M A S S
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ITS Speeds Commute in Springfield

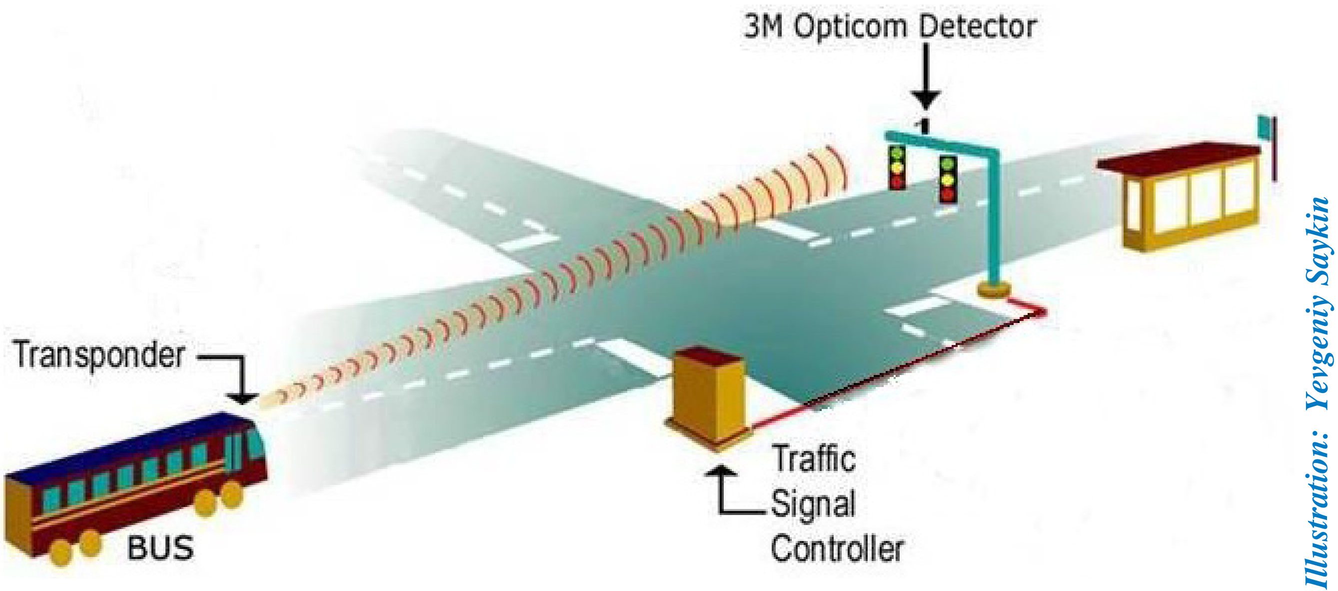

Figure 1: Traffic Signal Receives Request from Green Light Express Bus

A recent collaborative transit project undertaken by the Pioneer Valley Transit Authority (PVTA) and the City of Springfield integrated Intelligent Transportation System (ITS) technology anticipating improvements along the Sumner Avenue corridor.

This project had the support of many stakeholders in the region and proposed to decrease travel time and congestion at one of the busiest locations in Springfield, MA. Proposed benefits would include reduction of emissions, implementation of anti-sprawl strategies, and an increase in the number of transit commuters. Long term goals considered the positive impact of neighborhood livability along the corridor and development of a transferable model for advanced transit technologies and strategies for other communities. PVTA applied for a travel demand management (TDM) grant from the Commonwealth of Massachusetts.

A Memo of Understanding (MOU) between the City of Springfield and PVTA was a critical component of the plan. This MOU identified all of the partners and their roles for bringing the project together and making it operational. It served the PVTA in providing transit priority for a new crosstown bus express route and enabled the City to utilize the ITS technology for emergency response vehicles along the corridor.

The Green Light Express route begins at the Five Town Plaza, located in the southeast corner of Springfield at the intersection of Allen and Cooley Streets, continues along Sumner Avenue through the Springfield Business District, and ends at the Baystate Medical Center in the northern section of the City.

