Geogrids and High Strength PET Geotextiles for Soil Reinforcement Applications

Don Show

Synteen Technical Fabrics, Inc.

High Performance Geogrids
for Soil Reinforcement

Synteen

Synteen Technical Fabrics, Inc. is a **US owned and operated** company based in Lancaster, South Carolina. All Synteen products meet the FTC "Made in the USA" standard.

Finished Master Rolls

Ready For Packaging

STF

US Owned and Operated

STF, Inc. meets the Federal Trade Commission requirements to be labeled as "Made in the USA"

STF, Inc. qualifies for Section 1605 of the ARRA (American Recovery & Reinvestment Act) entitled "Buy American"

Product Types and Descriptions

PET – PP – PET/PP – PVA

PET – PP – PVA

Product Types and Descriptions

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 reinforcement.

Product Types and Descriptions

Polyester

- Flexible
- High tenacity (PET)

HDPE

- Rigid

Polypropylene

- Rigid

Polyvinyl Alcohol

- Low sensitivity to hydra carbons (oil & gas)

Geogrids vs. Geotextiles

- Geogrid - Holes for soil interlock
- Good with any soil type, including fine grain soils like silts and clay
- Geogrid - yarns / polymer in straight line
- Provides excellent tensile modulus
- Modulus is Strain compatible with soils
- Reduces deformation/movement of structures

Geogrids vs. Geotextiles

Geogrids – easier to install

- Weight per yd², roll weight
- Size of roll, width and weight
- Available in different roll widths
- Well suited for short lengths of walls/slopes relative to roll length
- Easy to use with different wall facing systems
- Easy to place and tension, less affected by wind

Geogrids vs. Geotextiles

- Use Geotextiles when separation needed like soft subgrades to prevent pumping
- Use Geotextiles to reinforce granular soils
- Use Geotextiles when very high strength concentrated in few (1-2) layers, like for embankment reinforcement at base
- Use Geotextiles when strain / deformation not a significant performance criteria

How Geosynthetics Work

- Stabilizes soil by creating a composite soil mass
- Increases bearing capacity of soft subgrade soils (allows use of “less desirable” onsite soils)
- Increases service life of pavements
- “Geogrid is to soil what reinforcing steel is to concrete”

How Geosynthetics Work

Unreinforced Soil

How Geosynthetics Work

Adding Geogrid

Geogrid Reinforced Soil

Products and Applications

Biaxial Geogrids

- Base Course/Subgrade Reinforcement
- Reinforced Foundations

Uniaxial Geogrids

- Reinforced Slopes and Embankments
- Mechanically Stabilized Earth Structures

High Strength Geotextiles

- Embankments, Levee and Dike Reinforcement
- Liner Stabilization and Void Bridging
- Lagoon and Pond Capping
- Tubes for Dewatering and Beach/Shoreline Erosion

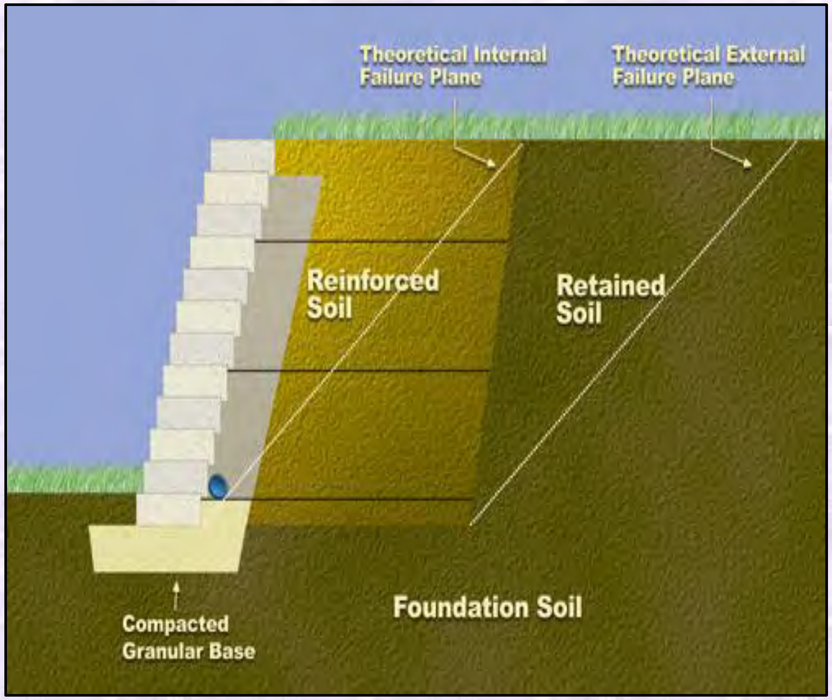
Applications

Subgrade Stabilization
(biaxial geogrids)

Earth Retention Systems
(uniaxial geogrids)

