

# Module 3 – Asphalt Overlay

## Introduction To Geosynthetics In Transportation

Prepared by



July 2007

For the Local Technical Assistance Program





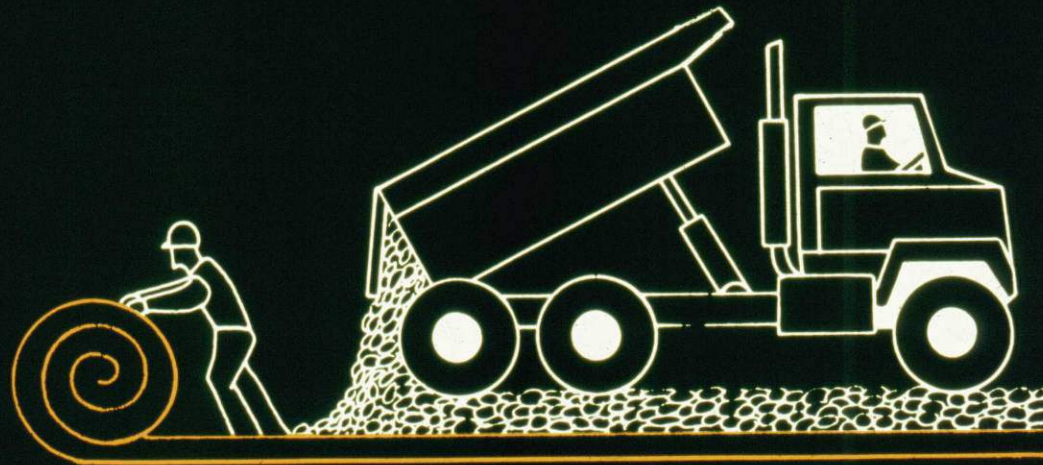
- **The Geosynthetic Materials Association (GMA)** represents all segments of the geosynthetics industry
  - Manufacturers
  - Companies that test or supply material or services to the industry
  
- GMA activities further the acceptance and use of geosynthetic materials in a variety of applications.
  - Trade association
  - Bimonthly magazine
  - Conferences and trade show
  
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In 2007 Geosynthetics magazine (formerly GFR) enters its 25th year of publication.

# Preface

- ❑ This short-course introduces geosynthetics from the perspective of practical application.
- ❑ It is intended to serve as a general reference in the field for those who are building structures that include geosynthetics.



# Geosynthetics

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The most versatile and cost-effective ground modification materials.



# Contents

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- Introduction**
  - Geosynthetic Functions**
  - Geosynthetic Materials**
  - Geosynthetic Applications**
    - Overlay Stress Absorption and Reinforcement**
  - Simplified Generic Specifications**
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# Introduction to Geosynthetics

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## **Geosynthetics, including:**

- Geotextiles
- Geomembranes
- Geonets
- Geogrids
- Geocomposites
- Geosynthetic clay liners

...Are often used in combination with conventional materials, offer numerous advantages over traditional materials

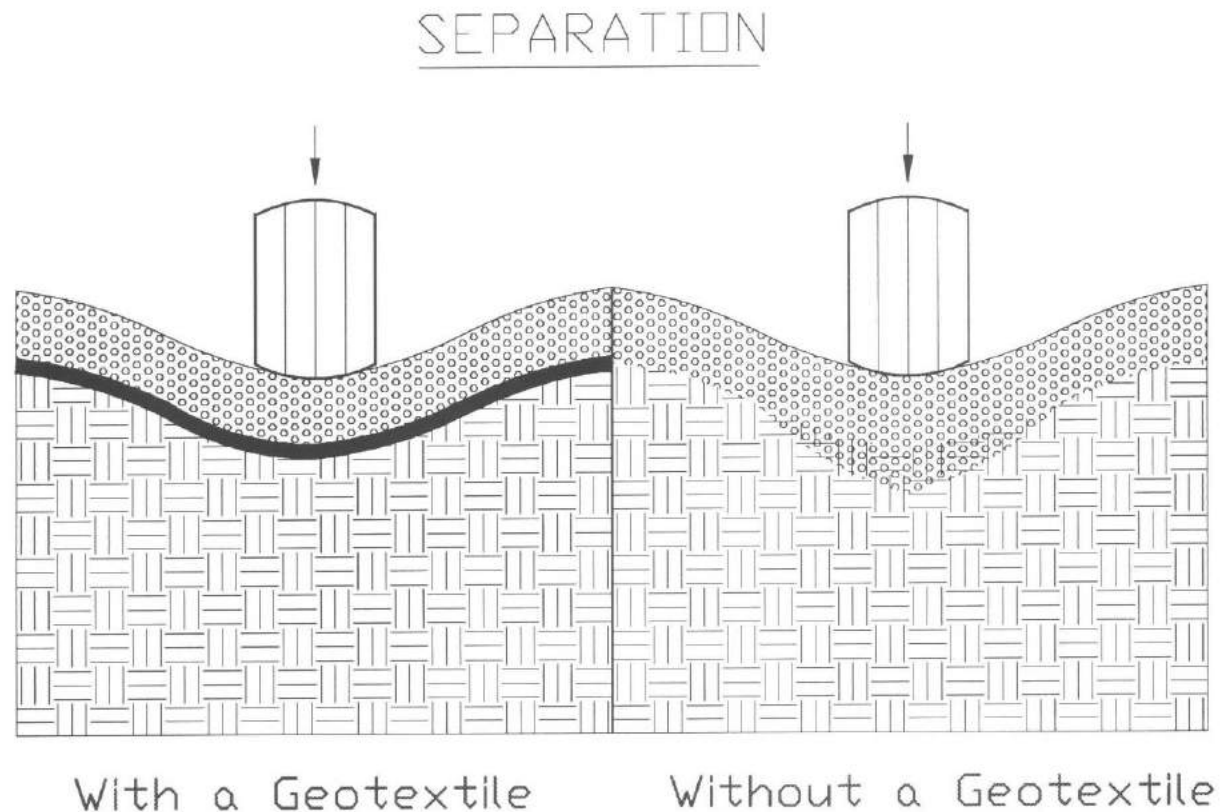
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# Geosynthetic Separator

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Geosynthetics can perform numerous functions, including the separation function.

