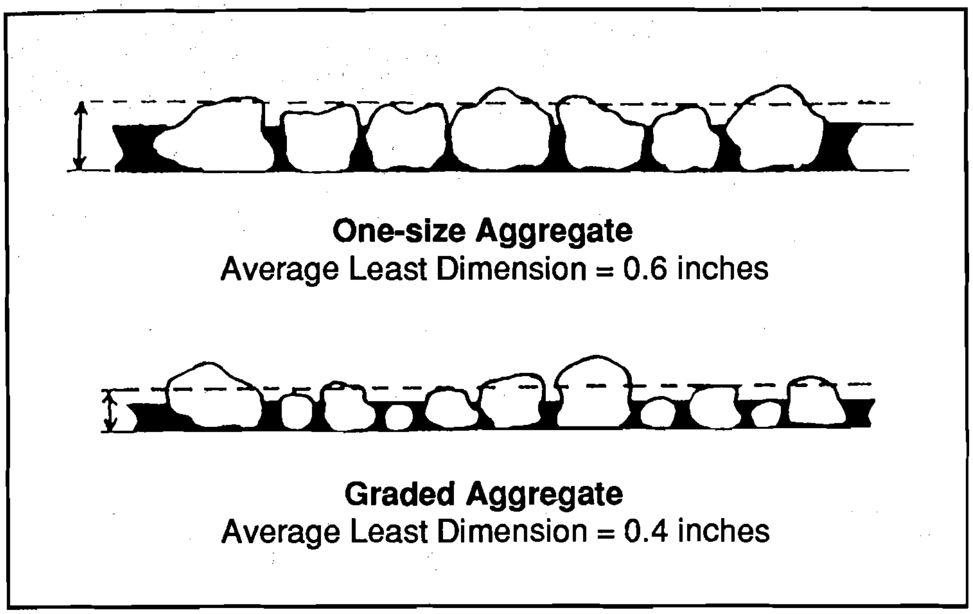

Figure 2: One-size Aggregate vs. Graded Aggregate

continued from Page 1

Weather conditions - Temperature, humidity, and wind affect the breaking and curing of an emulsion.

Moisture content of the aggregate - If the stone is wet when it is spread on the emulsion, water will be added to the emulsion. This could increase setting time. However, damp stone is coated more readily by the emulsion, so dry stone should be avoided.

The mechanical forces of rolling and traffic - This will force water from the material to a limited extent, and speed up curing.

Water absorption by the stone - A rough textured, porous stone speeds the setting time by absorbing water from the emulsion.

Emulsion-stone compatibility - When a cationic or anionic emulsion is properly matched with the appropriately charged stone, the curing rate will be enhanced.

Rapid-setting emulsions are composed of approximately 55-65 percent asphalt cement, with the remainder being water and possibly a small amount of solvent. After the emulsion "cures", the residue left behind is the asphalt cement binder.

Type of Emulsion to Use

Chip sealing requires the use of the rapid setting emulsions RS-1, RS-2, CRS-1, and CRS-2, which break quickly. A fast breaking time is desired to ensure that the cover stone is firmly "glued" in place shortly after it is spread. Fast breaking reduces the time that the fresh chip seal is vulnerable to stripping and scarring by traffic. This keeps the length of time requiring traffic control to a minimum. The road can be returned to service as soon as possible, minimizing inconvenience to the public.

Avoid use of a medium setting (MS) emulsion. An MS emulsion takes about 30 minutes to begin to set when the temperature is hot and the humidity is low, compared to a minute or two for an RS.

SELECTING THE PROPER STONE

Selecting proper stone is critical to producing a successful surface treatment. There are several important properties that you should look for:

- The stone should be one-size
- It should be chunky, not flat and flaky
- The stone should be clean

The need for each of these qualities is explained in the following section.

One-Size Stone

Figure 2 compares the Average Least Dimension (ALD) of one-size stone to an aggregate that includes various particle sizes. When the correct amount of asphalt emulsion is used with one-size stone the void space between stones will be filled to about 70 percent of the ALD. In other words, the stones will be buried to about two-thirds of their height. Experience shows that a stone oriented to its flattest dimension will most likely be dislodged by traffic if less than half its height is embedded in asphalt.

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Chunky Stone

Figure 3 compares a stone that is chunky to one that is flat and flaky. Notice that both the chunky and the flaky stone are labeled #1 stone. The #1 stone passes the 1/2 inch screen but is retained on the 1/4 inch. Stone that is either chunky, or flat and flaky, could be within this size range. However, when the stone is settled into its flattest orientation, a one-stone layer of flat, flaky material will not be as thick as a layer of chunky stone. The layer of asphalt required will be thinner for a flaky material. Therefore, it will be more difficult to control the correct application rate on the job site.