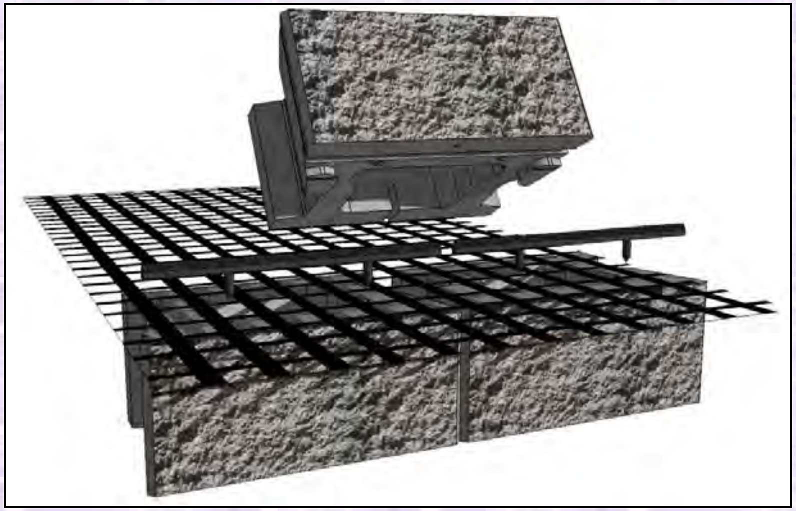
Earth Retention Systems

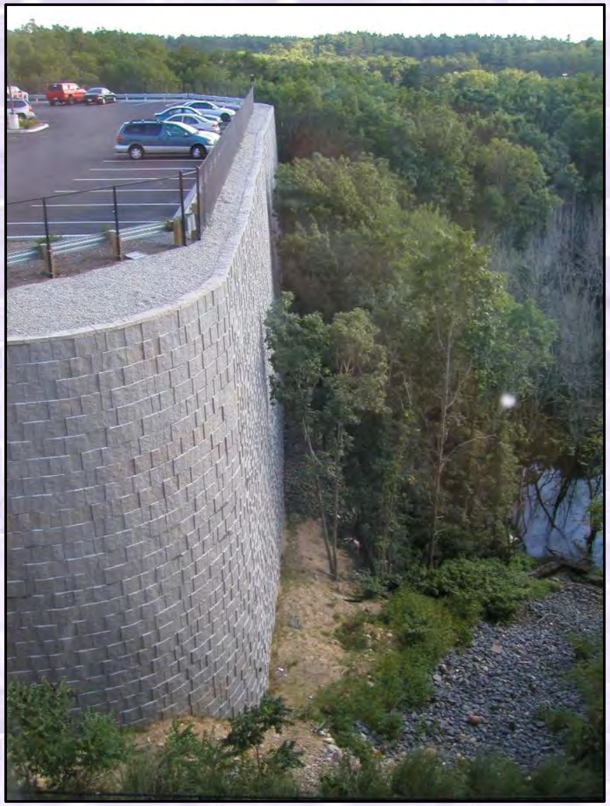
MSE Retaining Wall Systems



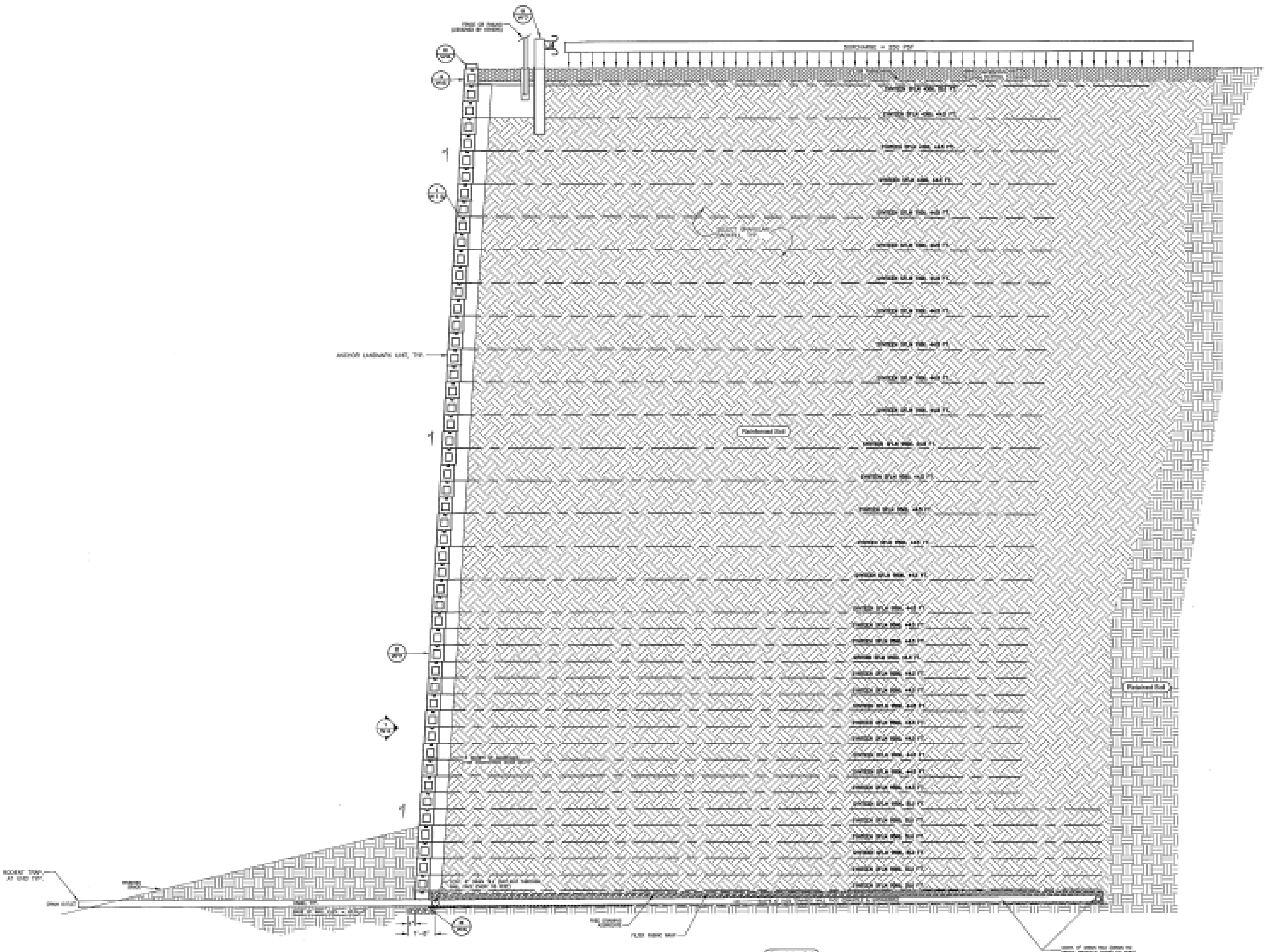
Modular Block (Frictional Connection)