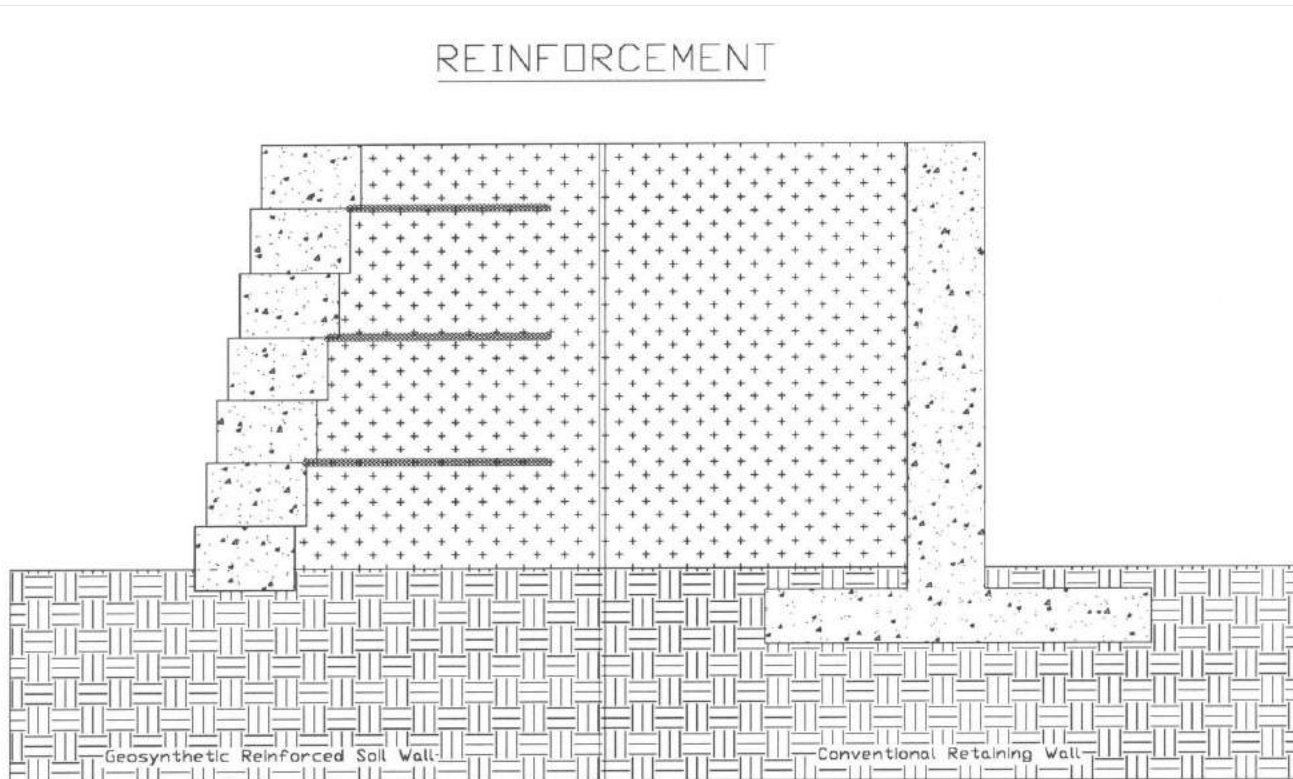
In roadways, a separator keeps the base aggregate and the subgrade from mixing.



# Geosynthetic Reinforcement

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A geosynthetic performs the reinforcement function when it contributes a tensile force within the soil mass.



