THE asphalt contractor

PAVING AMERICA

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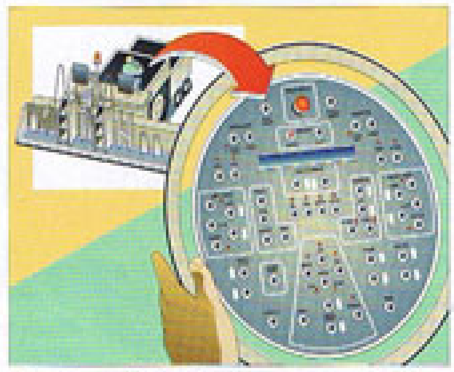

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Don't let fabric fuzzing or failure foul-up your paving job

Figure A: Delamination or fuzzing commonly occurs in non-heat bonded paving fabrics.

Tips on paving fabric characteristics and installation assist in successful projects

By Mounque Barazone

Failures of asphalt pavement overlays atop paving fabrics are most frequently traced back to improper installation techniques and/or fabric chosen, according to most transportation agency studies. When properly applied, the majority of reports show great success with fabric membrane systems.

Geotextiles are woven and non-woven fabrics used in construction for multitudes of applications. The main functions of geotextiles are reinforcement (stabilization), filtration (drainage), separation, liner cushioning and paving. Paving fabric has been placed in asphalt cement (AC) overlay systems since the 1960s to reduce and/or delay reflection cracking and to act as a waterproofing membrane.

The concept is to bond the new asphalt to the old asphalt through a fabric membrane system. This system consists of fabric and a bituminous tack coat sufficient to saturate the fabric and penetrate the old and new asphalt thus forming one integral, flexible structural system with enclosed membrane.

For contractors, it is hard to determine what information on fabrics and installation is correct and which is not. Manufacturers with differing proprietary interests suggest various reasons why their fabric is better. Often, different installation criteria is recommended or discounted around the individual fabric's installation benefits and problems. To further complicate matters, there is a wide range of specifications by both public and private engineers based on their personal experiences. This has caused a wide range of specifications both for the fabric and installation criteria.

To avoid confusion, contractors must understand the difference among the types of fabric available, know proper installation procedures and be aware of problems that can occur during installation.

Proper terminology

Various names have been given to the use of fabric in membrane systems. The most common is "pavement reinforcement fabric." This is incorrect terminology since Roger Smith, of the Office of Transportation Laboratory, California Department of Transportation (Caltrans), showed in laboratory testing that a fabric interlayer is not a significant tensile reinforcing element in an AC pavement. Reinforcement is obtained from high modulus fabrics (wovens) and geogrids. Non-woven fabrics have a high elongation and low modulus. This permits them to work within an asphalt system and remain flexible, but they provide little or no reinforcement. Terminology is changing to, fabric interlayer membranes.

Fabric types

The two commonly used polymer materials in the manufacture of geotextile fabric are polypropylene and polyester. Polypropylene fabric is slightly more absorbent to oil, is less expensive to manufacture and is easily recyclable in milling. Its only drawback is that it has a low shrinkage and melt point and can be damaged during installation.

Polyester fabric is stronger and has a much higher shrinkage and melt point making it virtually impossible to damage during installation. Its drawbacks are that it is usually more expensive and questions surround its recyclability.

With these geotextile fabric materials, there are two major manufacturing processes, woven and non-woven. Both can be broken down into sub processes which give fabric individual qualities. Paving fabric *must* be non-woven. The fabric needs an interior dimensional thickness so that the tack coat can saturate the fabric to form a membrane. Woven fabrics were found to be ineffective as they have no interior plane to hold

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asphalt tack coats for membrane formation.

Non-woven fabrics use thin filaments of polypropylene or polyester which are formed into a fabric by one of four manufacturing processes:

1. needlepunched
2. heatbonded (calendared) two sides,
3. resinbonded,
4. needlepunched and heatbonded one side.

Each type performs differently during installation, although their individual specifications may appear to be nearly identical.

