Technical Notes

Thrace-LINQ TECH NOTE #12
USING 125EX AND 130EX EFFECTIVELY IN ASPHALT OVERLAY APPLICATIONS[1]

More than 100 million square yards of paving fabrics are used annually in the United States. A large part can be attributed to repeat users who have experienced improved pavement results and a calculated return on their paving dollars. Thrace-LINQ, Geosynthetics Division, supplies two fabrics, 125EX and 130EX, specifically designed for your paving fabric needs. This pamphlet describes how to use Thrace-LINQ 125EX/130EX, and gives a brief review of installation procedures.

Thrace-LINQ 125EX is typically a 4-once-per-square-yard needlepunched nonwoven and 130EX is a minimum 4-once-per-square-yard needlepunched nonwoven. Both 125EX and 130EX are combined with a 0.25 gallons/square yard asphalt cement sealant, or tack coat (6-once-per-square-yard fabrics require 0.35 gallons/square yard). This forms a pavement membrane interlayer system, which we will refer to as a paving fabric interlayer.

When properly installed, a paving fabric interlayer

- forms a barrier to road-surface moisture infiltration
- provides a stress-absorption layer to retard reflective cracking and to greatly extend fatigue life in pavements.

Water problems in pavements

Many engineers have the misconception that pavements are watertight. Surface water, however, infiltrates through pavements at a rate of 33 percent to 50 percent through asphalt cement concrete (ACC) and 50 percent to 67 percent through portland cement concrete (PCC) pavements. Surface water comes from rain, surface drainage or irrigation (landscape watering) near pavements. A high percentage of the water hits the pavement, seeps through and goes into the road base. Since a great deal of road bases are not well-drained, the water stays in the base and subgrade, causing pavement deterioration by

- softening the subgrade soil
- mobilizing the subgrade soil up into the road base stone (especially if a separation/stabilization geotextile was not used at the road base/subgrade interface)
- hydraulically breaking down base structures (including stripping asphalt-treated bases and breaking down chemically stabilized bases).

Because of the minimal grade of road beds, only a clean, stone base tied into an adequate edge-drain system will remove road-base water within an acceptable time.

Most engineers who believe they have free-draining bases actually have a base that may take days to drain, may not be tied into an edge-drain system or may even "dead-end" into tight-shoulder material. By the time the pavement finally drains, new surface water enters, causing the base to remain saturated.

An excellent discussion about pavement drainage can be found in "Highway and Airfield Pavement Drainage" by Harry Cedergren. He explains that a pavement structure saturated 10 percent of the time achieves only 50 percent of its intended or design life.[2] Also, the 1986 AASHTO Guide for Design of Pavement Structures recommends a 60 percent reduction in design subgrade support under poorly drained pavements.[3]

Waterproofing with 125EX or 130EX

How do you keep pavements drained? When constructing a new pavement, use a Thrace-LINQ separation/stabilization geotextile and a clean, free-draining base. Do not use the slow-draining bases designed with some fines to help prevent upward subgrade soil migration.

For pavements with free-draining bases, the bases must be tied into an effective edge-drain or under-drain systems to help evacuate the water quickly. Most old pavements don't have bases that drain quickly enough to allow retrofit edge drains to remove the water within a reasonable time. For these and other pavements (including new pavements), another simple solution is to keep the water from entering the road base from the start using a paving fabric interlayer incorporating Thrace-LINQ paving fabrics.

Several studies of pavement cores reveal that pavements are permeable without the paving fabric interlayer system (including "tight pavements," such as dense mixes and pavements using recycled rubber). These studies also indicate that pavements can be close to impermeable with paving fabric interlayer systems.[4,5]

Although most widely used in rehabilitation projects, 125EX or 130EX should be considered for new pavements to keep the water out of the road base for maximum pavement life. Roads can be the easiest pavements to drain, particularly when compared to wide pavements, such as airfields or parking lots, where the path to underdrains or edge drains can be distant. Paving fabric interlayers are very popular for these wide pavements, because it is much easier to handle surface water than water in the pavement base.

Pavement cracking

Pavement cracking is the most visible indicator of pavement distress. Two common types of cracking, reflective and fatigue, begin at the base of the pavement layers and work up to the surface. Both can be retarded and controlled using a Thrace-LINQ paving fabric interlayer system.

Thermal cracking is caused by actual expansion and contraction, mostly within the top layer, such as an overlay. Thermal cracking cannot be prevented by the underlying paving fabric layer. The waterproofing benefits of the paving fabric interlayer system, however, generally remain intact even if thermal cracking occurs.

Because water in the base is eliminated, which could otherwise cause freeze/thaw damage and base deterioration, Thrace-LINQ's paving fabrics are widely used in areas at risk of severe thermal cracking. Deterioration along the thermal crack is minimized and can be repaired.[6]

Reflective crack retardation

Stresses related to cracking in the overlaid pavement are transmitted into the new overlay. This can quickly create reflective cracking if conventional "hard contact" overlay placement is made directly on the old pavement.