With Geotextiles

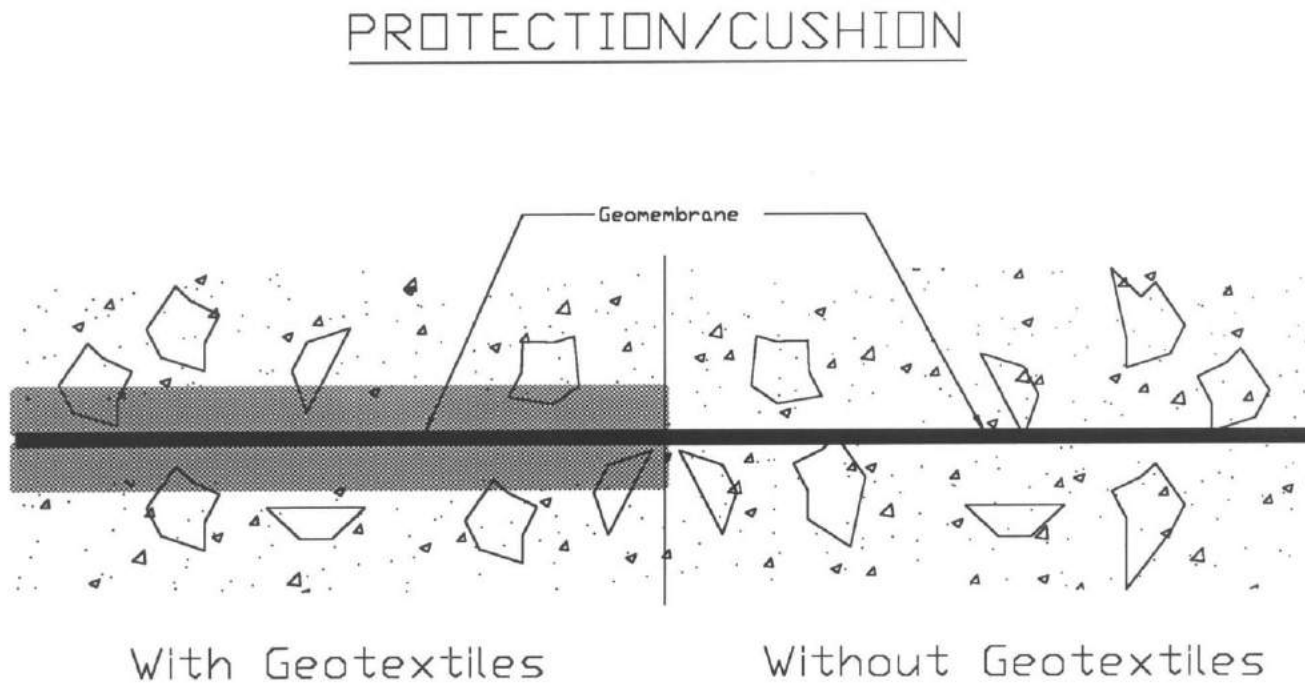
Without Geotextiles



# Geosynthetic Cushion / Protection

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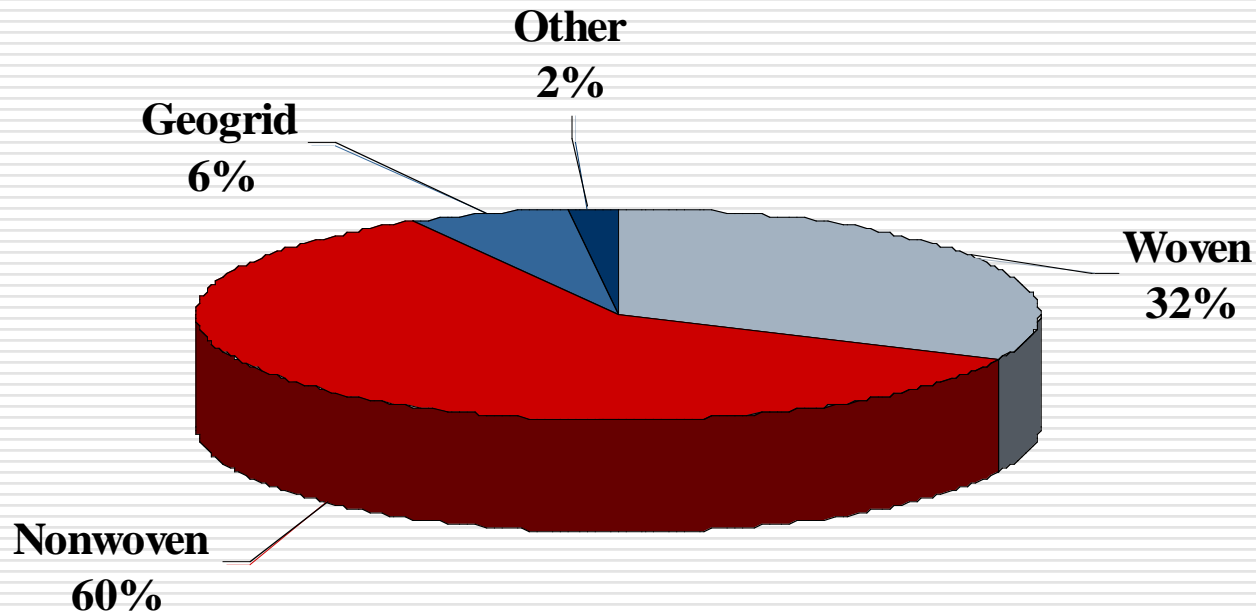
A geosynthetic performs the cushion/protection function when it alleviates or distributes the stresses and strains transmitted to the material to be protected.



# Geosynthetic Categories

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Geotextiles – both woven and nonwoven – make up the largest percentage of geosynthetics used in transportation applications.

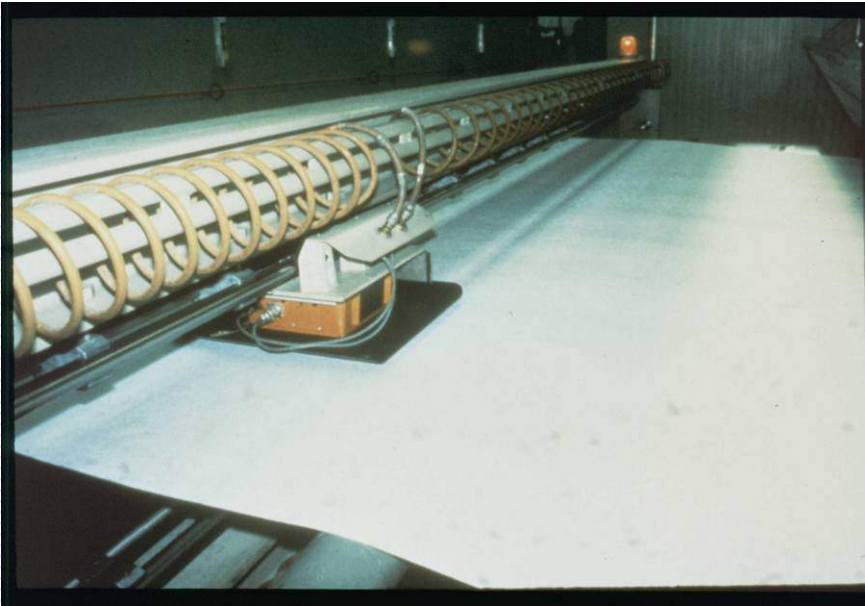


**USA Market**

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# Geotextiles

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Geotextiles, like other geosynthetics, are manufactured in state-of-the-art facilities using sophisticated equipment.

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# Geotextiles

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## Polymers

- Almost all are polyester or polypropylene.
  - Polypropylene is lighter than water (specific gravity of 0.9), strong and very durable.
  - Polyester is heavier than water, has excellent strength and creep properties, and is compatible with most common soil environments.

## Structures

- Nonwoven
  - Woven
  - Other
    - Knitted
    - Stitch bonded
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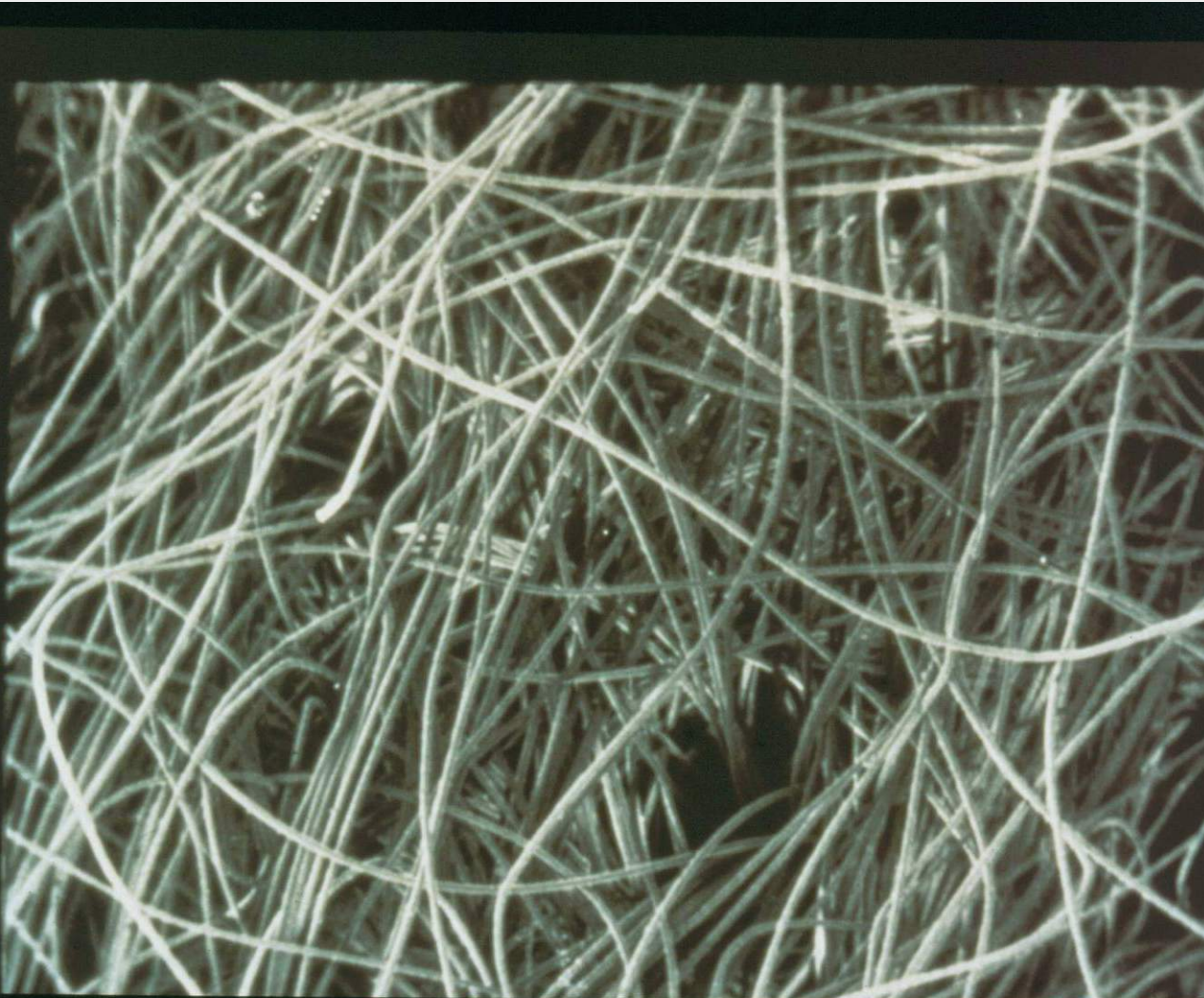
# Nonwovens