Needlepunched (or entangled) non-heatbonded fabrics are formed by one of two methods. One uses long continuous filaments spun together. The other uses short staples of filaments six to 12 inches long which are arranged on a carded conveyer system. The barbed needles go up and down through the filaments, entangling the strands together to form the fabric. The fabric is thicker, fuzzier, softer and more pliable than non-needlepunched fabrics. This fabric is best suited for drainage, separation and pond cushioning. Many of its features are desirable in a paving application. But, due to inherent installation problems, it is undesirable for paving fabric.

Installation problems include delamination and fuzzing. FHWA(Federal Highway Administration)-Texas report 261.2 mentions problems with non-heatbonded fabrics on every test section, delaminating and fuzzing up in the wheel paths of traffic during construction (see figure A, page 36).

Benefits are that it installs smoother with less wrinkles due to its high elongation (stretch) and seems to bond better to the oil and old asphalt. Numerous reports state the fuzzy side, when placed onto the asphalt tack coat on the old pavement surface, provides reinforcement at the interface. The fuzzy side provides a greater effective surface area on the fabric which offers better adhesive and shear strength with far less slippage.

Heatbonding is a process where one or both sides of the filaments are

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heated together to form the fabric. A light heating is called calendaring. The benefit is that the fabric holds up well during construction without delamination or fuzzing.

Dual sided heatbonded fabric is very thin and stiff. It is difficult to place smoothly, the wrinkles and folds transverse the full width of the fabric. They have no fuzzy side and have been prone to slippage problems. The thin fabric does not hold tack coat easily and bleed-through occurs, exposing workers and equipment to the hazards of hot tack coats.

Resin bonded fabrics add a chemical process which forms the fabric. This is similar to gluing and is seldom used. The fabric is thin, stiff and has problems absorbing a tack coat.

A needlepunched-heatbonded on one side fabric combines the benefits of the entangling process with the durability of heatbonding. They do not experience the delamination, severe wrinkling or bleed through problems during construction. They provide the fuzzy side for bonding and a good thickness to hold the tack coat in their interior plane to form a solid membrane.

The only installation problem is that the fabric can be placed upside down. The *heat bonded side must be up* and the fuzzy side to the tack coat. Otherwise both delamination and slippage can occur.

Caltrans changed its specification in 1989 to permit only non-woven, needlepunched, heatbonded on one side fabrics. This occurred after 15 years of field evaluation. In 1991, Los Angeles County also changed to this fabric and has recently introduced the most comprehensive specification in existence.

Understanding specifications

Specifications contain individual fabric properties that engineers or agencies have found desirable and can be tested, usually by American Society for Testing and Materials (ASTM) standards. Manufacturers publish their standard specifications which show the fabric's properties and to make it easier to match fabric to engineering specification. But, not all manufacturers use the same ASTM tests and many times they alter the tests—putting sub notes on their specification pages.

The basic properties used in paving fabric by noted agencies such as Caltrans, Texas Department of Transportation (DOT) and Los Angeles County are:

1. Weight (ounces per square yard)
2. Fabric thickness (mills)
3. Grab tensile strength (weakest principle direction)
4. Elongation
5. Asphalt retention
6. Heat Shrinkage
7. Fabric storage

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Not all manufacturers publish every specification of the first six properties. Many fabric producers disagree with some of them—saying that engineers are being too specific and that the properties are not necessary for paving fabric. Still, when forced to provide data or undergo testing, the information is available.

Weight, ounces per square yard, is an easy way for the engineer to see that he is getting the quantity of fabric necessary to absorb the sufficient amount of tack coat to form a membrane. This is usually three to six ounces. Many specifications are written with the standard fabric weight of four ounces, plus or minus one-half ounce.

Fabric thickness in mills measures the fabric in a device which exerts a certain pressure on the fabric. This tests fabrics' thicknesses under similar conditions. Most fabric specifications require fabric thickness from 30-100 mills. Recently, many agencies are changing their limits to 30-60 mills. The thicker the fabric, the more tack coat required to saturate the fabric and make a bond.

