

## SECTION 145 GEOSYNTHETIC REINFORCEMENT

### **145-1 Description.**

This Section specifies the construction requirements for geosynthetics used in: (1) geosynthetic reinforced soil slopes, and (2) geosynthetic reinforced foundations constructed on soft in-situ soils. Furnish and place geosynthetics and any associated facing material or drainage blankets.

### **145-2 Responsibility.**

Construct the geosynthetic reinforced feature, including materials, method, and installation based on information provided in the Contract Documents and the geosynthetic supplier's recommendations. Provide shop drawings depicting the details and distribution of the selected geosynthetics which are required to meet the design shown in the plans and in accordance with the requirements contained in the Department's Plans Preparation Manual and Design Standard, Index No. 501 for these items. Alternate designs optimizing the selected geosynthetic materials may be submitted.

For alternate designs, provide complete design calculations and details which include: plan view, elevation view, and details in accordance with the Contract Documents. These shall show the extent, number of layers of geosynthetic reinforcement, minimum properties of each geosynthetic reinforcement layer, vertical spacing of geosynthetic reinforcement, orientation of geosynthetic facing details, details at special structures or obstructions, typical construction sequence, and top and bottom elevations of the geosynthetic reinforcement. Calculations shall be submitted to substantiate the design meets the requirements of Chapter 31 of the Department's Plans Preparation Manual and in accordance with the Contract Plans. As a minimum these shall clearly show the derivation of reinforcement requirements (i.e., type, spacing, length, etc.) and determination of all design parameters and factors. All plans and calculations are to be signed and sealed by a Professional Engineer registered in the State of Florida.

### **145-3 Materials.**

**145-3.1 Geosynthetic Materials:** Use primary and secondary reinforcing elements consisting of a regular array of tensile elements that have sufficient reinforcement strength to perform the prime functions of reinforcement and which are listed on Roadway Index No. 501.

Deliver geosynthetic materials (including facing and drainage elements) to the job site in unopened shipping packages labeled with the supplier's name and product name. During shipping and storage, protect the geosynthetic from physical damage, debris and from temperatures greater than 140°F [60°C]. Follow the supplier's recommendations regarding protection from direct sunlight. At the time of installation, the Engineer will reject the material if it has defects, tears, punctures, flaws, deterioration, or other damage. However, if approved by the Engineer, the Contractor may repair torn or punctured sections by placing a patch over the damaged area. Replace or repair any rejected geosynthetic at no additional expense to the Department.

**145-3.2 Backfill Materials:** Use only free draining backfill material in the reinforced volume as shown in the plans meeting the following gradation limits as determined in accordance with AASHTO T 27 and FM 1-T 011:

Sieve Size	Percent Passing
3 1/2 inches [90 mm]	100
3/4 inch [19 mm]	70 to 100
No. 4 [4.75 mm]	30 to 100
No. 40 [425 µm]	15 to 100
No. 100 [150 µm]	5 to 65
No. 200 [75 µm]	0 to 15

Do not use backfill material containing more than 2.0% by weight of organic material, as determined by FM 1-T 267 and by averaging the test results for three randomly selected samples from each stratum or stockpile of a particular material. Consider the stratum or stockpile unsuitable for construction of the reinforced volume if an individual test value exceeds 3.0%.

Use backfill with a maximum plasticity index of six as determined by AASHTO T 90, and a maximum liquid limit of 15 as determined by AASHTO T 89. Use backfill materials with a pH between 4.5 and 10.0. When metal pipes or other metal items are embedded in the backfill, use backfill with a pH between 6.0 and 10.0. Do not use soil cement or lime stabilized backfill unless approved by the Engineer.

Submit a copy of certified test results and a certificate of compliance certifying that the fill material meets the above requirements to the Engineer for review and approval prior to delivering the backfill to the site. Use a Department-approved testing laboratory for all testing. Submit an alternate design, prepared in accordance with 145-2, when backfill meeting alternate gradation limits is proposed.

