M A S S

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ASPHALT PASSAGES

A Holistic Approach to Increasing Pavement Life

Grieving is an important human process in that it allows us to acknowledge and deal with successes and setbacks, but it is the magnitude of these events that defines the state of our psyche. For those concerned with the wellness of the infrastructure, it is especially hard to watch a young pavement dying because it could not survive the effects of its natural environment. However, every year, numerous pavements representing millions of dollars are lost to a lack of durability.

Durability, or the resistance to weathering, should be considered at each step of the engineering process, including structural design, materials selection, mixture design, construction, and maintenance. This is especially true in Massachusetts with its cold winters, moderately hot summers, relatively high preciptation, and numerous cycles of freezing and thawing. Water is the main culprit, and minimizing its effects means designing and building the pavement so that water does not stay in contact with the mixture.

In pavement design, it is particularly important not to trap water in the pavement by placing impermeable layers on top or below those having a substantially greater permeablility. For instance, if a paving fabric is placed prior to overlaying an existing pavement, water may

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LTAP Local Technical Assistance Program

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DREAM TEAMS BRING WINNING ATTITUDES TO THEIR WORK

Go for the Gold in Massachusetts

Creating dream teams not unlike some of those who were in Salt Lake City last year for the Winter Olympics is not easy, but all of us are capable of becoming more effective team leaders and team members.

The following elements are the basis for a dream team in your workplace.

Commitment to a clear mission. Success of dream teams is a clear understanding in the minds of all team members of why the team exists. The success is derived from the belief that "what we are doing is important--it is what we all do."

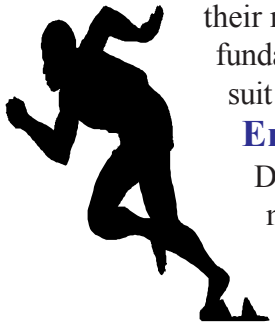
Mutual support and encouragement. Geese fly in a "V" formation. As each bird flaps its wings, it creates an uplift for the bird immediately following. By flying in a "V" formation, the whole flock adds at least 71 percent greater flying range than if each bird flew on its own. *People who share common direction and sense of community can get where they are going quicker and easier, because they are traveling on the thrusts of one another.*

When a goose falls out of formation, it suddenly feels the drag and resistance of trying to go it alone, and quickly returns to formation to take advantage of the lifting power. *If we have the sense of a goose, we will stay in formation with those who are headed the same way we are going.*

When the lead goose gets tired, he rotates back in the "V", and another goose flies point. *It pays to take turns doing the hard jobs.*

The geese honk from behind to encourage those up front to keep up their speed. *An encouraging word goes a long way.*

Finally, when a goose gets sick or is wounded and falls out, two geese drop out of formation and follow the goose down to help and protect it. They stay with the goose until it is either able to fly or until it dies. They then launch out on their own or with another formation. *If we had the sense of a goose, we will stand by each other.*



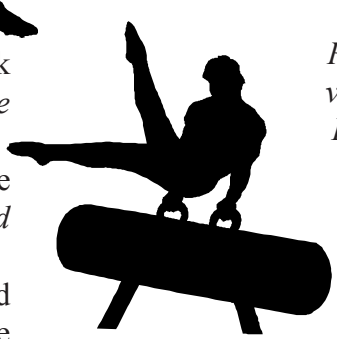
Clearly defined roles. A wide range of diverse skills, knowledge, values and attitudes are required for team success. A respect for this diversity, accompanied by the ability to clearly define who does what, creates the magic of synergy of everyone working together.

Win-win cooperation. Cooperation can best be defined as an attitude that asks: What can I do for you? What is in the best interests of the whole team? How can I help? This is the glue that holds dream teams together.

Individual competency. The individuals who make up up dream teams are committed to personal excellence--becoming the best they can be in their roles. They work hard, focus on the fundamentals and are relentless in their pursuit of personal improvement and growth.

Empowering communication. Dream teams have discovered that the major key to successful teamwork is effective communication. People on dream teams talk with each other about any issue that affects team performance.

Winning attitude. No team wins every time. But dream teams *expect* to win every time. Their winning attitude creates confidence, focus and high levels of motivation. As a result, they usually win.



Reprinted with permission from Nevada Milepost by Nevada T2 Center, Fall 2002.