The Green Light Express operates along this corridor making limited stops and using signal pre-emption

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Figure 2: Green Light Express Bus Stop

equipment that allows the bus to request an extended green phase through an emitter located on the bus when it approaches the intersection. The request is transmitted to the receiver located on the traffic signal and priority is then granted to the bus as seen in Figure 1. This same type of technology has been used for emergency vehicles for some time. It is important to note that advancements in the technology allow the requests to be prioritized so that emergency vehicle demands will receive priority.

Ten traffic signals located along Sumner Avenue were upgraded and equipped with 3M Opticom receivers and signal pre-emption equipment was installed on buses serving the express route. Figure 3 illustrates this equipment. When the emitters are activated by the operators, buses will automatically request the priority mode when it is within a short distance of the signal. More information can be obtained at:

www.pvta.com/downloads/routes/se/01_sumnerexpress_2006aug.pdf

Although this technology allows the bus to obtain an extended green phase, thereby decreasing travel time for transit, decreases in travel time for vehicles has also been noticed along the corridor. The Pioneer Valley Planning Commission is currently gathering data on travel time along this corridor for buses and vehicles in order to quantify the time savings. Decreasing travel time and increasing transit ridership are two measures of effectiveness for the implementation of this service. Participation of riders has been increasing at a steady rate; in the fourth month of operation, it averaged 75-83 passengers per day.

The Sumner Express Project is an excellent example of collaboration between municipal and private sectors. It continues to provide opportunities to study ridership shifts and travel time shifts on an inner city signal pre-emption route. When contemplating the use of ITS in your community, consider how these advanced transit technologies can be coordinated with local transit authorities to maximize funding and thereby enhance travel conditions for all stakeholders.

This article was provided by Melissa Paciulli, Program Manager, Massachusetts Cooperative Research Program, University of Massachusetts, Amherst, MA

3M Opticom components: detectors (left), emitter (center), phase selectors (right).

Figure 3: 3M Opticom Equipment used in the Project

FULL DEPTH RECLAMATION WITH LIQUID CALCIUM CHLORIDE

As reported in the last issue of *Mass Interchange*, reclamation has become a good option for rebuilding more miles and staying within budgets. The full-depth reclamation (FDR) technique for rehabilitating asphalt and chip-seal roads is being embraced across the country. Highway superintendents have found the practice of pulverizing an asphalt surface and blending it with the underlying base delivers a long list of advantages including:

- √ FDR is performed entirely at the job site eliminating the costs of removing, loading, hauling crushing, and sizing the old pavement material
- √ Disposal costs are eliminated because the old material is recycled
- √ Less equipment and fewer workers are needed resulting in lower costs and better traffic flow
- √ Base material costs are minimized or eliminated and natural resources are conserved because all existing materials are reused
- √ Structural integrity of the road base is increased to protect the overlay, thereby adding years to road life and improving ride quality
- √ Thickness of pavement can be reduced, resulting in lower overlay material costs
- √ Traffic flow can be maintained during construction
- √ Curb reveal and proper drainage can be restored

Reclamation economically repairs serious surface and base deficiencies by recycling your roadway into a strong, dense, stabilized base. Studies suggest savings as high as 50% over other methods of reconstruction while achieving the same, or better, finished road quality and durability levels.

Beginning with pulverization, equal portions of pavement and base are broken into pieces 3" or smaller with a traveling rotary reclaimer. Machines can grind pavement up to 13" deep but general depth is 6" to 8". Controlled depth of cut prevents poor base materials from entering into the recycled mix. If needed, material can be removed or added after the initial grinding.

Blending in additives, shaping, and compacting follow the grinding process. Generally a 35% solution of liquid calcium chloride ($CaCl_2$) is sprayed at a rate of 0.8 to 1.0 gallon per square yard in two separate applications. Once 0.5 to 0.75 gal of $CaCl_2$ per square yard is sprayed onto the reclaimed base, a second pass with the reclaimer throughly blends the recycled road. The mix is carefully graded to an agency's specifications, compacted with a vibratory roller, and capped with 0.2 to 0.3 gallon of $CaCl_2$ per square yard.