MSE Retaining Wall Systems





Modular Block (positive connection)



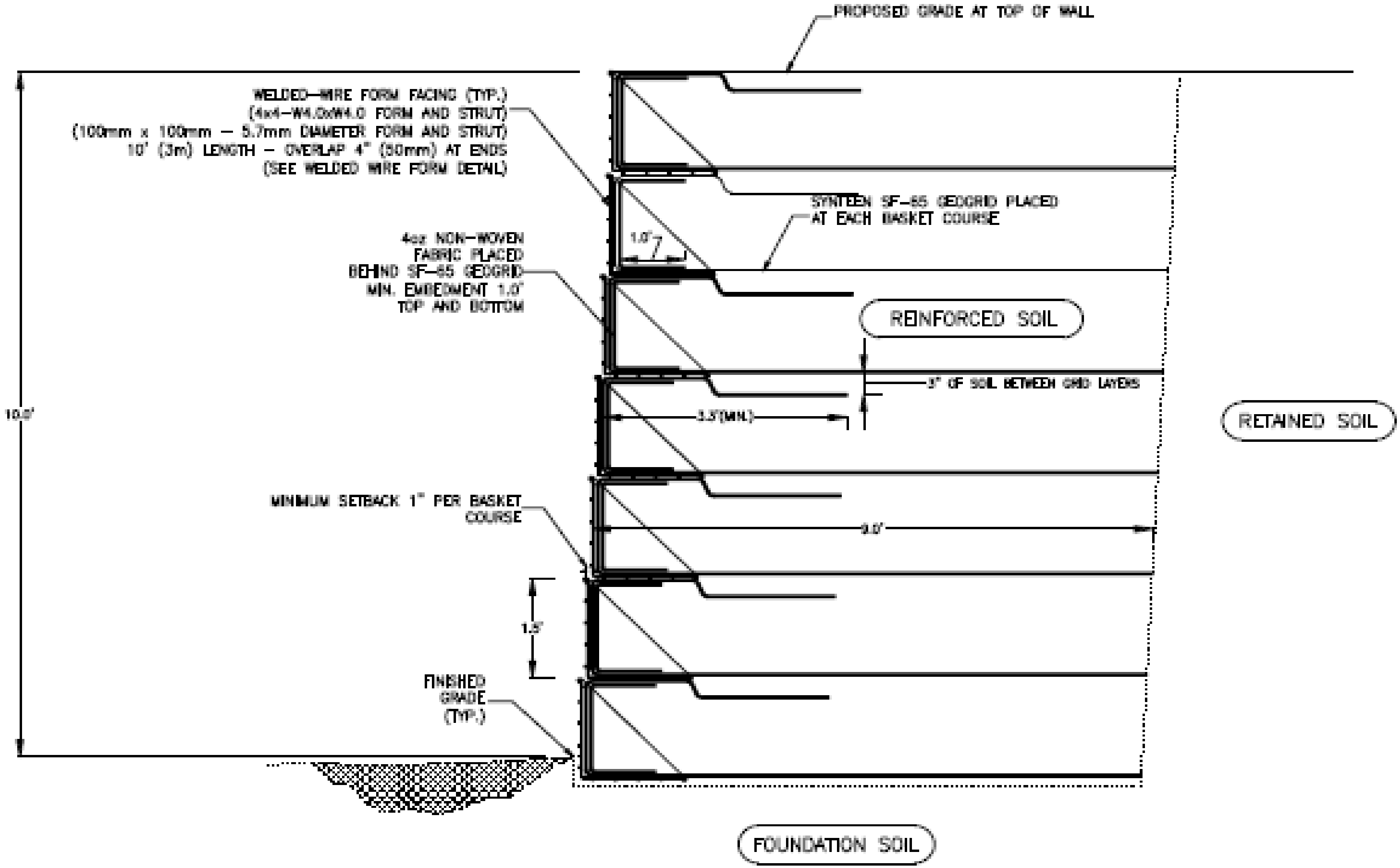
1 W3 LANDMARK SYSTEM WALL 1: LOT 52 NOT TO SCALE

MSE Retaining Wall Systems

Modular Block (“Big Block”)

