CHAPTER 1 – INTRODUCTION

Geosynthetics are a construction material made from polymers. These materials are manufactured as textiles, grids, nets, solid membranes or as a combination of one or more of the above. The type of geosynthetic selected for a particular project depends on the intended application, which can include drainage, separation of different materials, filtration of soil particles from draining water, reinforcement, confinement and containment. Geosynthetic usage has steadily increased in both public and private construction projects and innovative uses and new products continue to appear on the market.

The Federal Lands Highway Division (FLHD) seeks to optimize highway work through broader use of geosynthetic materials, in a manner that can lead to cost effective design. In general, geosynthetics have been successfully used in numerous highway construction projects including reinforcement and stabilization, separation and filtration, erosion control, and as moisture barriers. However, it has been recognized by FLHD engineers that geosynthetics may be underused within FLHD and by many state departments of transportation across the nation. The inability to capture some of the benefits of geosynthetics can be partly attributed to the lack of standardized design approaches that can be used to address certain project situations faced by FLHD.

It is apparent that in many cases geosynthetics are implemented in practice by FLHD due to "individual" effort without specific system-wide guidance. Accordingly, this study was motivated by FLHD engineers to seek direction, guidance and procedures that can lead to increased use of geosynthetics materials in geotechnical and pavement applications, when such use is advantageous.

PROBLEM STATEMENT

It has been identified by engineers from FLHD that geosynthetics are "under-used in Federal Lands Highway practice and under-represented in the FP-03 'Standard Specification for Construction of Roads and Bridges on Federal Highway Projects' when compared to how prevalent geosynthetics are used in highway and other civil construction applications." Accordingly, this study aims to develop recommendations and guidelines to identify, promote, and advance the use of geosynthetic materials across FLHD in the Roadway, Bridge/Structures, and Geotechnical areas.

STUDY OBJECTIVE AND TARGET APPLICATIONS

The main objective of this study is to develop systematic recommendations to guide a three to five year effort that will culminate in advancing the use of geosynthetic materials in FLHD highway projects across their three divisions. The target areas include geotechnical, structural, and roadway applications. Structural/geotechnical focus applications include:

- Slopes
- Walls

- Embankment reinforcement
- Reinforced soil (shallow) foundations
- Moisture barriers
- Deep patches for soft shoulders, and
- Liners to control/prevent seepage

Roadway applications will include both paved and unpaved roadways and will be focused on:

- Unbound Layers
- Bound Layers

Note that erosion control and drainage applications of geosynthetics were excluded from this scope of work and therefore are not addressed in great details.

TASKS

The study was separated into three major tasks. Two of the tasks involved investigating the current state-of-art and state-of-practice on geosynthetic utilization in target applications. The third synthesized the results of the investigation into recommendations for the future advancement of geosynthetics use in FLHD. The study proceeded along the following tasks:

Literature Review

In each target area, the opportunities and needs for geosynthetics applications were reviewed. Initially, the existing guidance documents from the American Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA) were reviewed for applicable contents. A literature review was then performed to determine recent advancements in the appropriate target areas. These sources are summarized as the state-of-art in design and research guidelines.

Survey of FLHD Engineers

In parallel, a survey was developed to collect information on current approaches and practices of various engineers in agencies related to FLHD. The survey was e-mailed to a list of professionals identified by FLHD engineers. The survey collected data on several aspects of geosynthetics usage in the engineers' areas of practice. These included:

a. The extent of including geosynthetics in highway projects,
b. Examples of past projects and typical applications,
c. Approaches followed in designing geosynthetics in pavement, structural, and geotechnical applications, and,
d. Advantages and disadvantages defined as a result of using geosynthetics (i.e., past experience).

The survey results are compiled and trends are identified. A summary is presented on the current state of FLHD practice.

Study Recommendations

Once the survey and literature review were compiled, gaps in current practice, as well as possible future directions were identified for each target area. The level of maturity of a particular application was assessed, as well as research needs and the likelihood that implementation of geosynthetics for a particular application will be successful. The study recommendations target "discrete and attainable" work items for future sponsorship and deployment within FLH divisions.

Guidelines regarding types of field validation for various projects involving geosynthetics, and criteria for assessing the acceptability of new application and/or products are recommended. This information is also used to establish the type of empirical evaluations of performance that are needed for informed decisions. Furthermore, the need for proposed training and workshops to be held throughout a multi-year plan to increase the staff awareness of geosynthetics applications is presented.

REPORT ORGANIZATION

This report is organized into seven chapters. Chapter 1 introduces the study and its objectives. Chapter 2 reviews existing AASHTO, FHWA and FLH specifications, design procedures and design manuals for projects that include geosynthetics. Chapter 3 summarizes the results of the survey of the engineers selected by the FLHD. Chapters 4 through 6 deal with a particular target area as defined below:

- Chapter 4: Walls and Slopes
  - Mechanically Stabilized Earth Walls
  - Reinforced Soil Slopes
  - Deep Patches for Soft Shoulders
- Chapter 5: Reinforced Soil Foundations
  - Embankments over Soft Soils
  - Column Supported Embankments
  - Shallow Foundations on Reinforced Soils
  - Bridging Subsurface Voids
- Chapter 6: Paved and Unpaved Road Applications
  - Paved Roads: Unbound Layers and Subgrade
  - Paved Roads: Bound Layers
  - Permanent Unpaved Roads
  - Temporary Unpaved Roads (Construction Platforms)
  - Moisture Barriers
  - Liners to Control/Prevent Seepage

Chapter 7 provides a summary of the above work, including final conclusions and recommendations for where the authors feel resources should be directed in coming years.