$CaCl_2$, a critical part of the process, facilitates compaction by maintaining optimal moisture content. By binding fines to aggregates, $CaCl_2$ eliminates dust for faster and denser compaction. It also improves the adhesion between the base and wearing surface. In the long run, the road has a stronger base, reduced frost heaving potential, and a smoother riding surface, all of which translates into an extended life.

Thanks to All States Asphalt, Inc. for providing information and photos for this article.

COMPACTION

Compaction is the greatest determining factor in dense graded pavement performance. Inadequate compaction results in a pavement with decreased stiffness, reduced fatigue life, accelerated aging, decreased durability, rutting, raveling and moisture damage.

MEASUREMENT AND REPORTING

Compaction reduces the volume of air in hot mix asphalt (HMA). The characteristic of concern is the volume of air within the compacted pavement, typically quantified as a percentage of air voids by volume and expressed as "percent air voids." This percent is calculated by comparing a test specimen's density with the density it would theoretically have if all the air voids were removed, known as "theoretical maximum density" (TMD) or "Rice density" after the test procedure inventor.

Although percent air voids is the HMA characteristic of interest, measurements are usually reported as a measured density in relation to a reference density. This is done by reporting density as:

1. Percentage of TMD or "percent Rice." The expression of density is easy to convert to air voids because any volume that is not asphalt binder or aggregate is assumed to be air. For example, a density reported as 93 percent Rice means that there are 7 percent air voids (100% - 93% = 7%).

2. Percentage of a laboratory-determined density. The laboratory density is usually a density obtained during mix design.

3. Percentage of a control strip density. A control strip is a short pavement strip that is compacted to the desired value under close scrutiny and then used as the compaction standard for a particular job.

Pavement air voids are measured in the field by one of two principal methods:

1. CORES -- A small pavement core is extracted from the compacted HMA and sent to a lab to determine its density. Usually, core density results are available the next day at the earliest. This type of air voids testing is generally considered the most accurate but is also the most time consuming and expensive.

2. NUCLEAR GAUGES -- A nuclear density gauge measures in-place HMA density using gamma radiation. Gauges usually contain a small gamma source (about 10 mCi) such as Cesium-137 located in the tip of a small probe, which is either placed on the surface of the pavement or inserted into the pavement. Readings are obtained in about 2-3 minutes. Both moisture content and density are displayed automatically. For accurate results, the equipment must be calibrated and the operator experienced.

With a nuclear test, care must be taken when handling radioactive material. False readings sometimes occur in organic soils or material with high salt content.

FACTORS AFFECTING COMPACTION

HMA compaction is influenced by many factors as noted below:

A. **ENVIRONMENTAL FACTORS**

Temperature (ground or air)
Wind Speed
Solar Flux

B. **MIX PROPERTY FACTORS**

Aggregate (gradation, size, shape, volume, fractured faces)
Asphalt Binder (chemical/physical properties, amount)

C. **CONSTRUCTION FACTORS**

Rollers (type, number, speed, timing, passes, lift thickness). Other (HMA temperature, haul distance and time, foundation support)

EQUIPMENT

There are three basic pieces of equipment available for HMA compaction: (1) the paver screed, (2) the steel wheeled roller, and (3) the pneumatic tire roller. Each piece of equipment compacts the HMA by two principal means often referred to as "compactive effort. This is accomplished:

1. By applying its weight to the HMA surface and compressing the material underneath the ground contact area. Since this compression will be greater for longer periods of contact, lower equipment speeds will produce more compression. Obviously, higher weight will also increase compression.
2. By creating a shear stress between the compressed material underneath the ground contact area and the adjacent uncompressed material. When combined with equipment speed, this produces a shear rate. Lowering equipment speed can decrease the shear rate, which increases the shearing stress. Higher shearing stresses are more capable of rearranging aggregate into more dense configurations.