Figure 3 indicates that the chunky material requires 0.30 gals./sq.yd. of residual asphalt to fill the voids to the desired 70 percent. If an additional 0.13 gals./sq.yd. were applied, the voids would be 100 percent filled and the road would bleed. However, for the flaky material, only 0.25 gals./sq.yd. of residual asphalt are required to fill the voids to 70 percent. Furthermore, only 0.04 gals./sq.yd. more would ruin the chip seal by filling the voids completely, causing bleeding.

Clean Stone

The stone must be clean. If it is coated with rock dust, silt, or clay fines the asphalt will not adhere well to the aggregate. This, of course, will greatly increase the risk of a stripping failure. To prevent the problem of dirty aggregate, precoated stone can be used. Precoated stone is typically covered with a 50/50 solution of RS emulsion and water. The precoating helps prevent the increase of fines. It also promotes good adhesion of the emulsion to the stone. However, double-washed stone should work quite well.

SELECTING THE STONE AND EMULSION APPLICATION RATES

Most highway superintendents think of applying stone in tons-per-mile and emulsion in gallons-per-mile. Thinking in such big numbers is fine for rough estimations of the size of a project. However, if you really want to consistently build up chip seals that do not strip or bleed, this is not accurate enough.

In order to prevent bleeding or stripping, the emulsion and stone application rate must be carefully selected and then controlled on the job site. Good control can only be achieved if you consider application rates in terms of pounds of stone and gallons of asphalt emulsion per square yard. You may think this is not practical. However, it is not that difficult to do. This section will explain how to select application rates in pounds and gallons per square yard.

The stone and emulsion application rates depend upon the condition of the road being chip sealed and the stone that will be used. Remember that two aggregates, both specified as #1 stone, could require different amounts of emulsion due to a difference in the degree of chunkiness/flakiness. It is very possible that from year to year a 1ST produced from the same pit could have a different ALD. A change in crushing equipment or the location in the pit from which material is being taken could affect the chunkiness/flakiness of the material being produced.

Condition of the road surface will also affect the amount of emulsion needed. A surface that is extremely weathered will be porous and oxidized. It will be absorbent and therefore require extra emulsion. In contrast, a surface that is bleeding will need less asphalt.

In addition, traffic affects the amount of emulsion needed. A road that receives heavy traffic will require less emulsion than one with light traffic. The stones of the chip seal receiving heavier traffic will likely be pressed more deeply into the road surface, and therefore need a thinner layer of emulsion to bind them to prevent bleeding. In contrast, the stones of a chip seal under light traffic may never be fully seated to their lowest possible orienta-

Chunky NYSDOT #1 Stone; ALD = 3/8 inches

70 percent voids filled requires:	0.30 gals./sq. yd. of residual asphalt
100 percent voids filled requires:	0.43 gals./sq. yd. of residual asphalt
Difference:	0.13 gals./sq. yd.

Flaky NYS #1 Stone; ALD = 1/4 inches

70 percent voids filled requires:	0.25 gals./sq. yd. of residual asphalt
100 percent voids filled requires:	0.29 gals./sq. yd. of residual asphalt
Difference:	0.04 gals./sq. yd.

Figure 3: Chunky vs. Flaky Aggregate

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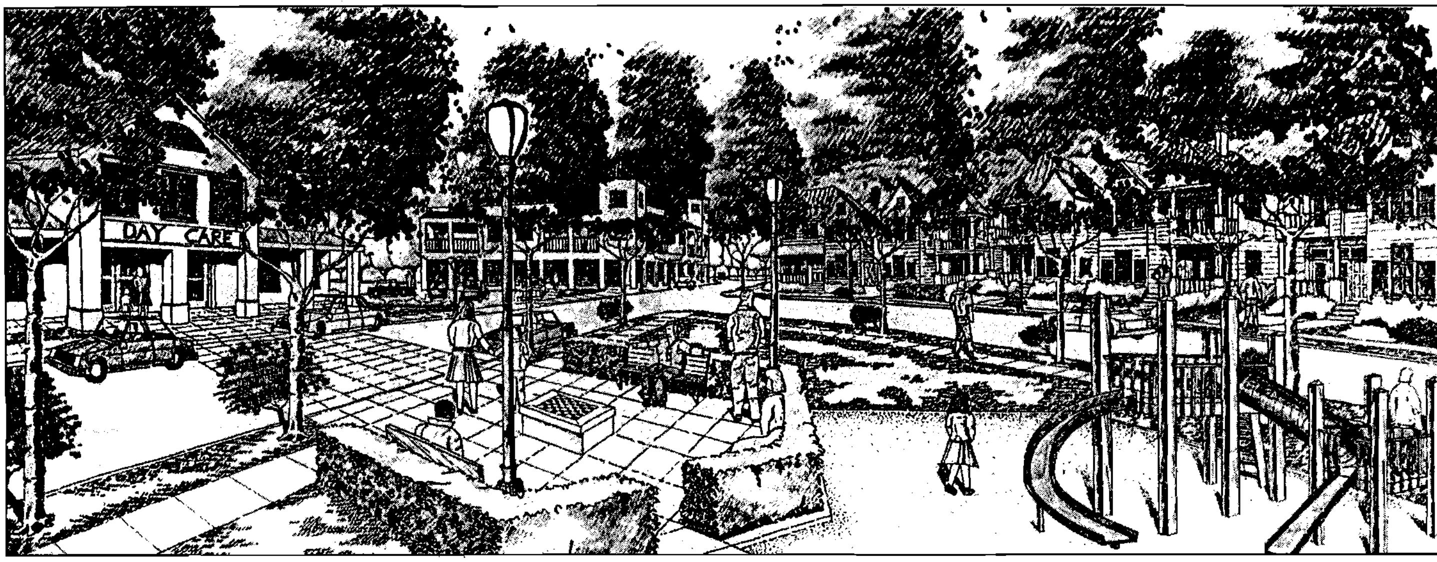
NEO-TRADITIONAL NEIGHBORHOOD DESIGN