Grab tensile strength determines fabric strength when pulled between the jaws of a testing machine until it ruptures (see figure C, at right). This specification is sometimes misreported. Fabric has a strong and weak direction, called cross and machine or warp and fill. Most agencies only care about the strength in the weakest direction. However, for publication, many manufacturers average the strength in both directions. This is called typical average. When using these numbers, it is possible that fabric will not meet agency specification when tested.

Elongation is also derived from grab tensile testing. It is the determination of how far fabric stretches prior to rupturing.

Asphalt retention is the quantity of oil necessary to saturate the fabric and make a bond. Various fabrics absorb different amounts of tack coat depending upon weight and thickness. A typical four ounce, 50 mil fabric (113 grams, 1.27 mm) will absorb two-tenths gallons per square yard (0.76 liters per square meter). An

Figure C: Grab tensile testing device stretches fabric sample to determine its strength and elongation.

additional .005 gallons per square yard (.0184 liters per square meter) of

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tack coat must be included for penetration into the old and new asphalt. Quantity of tack coat used during construction is extremely important in the final membrane system. Too much tack will bleed through the new asphalt, and too little will fail to complete the bond. Proper quantity of tack coat is based on thickness and weight of the fabric and condition of the old asphalt. There are different test methods developed to determine asphalt retention of fabric. None have been standardized yet. Currently Caltrans uses and has found to be very accurate these quantities for various thicknesses of fabric.

Thickness (mils)	Thickness (millimeters)	Gallons (per sq. yrd)	Liter (per sq. M)
under 50	under 1.270	.25	0.95
50-60	1.270-1.524	.30	1.14
60-70	1.524-1.778	.35	1.32
70-80	1.778-2.032	.40	1.51
80-90	2.032-2.286	.45	1.70
90-100	2.286-2.540	.50	1.89

Current specification trends are toward limited specification in regards to thickness and weight. Los Angeles County and the Southern California Public Works Association Materials Greenbook now limit thickness to between 30 and 50 mils (.762 - 1.270 mm) and weight to between 3.5 and five ounces per square yard (99.25 - 141.75 grams per square meter).

Fabric storage is critical to proper performance. If the fabric or cardboard cores get wet, problems occur. Wet fabric creates steam which causes stripping of the asphalt from the fabric due to a poor bond. Wet cores create two problems. First, they become weak and break. Second, if the ends of the cores become damaged from water, various cones on mechanized equipment cannot grab cores to hold the rolls. Under such conditions, core ends usually shred before the whole roll can be installed. This reduces tensioning capability by allowing rolls to spin freely and causes wrinkles.

Fabric installation

Caltrans and Texas DOT reports conclude that placing fabric properly is the most important single factor in performance of an interlayer system. Improperly placed fabric results in less waterproofing, asphalt stripping and cracks from heat damage—at wrinkles, overlaps and in wheel paths. Such conditions reduce the long term benefit of the membrane system. A serious installation problem is fabric shrinkage and damage due to higher heat exposure than the polymer's shrinkage or melt point.

Fabric may be installed manually or by mechanized methods. Manual placement involves hand rolling the fabric and using six or so laborers to broom it in place. This is a time consuming, labor intensive process. Often the fabric gets off course in rolling, causing large wrinkles. The laborers are exposed to the hot tack coat, which can be hazardous.

Patented equipment for fabric installation has been

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developed to speed and improve the installation process. This equipment has been mounted as attachments on tractors, the back of the oil spreading trucks and other equipment. The equipment aligns, tensions, stretches and brushes fabric while placing it (see *Asphalt Contractor* article, "Here's How It Works," December 1992, issue, page 34) . Usually a roll can be installed in a couple of minutes.

When using installation machinery, two laborers and an operator make up a crew. The laborers change rolls of fabric, broom fabric edges that may curl from heat after placement and slit any wrinkles that may appear.