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become trapped either at the top of the existing pavement or at the bottom of the new overlay. The use of drainage layers and edge drains can greatly reduce the concentrations of moisture underneath the pavement and thus prevent moisture damage in pavements.

It is critical to pay attention to aggregate characteristics when selecting materials for a durable asphalt mixture. The asphalt binder has only a minor influence on moisture sensitivity. Aggregate mineral composition is usually the cause of stripping, where the asphalt film becomes detached from the aggregate surface in the presence of water. In a survey of state DOTs, Root and Tunnicliff found that moisture sensitivity was most often associated with gravel aggregate followed by limestone and granite. Aggregates that have high silica contents, such as granites, quartzites, and some gravels, have negatively charged surface particles which do not allow good chemical bonding with the polar molecules in the asphalt. Some limestone and traprock materials can absorb harmful chemical compounds out of the air after quarrying, and these can act to prevent bonding with the asphalt. Also, some limestone aggregates contain dissolvable salts, which result in aggregate disintegration in the presence of water.

One must consider not only the mineral characteristics of the aggregate but also the gradation. The gradation governs the amount of asphalt coating the aggregate particles, and this coating provides waterproofing for the aggregate. Figure 1 illustrates the general concept that as the fineness of an aggregate increases, so does the surface area, the lower the asphalt film thickness surrounding the aggregate particles. Ultimately, a lower film thickness means reduced durablility.

However, a direct calculation of asphalt film thickness is not possible because of differences in the aggregate shape, texture, and asphalt absorption. Instead, an indirect measure of film thickness, called the effective asphalt content, is usually expressed as Voids in Mineral Aggregate (VMA), which is simply the volume of space between aggregate particles in the asphalt mixture. The VMA includes the air voids and the asphalt which is not absorbed by the aggregate, or the effective asphalt. The air voids are normally held at 4 percent of the mixture volume during the mix design and the amount of asphalt absorbed by the aggregate can be computed knowing the specific gravity of the aggregate and the maximum specific gravity of the mixture. Since the total asphalt content of the mixture is known and the air voids are known, the effective asphalt content is clearly represented by the VMA.

Consideration of asphalt mixture durability does not simply end after the mixture design process. Many asphalt pavements are not durable due to lack of adequate compaction during construction. This is especially true of pavements that are built during the late fall and early winter period. The problem is that the apshalt mixture cools and stiffens before it can be rolled with a compactor.

Figure 2 shows that the time for asphalt temperature is much shorter if the air temperature is 30 degrees F rather than 60 degrees F. If the mixture is not compacted by this time it will have high voids, allowing for the intrusion of water, and ultimately it will be subject to one of the mechanisms of moisture damage.

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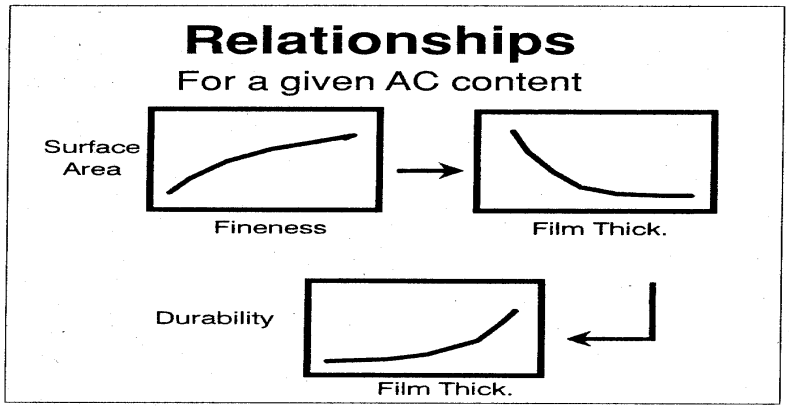

Fig. 1: A lower film thickness means reduced durability.

