Engineering Uses of Geotextiles

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PDH: 6

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Module 1: Introduction

Learning Objectives

By the end of this section, you will be able to:

- **Identify** the primary polymers and manufacturing methods used to produce woven and nonwoven geotextiles.
- **Evaluate** the environmental factors that impact geotextile durability and long-term performance.
- **Select** appropriate geotextile functions—such as filtration, reinforcement, or separation—for specific civil engineering applications.

Executive Summary: Geotextiles are versatile polymer-based materials used to enhance the performance of pavements, embankments, and drainage systems. Success in engineering applications depends on matching the specific manufacturing construction (woven vs. nonwoven) and polymer type to the required function (filtration, reinforcement, or separation) while accounting for site-specific durability constraints such as UV exposure and chemical environment.

Design Purpose

This manual provides the technical framework for describing various geotextiles, established test methods for property evaluation, and recommended design and installation procedures.

Scope of Applications

The scope of this manual encompasses the physical properties, functions, design methodologies, and construction procedures for geotextiles in the following areas:

- **Pavements and Railroad Beds**
- **Retaining Walls and Earth Embankments**
- **Rip-rap and Concrete Revetments**
- **Drainage and Sediment Control**

Note: This manual specifically excludes other geosynthetics such as geogrids, geonets, geomembranes, or composite products made from natural fibers.

Geotextile Types and Construction

Materials and Composition

Geotextiles are primarily manufactured from synthetic polymers. The choice of polymer dictates the chemical and physical resistance of the final product.

- **Primary Polymers:** Polypropylene and polyester (most common), polyethylene, polyamide (nylon), and polyvinylidene chloride.
- **Fiber Formation:** Yarns are formed by bundling and twisting fibers (spinning). These can be **filaments** (very long fibers) or **staple fibers** (short pieces cut from filaments).
- **Fiber Additives:** Physical properties are adjusted using additives in the composition or by varying the extrusion process.

Geotextile Manufacture

1. **Woven Geotextiles**

   Woven construction involves interlacing **warp yarns** (machine direction) with **fill yarns** (cross direction).

   - **Performance:** High strength and moduli with low elongation at rupture.
   - **Variability:** Modulus decreases when pulled on a bias. Pore structures are simple with a narrow range of opening sizes.
   - **Types:**
     - **Monofilament:** Simple, open weaves (e.g., leno weave).
     - **Multifilament:** Highest strength and modulus; typically higher cost.
     - **Slit-film (Ribbon):** Made by cutting plastic sheets into narrow strips; cost-effective for **separation** tasks.

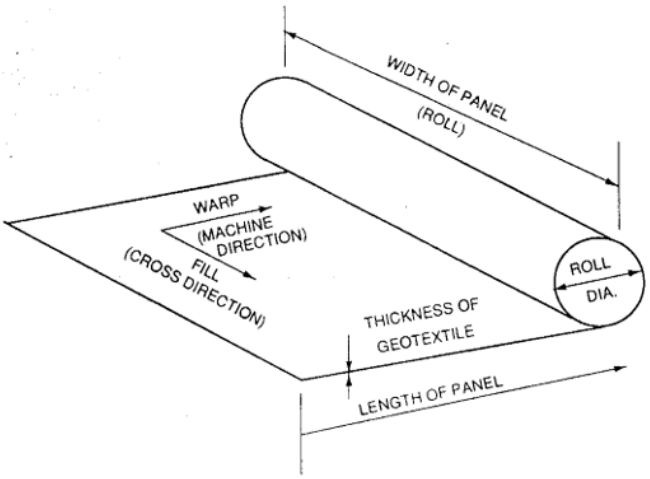

Figure 1-1. Dimensions and Directions for Woven Geotextiles.