Compaction is the simplest, most economical method of improving the load-carrying capability of roads. When done during construction it costs very little per ton of pavement material and can significantly reduce future maintenance costs. Refer to Baystate Roads Tech Note 15 for more detailed information.

Sources: Washington Asphalt Pavement Assn. and National Asphalt Pavement Assn.

NEW PUBLICATIONS

ASP-164 Distress Identification Guide
Long-Term Pavement Performance Program
LTAP 2005

ASP-167 Slurry Seal Application
Pocket Guide from Pavement Preservation Series
FHWA 2005

ASP-168 Hot In-Place Asphalt Recycling Application
Pocket Guide from Pavement Preservation Series
FHWA 2005

ASP-169 Cold In-Place Asphalt Recycling Application
Pocket Guide from Pavement Preservation Series
FHWA 2005

COC-146 Partial-Depth Repair of Portland Cement Concrete Pavements
Pocket Guide from Pavement Preservation Series
FHWA 2005

COC-147 Full-Depth Repair of Portland Cement Concrete Pavements
Pocket Guide from Pavement Preservation Series
FHWA 2005

COC-158 Dowel-Bar Retrofit for Portland Cement Concrete Pavements
Pocket Guide from Pavement Preservation Series
FHWA 2005

PED-25 Safe Routes to School Program
Safe Routes to School Initiative
3M 2006

TRA-82 Sign Installation Guide
US Dept. of Agriculture/Forest Service 2003

TRA-119 Incident Sign Installation Guide
US Dept. of Agriculture/Forest Service 2003

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CABLE MEDIAN BARRIERS

Median crossover crashes often result in fatalities or severe injuries to occupants of the errant vehicle and the motorists in the opposing traffic lanes. State departments of transportation (DOT) are becoming interested in reducing median crossover crashes through the use of median barriers. The concrete and metal beam barriers traditionally used to prevent these crashes, however, are difficult to install on sloped terrain where their performance is often suboptimal. In addition, concrete and metal beam barriers are expensive, and State and local agencies often lack the resources to rapidly deploy these technologies to areas where vehicles frequently cross over the adjacent medians.

Recent research shows that cable median barriers are more forgiving than traditional concrete and metal beam barriers and can be effective when installed on sloping terrain. Collision forces are deflected laterally thereby reducing the forces transmitted to vehicle occupants.

Although cable barriers have been used since the 1960s, it was not until the 1980s that some State DOTs started using a modified cable rail as a median barrier. New data suggest that cable median barriers are an effective mechanism for preventing fatal and disabling crashes. In Washington, annual cross-median fatal crashes declined from 3.00 to 0.33 fatalities per 100-million miles of vehicle travel, while annual disabling accidents went from 3.60 to 1.76.

While cable median barriers have low installation costs, they can be costly to repair after a crash. In addition, when several posts are hit during a single crash, the cable barrier may then be vulnerable to crossovers until the damaged section is repaired. Rapid maintenance can be difficult, especially during winter months. Several proprietary high-tension cable designs are now available, however, that can withstand multiple hits.

Cable median barriers have been successful in South Carolina where three-strand cable systems were installed in areas with multiple median crossover crashes. From 2000 to 2003 the system was hit 3,000 times, but only 15 vehicles penetrated the cables.

Many State DOTs have independently assessed the extent of their median crossover problem and have modified barrier warrants established in the 1970s. Most of these States also have installed a significant number of cable barriers, including both the generic, lower-tension design and high-tension patented cable barriers. The American Association of State Highway and Transportation Officials (AASHTO) is modifying its median barrier warranting criteria to reflect these trends. Current research at the UMass Transportation Center funded by the Executive Office of Transportation will provide Massachusetts with more information on safety, structure, and cost effectiveness issues.