MSE Retaining Wall Systems

Welded Wire Facing



TYPICAL CROSS-SECTION 10 FT HEIGHT
NOT TO SCALE

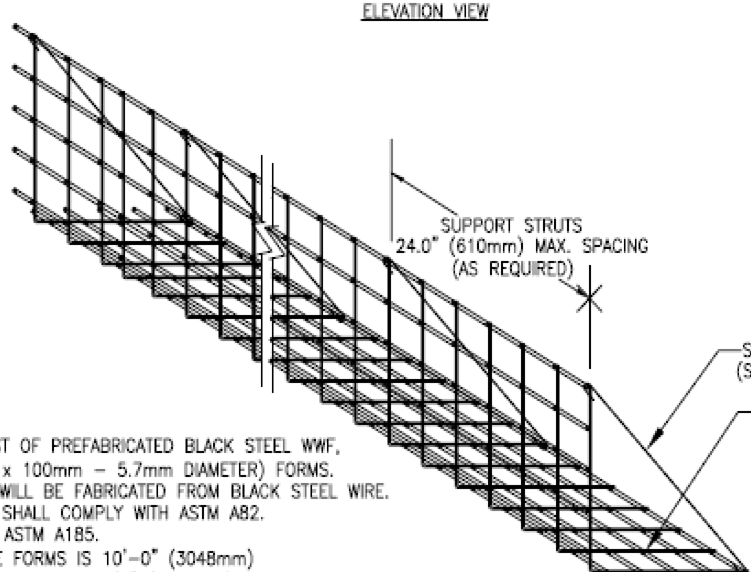
Synteen
TECHNICAL FABRICS

Synteen
TECHNICAL FABRICS

1950 W. Meeting St.
Lancaster, SC 29720
803.416.8336
www.Synteen.com

G eogrid
R einforced
E arth
S ystems

MSE Retaining Wall Systems



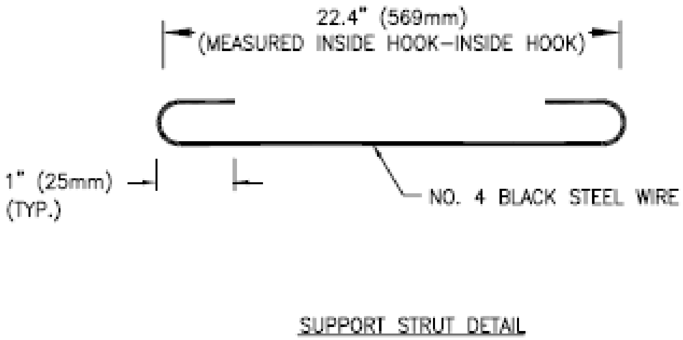
NOTES:

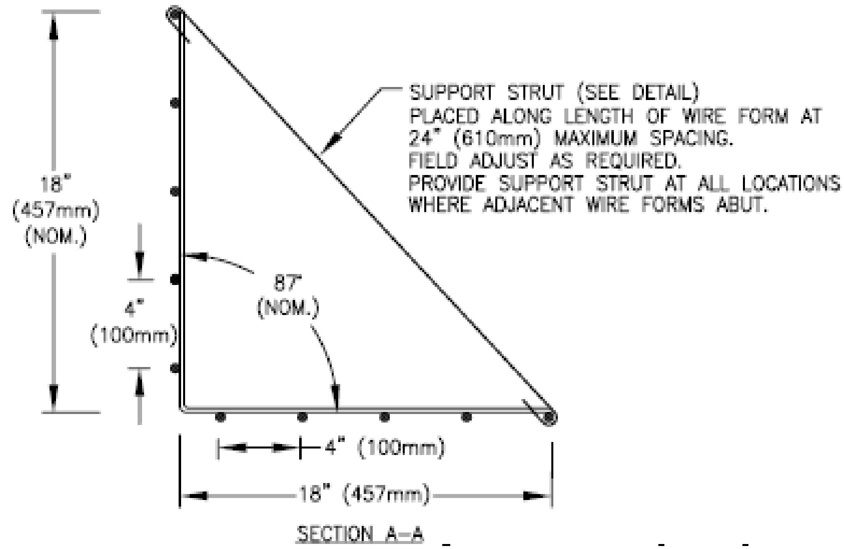
1. SLOPE FACING TO CONSIST OF PREFABRICATED BLACK STEEL WWF, 4x4–W4.0xW4.0 (100mm x 100mm – 5.7mm DIAMETER) FORMS.
2. ALL FORMS AND STRUTS WILL BE FABRICATED FROM BLACK STEEL WIRE.
3. STEEL WIRE AND STRUTS SHALL COMPLY WITH ASTM A82. FABRICATION SHALL MEET ASTM A185.
4. OVERALL LENGTH OF WIRE FORMS IS 10'–0" (3048mm) EFFECTIVE CONSTRUCTED LENGTH IS 9–'8" (2946mm) WITH 2" (50mm) OVERLAP AT ENDS.

Standard Specifications:

- Welded Wire Forms:
  - No. 4 steel wire
  - Form pattern: 4" x 4"
  - Length: 10'
  - Height: 18"
  - Width: 18"
  - All steel wire forms comply with ASTM A82
  - All fabrication meets ASTM A185
  - Black or galvanized steel upon request