The use of a Thrace-LINQ paving fabric interlayer system over the old pavement, however, provides a medium that absorbs the stress related to the old pavement cracking. This greatly retards the propagation of cracks up into the new overlay.

This system is very effective, unless significant vertical and horizontal movement is associated with the old cracking (that is, greater than 0.002 inch differential vertical movement from rocking slabs). If this occurs, the interlayer is not adequate to absorb all the stress and some reflective cracking can occur. Waterproofing benefits, however, would still apply.

Fatigue cracking resistance

Fatigue cracking is a result of too many flexures of the pavement system. The pavement cracks from the base of the pavement layer where the layer is in tension. Beam mechanics explain that the thicker the beam, the greater the amount of tensile stress at the base, for a given amount of flexure. This also is applicable to individual layers within a pavement structure. The thicker the layers, the more tensile stress at their base, and the sooner they begin to fatigue crack.

The "hard-contact" overlay application with only a minimal tack coat tends to interlock the overlay to the pavement layers below. This creates a thicker pavement layer.

The use of a Thrace-LINQ paving fabric interlayer allows the overlay and the existing pavement layers to act independently without building up high-tensile stresses and without resultant cracking as with thicker pavement layers.

Pavements should be built to minimize flexure. If flexure occurs, a pavement layered with a paving fabric interlayer has been proven to flex many times more before cracking. One analogy is that plywood can be bend many more times without cracking than can a solid wood board of the same thickness.

A multitude of combination effects can result in pavement failures. Once the water enters the

road, the subgrade and base progressively fail. This creates cracks that let more water in. If fatigue cracking occurs, more water infiltrates, which promotes base and subgrade failure. Note that a Thrace-LINQ paving fabric interlayer system minimizes this multitude of pavement problems that lead to pavement deterioration.

Economic benefits

Controlled studies have shown that an overlay thickness designed to retard reflective cracking can be reduced by up to 0.1 foot for equal performance, plus the additional waterproofing advantage if a paving fabric interlayer is included in the system.

The economic advantages are dramatic, because the installed cost of a Thrace-LINQ paving fabric interlayer system is generally less than the cost of 0.05 foot of ACC overlay. (Typical ACC pavement costs \$0.15 - 0.20/feet.^{2}/inch thick. A typical installed Thrace-LINQ paving fabric system costs \$0.06 - 0.08/feet^2.)

Whereas a paving fabric interlayer effectively decreases pavement costs, alternatives, such as crumb rubber in asphalt concrete, increase the cost.

Because initial savings and longer-lasting pavements are experienced with Thrace-LINQ paving fabric interlayers, transportation agencies save millions of dollars annually and efficiently pave more highways.

Paving fabric interlayer systems also can be installed beneath a seal coat, or chip-seal surface treatment, which may be the most economical way to incorporate the waterproofing layer.

The chip seal also experiences dramatically longer life. The paving fabric interlayer absorbs the stresses from underlaying cracks and the stone chips have a better medium in which to be seated - which minimizes stripping. This same pavement can later be covered with an ACC overlay and benefit from the underlying paving fabric interlayer.

Thrace-LINQ paving fabric interlayers can readily be recycled. The most common practice is to mill down to just above the paving fabric interlayer. This process maintains all the benefits of the interlayer when the recycled overlay is replaced.

Installing paving fabrics

125EX and 130EX installation can be simple and straightforward - with proper understanding of the system. The following addresses standard application procedures and deals with commonly encountered field variables.

Site evaluation

Choosing proper application sites for the Thrace-LINQ paving fabric system is a function of the existing pavement's structural integrity and crack types - not its surface condition. For successful performance, proper installation must occur on a pavement without significant differential

vertical or horizontal movement between cracks or joints and without local deflection under design loading.

Applications include asphalt overlays on PCC pavement, ACC pavement and asphalt surface treatments under controlled conditions. We will consider applications with hot-mix asphalt concrete (HMAC) overlays of 1 inches or thicker.

Surface preparation

Our objective is to provide a consistent surface where the 125EX or 130EX can maintain intimate contact. Tight hair-line cracks under _ inch generally will be filled with the tack coat application. Larger cracks and spalls should be filled with crack filler, asphalt slurry, "skin patch" or a leveling course. Cracks should not be overfilled, and excess crack filler should be removed.

Crack fillers containing volatiles should be given time to cure before interlayer and overlay placement. The prepared surface should be dry and free of dirt or loose material.

Tack coat application

The tack coat is the main active ingredient of the Thrace-LINQ paving fabric system and should be considered as such. Although it is sometimes misused, proper tack application is simple to achieve with today's sophisticated asphalt spreading equipment - once the proper spread rate is determined (*Table 1*).

