KYTC Guidelines for Submittal and Evaluation of Geogrids for Reinforced Soil Applications

A.1 Introduction

Geogrids used to reinforce soil or aggregate for soil slopes and embankments shall be evaluated prior to use. Products shall be submitted to KYTC's Kentucky Product Evaluation List (KYPEL) for evaluation. The Division of Materials Structural Materials Branch and the Division of Structural Design Geotechnical Services Branch shall review geogrids submitted for approval. Approved products will be placed in Phase 9 of KYPEL (i.e., specifications exist for the product; however, there is no List of Approved Materials for this type of product at this time). After a geosynthetic is approved for Phase 9, a renewal is required every 5 years, when the geosynthetic or manufacturing process changes, or when a new AASHTO Product Evaluation and Audit Solutions (formerly NTPEP) Qualification Evaluation is available. Failure to submit a renewal as required will void the geogrid reinforcement from KYPEL and from use on KYTC projects.

A.2 Definitions

Terms and abbreviations are defined below followed by the source, if applicable:

- Cross-Machine Direction – The direction in the plane of the geogrid perpendicular to the direction of manufacture. (*Standard Terminology for Geosynthetics*, ASTM D4439)
- Geogrid – A geosynthetic formed by a regular network of integrally connected elements with apertures greater than ¼" to allow interlocking with surrounding soil, rock, earth, and other surrounding materials to function primarily as a reinforcement.
- High Density Polyethylene (HDPE) or Polypropylene (PP) Geogrid – Geogrid manufactured by extruding and orienting sheets of polyolefins. (*Geosynthetic Design and Construction Guidelines*, FHWA-NHI-07-092)
- Long-Term Design Strength (LTDS) – Nominal long-term reinforcement tensile strength in accordance with 11.10.6.4.3b of the *AASHTO LRFD Bridge Design Specifications*.
- Machine Direction (MD) – The direction in the plane of the geogrid parallel to the direction of manufacture. (*Standard Terminology for Geosynthetics*, ASTM D4439)
- Polyester Type (PET) Geogrid – Geogrid manufactured from multifilament polyester yarns, joined at the crossover points by a knitting or weaving process and encased with a polymer-based, plasticized coating. (*Geosynthetic Design and Construction Guidelines*, FHWA-NHI-07-092)
- Reduction Factors – Strength reduction factors to account for potential long-term degradation due to installation damage, creep, and chemical and biological degradation in accordance with 11.10.6.4.3b of the *AASHTO LRFD Bridge Design Specifications.*
- Soil Type I – Material that meets the requirements of AASHTO Product Evaluation and Audit Solutions REGEO-19-01, Section 11.3, and classified as a sand in accordance with ASTM D2487 with a d_{50} size within the range of 0.2 to 2.0 mm. ASTM D5818 recommends a silty sand (SM) with a $d_{50} > 0.4$ mm.
- Soil Type II – Material that meets the requirements of AASHTO Product Evaluation and Audit Solutions REGEO-19-01, Section 11.3, with a gradation that falls between Soil Types I & III. ASTM D5818 recommends a concrete sand (SW) with a $d_{50} > 1.0$ mm.

- Soil Type III – Material that meets the requirements of AASHTO Product Evaluation and Audit Solutions REGEO-19-01, Section 11.3, classified as an angular to subangular gravel in accordance with ASTM D2488 with a d_{50} size in the range of 10 mm or more. ASTM D5818 recommends a coarse gravel (GP) with a $d_{50} > 20$ mm.

A.3 Submittals

Provide the following properties listed below for each geogrid seeking approval. Sources for the properties shall be from AASHTO Product Evaluation and Audit Solutions or from qualified testing laboratories. Testing laboratories other than AASHTO Product Evaluation and Audit Solutions shall submit information verifying their qualification to perform the noted tests.

Table A.3.1 Geosynthetic Property Test Methods

Geosynthetic Property	**Test Method**
Tensile Strength at Ultimate	ASTM D6637 per AASHTO R 69
Reduction Factors for installation damage, durability, and creep	AASHTO R 69
Pullout Resistance[1]	ASTM D6706
Direct Shear[1]	ASTM D5321
[1] If the manufacturer does not have test data for pullout resistance and direct shear, they may indicate the use of minimum values from AASHTO LRFD Bridge Design Specifications. This value may be no greater than 0.67; however, the Department reserves the right to require the use of a lesser value when approving the geogrid.	

After receiving a complete submittal and provided no additional information is required during the review, the geogrid will be approved or rejected within 30 days. Test data should not be more than 9 years old, but older data may be accepted depending on the data quality and provided the geosynthetic has not changed since tested.

Do not include AASHTO Product Evaluation and Audit Solutions reports in submittals. For approvals, submit the following for each geosynthetic:

- Any laboratory testing data separate from AASHTO Product Evaluation and Audit Solutions reports including gradation and angle of internal friction (Ø) from materials used to determine reduction factors, coefficient of interaction, pullout resistance, and direct shear.
- Qualifications for third-party testing laboratories (i.e., laboratories other than AASHTO Product Evaluation and Audit Solutions) including AASHTO re:source for soil testing and Geosynthetic Accreditation Institute-Laboratory Accreditation Program (GAI-LAP) for geosynthetic testing.
- Required information as shown in the following table (add rows to table for each geogrid seeking approval.

Table A.3.1 Geogrid Property Submittal Table

Geogrid and Direction (MD, CD)	Polymer (PET, HDPE, PP)	Geogrid Aperture Size (in)	Tult[A], lb/ft	RF_{cr}			RF_d
				3-yr	75-yr	100-yr	

Geogrid and Direction (MD, CD)	Soil Type I										
	RF_{id}	RF			T_{al}, lb/ft			C_i	F*	C_{ds}	ρ (deg)
		3-yr	75-yr	100-yr	3-yr	75-yr	100-yr				

Geogrid and Direction (MD, CD)	Soil Type II										
	RF_{id}	RF			T_{al}, lb/ft			C_i	F*	C_{ds}	ρ (deg)
		3-yr	75-yr	100-yr	3-yr	75-yr	100-yr				

Geogrid and Direction (MD, CD)	Soil Type III										
	RF_{id}	RF			T_{al}, lb/ft			C_i	F*	C_{ds}	ρ (deg)
		3-yr	75-yr	100-yr	3-yr	75-yr	100-yr				

[A]"Minimum Average Roll Values" (MARV) in accordance with ASTM D4439

Where,

T_{ult} = Ultimate Tensile Strength, lb/ft
RF_{cr} = Creep Reduction Factor for 3, 75, and 100-year design life
RF_d = Durability (degradation) Reduction Factor
RF_{id} = Installation Damage Reduction Factor
RF = (RF_{cr} x RF_{id}) for 3-yr design life or (RF_{cf} x RF_d x RF_{id}) for 75 and 100-year design life
T_{al} = Short-Term Design Strength for 3-yr design life or Long-Term Design Strength (LTDS) for 75 and 100-yr design life, lb/ft = T_{ult}/RF
C_i = Coefficient of Interaction
F* = Pullout Resistance Factor = C_i x tan Ø
C_{ds} = Coefficient of Direct Sliding
tan ρ = Soil-Geogrid Friction Angle (deg) = C_{ds} x tan Ø