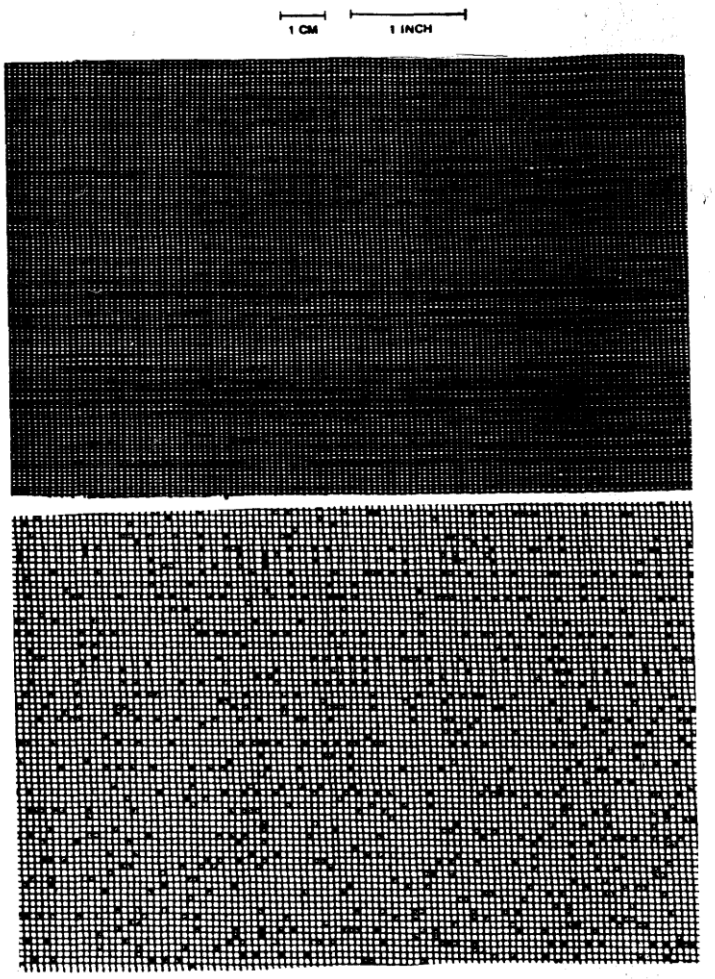

Figure 1-2. Woven Monofilament Geotextiles Having Low Percent Open Area (Top), and High Percent Open Area (Bottom)

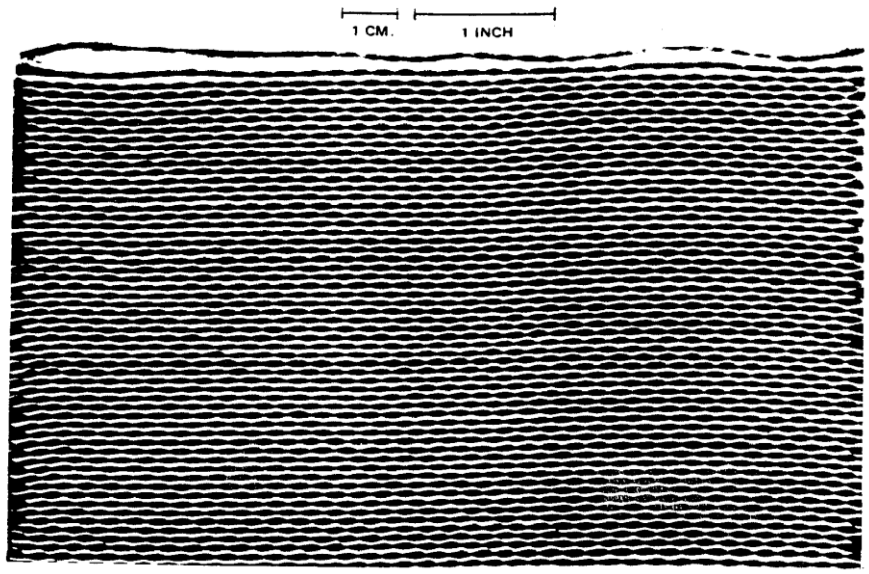

Figure 1-3. Woven Multifilament Geotextile.