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- Manufactured from (short) staple fibers or continuous filaments randomly distributed in layers onto a moving belt to form a "web".
  - The web then is needled or heat and pressure bonded to interlock the fibers.
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# Needle-punched Nonwoven Geotextiles

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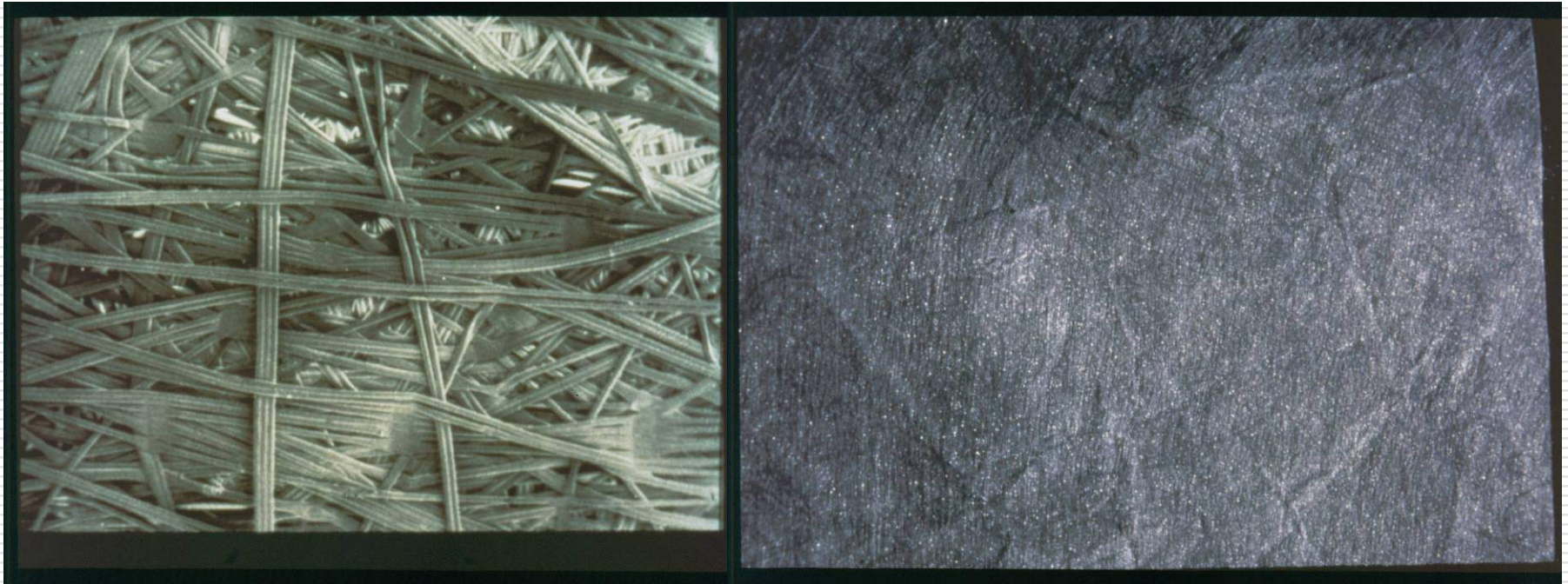
Needle-punched nonwovens are “felt-like” and very flexible.

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# Heatbonded Nonwoven Geotextiles

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Heat-bonded nonwovens are thinner and have greater stiffness.



