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Functions and applications of geosynthetics in roadways

Jorge G. Zornberg [a,*]

[a]*Professor, Department of Civil, Architectural and Environmental Engineering, the University of Texas at Austin, 301 E. Dean Keeton St. Stop C1700, Austin, Texas, 78712-0273, USA*

Abstract

Geosynthetics have been successfully used to fulfill a number of functions that contribute significantly to the good performance of roadways. They include the functions of separation, filtration, reinforcement, stiffening, drainage, barrier, and protection. One or more of these multiple functions have been used in at least six important roadway applications. The applications include the migration of reflective cracking in asphalt overlays, separation, stabilization of road bases, stabilization of road soft subgrades, and lateral drainage. This paper illustrates the mechanisms as well as key advances in each one of these multiple applications.

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The geosynthetic products most commonly used in roadway systems include geotextiles (woven and non-woven) and geogrids (biaxial and multiaxial), although erosion-control products, geocells, geonets (or geocomposite drainage products) and geomembranes have also been incorporated in a number of applications. These various types of geosynthetics can be used to fulfill one or more specific functions in a variety of roadway applications. For example, geosynthetics have been in use since the 1970s to improve the performance of unpaved roads on soft subgrade soils. Beginning in the 1980s, geosynthetics were utilized to minimize reflective cracking in asphalt overlays as well as to improve the performance of base aggregate layers.

The terminology used in the technical literature to describe the various applications of geosynthetics in roadway systems and the functions of geosynthetics incorporated into roadway design has not been consistent. This is

* Tel.: +1-512-232-3595; fax: +1-512-471-6548.
E-mail address: zornberg@mail.utexas.edu

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understandable, as the mechanisms that lead to roadway improvement in each application are complex and often intertwined. Consequently, a framework is presented in this paper that is expected to minimize inconsistencies regarding the terminology used when designing roadways using geosynthetics.

While strongly based on frameworks currently used for geosynthetic design [1], the refined framework proposed herein follows two key premises: (1) Different geosynthetic functions unequivocally correspond to different geosynthetic properties, and (2) Geosynthetic applications correspond to the different types of projects that can be implemented to achieve specific design goals. Each geosynthetic application may involve a single geosynthetic function or a combination of such functions to develop mechanical or hydraulic mechanisms aimed at enhancing the roadway performance.

Fig. 1 shows a paved road section with the location of possible geosynthetic layers and the various functions that these geosynthetics can fulfill. These functions include:

- Separation: The geosynthetic, placed between two dissimilar materials, maintains the integrity and functionality of the two materials. It may also involve providing long-term stress relief. Key design properties to perform this function include those used to characterize the survivability of the geosynthetic during installation.
- Filtration: The geosynthetic allows liquid flow across its plane, while retaining fine particles on its upstream side. Key design properties to fulfill this function include the geosynthetic permittivity (cross-plane hydraulic conductivity per unit thickness) and measures of the geosynthetic pore-size distribution (e.g. apparent opening size).
- Reinforcement: The geosynthetic develops tensile forces intended to maintain or improve the stability of the soil-geosynthetic composite. A key design property to carry out this function is the geosynthetic tensile strength.
- Stiffening: The geosynthetic develops tensile forces intended to control the deformations in the soil-geosynthetic composite. Key design properties to accomplish this function include those used to quantify the stiffness of the soil-geosynthetic composite.
- Drainage: The geosynthetic allows liquid (or gas) flow within the plane of its structure. A key design property to quantify this function is the geosynthetic transmissivity (in-plane hydraulic conductivity integrated over thickness).

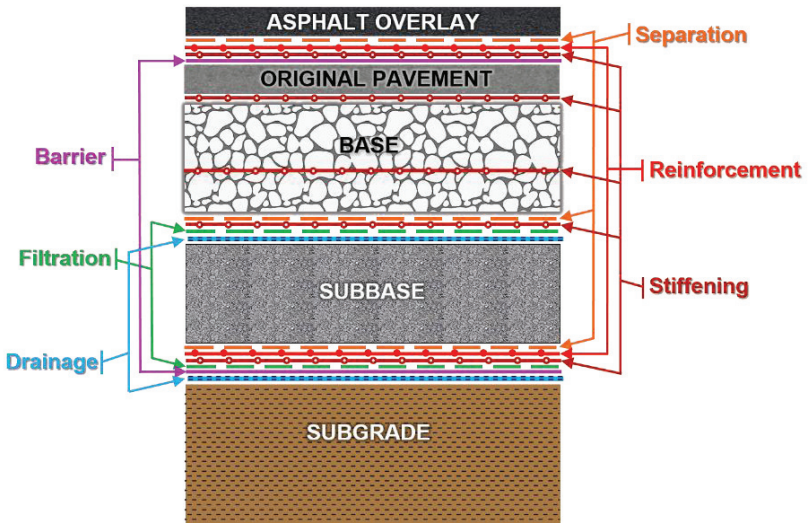

Fig. 1. Multiple functions of geosynthetics in roadway applications.

While comparatively less common in roadway applications, additional geosynthetic functions include:

- Hydraulic/Gas Barrier: The geosynthetic minimizes the cross-plane flow, providing containment of liquids or gasses. Key design properties to fulfill this function include those used to characterize the long-term durability of the geosynthetic material.
- Protection: The geosynthetic provides a cushion above or below other material (e.g. a geomembrane) in order to minimize damage during placement of overlying materials. Key design properties to quantify this function include those used to characterize the puncture resistance of the geosynthetic material.