#### **145-4 Construction.**

**145-4.1 General:** Obtain from the geosynthetic supplier, technical instructions, guidance in preconstruction activities, and on-site technical assistance during construction. Submit a copy of any instructions provided by the supplier to the Engineer prior to beginning installation.

##### **145-4.2 Reinforced Soil Slopes:**

**145-4.2.1 Preparation:** Remove all existing vegetation and all unsuitable foundation materials. Prepare the foundation in accordance with Section 110, except as noted herein.

Proof roll the graded area with a vibratory roller weighing a minimum of 8 tons [7 metric tons] or a sheepsfoot roller, where appropriate, exerting a compression of at least 250 pounds psi [1.7 MPa] on the tamper foot for at least five passes in the presence of the Engineer or as directed by the Engineer. Remove and replace any soft or loose foundation subsoils that are, in the opinion of the Engineer, incapable of sustaining the required proof rolling, in accordance with Section 125.

Provide proof rolled ground surfaces which are uniform, smooth, and free of abrupt changes in slope, debris, and irregularities that might damage the reinforcement. Promptly repair and restore to their original condition any areas outside the limits of disturbance shown on the plans which are damaged as part of this work at no expense to the Department. Make every possible effort to avoid such damage.

**145-4.2.2 Geosynthetic Placement:** Place the geosynthetics at the proper elevation, location and orientation as shown on the plans. In general, place the geosynthetics used for slope stabilization such that its primary direction of tensile strength is perpendicular to the plan face of the slope. Pull the geosynthetic material tight, and secure it as necessary to lay flat against the soil prior to fill placement.

Place adjacent rolls of geosynthetic to maintain 100% horizontal coverage. Do not allow less than 50% horizontal coverage or an unreinforced horizontal spacing greater than 3 feet [1 m]. Do not allow vertical spacing of the geosynthetic layers to exceed the spacing shown on the shop drawings.

Do not make any splices or seams in the primary direction of tensile strength in the geosynthetic without approval of the Engineer. When splices in the primary direction are approved,

make splices full width of the geosynthetic strip by using a similar material with similar strength. Use a splice mechanism that allows a minimum of 95% load transfer from piece to piece of geosynthetic. Make only one splice per length of geosynthetic. Do not place splices within 6 feet [2 m] of the slope face, within 6 feet [2 m] below top of slope, or horizontally adjacent to another splice.

Place only that amount of geosynthetic material, including facing and drainage material, which will be covered in a single days production.

Do not operate equipment directly on the geosynthetics. Operate equipment such that no turning movements occur on the areas where geosynthetic is in place with less than 12 inches [300 mm] of fill cover. Fill and compact ruts of more than 3 inches [75 mm] in depth as they develop.

**145-4.2.3 Backfill Placement:** Maintain uniform moisture content of the backfill material prior to and during compaction throughout each layer of material. Use backfill material having a placement moisture content within 2% on the dry side of optimum. Do not place wet backfill with moisture content greater than optimum in the fill. Spread backfill material over the geosynthetic in the direction of geosynthetic overlaps. Do not stockpile backfill materials on the installed geosynthetics. Avoid construction procedures or equipment which, in the opinion of the Engineer, cause excessive mudwaving.

Compact the backfill using either smooth wheel or rubber tire rollers. Do not use sheepsfoot, grid rollers, or other types of equipment employing a foot. At the end of each day's operation, slope the backfill surface in order to permit runoff of rainwater away from the slope face, or provide some other positive drainage.

Place and compact the backfill material in accordance with Section 120 to obtain a density in each soil layer of at least 95% of the maximum density as determined by AASHTO T 180.