Neo-traditional neighborhood design encourages the creation of a pedestrian-friendly center. A sense of place and community are established by utilizing complex, geometric street layouts, slower speed street design, and mixed land uses. Here, an example of a mixed use neighborhood center.

The Institute of Transportation Engineers (ITE) Journal published an article on Neo-Traditional Neighborhoods in the January 1992 issue. It stated that Neo-Traditional Neighborhood Design (NTND) has begun to take root in the United States, and its implications for traffic engineers are significant. Suburban communities have been designed primarily for private auto use, with little attention given to other transportation modes. Zoning helps to reinforce this practice in most localities by preventing mixed use development and promoting dispersed development.

The scale and close mixing of land use in NTND plans supports a new transportation mode balance, which tries to reduce auto design speed in order to allow the pedestrian and non-motorized modes equal or preferred right-of-way. NTND is being used by planning and zoning boards to promote growth management, sustainable communities, quality of lifestyle, open space preservation, and affordable housing.

Background

NTND can generally be characterized by:

- a neighborhood center, which ideally provides the goods and services needed daily by local residents, within a five minute walking distance (roughly .25 mile radius)

- streets are laid out in well connected patterns to yield alternate automobile and pedestrian routes to every destination

- streets are complex public spaces containing traffic, parking, and shade trees

- streets are relatively narrow

- on street parking is permitted (acts as a buffer for pedestrians and slows down passing traffic)

- streets and sidewalks are designed to accommodate bicycles

- buildings are generally limited in size

Traffic Engineering for NTND

One of the primary objectives of NTND is to reduce the dependence on the car. This will mean fewer cars on the roads, fewer accidents, and less congestion. A regular geometric pattern of interconnected streets is the basis for the typical NTND development. The grid pattern has been shown to reduce travel demand on collector streets, by promoting greater use of distribution streets. This is excellent for pedestrians and bicyclists, but challenging to engineering as far as speed control. The traffic engineer must balance the accessibility of large public service and emergency vehicles with the shortening of curb radii and narrower widths which will help control speeds. Street width and curb radii should not be so tight to preclude the safe turning of buses and emergency vehicles. Where such vehicles will only visit an area infrequently, turning movements encroaching into the oncoming lane may be acceptable. The reality is that many large public service vehicles and all emergency vehicles use all of the street. Narrow street width is also a concern for bicycle safety.

There are two Neo-Traditional Neighborhood Design projects from Massachusetts listed in the ITE article. Lenox South is a 63 acre project which is in the permitting stage, while Mashpee Commons is under construction on a portion of its 278 acres.

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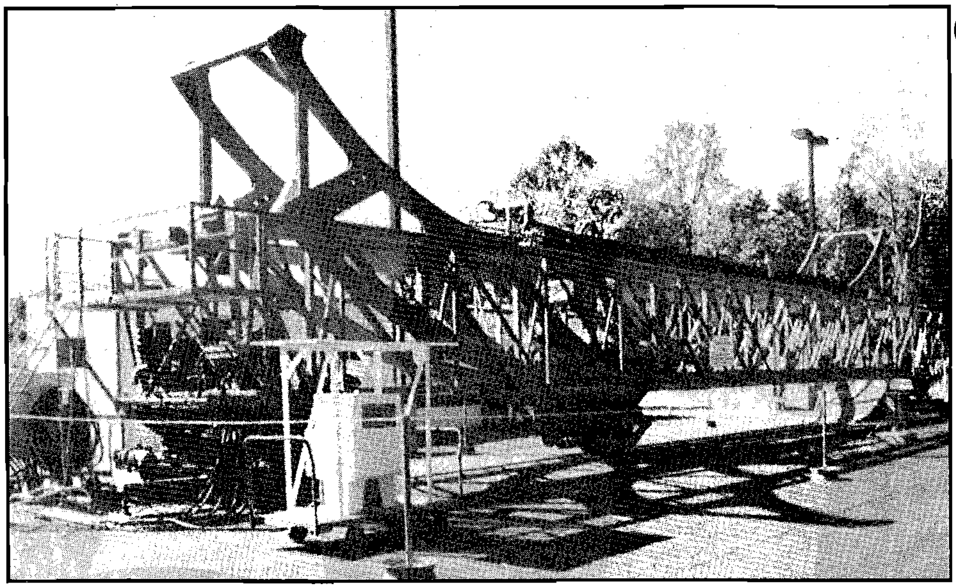
NTND: Comparison of Traffic Engineering and Related Design Characteristics

