

TerraGrid DESIGN PROPERTIES



TerraGrid geogrids are routinely used to reinforce soil for steepened slopes and retaining walls. To be effective as a soil reinforcement, TerraGrid 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. Following is a brief description of TerraGrid 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:

$$\begin{aligned}T_{al} &= T_{ult} \div (R_{FCR} \times R_{FD} \times R_{FID}) \\T_{al} &= \text{ALLOWABLE Tensile strength} \\T_{al} &= \text{LTDS (Long Term Design Strength)} \\T_{ult} &= \text{Ultimate Tensile strength} \\R_{FCR} &= \text{Creep reduction factor} \\&\quad (\text{typical range: min. 1.5 to 5.0}) \\R_{FD} &= \text{Durability reduction factor} \\&\quad (\text{typical range: min. 1.1 to 2.0}) \\R_{FID} &= \text{Installation Damage reduction factor} \\&\quad (\text{typical range: min. 1.05 to 3.0})\end{aligned}$$

The allowable tensile strength, T_{al} or LTDS, 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 for retaining wall design, $LTDS_{RW}$, is determined as follows.

$$\begin{aligned}LTDS_{RW} &= T_{al} \div FS_g \\FS_g &= \text{Global Safety Factor} \\&\quad (\text{min. 1.25 to 3.0})\end{aligned}$$

Creep reduction factors, R_{FCR} , were determined by creep testing three TerraGrid 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. R_{FCR} varies from 1.61 to 2.

Durability reduction factors, R_{FD} , 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, $R_{Fbd} = 1.0$)

The installation damage reduction factor, R_{FID} , was determined by direct testing of TerraGrid [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 R_{FID} for TerraGrid geogrids is 1.05 to 1.75.

Soil Interaction Properties

Coefficient of interaction, C_i relates pullout resistance of TerraGrid 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 TerraGrid geogrids to the available soil shear strength. Direct sliding occurs when earth pressures force soil to slide along a preferred plane, (i.e., the TerraGrid geogrids).

Using product specific [15] and research [13,14] testing TerraGrid geogrid coefficients vary, depending on soil type, as follows:

Interaction,	C_i	0.7 to 0.85
Direct Sliding	C_{ds}	0.65 to 0/9

References

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