

# GEOSYNTHETICS USED IN SOIL REINFORCEMENT APPLICATIONS

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### **General**

This document is prepared to help ensure that the geosynthetic soil reinforcement, once installed, will perform its intended design function. To do so, the geosynthetic must be identified, handled, stored, and installed in such a way that its physical property values are not affected and that the design conditions are ultimately met as intended. This document contains information consistent with generally accepted practices of identifying, handling, storing, and installing geosynthetic materials. Failure to follow these guidelines may result in the unnecessary failure of the geosynthetic in a properly designed application.

### **Material Identification, Storage and Handling**

The geosynthetic shall be rolled on cores having strength sufficient to avoid collapse or other damage from normal use. Each roll shall be wrapped with plastic covering to protect the geosynthetic from damage during shipping and handling, and shall be identified with a durable gummed label showing the manufacturer's name, the style number, and the roll number. Roll identification corresponding to the proposed location of the roll as shown on the construction drawings and as approved by the Engineer, owner and contractor can be provided.

While unloading or transferring the geosynthetic from one location to another, prevent damage to the wrapping, core, label, or the geosynthetic itself. If the geosynthetic is to be stored for an extended period of time, the geosynthetic should be located and placed in a manner that ensures that the integrity of the wrapping, core, and label as well as the physical properties of the geosynthetic. This can be accomplished by elevating the geosynthetic off the ground and ensuring that it is adequately covered and protected from ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, fire or flames including welding sparks, temperatures in excess of 60°C (140°F), and human or animal destruction.

### **Geosynthetic Placement**

Prepare the surface on which the geosynthetic reinforcement is to be placed so that no damage to the geosynthetic will occur. The sub grade should be cleared of all obstacles and proof rolled. The surface should be smooth and level such that any shallow depressions or humps do not exceed 15 cm (6 in) in depth and height. This exercise should be performed prior to each subsequent geosynthetic layer installed.

Before unrolling the geosynthetic, verify the roll identification, length, and installation location with the contract drawings. While unrolling the geosynthetic, inspect it for damage or defects. Damage that occurs during storage, handling, or installation shall be repaired as directed by the Engineer.

Orientation of the geosynthetic is of extreme importance since geosynthetics may vary in strength with direction. The geosynthetic panel length should be measured in the field then the geosynthetic should be rolled out and cut to the measured length using a razor blade, scissors, sharp knife, or equivalent.

To install the geosynthetic around manholes, gas collection headers, and other obstacles, slice the geosynthetic through the cross machine members an appropriate length to place

around the obstacle. This will allow the geosynthetic to be installed in a continuous sheet over the top of the obstacle. Certain fill properties, fill placement procedures and/or weather conditions may require the reinforcement to be held in place by sandbags or fills, as directed by the Engineer.

### **Retaining Walls/Steepened Slopes**

After the geosynthetic has been laid in place, it should be tensioned by hand until taut, free of wrinkles and lying flat. Adjacent geosynthetic panels, in the case of 100 percent coverage in plan view, should be butted as necessary to ensure 100 percent coverage, unless otherwise specified on the construction drawings. Joint spacings are entirely contingent upon the contractor's ability to prevent wrinkles or separation of panels during fill placement. Geosynthetic panels may be secured in-place with staples, pins, sand bags, or backfill as required by fill properties, fill placement procedures, or weather conditions, or as directed by the Engineer.

The geosynthetic may **not** be spliced in the principal strength direction through overlap, sewing or mechanical connection. Therefore the geosynthetic should be installed on one continuous piece with the principal strength direction extending the full length of the reinforced area.

Place only that amount of geosynthetic required for immediately pending work to prevent undue damage. After a layer of geosynthetic has been placed, the succeeding layer of soil shall be placed, compacted and prepared as appropriate. After the specified soil layer has been placed, the next geosynthetic layer shall be installed. This process shall be repeated for each subsequent layer of geosynthetic and soil.

### **Veneer Reinforcement**

The geosynthetic should then be laid in the direction of main reinforcement from the anchorage area (top of slope) down towards the toe of slope. The contractor is responsible for correct geosynthetic orientation.

After being rolled out, the geosynthetic should be tensioned until taut, free of wrinkles and laying flat. Adjacent geosynthetic rolls should be overlapped as necessary to ensure 100 percent coverage, unless otherwise specified on the contract drawings. Adjacent geosynthetic panels should be joined or sewn to prevent the loss of 100 percent coverage due to geosynthetic panel shifting during backfill operation. No splices are allowed in the principal strength direction. Therefore the geosynthetic should be installed with the roll direction extending the full length of the reinforced area.