Guidelines for median barrier warrants, selection, and installation are contained in AASHTO's 2002 *Roadside Design Guide*. For information on crash-tested cable barriers, go to: http://safety.fhwa.dot.gov/report350hardware under "Longitudinal Barriers" using the keywords "Cable Barriers."

BREAKAWAY OR YIELDING SUPPORTS IN THE CLEAR ZONE

OOOPS

DEFINITIONS:

"BREAKAWAY" refers to a sign support that, when struck by a vehicle, separates from its base and is knocked ahead of or up and over the errant vehicle. **"YIELDING"** refers to a sign support that bends, allowing a vehicle to run over it. Many sign supports are yielding at low speeds and breakaway at high speeds.

Breakaway supports have been required on the national highway system since 1998. However, the *2000 MUTCD*, which applies to all roads in the United States, revised the wording from **"SHOULD" to "SHALL"** regarding the use of breakaway supports for signs located within the clear zone as follows:

SECTION 2A.19 LATERAL OFFSET

Standard: For overhead sign supports, the minimum lateral offset from the edge of the shoulder (or if no shoulder exists, from the edge of the pavement) to the near edge of overhead sign supports (cantilever or sign bridges) shall be 1.8 m (6 ft.). Overhead sign supports shall have a barrier or crash cushion to shield them if they are within the clear zone.

Ground-mounted sign supports shall be breakaway, yielding, or shielded with a longitudinal barrier or crash cushion if within the clear zone.

Target Dates: The 2003 MUTCD also establishes a target date for implementation of the crashworthiness of sign supports for roads with posted speed limits of 80 km/h (50 mph) or higher as **January 17, 2013**.

On roads posted less than 50 mph, there is no target date, but a program to replace non-breakaway supports within the clear zone needs to be in the highway agency's long term plans for complying with *MUTCD* changes. **Highway agencies ought to consider installing breakaway supports at the same time that sign faces are replaced to comply with future retroreflectivity requirements.**

"We don't want cities and counties complaining to their representatives that they went through all the effort to upgrade their sign faces and then were told to take them all down and put them back up on breakaway supports," said Nicholas Artimovich, Office of Safety Design, Federal Highway Administration.

In order for the breakaway or yielding supports to be acceptable for use, they must conform to the breakaway requirements of *NCHRP Report 350* or the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* (1985 or 2001 editions).

You may refer to the FHWA Office of Safety website for information on breakaway supports at:

http://safety.fhwa.dot.gov/roadway_dept/road_hardware/breakaway.htm

and

to the AASHTO Bookstore where you may purchase a copy of *A Guide to Small Sign Support Hardware* (1998 edition) at:

https://bookstore.transportation.org/item_details.aspx?ID=164

Adapted per email from Nicholas Artimovich, Office of Safety Design, FHWA.

TRIVIA QUIZ WINNERS

The Longest Interstate Highway: I-90
Road Trip from Boston, MA to SEATTLE, WA

Ron Danielson, MA Dept. of Telecommunications & Energy
Mark Hamel, Dracut DPW
Richard Hathaway, Concord DPW
Matthias J. Mulvey, Provincetown Department of Community Development
Irving Priest, Uxbridge DPW

in this issue

Congratulations to the newest Baystate Roads Scholars on their fine achievement. Keep saving those certificates and you, too, could be listed here

Francis Case, Jr.
Westfield DPW
Charles Kilmer
Old Colony Planning Council

Baystate Roads Scholars

The Baystate Roads Program, which publishes Mass Interchange each quarter, is a Technology Transfer (T2) Center created under the Federal Highway Administration's (FHWA) Local Technical Assistance Program (LTAP). This newsletter is prepared in cooperation with The Excecutive Office of Transportation (EOT) and the United States Department of Transportation Federal Highway Administration. FHWA is joined by EOT, UMass Transportation Center 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, inquiries, articles and ideas are encouraged.

LTAP Local Technical Assistance Program

To contact the Baystate Roads Program call (413) 545-2604 or FAX 413-545-6471

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