High Performance Geogrids for Soil Reinforcement

Synteen
Our geogrids are manufactured here in the United States in our own production facility. This enables us to constantly improve our geogrid product line and quickly respond to changes in the domestic market place. This flexibility in manufacturing allows the engineer greater design freedom and the developer lower construction costs due to increased manufacturing and product efficiency.

Efficient production methods, a highly motivated staff, a commitment to the highest level of quality and innovative solutions to your soil reinforcement problems make Synteen the logical choice for geogrid soil reinforcement.

Our SF Series geogrids provide the flexibility needed for easy installation and the stiffness and junction strength to stay in place.

- Stays in place
- Easy to tension
- Reduced installation time
- Cost effective
- Excellent facing connection properties in SRW applications
- Available in both 6' and 12' widths
- Available in site specific lengths for large projects

Manufactured and sold in the USA and North America by Synteen

Synteen Series Geogrids have been used by:
- Various State Departments of Transportation
- The US Army Corps of Engineers
- The United States Forest Service
- The Federal Highway Administration

SF SERIES SOIL REINFORCEMENT GEOGRID

The SF Series Geogrid is composed of high-tenacity multifilament yarns of high-molecular weight polyester that are woven into a stable network placed in tension. The high strength polyester yarns are coated with a PVC material. SF Geogrids are inert to biological degradation and are resistant to naturally encountered chemicals, alkalis and acids. SF Geogrids are typically used for soil reinforcement applications such as retaining walls, steepened slopes, embankments, sub-grade stabilization, embankments over soft soils, and waste containment applications.

The flexibility in both manufacturing and product selection makes SF Geogrids “the next generation” of polyester soil reinforcement grids. The standard geogrid product range, combined with STF’s ability to manufacture specialty site specific geogrids allows the engineer flexibility in the design of soil reinforcement structures. For example, SF Geogrids would aid in the design of a void bridging application where tensile strength requirements are high in both directions of the geogrid.

INSTALLATION

Installation of SF Geogrid is quick and easy. Because of the product’s light weight and flexibility, no special tools or equipment are required. Simply, lay out the geogrid, measure it to the required length, and cut it with a utility knife or scissors. When installed, SF geogrid lays flat. It will not recoil, even in cold weather.
Soil reinforcement is a common technique for stabilizing a variety of soil types in civil engineering applications. Placing Synteen Series Geogrid in soil creates a composite soil mass of increased strength. With such enhancements, much higher loads can be carried by the reinforced soil structure.

STF Geogrids are created to accommodate technical design considerations. Materials used for soil reinforcement need to resist degradation from naturally occurring conditions and withstand the pressures of long term creep. Because of the demands placed on soil reinforcement structures, only the best materials are used by Synteen.

RETAINING WALLS
Segmental Retaining Walls (SRW) and Mechanically Stabilized Earth (MSE) structures provide the most cost effective solution for retaining walls. Engineers planning these walls can turn to SF Geogrids for flexibility in the design.

ADVANTAGES
- Light Weight. No special tools or equipment for placement.
- Flexible. Conforms to soil. Eliminates many of the technical difficulties associated with construction of radius and serpentine structures.
- Cost Effective. Reduces labor. Enables structures to be created with native of lower priced fill materials.
- Longer Life. Significantly enhances the life cycle of the soil structure.

STEPPENED SLOPES
When (MSE) walls are not a feasible option, a SF reinforced slope needs to be considered. While native soils restrict the angle of construction, SF Geogrids could allow for a less than 1:1 soil structure. The additional steepness in the angle of slope construction promotes a more efficient use of available land.

BASE COURSE REINFORCEMENT
- Increase tensile strength of road Base Aggregate
- Prevents lateral spreading of the Base Aggregate

Synteen base course geogrids offer high modulus at 2 and 5% strain. When installation damage is taken into consideration, our base grids excel in performance over other grids used in this application.
Synteen geogrids are routinely used to reinforce soil for steepened slopes and retaining walls. To be effective as a soil reinforcement, SF geogrid must be able to maintain the tensile reinforcement load, and efficiently transfer that tensile load into the surrounding soil, throughout the service life of a structure.

The three most popular design methodologies utilized for these types of structures are the AASHTO [Refs. 1,2], NCMA [3], and GRI [4] design guidelines. These design methods take basically the same approach to determining the design tensile strength and interaction properties for geosynthetic reinforcement. The following is a brief description of STF design properties.