# Wovens

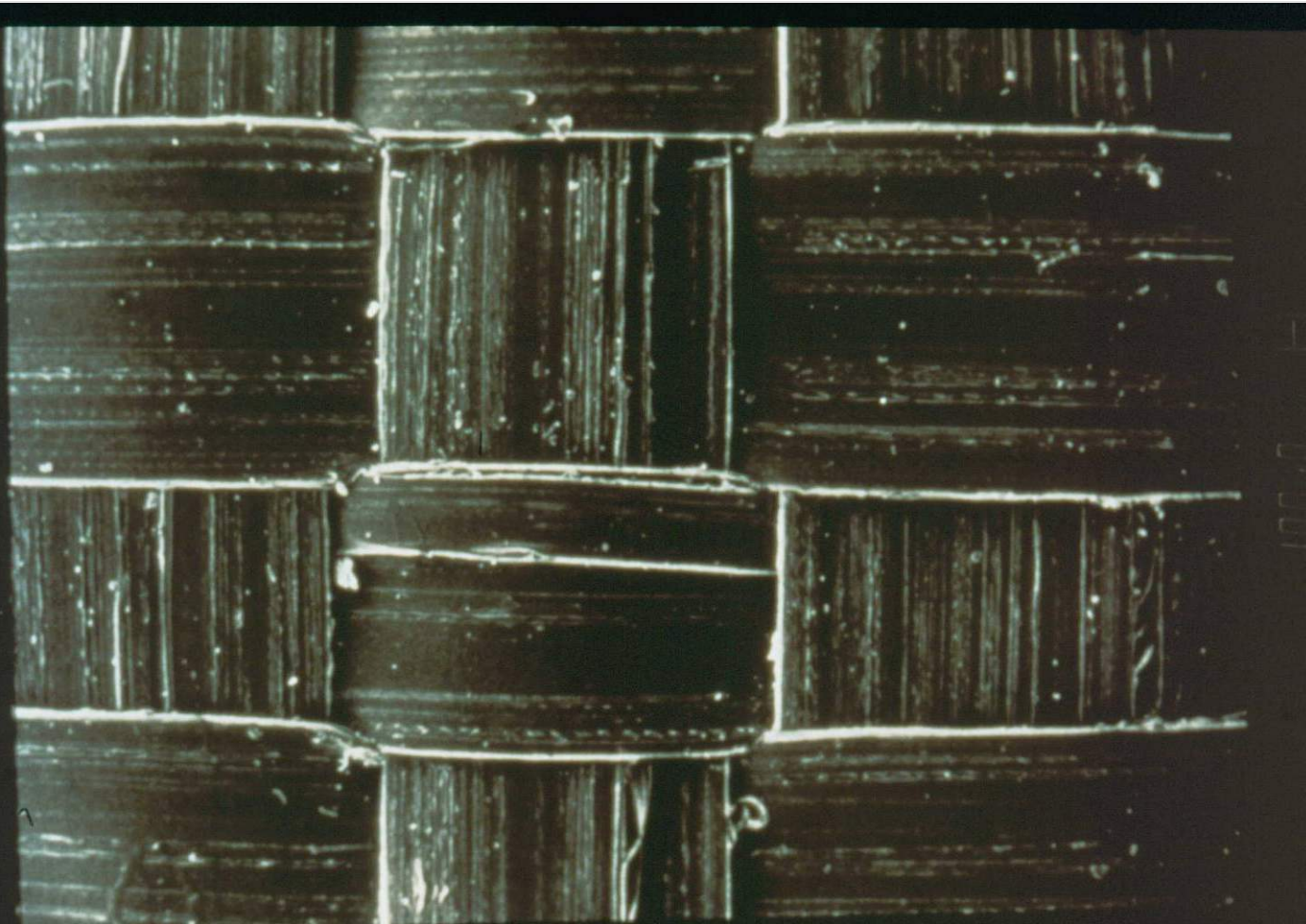
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- ❑ Weaving is a process of interlacing yarns to make a fabric.
  - ❑ Woven geotextiles are made from weaving slit film, monofilament, or multifilament yarns.
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# Slit Film Woven Geotextiles

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Slit film woven geotextiles provide economical separation of materials.

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# Monofilament Woven Geotextiles

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## MONOFILAMENT WOVEN



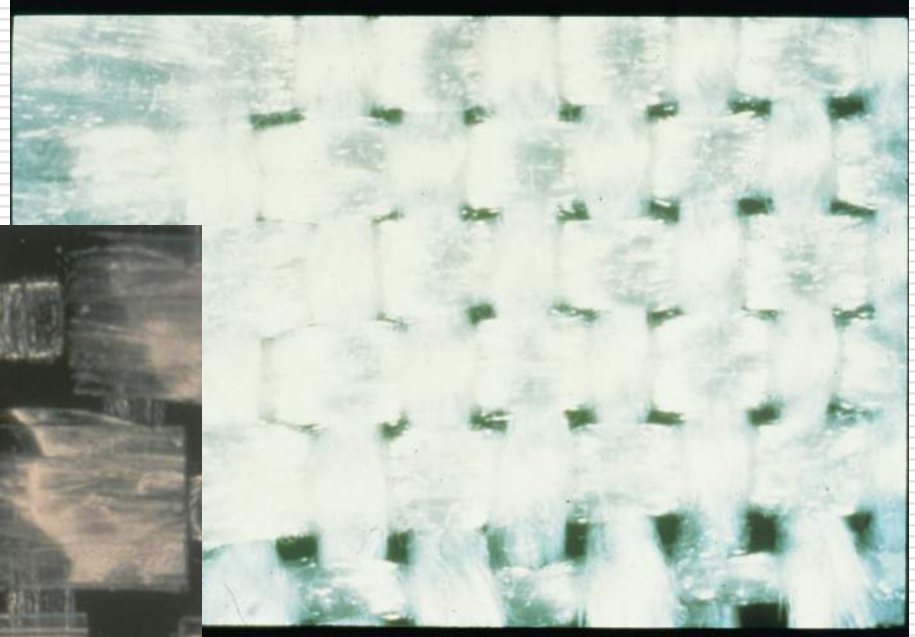
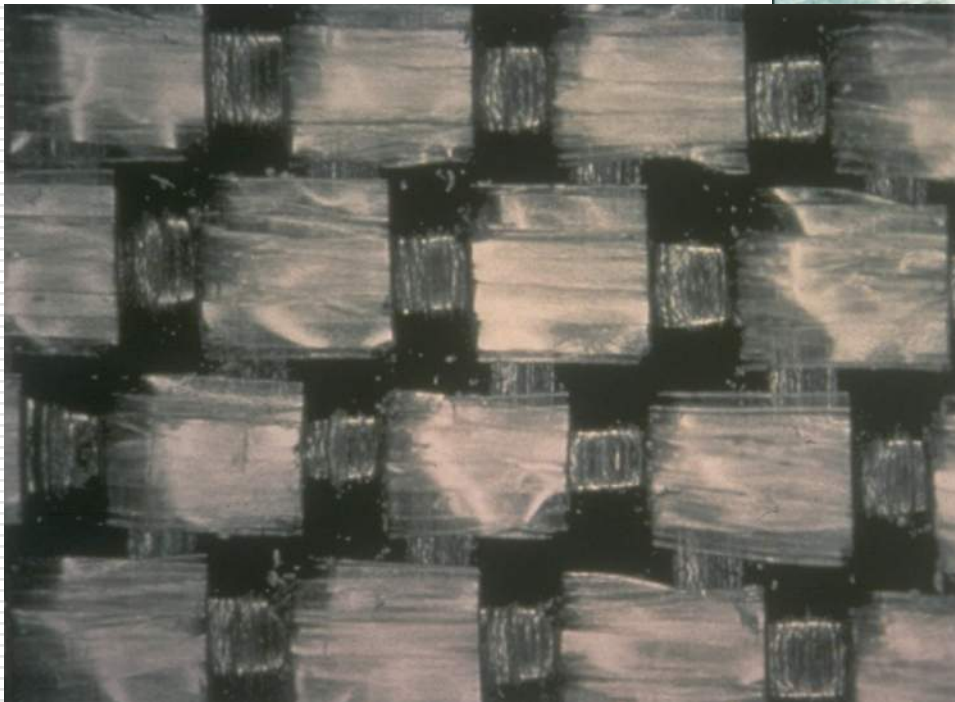
Monofilament woven geotextiles provide enhanced filtration properties.