MSE Retaining Wall Systems





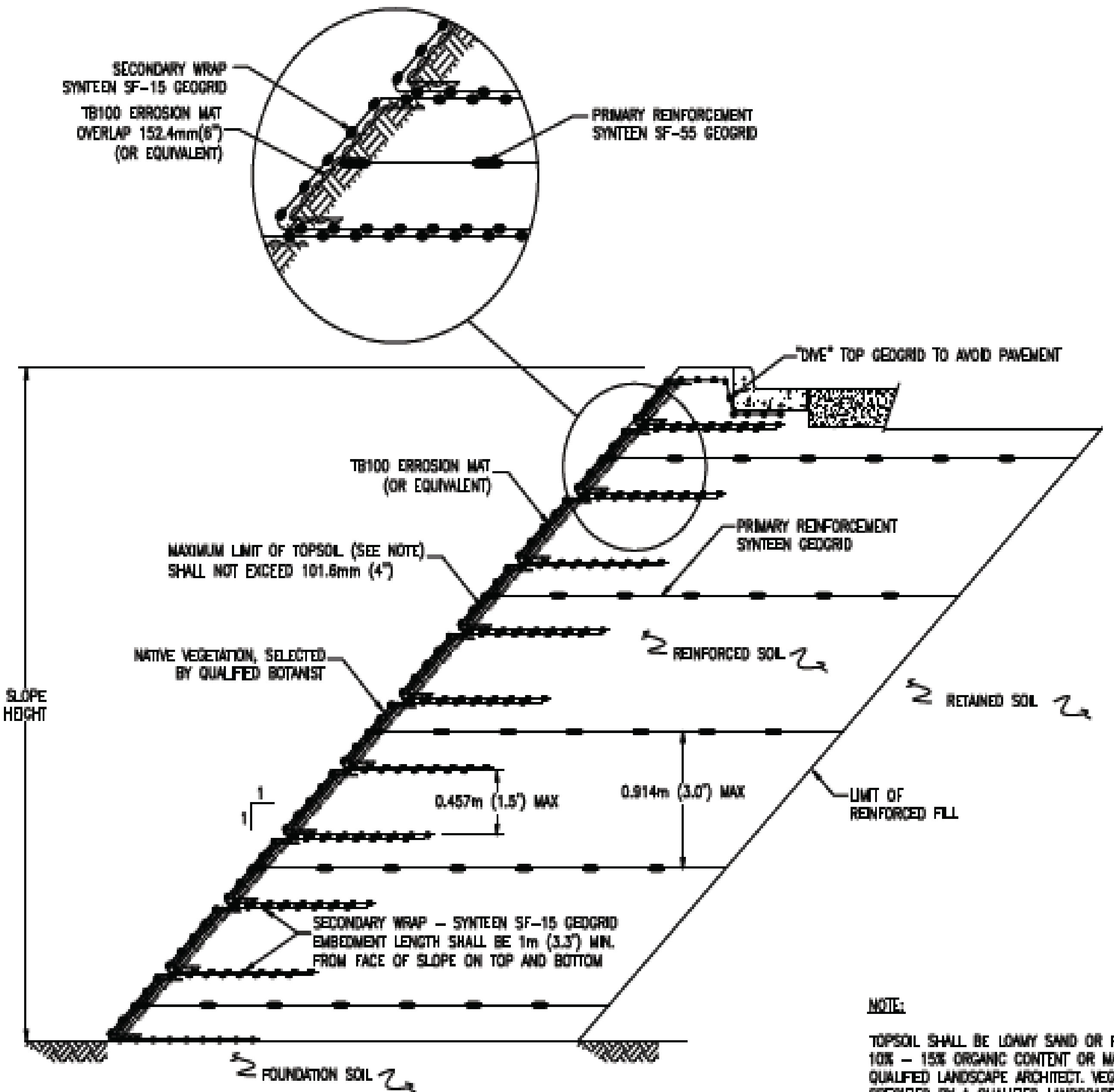
- Struts:
  - No. 4 steel wire
  - Length: 25.1"
  - All steel wire forms comply with ASTM A82
  - All fabrication meets ASTM A185
  - Black or galvanized steel upon request

MSE Retaining Wall Systems

Geocell

MSE Retaining Wall Systems

Reinforced Soil Slope (RSS)



NOTE:

TOPSOIL SHALL BE LOAMY SAND OR FINER GRADATION WITH 10% – 15% ORGANIC CONTENT OR MATERIAL APPROVED BY A QUALIFIED LANDSCAPE ARCHITECT. VEGETATION TYPE SHALL BE SPECIFIED BY A QUALIFIED LANDSCAPE ARCHITECT.

MECHANICALLY STABILIZED REINFORCED SLOPE
TYPICAL CROSS-SECTION

MSE Retaining Wall Systems

Panel Facing

MSE Retaining Wall Systems

Natural Stone

U.S. Department of Transportation
Federal Highway Administration

Publication No. FHWA NHI-00-043
March 2001

NHI Course No. 132042

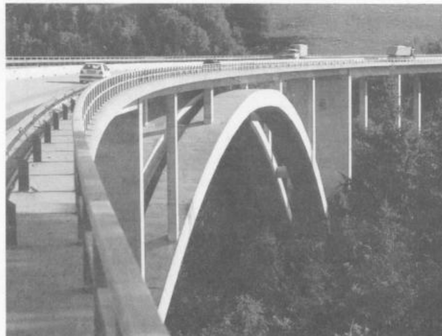
Mechanically Stabilized Earth Walls and Reinforced Soil Slopes

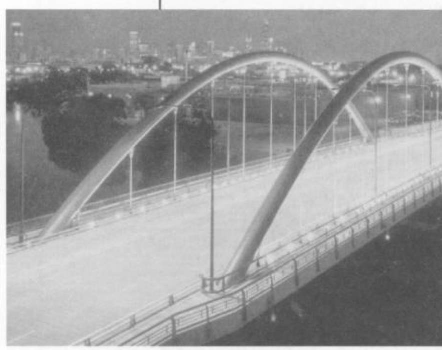
Design and Construction Guidelines

National Highway Institute

Standard Specifications for Highway Bridges

17th Edition – 2002





Upper right-hand and lower left-hand pictures courtesy of the National Steel Bridge Alliance.
Lower right-hand picture courtesy of William Oliva and Scott Becker.