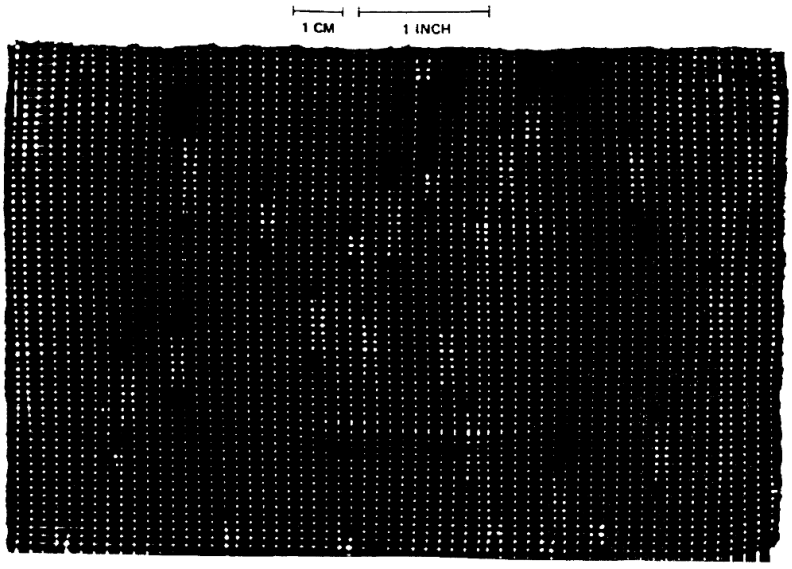

Figure 1-4. Woven Slit-Film Geotextile.

2. Nonwoven Geotextiles

Formed by random fiber orientation, nonwovens are generally thicker than wovens.

- **Needle Punching:** Barbed needles mechanically entangle fiber layers, creating a felt-like mat.
- **Heat Bonding:** Uses fibers with different melting points or heterofilaments (sheathed fibers) to fuse the mat together.
- **Resin Bonding:** Fibers are coated and bonded using a resin medium.

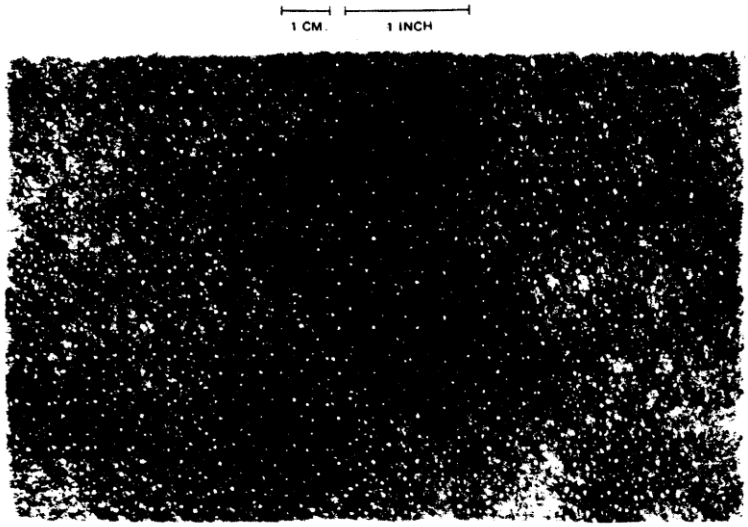

Figure 1-5. Needle-Punched Nonwoven Geotextile.

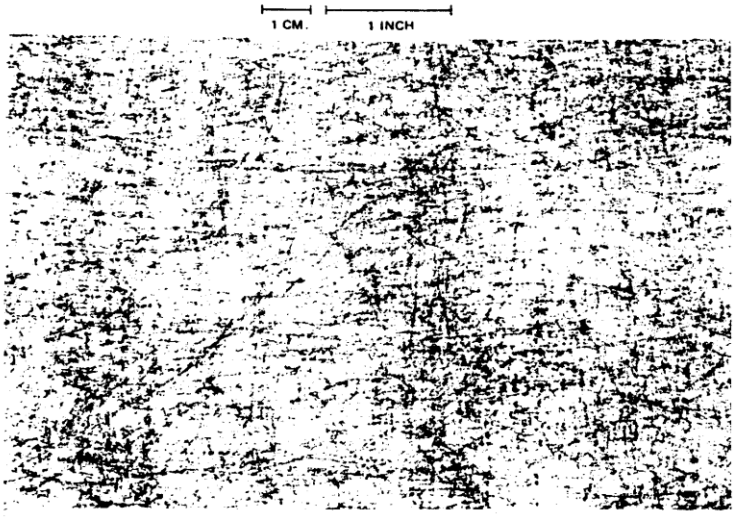

Figure 1-6. Heat-Bonded Nonwoven Geotextile.

3. Composite Geotextiles

These materials combine multiple fabrication techniques. A common example is a nonwoven mat needle-punched to a woven scrim to combine filtration and high-strength properties.

Purchase this course to see the remainder of the technical materials.