Standard Practice for

Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures

AASHTO Designation: R 50-09[1]

1. SCOPE

1.1. This standard practice provides guidance to pavement designers interested in incorporating geosynthetics for the purpose of reinforcing the aggregate base course of flexible pavement structures. Geosynthetic reinforcement is intended to provide structural support of traffic loads over the life of the pavement.

1.1.1. For the purpose of this guide, base reinforcement is the use of a geosynthetic within, or directly beneath, the granular base course.

1.1.2. When referring to geosynthetics, the discussion is limited to geotextiles, geogrids, or geogrid/geotextile composites.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standard*:

- M 288, Geotextile Specification for Highway Applications

2.2. *Other References*:

- Geosynthetics Materials Association (GMA) White Paper I—"Geosynthetics in Pavement Systems Applications," May 1999. Available at bookstore@ifai.com.
- Geosynthetic Materials Association (GMA) White Paper II—"Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures," June 2000. Available at bookstore@ifai.com.
- National Highway Institute (NHI) Participant Notebook—*Geosynthetic Design and Construction Guidelines*, April 1999. Available at www.nhi.fhwa.dot.gov.

3. INTRODUCTION

3.1. Because the benefits of geosynthetic reinforced pavement structures may not be derived theoretically, test sections are necessary to obtain benefit quantification. Studies have been done that demonstrate the value added by a geosynthetic in a pavement structure. These studies, necessarily limited in scope, remain the basis for design in this field.

3.2. This standard practice is very empirical in nature and restricted to applications already demonstrated to be useful. The practitioner will need to consult the references and locate a tested

section similar to that which is expected in their own design. In that way, the experimentally determined benefit may be applied to the project being designed.

4. TERMINOLOGY

4.1. *Definitions*:

4.1.1. *base course* reduction *(BCR)*—percentage of the base or subbase thickness in a reinforced pavement, as compared to the base or subbase thickness in an unreinforced pavement with the same material components, such that equal life cycles for a defined failure state result between the two.

4.1.2. *separation*—use of a geotextile to prevent the mixing of a subgrade soil and an overlying aggregate material.

4.1.3. *stabilization*—use of a geotextile in wet, saturated conditions to provide the functions of separation and drainage.

4.1.4. *traffic benefit ratio (TBR)*—ratio of the number of load cycles of a reinforced pavement structure to reach a defined failure state to the number of loads for the same unreinforced section to reach the same defined failure state.

4.2. *Discussion*—Use of geotextiles for separation and stabilization applications is covered in M 288 and, therefore, is not included in this guide.

5. SUMMARY OF DESIGN METHOD

5.1. The purpose of this guide is to provide the practitioner with general information regarding the use of a geosynthetic for reinforcement in a pavement structure. The guide will not provide step-by-step procedures for the design of the geosynthetic in this application; instead, overall design considerations are outlined.

5.2. Design procedures use experimentally derived input parameters that are often geosynthetic specific. Thus, computed engineering designs and economic benefits are not easily translated to other geosynthetics. Therefore, users of this document are encouraged to affirm their designs with field verification of the reinforced pavement performance, both in engineering design and economic benefits.

6. SIGNIFICANCE AND USE

6.1. Geosynthetics are used in the pavement structure for structural support of traffic loads over the design life of the pavement. The geosynthetic is expected to provide one or both of these benefits: (1) improved or extended service life of the pavement, or (2) reduced thickness of the structural section.

6.2. Service life improvement may be in the form of extended performance periods or increased reliability (1) so that the constructed pavement will support the actual versus designed equivalent single-axle loads, or (2) to account for actual subgrade strengths lower than assumed designed subgrade strength.

7. GENERAL DESIGN STEPS

7.1. In general terms, the design steps to be followed in determining the applicability of incorporating geosynthetic reinforcement in a pavement design are shown below.

7.1.1. General design procedures may be found in the NHI Participant Notebook on this topic.

7.1.2. A general design procedure for the reinforcement application, detailing the steps summarized below, is contained in GMA White Paper II.

7.1.3. Make an initial assessment of the applicability of a geosynthetic. This is based on an assessment of the subgrade strength and the past performance in similar soils. Consideration should be given to each type of geosynthetic appropriate for the installation.

7.1.4. Design the thickness of an unreinforced pavement section based on representative material parameters for a pavement design unreinforced by geosynthetics.

7.1.5. Determine the benefits of using a geosynthetic. Refer to Section 6.1 to determine what the target benefit or benefits should be.

7.1.6. The target benefits should indicate whether a TBR or BCR, or both, needs to be identified.

7.1.6.1. The TBR is defined as the ratio of the number of load cycles of a reinforced pavement structure to reach a defined failure state, to the number of loads for the same unreinforced section to reach the same defined failure state.

7.1.6.2. The BCR is defined as the percentage of the base or subbase thickness in a reinforced pavement, as compared to the base or subbase thickness in an unreinforced pavement with the same material components, such that equal life cycles for a defined failure state result between the two.

7.1.7. Develop a trial reinforced pavement design that reflects the desired target benefits. Though the design procedures mentioned in Sections 7.1.1 and 7.1.2 can be used to estimate the potential benefit of geosynthetic reinforcement, the accuracy of these methods for specific applications is yet to be determined; hence, construction and performance monitoring as discussed in Sections 7.1.11 and 7.1.12 is recommended. Similar case histories of pavement reinforcement should also be used to help estimate the potential benefit of geosynthetic reinforcement for the specific application being considered.

7.1.8. Perform a life-cycle cost analysis. There needs to be a knowledge of the initial construction costs for both the unreinforced and the reinforced options, the life-cycle costs for both options, and other benefits, which may not be easily quantifiable in order to complete a life-cycle cost analysis.

7.1.9. Prepare material specifications. Based on the results of the above process, the engineer may want to develop an approved list of products that are considered appropriate for this application, based on successful past applications. The construction contractor then has the option, based on the results of the design, to select products based on suitability, availability, and economics.

7.1.10. Prepare contract documents, specifications, and construction drawings. Specific attention needs to be paid to installation guidelines, location within the pavement section, and quality assurance procedures when preparing these documents and drawings.

7.1.11. Monitor the construction sequences to ensure that the correct geosynthetic is installed in the correct locations, both vertically within the pavement section and horizontally along the project. Monitoring of the installation procedures should also be done to eliminate any construction damage to the geosynthetic and to ensure proper performance of the material.

7.1.12. Monitor long-term performance. Formal documentation of the pavement's performance is recommended to allow for a complete evaluation of the geosynthetic's performance in relation to the benefits that the section was designed to provide.

7.1.13. Users of this guide are encouraged to prepare an annual assessment as to the performance of the geosynthetic.

7.1.14. Based on the above assessment of performance, design procedures and/or material specifications may be developed or revised to reflect the results of the study.

[1] This standard was first published in 2001 as PP 46.