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adopted - 199
current revision - 7/14/0

GRI Standard Practice GG4(b)*

Standard Practice for

"Determination of the Long-Term Design Strength of Flexible Geogrids"

1. Scope

1.1 This standard practice is to be used to determine the long-term design load of flexibl geogrids for use in the reinforcement of such structures as embankments, slope retaining walls, improved bearing capacity, and other permanent geotechnical an transportation engineering systems. By "flexible" the Standard Practice is meant to b applicable to those geogrids exhibiting less than 1000 g-cm flexural rigidity in th ASTM D1388 stiffness test.

1.2 The method is based on the concept of identifying and quantifying reduction factors fo those phenomena which can impact the long-term performance of flexible geogri reinforced systems and are not taken into account in traditional laboratory testin procedures.

1.3 The reduction factors to be considered are for installation damage, creep deformatio chemical degradation, biological degradation and joints (seams and connections).

1.4 These reduction factors values can be obtained by direct experimentation an measurement, or by using default values which are given for the various applicatio which use geogrids.

2. Reference Documents

2.1 ASTM Standards

D123 Terminology Relating to Textiles
D1388 Test Methods for Stiffness of Fabrics
D4354 Practice for Sampling Geotextiles
D4439 Terminology for Geotextiles

* This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by t member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In th regard it is subject to change at any time. The most recent revision date is the effective version.

MEMORANDUM

U.S. Department of Transportation
Federal Highway Administration

Subject: **ACTION:** Geotechnical Engineering Computer Program - Reinforced Slope Stability Analysis - ReSSA 1.0

Date: October 17, 2001

From: James D. Cooper */s/ original signed by*
Director, Bridge Technology

Reply to Attn of: HIBT-20

To: Director of Field Services
Division Administrators
Federal Lands Highway Division Engineers

The Geotechnical Group of the Office of Bridge Technology has been involved in the development and national acceptance of mechanically stabilized earth walls (MSEW) and reinforced soil slopes (RSS). These combined technologies have been extensively implemented into national transportation practice and provide significant cost-savings and pleasing aesthetics compared to other earth retention systems. The majority of FHWA's technology development and deployment activities on this subject were accomplished within the scope of the Demonstration Project No. 82 which concluded in September 2000. The workshop segments of the demonstration project have been recently updated and are available as National Highway Institute Courses 132042 (Design and Construction) and 132043 (Inspection). Additional information on these NHI courses can be found at http://www.nhi.fhwa.dot.gov. Concurrently with the course updates, design and construction reference materials have been updated to reflect the latest recommendations in soil reinforcement technology. The revised publications are available from the FHWA Reports Center (FHWA-NHI-00-043 and FHWA-NHI-00-044). The Reports Center can be reached by phone at 301-577-0818 or by email at report.center@fhwa.dot.gov.

This memorandum announces the availability of the computer program *ReSSA 1.0* developed by ADAMA Engineering, Inc. The program follows the latest reinforced slope design guidelines and recommendations as presented in the new NHI course and reference manual, and it will be of interest to geologists, and geotechnical and structural engineers. The *ReSSA* program permits the user to design or analyze a range of reinforced slope problems by a variety of slope stability methods. There is a wide range of options specifically designed to accommodate most input variables encountered on both simple and complex reinforced slope problems. The program interface is modeled after the widely popular program, MSEW, and users are provided extensive help and output options.

The *ReSSA* 1.0 program is copyrighted and password protected. The FHWA is authorized by the developer to distribute a limited number of copies of the program to Federal agencies and State departments of transportation. Complete details on obtaining the ReSSA 1.0 program can be found in the attachment.

Please forward the above information to appropriate individuals within your office and State DOT offices. Organizations and individuals interested in the program who are not covered under the FHWA license can contact ADAMA Engineering, Inc., at 302 368-3197, or www.GeoPrograms.com for additional information. General questions regarding the subject program may be directed to Mr. Chien-Tan Chang at 202 366-6749. Specific technical questions should be directed to Mr. Jerry DiMaggio at 202 366-1569. Program updates will be posted on the Geotechnical Section of the Office of Bridge Technology Web site (www.fhwa.dot.gov/bridge).

Attachment

STRENGTH: Allowable (slope) vs. Design (walls)

The long-term design strength of the geosynthetic is determined as follows: LTDS

[Eq. 3-20]

$$T_{al} = \frac{T_{ULT}}{RF_{CR} \cdot RF_{D} \cdot RF_{ID}}$$

The allowable strength of the geosynthetic is determined as follows: T_{al}

[Eq. 3-21]

$$T_a = LTDS = \frac{T_{al}}{FS_{UNC}} = \frac{T_{ult}}{RF_D \cdot RF_{ID} \cdot RF_{CR} \cdot FS_{UNC}}$$

where:

- T_{ult} = Ultimate (or yield tensile strength) from wide width tensile strength tests (ASTM D 4595 or GRI "GG1: Single Rib Geogrid Tensile Strength"), based on minimum average roll value (MARV) for the product.
- RF_D = Durability reduction factor. It is dependent on the susceptibility of the geosynthetic to attack by microorganisms, chemicals, thermal oxidation, hydrolysis and stress cracking. The typical range is from 1.1 to 2.0.
- RF_{ID} = Installation damage reduction factor. It can range from 1.05 to 3.0, depending on backfill gradation and product mass per unit weight.
- RF_{CR} = Creep reduction factor is the ratio of the ultimate strength (T_{ult}) to the creep limit strength obtained from laboratory creep tests for each product, and can vary typically from 1.5 to 5.0.
- FS_{UNC}= Overall factor of safety or load reduction factor to account for uncertainties in the geometry of the structure, fill properties, reinforcement properties, and externally applied loads. The typical value is 1.5.