**145.4.2.4 Repairs:** Replace geosynthetic reinforcement damaged during or after installation at no expense to the Department. Repair geosynthetics damaged during or after installation only after the supplier establishes that the interior and exterior stability is not affected and after obtaining the Engineer's approval. Make such repairs as follows:

Remove all backfill material from the damaged area of the reinforcement geosynthetic plus an additional 4 feet [1.2 m] in all directions beyond the limits of damage. Place a patch consisting of the same material as the reinforcement geosynthetic over the damaged area. Overlap the undamaged reinforcement geosynthetic with the patch a minimum of 3 feet [1 m] in all directions. Then replace and compact backfill material in accordance with 145-4.2.3.

#### **145-4.3 Reinforced Foundations Constructed on Soft In-Situ Soils:**

**145-4.3.1 Preparation:** For some applications involving reinforcement of soft insitu soils, the Engineer may require that some vegetation be left in place. If directed in the plans or by the Engineer, cut trees to within 6 inches [150 mm] of the ground line, and leave the stumps in place. Remove fallen trunks, limbs, etc. greater than 3 inches [75 mm] in diameter.

**145-4.3.2 Backfill Placement:** Meet the requirements of 145-4.2.3.

**145-4.3.3 Geosynthetic Placement:** Position and orient the geosynthetics over prepared surfaces. Place a geotextile filter of a type recommended by the designer of the geosynthetic system under the reinforcement geosynthetic. Cut and overlap geosynthetics as necessary to accommodate curves. Overlap or join ends and sides of adjacent geosynthetic courses as shown on the plans and in accordance with 145-4.2.2. Make any overlaps in geosynthetics in the same direction that covering embankment will be spread. Take care to ensure that the geosynthetic sections do not separate at overlaps during construction. Pull the geosynthetic material tight by hand to a tension that removes all slack.

**145-4.3.4 Repairs:** Meet the requirements of 145-4.2.4

#### **145-5 Certification.**

Furnish certification from the supplier, at least ten days prior to placement, that the products used are the same products listed on Design Standard, Index No. 501, are in accordance with the project design requirements and is recommended by the supplier for use at this location.

Acceptance of furnished material will be based on the suppliers certification and visual inspection by the Engineer.

**145-6 Method of Measurement.**

**145-6.1 Geosynthetic Reinforced Soil Slopes:** The quantity to be paid for will be the plan area, in square feet [square meters], of the projected vertical height of the slope face, measured from the top of slope to the proposed final ground line at the toe of slope and from the beginning to end limits as shown on the plans, regardless of the length or number of layers of geosynthetic within the reinforced volume and including any reinforcement required below the toe of slope elevation.

**145-6.2 Geosynthetic Reinforced Foundations over Soft Soils:** The quantity to be paid for will be the plan area, in square yards [square meters], of the embankment to be reinforced as shown on the plans, regardless of the length or number of layers of geosynthetic within the reinforced soil volume, and including any reinforcement required below the original ground elevation.

**145-7 Basis of Payment.**

**145-7.1 Geosynthetic Reinforced Soil Slopes:** Price and payment will be full compensation for all work, materials, and services specified in this Section, including design and shop drawings, geosynthetic materials, facing materials and/or treatment, installation, testing, and required submittals. The cost and placement of all backfill material will be included in the pay quantity for embankment or borrow excavation, as applicable.

**145-7.2 Geosynthetic Reinforced Foundations over Soft Soils:** Price and payment will be full compensation for all work, materials, and services specified in this Section, including geosynthetic materials, geotextile filter materials, facing materials, drainage materials, installation, testing, and required submittals. The cost and placement of all backfill will be included in the pay quantity for embankment or borrow excavation, as applicable.

**145-7.3 Payment Items:** Payment will be made under:

- Item No. 145-1- Geosynthetic Reinforced Soil Slopes - per square foot.
- Item No. 2145-1- Geosynthetic Reinforced Soil Slopes - per square meter.
- Item No. 145-2- Geosynthetic Reinforced Foundations over Soft Soils - per square yard.
- Item No. 2145-2- Geosynthetic Reinforced Foundations over Soft Soils - per square meter.