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# Fibrillated and Multifilament Woven Geotextiles

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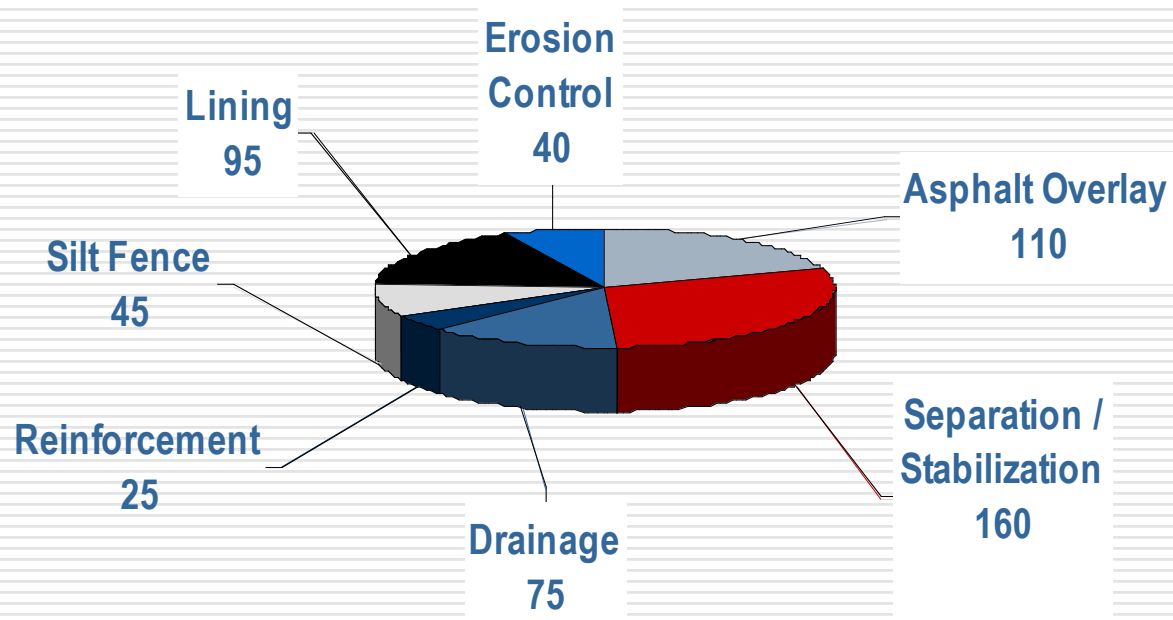
Multifilament woven geotextiles provide enhanced tensile strength.



# Estimated Annual North American Geotextile Market (in millions of square yards)

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An approximate breakdown of geotextile and geotextile-related product use in the US by application.



**USA Market**

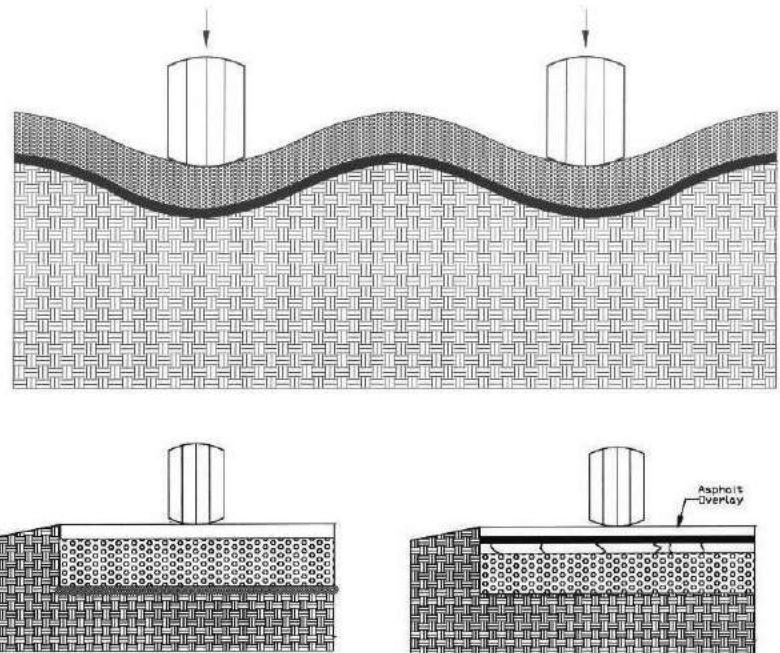
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# Geosynthetics In Roads & Pavements

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Subgrade separation and stabilization, base reinforcement, overlay stress absorption and reinforcement

As shown previously, the largest use of geotextiles is in road applications, including separation/stabilization and asphalt overlay applications.



# Geosynthetics In Roads & Pavements History

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Though only widely recognized since the latter half of the 1900s, geotextile advantages were initially demonstrated as early as the 1930s using conventional textile materials.



# Rehabilitation of Distressed Pavements

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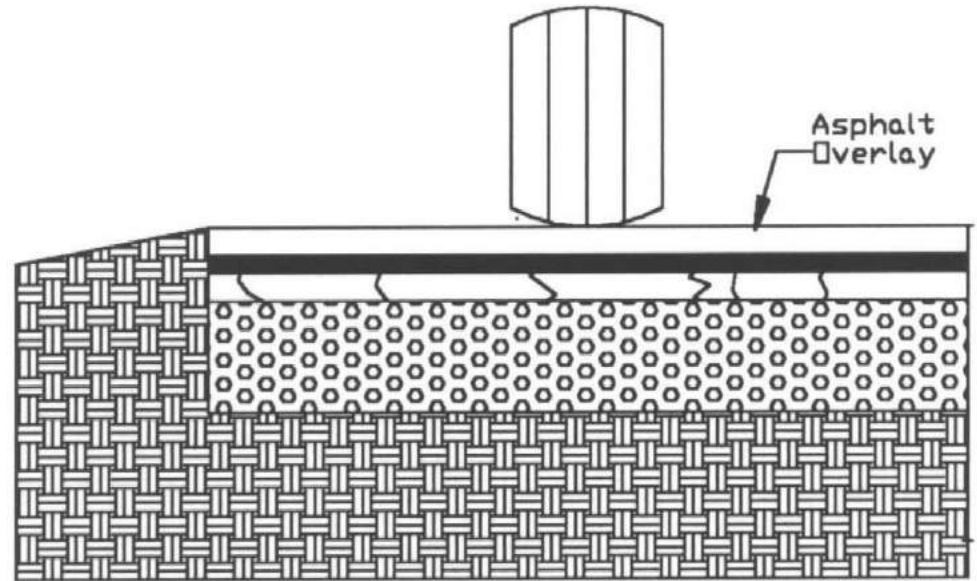
## The Geosynthetic Solution

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# Overlay Stress Absorption & Reinforcement

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- ❑ Overlays are still the most common option for extending the life of distressed pavements.
- ❑ While special asphalt mixes can be specified and thicker overlays improve performance, a geosynthetic interlayer can be placed over the distressed pavement prior to the overlay to create an economical, long-lasting overlay system.