Based on NCMA 97 Criteria - June 2009 version 5
Supersedes all prior spreadsheets

M.A.R.V. Properties
of
STF Inc. Geogrids

Approved by

Date

Property	Symbol	Method	SF20		SF35		SF55		SF 65		SF80		SF90		SF110		SF350	
Note: All geogrids woven PET with PVC Coatings																		
Tensile Properties			kN/m	Lbs/Ft	kN/m	Lbs/Ft	kN/m	Lbs/Ft	kN/m	Lbs/Ft	kN/m	Lbs/Ft	kN/m	Lbs/Ft	kN/m	Lbs/Ft	kN/m	Lbs/Ft
MD - Ultimate Strength	Tult	ASTM D-6637	28.4	1940	50.2	3435	68.38	4670	87.9	6000	108.4	7400	124.5	8500	150.1	10250	401.3	27390
MD - Ultimate Strain at Failure	%	ASTM D-6637	14.4%		14.0%		15.0%		15.0%		15.0%		15.0%		17.0%		14.0%	
MD - Creep Reduced Strength	Tl	ASTM D-5262	18.4	1269	32.6	2230	44.4	3032	56.7	3871	69.9	4774	80.3	5483	95.2	6500	255.6	17445
DESIGN STRENGTH PROPERTIES																		
CREEP Reduction Factor(ed=10'	RFCR	NCMA 97	1.54		1.54		1.54		1.55		1.55		1.55		1.57			
AGING/DURABILITY Reduction Factor																		
5<soil PH<8	RFD	NCMA 97	1.10		1.10		1.10		1.10		1.10		1.10		1.10		1.10	
INSTALLATION DAMAGE Reduction Factor																		
1:100mm Max, 30mm D50, PI<6	RFID	NCMA 97	1.73		1.63		1.55		1.55		1.50		1.50		1.40		1.40	
2:20mm Max, 0.7mm D50, PI<6	RFID	NCMA 97	1.10		1.08		1.05		1.05		1.05		1.05		1.05		1.05	
3:20mm Max, .1-.5mmD50, PI<20	RFID	NCMA 97	1.10		1.08		1.05		1.05		1.05		1.05		1.05		1.05	
Tult / RF for Soil Type 1:	LTDS	NCAM 97	9.68	661	18.2	1244	26.0	1779	33.2	2270	42.3	2893	47.2	3323	61.8	4220	165.9	11328
Tult / RF for Soil Type 2:	LTDS	NCMA 97	15.2	1040	27.4	1878	38.4	2625	49	3351	60.5	4133	69.5	4747	82.4	5627	221.3	15104
Tult / RF for Soil Type 3:	LTDS	NCMA 97	15.2	1040	27.4	1878	38.4	2625	49	3351	60.5	4133	69.5	4747	82.4	5627	221.3	15104
DESIGN INTERACTION PROPERTIES			Note: Ci & Cds tests type 2 & estimate from tech. Literature; Ci tan o = F* a & Cd															
Coefficient of Interaction:	Ci	GRI - GG5 '91	Ci		Ci		Ci		Ci		Ci		Ci		Ci		Ci	
Coefficient of Direct Sliding:	Cds	ASTM D-5321		Cds		Cds		Cds		Cds		Cds		Cds		Cds		Cds
Soil Type 1:		see above	0.75	0.70	0.75	0.70	0.75	0.70	0.75	0.70	0.75	0.65	0.75	0.65	0.75	0.65	0.75	0.65
Soil Type 2:		see above	0.80	0.80	0.80	0.80	0.80	0.85	0.80	0.85	0.85	0.90	0.85	0.90	0.85	0.90	0.85	0.90
Soil Type 3:		see above	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.85	0.80	0.85	0.80	0.85	0.80	0.85	0.80	0.85
PHYSICAL PROPERTIES			Metric	US	Metric	US	Metric	US	Metric	US	Metric	US	Metric	US	Metric	US	Metric	US
MD - Aperture Size:	MM	measured	25		23		22		22		22		21		20		11	
	Inches	measured		0.98		0.91		0.87		0.87		0.87		0.83		0.79		0.43
CMD - Aperture Size:	MM	measured	20		25		25		25		25		25		25		26	
	Inches	measured		0.79		0.98		0.98		0.98		0.98		0.98		0.98		1.02
	STF INC																	

Current 2009

Opening size for SF 20 can be changed to 0.25 x 0.25 for smaller opening requirements

Reduction factors
FHWA Durability 1.15
Installation damage 1.10 minimum

GRI reduction factors
CR 1.70 - 1.75
Durability 1.10
Installation damage installation - test specific

Subgrade Stabilization

Subgrade Stabilization

- Paved Roads
- Haul Roads
- Parking Lots
- Storage Yards
- Railway Stabilization
- Runways/Taxiways
- Reinforced Foundations

Why Design with Biaxial Geogrids?