Table 1. Asphalt Tack Coat Information

Approximate asphalt cement equivalents:

AC 2.5 <--> AR1000
AC 5 <--> AR2000
AC 10 <--> AR4000 - most commonly used tack for 125EX and 130EX paving fabrics
AC 20 <--> AR8000 - optional hot weather tack (in hot weather, a switch to a higher viscosity tack will help avoid bleed-through problems)

Asphalt cement application volumes: asphalt cement required for various rates of application (gallons per mile):

Road width (ft.)	Gallons per square yard		
	0.20 gal/yd^2	0.25 gal/yd^2	0.30 gal/sy^2
8	939	1173	1408
10	1173	1467	1760

12	1408	1770	2112
14	1643	2053	2464
16	1877	2347	2818
20	2347	2933	3520
24	2816	3520	4224
30	3520	4400	5280

The asphalt spread rate should be applied at the rate of approximately .25 gal/yd^2 (This rate includes the fabric's minimum asphalt retention in gallons per square yard .20 gal/yd^2, in addition to 0.05 gal/yd^2.) The .25 gal/yd^2 is applied to fill surface voids and cracks, and bond the pavement and fabric surfaces.

The estimated amount of tack coat can be customized by project. The minimum rate over a dense or new ACC surface should not fall below the fabric's minimum asphalt retention, and the maximum additional rate on a porous or textured surface should not exceed 0.09 gal/sy.

Adjusting tack rate to compensate for the effects that ambient temperature have on asphalt viscosity is incorrect and detrimental to performance objectives.

In cold conditions, when the tack coat becomes hard quickly, fabric placement should be coordinated to follow closely behind the tack coat application, to achieve a strong temporary bond until the overlay is placed.

In hot conditions, it may become necessary to separate the application of tack coat and fabric laydown to allow a cooling time. This helps to prevent construction problems caused by premature fabric saturation. In hot weather, a light broadcast of hot mix on top of the fabric will deter fabric pickup on equipment - allowing full saturation of the fabric prior to overlay.

Straight paving-grade asphalt is the best and the most economical choice for paving fabric tack coat and should be spread at between 300 F and 350 F. The most commonly specified asphalt cements are AR4000 and AC20, although stiffer grades such as AR8000 can be used in hot weather to avoid premature fabric saturation.

Asphalt emulsions such as RS-2 are used successfully, but generally are more expensive. They contain a high percentage of water that can increase the required spread rate up to 60 percent to obtain equivalent residual asphalt after curing. The greater required application rate and the emulsion's fluid nature also can cause the tack coat to run off of sloping and milled pavements.

Also, the paving fabric cannot be placed until the water has evaporated from the emulsion. This curing time is often a problem during construction. For this reason, Thrace-LINQ does not recommend the use of emulsions in paving fabric interlayers.

Installation

Today, most 125EX and 130EX installations are performed with tractor-mounted rigs. Slight tension applied during paving fabric installation will help minimize wrinkling. Stretching is not recommended, because it will change the fabric's asphalt retention properties. This subsequently can create construction and performance problems.

With an adequate tack coat and sufficient overlay thickness, small wrinkles do not impede performance. Wrinkles more than 1 inch high, caused by product, equipment and surface inconsistencies, should be cut to lay flat.

Wrinkles that fold and cause a triple fabric thickness are sometimes damaging to the overlay and should be minimized. Fabric placement should occur so that longitudinal laps are 6 inches or less, transverse laps are 6 inches or less and are shingled or overlapped in the paving operation direction.

All laps should receive additional tack coat for proper fabric saturation. Exceeding these overlap dimensions in the presence of appropriate tack coat and overlay thickness generally will not detract from performance but may increase construction complications.

Fabric edges should extend halfway through the asphalt cement sprayed by the outside snivy on a distributor truck spray bar (approximately 2 inches inside the tack width on each side). Paving fabric placement is fast and will stay ahead of any paving operation.

Freshly installed paving fabric may have less skid resistance than dry pavement. Moisture can further reduce this skid resistance. Although durable enough to withstand trafficking, the 125EX or 130EX should not be trafficked because of safety considerations. If local conditions require trafficking, traffic signs or flagbearers should warn motorists that there is a potential for slippery conditions and that speeds should be significantly reduced. If premature asphalt bleed-through occurs in the fabric, traffic should be minimized and some hot mix should be broadcast lightly to prevent pickup on equipment.

Overlay placement

This can be done immediately after fabric placement. HMAC should be placed at the temperatures and compaction levels consistent with good paving practices - whether or not there is a paving fabric interlayer.

A minimum compacted asphalt thickness of 1 to 1 inches is required depending on the climate, ambient installation temperatures, roadways surface conditions and projected traffic volume. Adequate overlay thickness generates enough heat to draw the tack coat up, into and through the 125EX or 130EX.

In summary, the paving fabric interlayer system using Thrace-LINQ's 125EX and 130EX paving fabrics is easy to install and readily complements any paving operation. Design professionals or first-time users of paving fabric interlayers can obtain free help from Thrace-LINQ and its experienced group of distributors. Just call 1-800-543-9966.

References

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4. Laboratory testing by Los Angeles County, California Department of Public Works
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6. "Fabric Reinforced Asphalt on Runways to Reduce Reflective Cracking," U.S.Corps of Engineers, February 1982