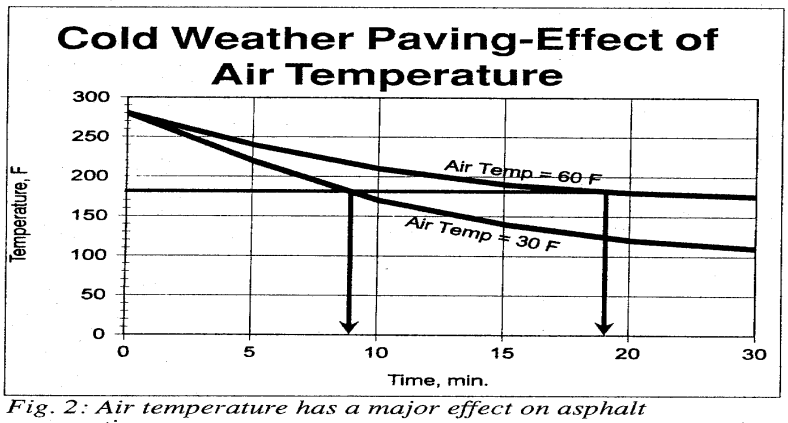

Fig. 2: Air temperature has a major effect on asphalt compaction.

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Current members' affiliations are listed below. The program manager ecourages you to forward suggestions or comments to board members regarding improvement of your LTAP center. Their advice and assistance have been invaluable in planning this year's schedule of training workshops.

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A computer program has been developed at the University of Minnesota for predicting the time it takes for the asphalt mixture to cool. It has been designed for use by construction personnel, and only requires readily available information on the mixture, weather condition, and the type of paving to be done. The early versions of this program have been very popular, and researchers are working on ways of making it even more useful.

The early loss of an asphalt pavement is indeed a cause for mourning, but the reconstruction of a pavement that has lived a full and serviceable life is an event which should be celebrated with joy, for not only has the pavement proved its worth as an investment, but it shall be reincarnated in a new recycling bituminous mixture. The key to long and fruitful life is careful engineering during the planning, design, construction, and operation of the pavement. Durabilty needs to be an engineering consideration in every phase.

Adapted with permission from an article by David Newcomb, Bruce Chadbourn, and Mary Stroup-Gardner, University of Minnesota for the Minnesota LTAP newsletter, Technology Exchange.

THE OVERLOOKED ROADSIDE HAZARD

Government agencies spend millions of dollars attempting to eliminate or at least reduce roadside hazards. There are regulations and guidelines agencies must follow in the design and construction of roads and streets for the safety of the traveling public. With all regard to safety these same agencies seem to overlook the manner in which the rural population receives their mail, yet the rural mailbox and its support is usually the closest fixed object to the driving lane.

It is the responsibility of all agencies to educate the public about the potential safety hazard of a rural mailbox and to eliminate those roadside hazards.

Rural Free Delivery (RFD) began in 1896 with experimental rural delivery routes and became an official service in 1902. At some point in time the mailbox became a link to, or an extension of the postal patron. It has advertised for the businessman, kept busy the hobbyist, expanded the artistic, and amazed the onlooker. Rural mailboxes have become a part of our history.

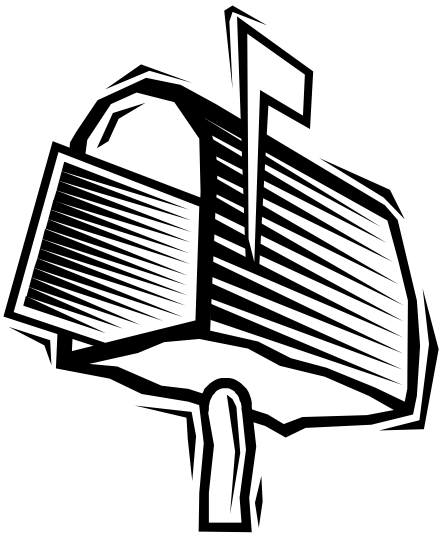
"A byproduct of rural free delivery was the stimulation it provided to the development of the great American system of roads and highways. A prerequisite for rural delivery was good roads. After hundreds of petitions for rural delivery were turned down by the Post Office because of unserviceable and inaccessible roads, responsible local governments began to extend and improve existing highways. Between 1897 and 1908, these local governments spent an estimated $72 million on bridges, culverts, and other improvements." (This paragraph reprinted from the USPS Website.)

There have been unimaginable advancements in the last 100 years since the start of RFD including motor vehicles and the roads they drive on. A person would be hard pressed to think of an item that has not been improved on (for safety) since its inception, except for the rural mailbox and its support.

Upon the unfortunate event of an injury or worse yet a death due to a solid fixed mailbox or a support with many pieces being broken away, questions will have to be answered. Is the owner who installed the box responsible or the agency that allowed it, or both?