Since there are many different manufacturers of fabric, the contractor needs to check more than just the fabric meeting specification. Each manufacturer may use different diameter, three- to six-inch, cardboard cores on which fabric is rolled. Equipment cones should be checked to ensure that the diameter of the core will fit. Not all cones fit all cores.

Core thickness is also important. Some manufacturers use thicker cores, three-quarters to one inch, for strength to ensure the core will not break during installation. Many manufacturers still use thin drainage fabric cores which are not suitable for equipment installation. This can cause the roll to break or sag in the middle during installation—causing wrinkles. If this should occur, two methods will solve the problem. Obtain a solid steel pipe slightly smaller than the diameter of the fabric core and about a foot shorter than the fabric width to allow the cones to grab the core without hitting the pipe. This reinforces cores and eliminates breaking and sagging. Having more than one pipe speeds installation. Preload rolls so a new roll can be loaded and the tractor can return to installation while the other pipe is retrieved. Wood also works well if it is custom cut (square) to fit the cores.

Fabric can be rolled onto the core two ways. With the heat bonded side up or down. Hand and machine placed fabric need to be rolled in opposite directions. When placing fabric by hand, it is important to order the fabric to unroll with the

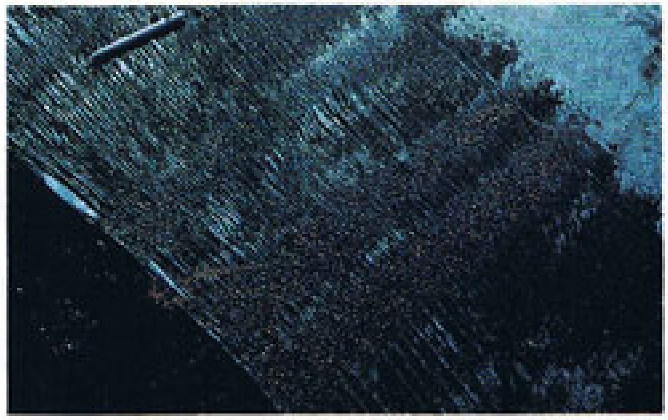

Figure D: If fabric is installed too close to the hot oil truck, excessive shrinkage and melting damage occurs.

heat bonded side up. Otherwise the laborers will have to hold the fabric up off the ground (baseball bats work well for

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this) and walk backwards when unrolling the fabric. When ordering fabric for equipment installation it should be rolled onto the core in reverse direction. When the fabric is placed on the equipment it should come off the back of the roll, providing for more stretch while placing the heat bonded side up. If the fabric comes off the front of the roll, reduced tension is likely to cause more wrinkles.

Wrinkles and overlaps in fabric can cause cracks in new overlays if not properly handled during installation. Wrinkles twice the thickness of the fabric should be slit laid flat (see figure E, at left). Excess fabric over two inches should be trimmed. Overlaps and slit wrinkles should be shingled in the direction of the paving. If shingled in the wrong direction, the paver is likely to lift or tear fabric while paving. The overlapped fabric should have an additional tack coat.

Figure E: Wrinkles are a fact of installation. But, minimizing them and proper slitting assure a quality job.

Tack must be sufficient to saturate two layers of fabric and make a bond. Failure to do this creates a slip place at each overlapped joint which can result in a crack and potential for stripping of the asphalt from the fabric. Overlaps should be no more than six inches on longitudinal joints (see figure F, below), and one foot at transverse joints.

Nailing down fabric with case hardened nails or surveying shiners to hold fabric in place is not recommended. An old practice, this has been found to cause damage later if the pavement is recycled.

Figure F: Fabric overlaps from adjoining lanes should be six inches. When overlaying adjoining lanes, AC should be held back to ensure lap length.

Installing fabric around curves without excessive wrinkles is the most difficult task. With the proper procedures, this is accomplished with ease. Never attempt to roll the fabric around the curve by hand or drive the fabric around the the curve with machinery. This creates excessive wrinkles and makes it almost impossible to cut all of them without damaging the fabric.