With a Paving Fabric or Paving Grid



# Introduction to the Problem

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- ❑ The rehabilitation of cracked roads by simple overlaying is rarely a durable solution.
- ❑ The cracks under the overlay rapidly propagate through to the new surface.
- ❑ This phenomenon is called reflective cracking.



**Typical Cracked Pavement**

# A Geosynthetic Interlayer

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The geosynthetic interlayer contributes to the life of the overlay by providing stress relief and/or reinforcement and pavement moisture barrier.



Paving Fabric for Overlay Stress Absorption & Waterproofing



Paving Grid for Overlay Reinforcement

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# The Benefits of Geosynthetic Interlayers

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- ❑ Delaying the appearance of reflective cracks
  - ❑ Lengthening the useful life of the overlay
  - ❑ Added resistance to fatigue cracking
  - ❑ Saving up to 2 inches of overlay thickness
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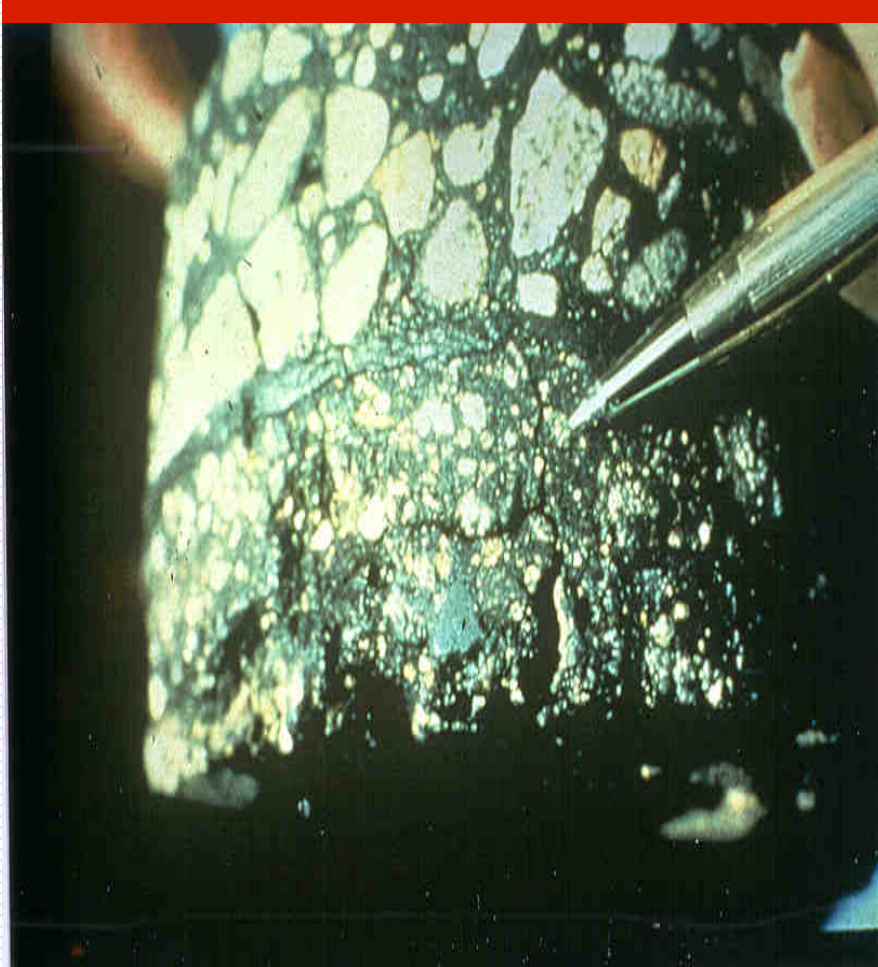
# Geosynthetic Interlayer Mechanics

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- **Stress Absorption and Moisture Proofing** – Nonwoven paving fabrics, when saturated with asphalt, allow considerable movement around a crack lessening the effect pavement movements have on the overlay, and create a moisture barrier within the pavement, preventing infiltration.
  - **Reinforcement** – Paving grids resist horizontal movement of cracks in the old pavement and/or, when used over a leveling course or a paving fabric, holds the overlay together while allowing the cracked pavement underneath to move independently.
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# Paving Fabric Waterproofing

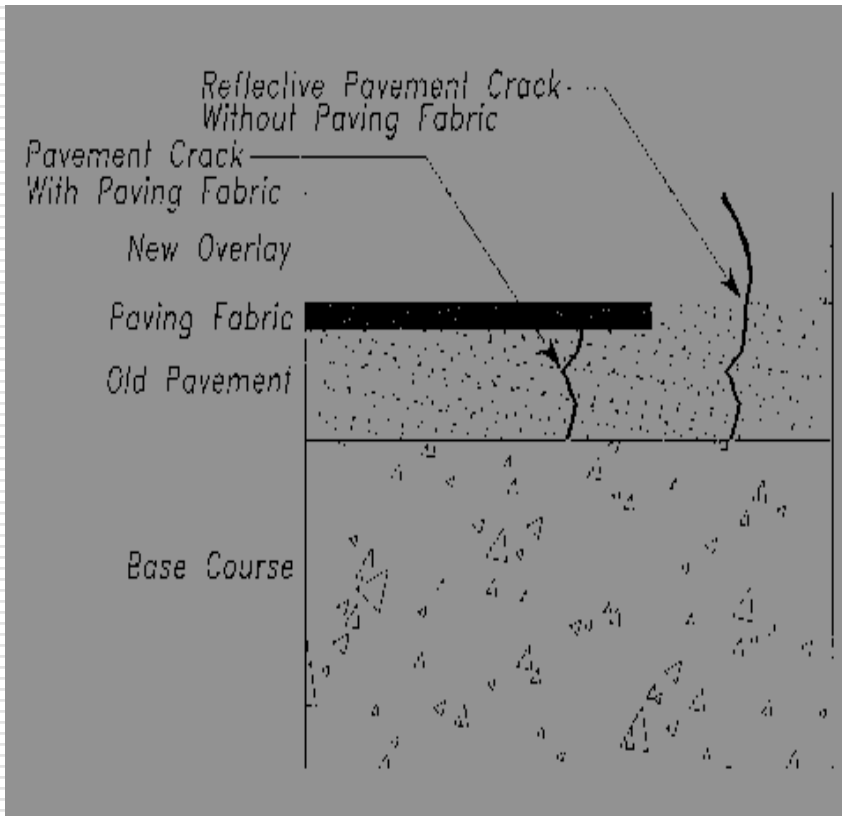
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- ❑ Most 'water' in roadway is surface infiltration
  - ❑ Permeability of barrier  $5 \times 10^{-7}$  cm/sec
  - ❑ Paving fabric bridges cracking
  - ❑ Commonly used with edge drains
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# Paving Fabric Stress Relieving

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- Soft layer reduces transfer of stress to old paving
- Effectiveness depends on cause of initial cracking
- Will not stop thermal cracking

# Easily Integrated with Paving Operations

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Paving fabric is easily integrated into common paving operations, as demonstrated in this interstate overlay project.