TIPS FOR RURAL MAILBOX INSTALLATION

- Contact your Postmaster for specific installations.
- Use Mailboxes approved by The U.S. Postal Service.
- Locate the mailbox away from traffic so the postal carrier can stop out of the flow of traffic.
- Multiple boxes should use individual posts. Newspaper boxes may be mounted below the mailbox on the side of the mailbox support.
- A single 4-inch x 4-inch or a 4-inch diameter wood post or metal pipe no greater than 2-inch diameter imbedded into ground no more than 2-feet. (Do not set into concrete)



- Post-to-box attachments should prevent the box from coming loose from the post if struck by a motor vehicle.

"A Guide For Erecting Mailboxes On Highways" by The American Association of State Highway Transportation Officials (AASHTO) is a manual explaining principles, guidelines, design illustrations, and tips for regulating mailboxes.
Item #EMOH-3 is available from:
www.asshto.org
Phone: 1-800-231-3475
AASHTO, PO Box 96716,
Washington, DC 20090-6716

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USING GEOTEXTILES IN UNPAVED LOW VOLUME ROADS

There is an old saying about roads: "If you can drain it, you can maintain it." Excessive water in a roadbed is the most common cause of rutting on rural roads. A poor or insufficient base compounds the problems caused by water. Common sources of water in the roadbed are underground springs in or near the roadbed, a high water table in areas having flat terrain, or low areas where surrounding fields are higher than the roadway and there is nowhere to divert the water. The problem may be a continual one such as ground seepage or an intermittent one due to rain or flooding. Improving drainage is ideal but cannot always be accomplished. In order to increase the stability of weak subgrades and to increase the load bearing capacity while reducing the cost of maintaining the road, geotextiles have been used successfully.

Application of geofabric on unpaved road in Shutesbury.

The Function of Geotextiles

The four primary functions of geotextiles when they are used in unpaved roads are as follows:

■ Separation is the main benefit in stabilization work with geotextiles. It has the ability to prevent the intermixing of two materials. With a geotextile in place, aggregate base materials under load are not forced into the subgrade. Subgrade soils cannot mix with the clean aggregate layer. Without geotextiles the aggregate and weak subgrade soil would mix. Load bearing capacity would be reduced and rutting accelerated. The fabric would allow water to pass through while preventing the layers from mixing.

■ While acting as a separator, the geotextile may also function in a filtration and drainage capacity in wet or saturated soils. Under load, high pressure creates a soil slurry that "pumps" upwards against the fabric. The fabric acts as a filter, screening out the fines from contaminating the aggregate layer while allowing water to drain freely through the aggregate. Filtration is the process of allowing water to pass through the fabric while preventing soil migration. Evaporation from underlying soil can proceed, preventing development of water pockets and hydrostatic excessive pressure due to rapid or repeated loads.

■ Drainage can be critical to the structural performance. Water must be able to pass through the fabric. If the subgrade soil is subjected to persistent or even occasional wet conditions, the section must be premeable to allow rapid drainage of water from the loaded subgrade soils up into the free draining aggregate base. Maintaining the drainage of the aggregate base and of the subgrade soils is very important in preventing failure of the support system.

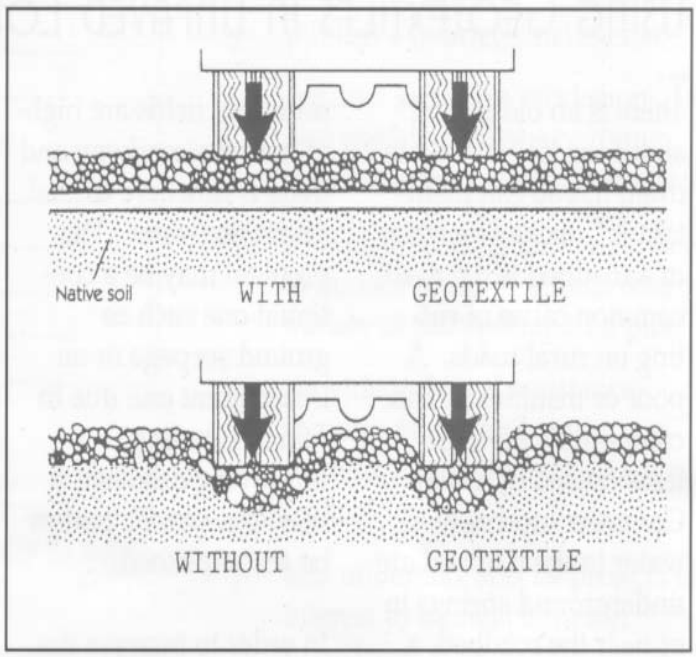
■ The use of geotextiles on a road section allows for the increase of stress of subgrade soils. Geotextiles with superior frictional characteristics, such as needle punched unwoven fabrics, aid in "locking" the aggregate in place. By keeping the aggregate in place, the base course retains its structural integrity. When using geotextiles, a reduction in the thickness of aggregate is possible. *continued on page 7*