Traffic Engineering Design Characteristics	Standard Residential Pod	Neo-Traditional Neighborhood
STREET LAYOUT		
Basic Layout	Hierarchical layout designed to collect and channelize trips	Interconnected network of streets dispersing trips
Use of alleys	Often discouraged, especially in residential areas	Encouraged to accommodate narrower lots and fewer driveways on local streets, which allow for narrower streets
STREET DESIGN		
Design speed	Typically 25-30 mph minimum, designed to recognize 85th percentile rate of travel	Typically 20 mph minimum, with design elements to assure design speed equals travel speed
Street width	This, and design speed, are determined by projected volumes and types of all of the users of the street	Determined by projected volumes and types of all of the users of the street
Curb radii	Generally selected to ensure in-lane turning movements for all types of vehicles	Selected considering impacts on pedestrian street crossing times and types of vehicles expected to generally use that street
Intersection geometry	Designed for efficiency, speed of vehicular travel, cost of operation, and safety	Designed to discourage through traffic, highlight civic buildings and safety
Street trees and landscaping	Where allowed, strictly controlled as to size and location	Encouraged to form part of the street space. Larger sizes and small clearances encouraged
Street lighting	Few, large, high and efficient luminaries	More and smaller streetlights of lesser wattage and scale
Sidewalk width and location within the street ROW	Typically 4-foot minimum; in many parts of the country, encouraged outside the right-of-way or to undulate	5-foot minimum, generally within right-of-way and parallel with the street
Building setbacks	Typically 15-foot or more	Typically no minimum
Superelevation	Sometimes required for streets under 40-mph design speed	Never a part of design for streets under 40-mph design speed
Construction centerline not always coincident with design	Not permitted	Encouraged where it serves to form vista terminations
PARKING	Off-street preferred, but often located between buildings and the adjacent street	On-street encouraged and counted toward minimum parking requirements; off-street generally located mid-block or to the rear of buildings
TRIP GENERATION	Developed from a sum of the uses; few "captured" trips	Develops from lesser need for vehicular trips; greater in-project opportunities for "captured" trips

SHRP, FHWA Plan Accelerated Load Tests to Validate Superpave™ Asphalt Specifications

Beginning this fall, the Federal Highway Administration (FHWA) and the Strategic Highway Research Program (SHRP) will use the FHWA's Accelerated Loading Facility (ALF) to catch a glimpse of the future of asphalt pavement performance. ALF will be used to test the first asphalt pavements constructed according to the Superpave™ performance-based asphalt specifications (see photo).



FHWA's Accelerated Load Facility

The Superpave™ pavements will be constructed at the test track at FHWA's Turner-Fairbank Highway Research Center in McLean, VA - home of ALF. ALF can simulate 20 years of highway traffic in six months or less, greatly accelerating the effects of long-term loading.

SHRP's use of ALF for the validation of its findings is the result of a joint effort by SHRP and FHWA.

ALF is 100 feet long and 13 feet wide, and simulates axle loads from 18,000 to 45,000 pounds. The device rolls half of a dual-wheel single axle across 38 feet of a test pavement, travelling about 12 miles per hour. Its trolley system picks up the tires and moves them to the end. The device repeats this pattern again and again, making allowances for traffic wander.

Validation of the accelerated laboratory tests for asphalt-aggregate mixes is the primary focus of the study. The equipment will allow comparison of performance predictions based on the Superpave™ tests with the actual fatigue and permanent deformation that result for sectors with different asphalt concrete thickness and maximum aggregate size.

Twelve test sections will be constructed using asphalt cements with a range of performance characteristics specified according to SHRP's asphalt binder specifications. Four sections will be used for the fatigue tests; six sections for the study of permanent deformation; and two for the moisture damage experiments. Each strip will have two locations for replicate testing.

"We will be able to observe the behavior of pavement under very defined loading by using ALF. The ALF tests will confirm whether we are on the right track," said Ramon Bonaquist, an FHWA Pavements Division research highway engineer. Bonaquist said that not all of these test sections are necessary for the research, but that some extra locations are included in the construction to cover contingencies. Pavement construction is scheduled for completion in September.

This article is reprinted from the May 1992 issue of Strategic Highway Research Program FOCUS, Washington, D.C.

NTND....from Page 4

Mashpee Commons is the redevelopment of an old shopping center. According to Margo Fenn, Chief Planner with the Cape Cod Commission, NTND is encouraged on the Cape because it is in accordance with the traditional patterns of village settlement.