**The benefits of paving fabric are important in this overlay of I-70.**

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# Other Fabric-Based Interlayers

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Pre-formed strip membranes have been developed to provide localized stress relief by combining very high strength reinforcement with a self-adhering membrane. These products are designed for construction and expansion joints.





# Installation Of Interlayers – Surface Preparation

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- ❑ Clean the roadway.
- ❑ Seal and fill large cracks.
- ❑ Milling of severely cracked or rutted pavement may be required, or a thin layer of asphalt called a leveling course may be applied.
- ❑ Sections of broken asphalt that move under traffic loading should be removed down to the subgrade and reconstructed.



# Installation Of Interlayers – Application of the Tack Coat

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- ❑ *Proper installation of the asphalt cement tack coat is crucial; mistakes can lead to early failure of the overlay.*
- ❑ Uncut paving grade asphalt cements are recommended with AC-20 and AR-4000 being the most popular.
- ❑ The spray of the nozzles should overlap so that uniform double coverage occurs. Heavy spots, streaks, or gaps will cause problems in the system.



# Installation Of Interlayers – Fabric Laydown

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- ❑ Geosynthetics may be deployed manually or mechanically with equipment designed specifically for this application. In either case, the geosynthetic should not be allowed to wrinkle.
- ❑ When two segments of fabric come together, an overlap of 2 to 6 inches (50 to 150 mm) should be created and treated with extra tack coat. The overlap should be shingled in the direction of the paving operation.



# Installation Of Interlayers – Paving Grid & Composite Laydown

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- If a reinforcing grid only is used, it may be attached to the existing pavement by mechanical means (nailing) or by adhesives.
- Composites of grid and paving fabric are installed with a tack coat the same as a paving fabric alone. Overlaps are again 2 to 6 inches (50 to 150 mm).



# Miscellaneous Considerations

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- ❑ In the case of drains, joints, or other irregularities, the geosynthetic should be placed normally and then cut out around the obstruction.
  - ❑ Any wrinkles over one inch (25 mm) should be slit open and treated as overlaps.
  - ❑ Any traffic on the geosynthetic should be carefully controlled. Sharp turning and braking will damage the fabric.
  - ❑ Sand may be broadcast to reduce the likelihood of skidding. Any excess must be removed prior to overlaying. For safety reasons, only construction traffic should be allowed on the installed paving fabric.
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# Standard placement and compaction techniques for the Overlay

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Standard placement and compaction techniques are used for the overlay.

- Installation of the geosynthetic and the asphalt concrete overlay should take place on the same day if possible. Paving can commence as soon as the fabric is laid down.
- Minimum compacted thickness of the first lift of the overlay is 1.5” (38 mm).
  - Thickness is necessary to produce enough heat to guarantee saturation of the paving fabric and bonding of the pavement layers.



# Standard placement and compaction techniques for the Overlay

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- Asphalt can be placed by any conventional means.
  - Compaction should take place immediately after asphalt placement in order to ensure that the different layers are bonded together.
- As with traditional overlays, timely and thorough compaction is critical for performance.



# The Special Case Of Chip Seals - Moisture-proofing & low-cost resurfacing

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❑ Chip seals are a low-cost technique involving multiple applications of asphalt tack coat followed by stone “chips”.

❑ A paving fabric effectively holds the tack coat and chip in place to form a longer lasting flexible, impermeable surface.



**As with overlays, paving fabric is installed over the distressed pavement.**



# The Special Case Of Chip Seals - Moisture-proofing & low-cost resurfacing



- A typical chip seal is then applied over the fabric providing a moisture proofing layer that also prevents surface raveling.
- Over time, the fabric-reinforced chip seal allows the road to stabilize sufficiently to accommodate a more expensive overlay.

# Simplified Generic Specifications For Routine Applications\*

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(\*The specification of “critical” geosynthetic applications will generally require the input of a qualified engineering professional)

## Specification Criteria:

- ❑ Construction Survivability
- ❑ In-Service Performance

❑ Geotextiles for routine applications are easily specified by using generic specifications such as AASHTO M288 and FHWA FP-03.

❑ The specifications use common geotextile properties to specify geotextiles based on empirical evidence of construction survivability and in-service performance over three decades.

❑ The FP-03 specifications are available for downloading at no charge at [www.wfl.fha.dot.gov/design/specs/fp03.htm](http://www.wfl.fha.dot.gov/design/specs/fp03.htm).

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# Simplified Generic Specifications For Routine Applications – FP03

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FP-03 specifications rely on a single table for each application that addresses both survivability-related properties and in-service performance-related properties.

## □ **Survivability & Performance Properties**

- Table 714-1 – Subsurface Drainage
- Table 714-2 – Separation
- Table 714-3 – Stabilization
- Table 714-4 – Permanent Erosion Control
- Table 714-5 – Temporary Silt Fence
- **Table 714-6 – Paving Fabric**

(All values in tables, with the exception of AOS, represent minimum average roll values in the weakest principal direction.)

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# FP03, Table 714-6

## Paving Fabric Requirements

|                     |              |                  |              | Specifications |
|---------------------|--------------|------------------|--------------|----------------|
|                     | Test Methods | Units            | Type VI      |                |
| Grab strength       | ASTM D 4632  | N                | 500          |                |
| Ultimate elongation | ASTM D 4632  | %                | 50% at break |                |
| Asphalt Retention   | ASTM D 6140  | L/m <sup>2</sup> | 0.90         |                |
| Mass per unit area  | ASTM D 5261  | g/m <sup>2</sup> | 140          |                |
| Melting Point       | ASTM D 276   | oC               | 150          |                |

- All numeric values represent MARV in the weaker principal direction.
- Asphalt retention is the amount required to saturate the paving fabric only. Value does not indicate the asphalt application rate required for construction.

FP03, Table 714-6 provides both survivability and performance properties for paving fabrics. Yellow designates the equivalent of the M288 spec.

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# Questions

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**THINK**

**GMAtechline@ifai.com**



# Thank You!

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**For more information go to [www.gmanow.com](http://www.gmanow.com)**