**Long-Term Design Strength**

The objective of this procedure is to design with the reinforcement tensile strength at the end of the service life. This can be accomplished by predicting the tensile strength based on a partial factor approach. Each partial factor isolates the effects of a particular degradation mechanism. Partial factors are lumped (i.e., multiplied) together to conservatively predict the effects of each degradation mechanism occurring at the same location in the reinforcement as the maximum applied tensile load. This prediction can be expressed as follows:

\[
T_{al} = \frac{T_{ult}}{RFCR \cdot RFD \cdot RFID} \\
T_{al} = \text{ALLOWABLE Tensile strength} \\
T_{ult} = \text{Ultimate Tensile strength} \\
RFCR = \text{Creep reduction factor (typical range: min.1.5 to 5.0)} \\
RFD = \text{Durability reduction factor (typical range: min.1.1 to 2.0)} \\
RFID = \text{Installation Damage reduction factor (typical range: min.1.05 to 3.0)}
\]

The allowable tensile strength, \(T_{al}\), is a material strength used directly in reinforced slope design, because the overall safety factor for the reinforcement is lumped together with the entire slope safety factor. For retaining wall design an additional safety factor, FS\(_g\), is applied to the material strength to account for uncertainties in geometry, fill properties, reinforcement properties, and loading conditions. The Long Term Design Strength, LTDS, is determined as follows.

\[
\text{LTDS} = \frac{T_{al}}{FS_g} \\
\text{FS}_g = \text{Global Safety Factor (min.1.25 to 3.0)}
\]

Creep reduction factors, RFCR, were determined by creep testing three SF geogrids [5]. Creep strain testing was extrapolated [7] to a design life of 125 years based on the results of stepped isothermal testing [6] for the same three geogrids, with a 10% strain limit applying only to GRI. RFCR varies from 1.61 to 2.

Durability reduction factors, RFD, were determined by research testing on polyester geosynthetics performed by FHWA [8] and others [9]. Durability reduction factors account for degradation due to hydrolysis, ultraviolet light, and biological activity (note: GRI, RFD\(_d\) = 1.0).

The installation damage reduction factor, RFID, was determined by direct testing of SF geogrids [10] and research testing on polyester geosynthetics performed by the FHWA [8] and others [11,12]. Installation damage factor must account for size, angularity, and thickness of the fill, the type of construction equipment utilized, and stiffness of the underlying soil. Based primarily on soil type, the range of RFID for SF geogrids is 1.05 to 1.75.

**Soil Interaction Properties**

Coefficient of interaction, C\(_i\), relates pullout resistance of SF geogrids to available soil shear strength. Pullout occurs when the applied tensile load pulls a free end of the geogrid through the soil. Coefficient of direct sliding, C\(_{ds}\), relates soil sliding resistance of Sympaforce\textsuperscript{®} geogrids to the available soil shear strength. Direct sliding occurs when earth pressures force soil to slide along a preferred plane, (i.e., the SF geogrids). Using product specific [15] and research [13,14] testing SF geogrid coefficients vary, depending on soil type, as follows:

**References**

6. “Stepped Isothermal Method tests on Sympaforce\textsuperscript{®} Geogrids” Test report prepared for STF by TRI (Nov. ’97, Aug. ’99)
SF SERIES GEOGRIDS have been used to reinforce soil structures for various State Departments of Transportation, The United States Army Corps of Engineers, The United States Forest Service, The FHWA and several high profile private sector projects.

The following laboratory tests and evaluations have been completed on SF Series Geogrids:

- ASTM D 4595 wide width tensile strength
- Geosynthetic Research Institute GG-2 Junction Strength
- 10,000 hour creep strain testing in accordance with ASTM D-5262
- Stepped Isothermal Method to evaluate long term strain rate
- Coefficient of Interaction for Geogrid pull out in accordance with Geosynthetic Research Institute Test Method GG 5
- Coefficient of Direct Shear in accordance with ASTM D 5321-92
- Installation Damage testing in accordance with a procedure as adopted by WSDOT Test Method 925

SYNTENE OFFERS A WIDE RANGE OF STRENGTH UP TO 500kn/m AND OUR OPENING SIZE CAN RANGE FROM

- Trail Grid
- SFLM
- STD
- Mine Grid
FULL LINE OF HIGH PERFORMANCE GEOGRIDS

- SOIL REINFORCEMENT
- BASE COURSE CONFINEMENT
- ASPHALT REINFORCEMENT