Parking seems to be one of the major areas of contention. Some traffic engineers cite on street parking as a safety hazard - especially to children who might dart from behind a parked car. NTND planners encourage on street parking as a buffer between pedestrians and traffic, and to reduce the need for large surface parking lots.

The table on page 5 illustrates some of the differences between a standard residential subdivision design and an NTND.

The article concludes that demand for NTND communities appears to be growing, with policy boards using it as an approach to deal with issues on conservation and other societal needs and desires. Traffic engineers should support and encourage concepts that strive to reduce dependence on the automobile and improve quality of life.

This article has been excerpted with permission from the Institute of Transportation Engineers Journal, Washington, D.C., copyright 1992.

Chip Seal.....from Page 3

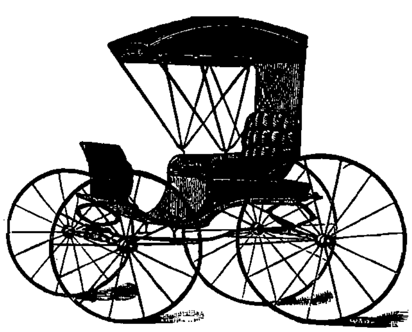
tion. Therefore, the void space between them will be higher than if they were completely reduced to their lowest possible orientation. This increased void space will require more residual asphalt to fill it to 70 percent.

If you use "favorite" or "standard" application rates of tons of stone and gallons of emulsion per mile, it may be the reason why year after year you have chip seals that bleed and others that ravel. If you begin to select application rates per square yard for each and every project to account for the road surface, traffic conditions, and the stone being used, you will get better results.

Many highway officials may have chip seal work done by contract where the vendor determines the application rates. Even in this case the highway department should determine the proper application rates for each road to be chip sealed prior to signing the contract and compare them to the rates proposed by the vendor. If there is a significant discrepancy the difference needs to be resolved. In addition to potential failures excessive rates are also costly.

Selecting application rates should be done well in advance of the day of construction. Enough time should be set aside to examine the road's surface condition, to estimate the volume of traffic, and to determine the spread rates.

This article is reprinted in part from the publication "Chip Seals and Surface Treatments", CLRP Report #91-5, Cornell University Local Roads Program.



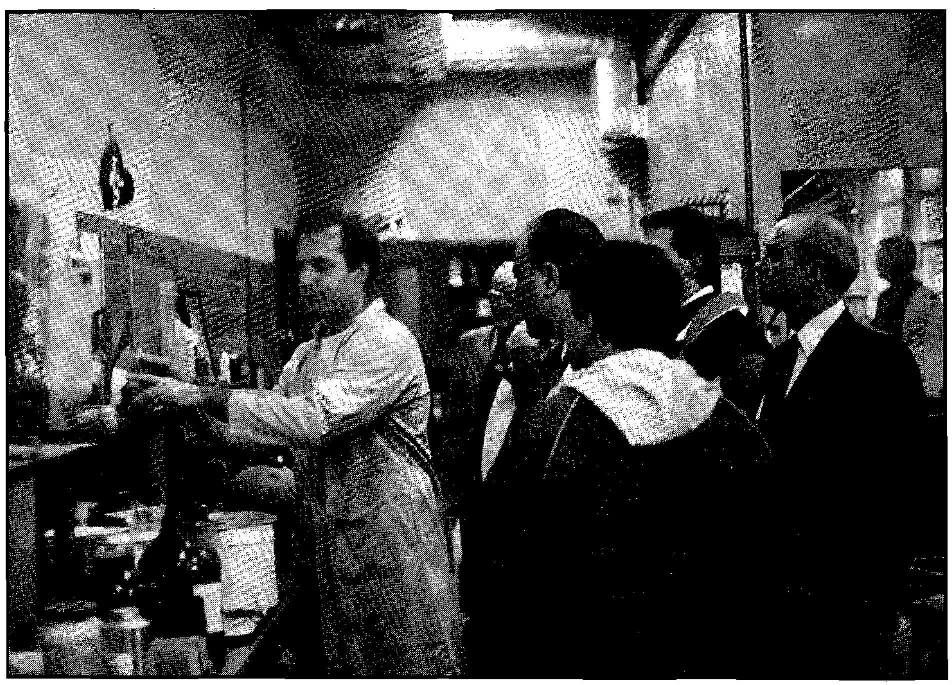
NEW!

MASSACHUSETTS PAVEMENT MANAGEMENT USER GROUP

On April 15, 1992, the Massachusetts Pavement Management User Group held its first meeting. The User Group is composed of representatives from the Regional Planning Agencies (RPAs), Massachusetts Highway Department, and the Federal Highway Administration. It is one of the first groups of its kind in the nation.