Cutting small pie shaped fabric sections placed by hand around the curve is one method. This permits matching the

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fabric to the curve with a number of overlaps. Mechanical placement is also possible by a hopping method around the curve. Most placement machines have either the McClure or Barazone patented tensioning cones. Tighten the inside cone and loosen the outside cone which places more stretch across the fabric allowing the outside to sweep more. Do not attempt to drive around the curve. Drive straight passes and then make one big, quick adjustment with the tractor, almost like hopping. This will place one or two large wrinkles in the fabric at each adjustment. Continue this all the way around the curve. After slitting the wrinkles the effect will be similar to pie shape placement. This method is not effective if the machine is mounted to the back of an oil truck and only works with a tractor.

If a non-heatbonded fabric is used, care must be taken to avoid delaminating and fuzzing the fabric with equipment during paving. Build a bridge on the fabric by spreading a light layer of asphalt for equipment to ride over. This is best done by backing a small dump truck onto the fabric and spreading the light layer. This permits the wheels of the dump truck to ride on the asphalt it is spreading and not damage the fabric.

Types of oil and construction

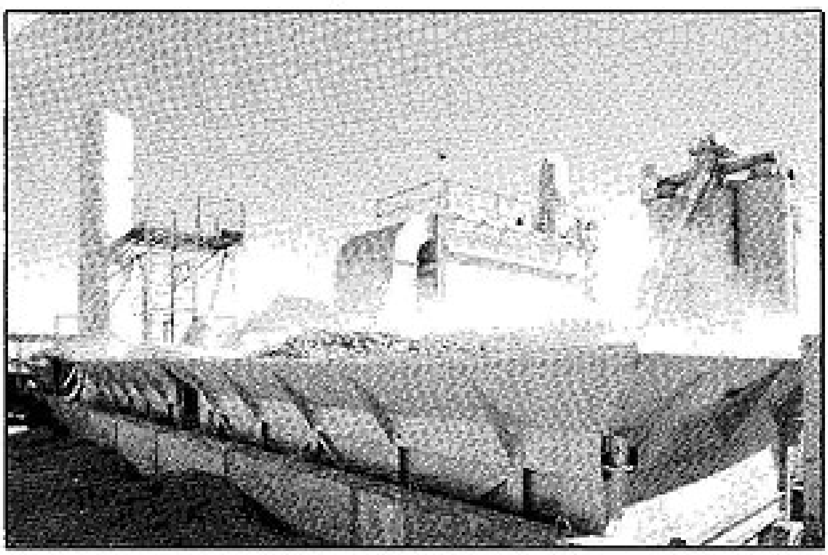
Both hot asphalt cements and rapid set emulsions have been successfully used for fabric installation. Vicelja of Los Angeles County reported that hot oils facilitate construction and have been the predominant choice by contractors and agencies for this reason.

Prior to starting the job, the distributor truck should be checked for proper spread rate. Since valves are often clogged, they must be cleared before work begins. Failure to do so causes streaking of the oil and prohibits full saturation and bonding of the fabric.

Heat shrinkage and melting from hot oil is a major problem. This is being tackled by the engineers, but is not readily acknowledged by some manufacturers.

Caltrans, Texas, Los Angeles County and Federal tests have been developed to address both the asphalt retention and area change (shrinkage) of paving fabrics. None are standardized at this time. Texas, Los Angeles County and Caltrans have all noted shrinkage of polypropylene fabrics when placed in hot oils over 250° F (121° C). Polyester fabrics have not been prone to shrinkage problems as their shrinkage point is over 400° F.

Lancaster of Los Angeles County tested fabrics for shrinkage and damage due to heat exposure. He



noted no problems with fabrics at 240° F (115.5° C) and serious shrinkage and damage at 280° F (137.77° C). Lancaster's first specification was to require that fabric to be placed onto the tack coat after it has cooled to 240° F (115.5° C)—measured by a surface temperature gun. If such equipment is not available, specifiers will likely require that fabric be placed one to five minutes after the oil spreading—depending upon the ambient and old asphalt temperature. The hotter the temperature, the longer the waiting period for installing the fabric. This specification was opposed by the manufacturers of polypropylene fabric and after numerous committee meetings was made less stringent. The committee chose an allowable amount of shrinkage (damage) to the fabric during construction, not to exceed six inches per roll (see figure G, at right).