Benefits of Using Geotextiles

- Longer serviceable life of the roadway.
- Reduced maintenance costs.
- Reduction of the depth of the structural section required to carry the load.
- Reduced initial construction costs.
- Possibility of reclaiming aggregate used in temporary roads.
- Structural section life is prolonged and maintenance costs reduced because soil intermixing between layers is restricted.
- Cost effectiveness--approximately 33% reduction in aggregate required in the initial design of unpaved structural sections.

Woven Versus Nonwoven Geotextiles

Woven fabrics have a higher modulus (stress/strain) and develop maximum tensile strength with minimum elongation, but woven fabrics have lower abrasion resistance, less permeability, and poorer surface structure friction than nonwoven fabrics. Passage of water within the plane is defined as lateral permeability or transmissivity. Woven fabrics do not pass within their plane, and, because they do not, woven fabrics can be a problem on gravel bases. Woven fabrics should be considered only for locations that are fairly dry, where abrasive forces are minimized and where soil/fabric/aggregate friction characteristics are not important. Nonwoven fabrics offer superior resistance to abrasion damage and provide excellent characterisitcs for separation and filtration/drainage. Under the load they developed high tensile strength and have good friction properties making them excellent for reinforcement. Nonwoven fabrics have the capacity of passing water through both normally and within the plain. Nonwoven geotextiles are recommended for most unpaved road applications.



Installing Geotextiles

In order for geotextiles to perform well in road stabilization, the fabric chosen must be of the proper type, and it must be installed properly. Fabrics damaged during placement or installed in a highly wrinkled condition will not perform well.

The aggregate overlay must be placed to its full depth and must be applied in a way that will not cause damage to the fabric from movement of constuction equipment. The performance of geotextiles will be no better than selection and installation procedures.

Packaging and Storage

Geotextiles come in rolls which are wrapped for protection from moisture and ultraviolet exposure. If these are stored outside, they should be elevated and covered with waterproof protection.

Site Preparation

Clear and grade the area. Remove sharp objects. Cut trees and shrubs flush with the subgrade. Top soil and vegetation need not be removed. Excavate soft spots, backfill, and compact so filled area provides an equal stability with the adjacent areas. Grade the surface as much as possible to provide suface drainage and cross slope shaping. Tight blading will provide a smooth surface to support the fabric and will also provide a well-established crown. When roadbed material contains gravel, as the blade or grader drags the surface, sharp tips and edges on the gravel will be rolled over and become flush with the surface, reducing the possibility of punctures or tears in the fabric.

Unroll the geotextile in the direction of the construction traffic. Overlap in the direction of subbase placement. Overlap is dependent on load bearing capacity of the subgrade, and it varies from 2 feet to 3 feet.

Dump the aggregate on top of the geotextile. Spread it using a loader or small bulldozer. Avoid heavy traffic directly on the geotextiles. Spread the aggregate in the same direction ad the geotextile. Overlap to avoid separation. Aggregate depth is determined by subgrade strength and anticipated wheel loading; usually 4-6 inches is used. Compact the aggregate using conventional methods. Vibratory compaction is NOT recommended. *continued on page 8*

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Damage Repair

If the geotextile is damaged during the installation process, repairs can be made. Clear the damaged area plus three additional feet of all fill material. Cover area with a geotextile patch extending three feet beyond the perimeter of damage. Replace subbase material and compact.

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Please refer also to BAYSTATE ROADS PRORAM Tech Note #16 on Geotextiles in Road Construction, Maintenance and Erosion Control.

in this issue...

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 MassHighway and the United States Department of Transportation Federal Highway Administration. FHWA is joined by Mass Highway, College of 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, inquiries, articles, and ideas are encouraged.

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