The User Group's goal is to promote communication between the RPAs involved in assisting local communities with implementing and maintaining pavement management systems. Several RPAs have been providing this service for years, others are just starting. The User Group will allow experience to be shared. Articles from the User Group newsletter, which are of interest to local communities, will be distributed through the Baystate Roads Program newsletter, *Mass Interchange.*

For more information on technical assistance with pavement management, contact your area's RPA or Joint Transportation Council (JTC) representative.
This article was contributed by Neil Andres, Cape Cod Commission.



As part of this first meeting, a tour of the Wellesley Laboratory facilities (Massachusetts Highway Department) was conducted. In the accompanying photo, Don Pettey, Laboratory Supervisor of the Concrete Lab, demonstrates equipment used to determine time of set of concrete in order to determine compliance with ASTM (American Society for Testing and Materials) specifications. Participants pictured in the photograph include Leonard Vanvorse, George Kahale, Pat Ciaramella, Jeff Pechulis, and Dave Luce.

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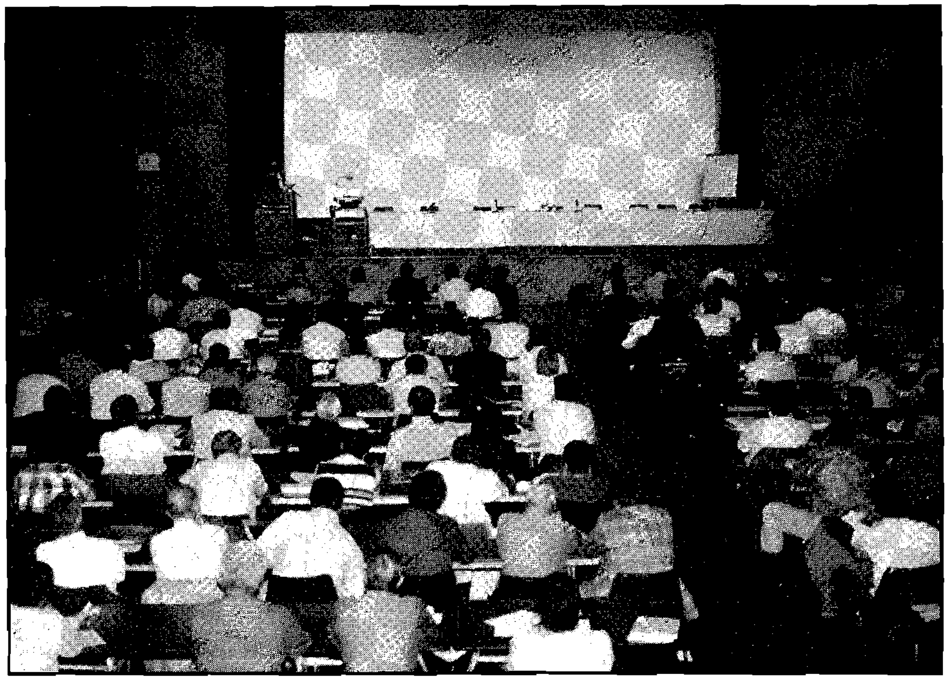
Asphalt Recycling & Reclaiming, May 13, 1992

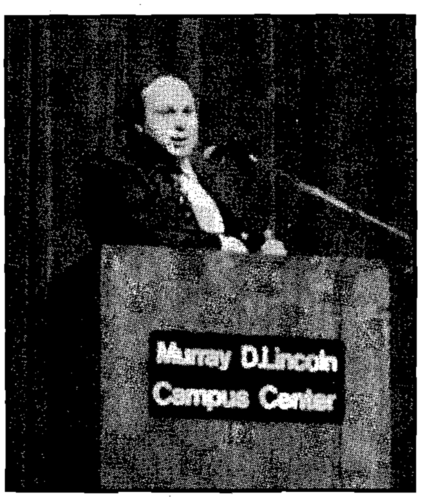
As evidenced by the photo, the Northeast Technology Transfer Conference on Asphalt Recycling and Reclaiming was an overwhelming success. This was due to the hard work and cooperation of a great many people and agencies. Some of the ones who deserve special recognition are:

- The New Hampshire T2 Center including Jennifer Rand, John Anderson, and A.R. Van de Meulebroecke
- Hank Lambert, Vermont T2 Center
- Gerald McCarthy, Connecticut T2 Center
- Toni Rosenbaum, New York T2 Center
- Rene Fontaine, Rhode Island T2 Center
- Pete Coughlin, Maine T2 Center
- Ben Colucci, Puerto Rico T2 Center
- Carolyn Golojuch and Claudia Knezek, New Jersey T2 Center
- David Milkey, UMASS Conference Services



The Conference drew a crowd from throughout the Northeast and Puerto Rico

The speakers all delivered very polished and professional presentations. Over 250 attendees provided extremely positive feedback. We would like to thank everyone for making it such a success.



Senator Stan Rosenberg

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Senator Stan Rosenberg (left), Franklin-Hampshire District, and **Professor Paul W. Shuldiner** (right), Department of Civil Engineering, UMass/Amherst, provided welcoming remarks for the conference.