### **Liner Reinforcement**

After being rolled out the geosynthetic shall be tensioned until taut, free of wrinkles and laying flat. Adjacent geosynthetic rolls should be overlapped as necessary to ensure 100 percent coverage, unless otherwise specified on the contract drawings. Adjacent geosynthetic panels should be sewn to prevent the loss of 100% coverage due to geosynthetic panel shifting during backfill operation.

Splices should be minimized in the principal strength direction. Therefore, when possible, the geosynthetic should be installed with the roll direction extending the full length of the reinforced area. Otherwise, splices along the roll direction should be limited to one splice per panel width and it should be constructed to ensure 100 percent strength efficiency. Splices occurring in adjacent panels should be staggered a minimum of 4.5 meters (15 feet).

### **Fill Placement**

Deployment of fill should be performed as directed by the engineer in charge of quality assurance. Fill should be compacted as defined in the project specifications or as directed by the Engineer. Fill placement and spreading should be done in a manner that prevents wrinkles and/or slippage of the geosynthetic.

### **Veneer Reinforcement/Liner Reinforcement**

Fill placement should proceed in the direction of the adjacent panel overlap (from the bottom of the slope upward in Veneer Reinforcement). Anchoring may be required at the trench/run out area to prevent geosynthetic pullout during slope fill placement.

After fill material is placed on the geosynthetic, final spreading and compaction may be carried out by small dozers with low to moderate ground pressure and /or front-end loaders. A minimum cover of 30cm (12 in) should be maintained between construction equipment and the geosynthetic, with thickness depending upon degree of site preparation performed prior to geosynthetic placement and upon the size and angularity of fill material. The contractor is responsible for verifying any equipment loading constraints with the Engineer before fill placement begins.

Construction equipment should not allow onto the exposed geosynthetic. Additional fill compaction can be accomplished after spreading, grading, and track/tire compaction using either a pneumatic or vibratory roller. Sheep foot rollers should not be used for initial compaction, as feet may damage the geosynthetic.

### **Retaining Walls/Steepened Slopes**

Soil fill shall be compacted to 95 percent of optimum dry density and plus or minus two percentage points of the optimum moisture content, according to AASHTO T-99. It is recommended that cohesive soils are compacted in 15cm (6 in) to 20 cm (8 in) compacted lifts and granular soils in 23 cm (9 in) to 30 cm (12 in) compacted lifts. The minimum compacted fill thickness between adjacent layers of geosynthetic should not be less than 15 cm (6 in) or twice the size of the larger stones, whichever is larger. Fill should be compacted as defined by the project specifications or as directed by the Engineer.

Backfill should be placed, spread, and compacted in such a manner that minimizes the development of wrinkles in and/or movement of the geosynthetic. Care should be taken to control the timing and rate of placement of fill material to ensure that damage does not occur due to compaction or site vehicles traveling on the exposed geosynthetic.

Backfill within 1 meter (3 feet) of the wall/slope face will typically be compacted with hand equipment. Density shall be measured every soil lift or as otherwise directed by the Engineer. Backfill shall be graded away from the slope crest and rolled at the end of each work day to prevent ponding of water on the surface of the reinforced soil mass. The site shall be maintained to prevent the flow of water from overtopping the slope crest during construction and after the completion of the slope.

Most rubber-tired vehicles can be driven at slow speeds, less than 16 km/h (10 mph) and in straight paths over the exposed geosynthetic without causing damage to the geosynthetic. Sudden braking and sharp turning should be avoided. Tracked construction equipment should not be operated directly upon the geosynthetic. A minimum fill soil thickness of 15cm (6 in) is required prior to operation of tracked vehicles over the geosynthetic. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geosynthetic.

## **Other Considerations**

### **Drainage**

Groundwater infiltration of surface runoff can cause saturation of the reinforced soil fill that will significantly reduce soil strength and reduce a retaining wall/steepened slope's factor of safety. If the wall was not designed with the extra reinforcement to handle these reduced strengths, then a drainage system should be provided to prevent the fill from becoming saturated.

### **Protection of the Slope Face**

For reinforced slopes, the slope face is hydro seeded and covered with a Rolled Erosion Control Mat (RECM), which will retain soil particles and promote vegetative growth. For slopes steeper than 1:1 V or in areas where vegetation is difficult to establish, the slope can be treated with durable facing (i.e.: concrete, timber ties, gabions).

### **Block Wall Requirements**

Be sure to check the installation guidelines from the modular block/facing manufacturer and the Engineer to determine any possible construction conflicts prior to the beginning of construction. All conflicts are to be resolved by the Engineer.

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