Rapid set emulsions work well in the membrane system, but emulsion must break completely prior to fabric placement—which slows installation and overlay processes. Run off problems can occur in applications of emulsions on sloped and crowned roadways which makes application rate difficult to control. Under no circumstances can fabric be placed in emulsion until all water has evaporated from the emulsion.

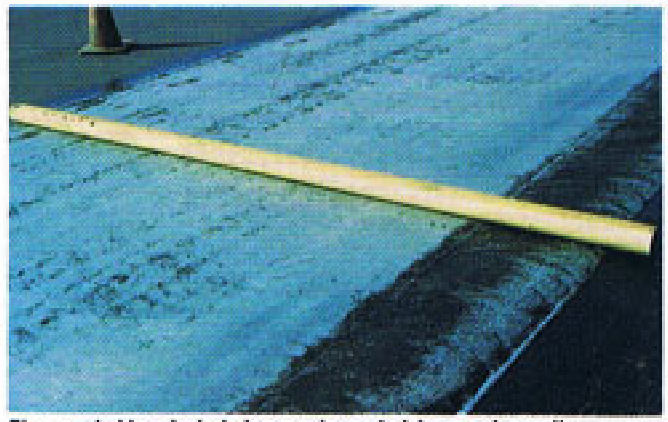


Figure I: Heat shrinkage is quickly and easily measured with the use of an empty core.

Button and Epps, of the Texas Transportation Institute, reported steam from water has been shown to create bubbles in the overlay. And, Smith, Caltrans, Office of Transportation Laboratory, reported that moisture can cause stripping problems of the asphalt in a short period of time.

Since four-ounce (113 gram) fabric absorbs .20 gallons per square yard (.76 liters per square meter) of residual AC, emulsion must be spread at a thicker rate. After emulsion has broken, the remaining AC must be sufficient to saturate fabric, old and new asphalt, as well as make a bond.

Petroleum based solvent cutbacks, according to Button and Epps, should never be used as tack or to secure overlaps. They are damaging to most synthetic fabrics.

Asphalt overlay construction

Thickness of the AC overlay must be 1-1/2 inches (3.81 cm) or more when

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installed under ideal climatic conditions, 70° F (21° C) or above. For temperatures between 50° and 70° F (10 -21° C), overlay thickness should be two inches or more. Overlays should not be attempted with temperatures less than 50° F (10° C). Since overlay heat draws the tack coat up through the fabric to make a bond, insufficient residual heat disrupts the bonding process. The results are slippage, stripping and eventual overlay failure. Rolling AC immediately after placement helps to concentrate heat and supply pressure to start the process of oil moving up into and through fabric.

Scrimscher of Caltrans found polypropylene fabric to be recyclable during experimental milling research. Cohesion values for both the hot and cold recycle briquettes with fabric exceeded the cohesion values of the control mixes. The fabric seemed to provide some tensile reinforcement to the AC mix. The surface abrasion test results showed a significant improvement in the hot recycle briquettes and no detriment in the cold recycle briquettes. Polyester manufacturers have run tests showing that their product is also recyclable.∎

For more information write in 666

Correction

In the November 1992 issue of *Asphalt Contractor*, the editorial on page 10, "Pseudo Science Seize Your Work," stated that *Gomaco World* magazine misquoted Joe Moore, chief city engineer of Alamogordo, N.M. *Gomaco World* magazine **did not misquote** Moore. *Asphalt Contractor* regrets the error.

At issue was a comment attributed to Moore that asphalt contains cancer-causing compounds that contaminate water. Though this is an erroneous statement, it was the belief expressed in a letter from the New Mexico Health and Environment Department, Environmental Improvement Division. Moore did not realize that this departmental quote would be attributed to him personally.∎