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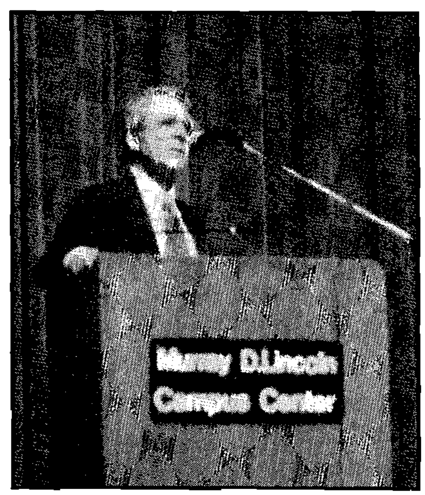

Professor Paul W. Shuldiner

Senator Stan Rosenberg gave a brief description on what was being done in Massachusetts. Legislation regulating waste tires in Massachusetts are in place to prohibit landfilling of waste tires in the near future. Legislation pending would regulate waste tire collection and accounting. Tax credits have passed the House to provide plant and equipment capital investment credits. It also covers the purchase of secondary use materials that were going to be landfilled. He mentioned a study being done at UMass, in conjunction with the Federal Small Business Adminstration, investigating the uses of waste tires in Massachusetts.

NEW LISTINGS

An Assessment of Travel Demand Management Approaches at Suburban Activity Centers, July 1989, U.S. Department of Transportation. This research focuses on Transportation Systems Management (TSM) and Parking Management (PM) carried out at employment sites in suburban settings. In transportation research and policy making today, TSM and PM encompass a variety of actions, many of which are outside the scope of this publication. The publication begins by indicating what is and is not TSM and PM for purposes of the study. Because TSM and PM aim at getting the best use of existing transportation resources at the least cost, strategies include actions as wide ranging as altering transit fares and parking prices; designating road lanes for transit and carpoolers; metering traffic onto freeways by signals (ramp meters); and removing street parking to improve traffic flows. The many strategies can be arrayed as to the degree they manage travel demand compared to reducing demand. The study focuses on the following: 1) TSM and PM are used primarily by employers and developers, not highway departments, or ridesharing agencies (though such agencies often play a role); 2) TSM and PM encourage demand for ridesharing, transit and cycling; discourage solo driving; and/or do both to some degree. Excluded are traffic engineering strategies such as High Occupancy Vehicle (HOV) lanes, channelization, signalization, and striping; and 3) TSM and PM strategies and programs are located in suburban rather than urban settings (though lessons from urban areas are provided when relevant).

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Vegetation Control for Safety - A Guide for Street and Highway Maintenance Personnel, U.S. Department of Transportation, Federal Highway Administration, Office of Highway Safety. During the growing season, grass, weeds, and brush often limit a driver's view of approaching vehicles. Likewise, lush vegetation can act as a screen that hides pedestrians and bikers from drivers and vice versa. The purpose of this handbook is to help maintenance workers be aware of safe ways to mow, cut brush, and control other vegetation to increase traffic safety.

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Guide for the Development of Bicycle Facilities, August 1991. Prepared by the AASHTO Task Force on Geometric Design; published by the American Association of State Highway and Transportation Officials. Increasingly, transportation officials throughout the United States are recognizing the bicycle as a viable mode of transportation. Since the early 1970's, bicycling for commuting, for recreation, and for other travel purposes has increased in popularity. Nationwide, people are increasingly recognizing the energy efficiency, the economy, the health benefits, the pollution-free aspects, and the many other advantages of bicycling. Local, state, and federal agencies are responding to the increased use of bicycles by implementing a wide variety of bicycle-related projects and programs. The emphasis now being placed on bicycle transportation requires an understanding of bicycles, bicyclists, and bicycle facilities. The bicycle, if adequately planned for and utilized, can play an important role in the overall transportation system. Safe, convenient, and adequate facilities are essential to encourage bicycle riding. The purpose of this guide is to provide information on the development of new facilities to enhance and encourage safe bicycle travel. The majority of bicycling will take place on ordinary roads with no dedicated space for bicyclists. Bicyclists can be expected to ride on almost all roadways; and sometimes they use sidewalks as joint bicycle and pedestrian facilities. This guide provides information to help accommodate bicycle traffic in all riding environments. It is not intended to set forth strict standards, but, rather, to present sound guidelines. ***This publication is available on loan only.***

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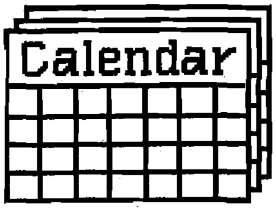
Mobility Management and Market Oriented Local Transportation, March 1991, U.S. Department of Transportation, Urban Mass Transportation Administration. The Urban Mass Transportation Administration has since the early 1970's fostered attempts to make greater use of market mechanisms in organizing, financing, and delivering public transportation services. UMTA's most recent venture in this area occurred in 1989, when it sponsored a program of "consumer choice" initiatives, involving both analytic studies and demonstration projects. The purpose of this program was to take the next step in market-oriented public transportation by developing and demonstrating concepts which went beyond the scope of the previous generation of activities in this area. In particular, UMTA requested that the International Taxicab and Livery Association (ITLA) and its contractor, Jeffrey Parker and Associates (JPA), work with local transportation agencies to identify and develop a set of potential demonstration projects which would test both the feasibility and the cost-effectiveness of new market-oriented approaches to local transportation service organization and delivery. This report describes the study that JPA conducted of consumer choice approaches to public transportation service delivery, and the evolution of the project towards a "mobility management" approach to service delivery which is consistent with, but more broadly construed, than market-oriented local transportation.

*To order these publications, use the postage paid reply form on pages 11 and 12 of this issue of **Mass Interchange**. See Page 12 for these listings.*



August 9 - 12, 1992
Institute of Transportation Engineers 62nd Annual Meeting
Washington, DC
Contact: ITE
(202) 554-8050

August 29 - Sept. 3, 1992
International Public Works Congress and Exposition
APWA
Boston, MA
Contact: APWA
(312) 667-2200

September 28 - 30, 1992
Transpo 1992
Lexington, KY
Contact: Lee Ann Maddox
(606) 257-4519

January 15 - 17, 1993
American Traffic Safety Services Association (ATSSA) Traffic Expo '93
Fort Lauderdale, Florida
Contact: ATSSA
(703) 898-5400

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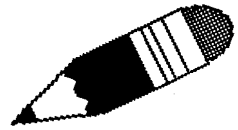

The **Baystate Roads Program** will sponsor a workshop on **Pavement Management Life Cycle Costs** on July 28 (Dedham), July 29 (Southborough), and July 30 (Amherst). This workshop will publicize the results of studies done over the past few years by University of Massachusetts/Amherst and Christman Associates, Inc. Speakers will be: John Collura, P.E., Associate Professor of Civil Engineering, University of Massachusetts/Amherst; Kenneth Black, P.E., Ph.D. Candidate, University of Massachusetts/Amherst; and Robert Christman, P.E., President, Christman Associates, Inc. For more information, call the Baystate Roads Program at (413) 545-2604.

MASSACHUSETTS ROAD DEATHS "LOWEST"

For the second year in a row, Massachusetts had the lowest rate of motor vehicle fatalities per mile traveled in the nation, the Registry of Motor Vehicles reported. The Registry said its figures came from a report released by the National Safety Council. Massachusetts has a rate of 1.2 deaths per 100 million motor vehicle miles traveled. That was 40 percent below the national average of two. The report also said that Massachusetts' rate of 9.1 motor vehicle deaths per 100,000 people was second only to Rhode Island's rate of 8.8 percent and was almost 50 percent below the national average of 17.1 deaths.

Plymouth County Highway Association Schedule of Meetings for 1992

July 9 - Day
Equipment Show
Upland Club
Plymton

August 13 - Day
Golf Bake
Ridders Country Club

September 15 - Day
Upland Club
Plymton

October 20 - Noon
All Seasons
Halifax

November 17 - Noon
Hearthside
Hanover

December 4 - Evening
Christmas Party
(Location to be announced)

Norfolk-Bristol-Middlesex Highway Association Schedule of Meetings for 1992

August 5
Old Fashioned Clambake
Francis Farm

October 7
Fall Technical
(Location to be announced)

November 13
Ladies Night
Lombardo's

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  U.S. DOT/FHWA/NHI, 1987
  (Work zone traffic control, layouts, operations, flagging)
- ☐ ***Local Highway Safety Studies (LHSS) - User's Guide***
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- ☐ ***Concrete-Paser Manual***
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  (Pavement Surface Evaluation and Rating)
- ☐ ***Techniques for Reducing Construction and Maintenance Costs - Participant's Notebook***
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  Clay Castleberry, 1991
  (Pavement management systems, pavement rating systems, inventory, maintenance)

- ❑ ***Work Zone Traffic Control Information Catalog***
  U.S.DOT/FHWA, 1990
  (Standards, handbooks, training, presentations, implementation, technology)

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

- ❑ ***Recycling Asphalt Pavement***
  Roger W. Gose, 1986
  (Hot-mix recycling, cold-recycling, surface recycling, heater-planer, heater scarifier, cold planning)

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Described in detail on page 9

- ❑ ***An Assessment of Travel Demand Management Approaches at Suburban Activity Centers***
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- ❑ ***Vegetation Control for Safety - A Guide for Street and Highway Maintenance Personnel***
  U.S. DOT/FHWA

- ❑ ***Guide for the Development of Bicycle Facilities***
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- ❑ ***Mobility Management and Market Oriented Local Transportation***
  U.S. DOT, March 1991

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