THE PROBLEM:

•Paved and unpaved roadways, when constructed over soft or very soft subgrades, will exhibit bearing or shear failure

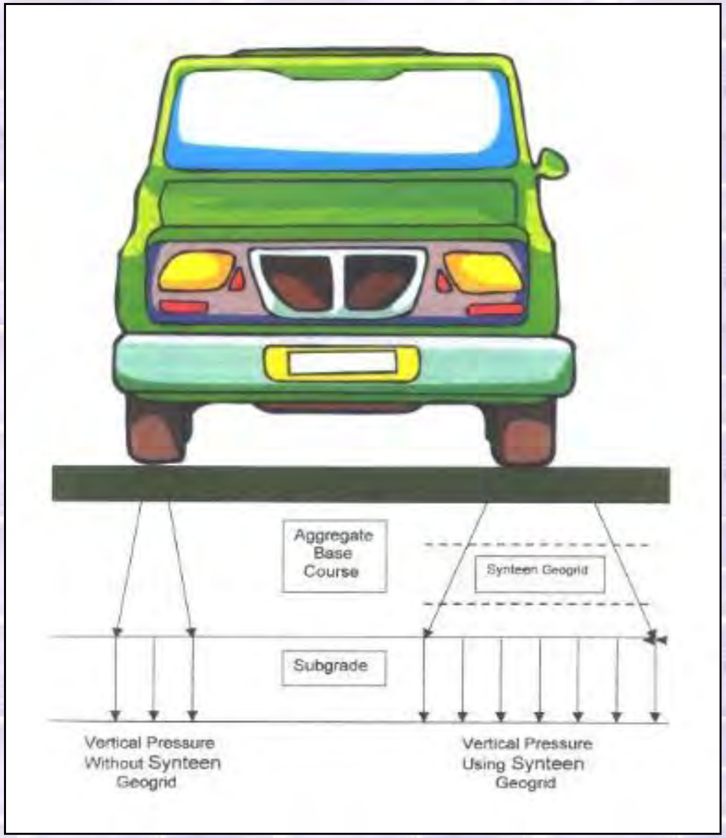
•This ultimately results in surface rutting

Why Design with Biaxial Geogrids?

THE SOLUTION:

The use of biaxial geogrids can:

- Increase the service life of roadways
- Help achieve equivalent performance with a reduced structural base course section



Why Design with Biaxial Geogrids?

Additional Benefits

Aggregate Base Course Reduction

- Because Synteen geogrids spread the concentrated wheel load more efficiently than unbound base course aggregate, this allows for a reduction in the thickness of the aggregate base course (ABC) materials while achieving the same applied load to the subgrade.

Base Course Reduction Percentage (BCR)

THIS REDUCTION IN AGGREGATE BASE COURSE THICKNESS IS CALLED THE "BASE COURSE REDUCTION PERCENTAGE"

CBR	No. 1	No. 2
<6	24%	28%
4-6	29%	34%
2-4	33%	39%
1-2	36%	43%
>1	40%	46%

Base Course Reduction Percentage (BCR)

	Aggregate Thickness
Unreinforced	**31.5”**
Lime Treated	**26.5”**
Biaxial Geogrid	**21.5”**

Asphalt thickness remained constant

Geogrid Benefits Over Chemical Treatment

Eliminates Skin and Respiratory Safety Hazards

Minimizes Dust and Water Use

Not Weather Dependent

Consistent Application

No Curing

Maintains Strength over time

Lower Costs

Paved Roads

- **GA Highway 400**
- Alpharetta, GA

- Owner: GADOT
- Engineer: GADOT
- Contractor: AAPAC

- Product: SF11
- Scope: 200,000 yd^2

Haul Roads

- **Blue Knob Wind Farm**
- Altoona, PA

- Owner: Gamesa
- Contractor: Horst Excavating

- Product: SF11
- Scope: 150,000 yd^2

Owner saved **$300,000** by selecting SF11 over the equivalent PP brand

Storage Yards

- **CalFrac Storage Facility/Haul Roads**
- Western PA
- Owner: CalFrac
- Product: SF11
- Scope: 110,000 yd^2

SF11 was produced in 17’ x 200’ rolls to increase installation efficiency

Parking Lots

- **Love's Travel Stop**
- Columbia, TN

- Owner: Love's Travel Stop
- Engineer: Terracon

- Product: SF12
- Scope: 50,000 yd^2

Railway Stabilization

- **Brunner Island**
- York Haven, PA
- Owner: PP&L
- Product: SF12A
- Scope: 48,000 yd^2

Owner saved **$50,000** by selecting SF12A over the equivalent PP brand

Runways and Taxiways

- **Erie International Airport**
- Erie, PA

- Product: SF11
- Scope: 12,400 yd^2

Biaxial Geogrid Specifications

To date, a universally accepted specification for biaxial geogrids has not been developed. This has created much confusion in the preparation of specifications for base and subgrade reinforcement.

Biaxial Geogrid Specifications

Independent Research Papers

FHWA

•NHI 07 092 Geosynthetics Design and Construction Guidelines 2008

Geosynthetic Materials Association (GMA)

•White paper II, June 2000

US Army Corps of Engineers

•Technical Letter No. 1110-1-189 (Use of Geogrids in Pavement Construction, February 2003)

FHWA, USACOE & GMA Recommended Properties

Ultimate Strength

2% Strain

Junction Strength

Aperture Size/Percent Open Area

Comparison of Physical Properties

JUNCTION STRENGTH OR JUNCTION EFFICIENCY

Please review Synteen Technical Note in your Packet of Information

Federal Highway Recommendations(FHWA)

The Sum of The junction Criteria as follows:

The minimum junction strength (lbs/ft) shall be greater than the ultimate unit strength of a product in a unit area (Square Foot).

Synteen SF 11   91 junctions in a square foot x 37.4 lbs/junction =3403 lbs/ft (Ultimate-2388 lbs/ft)

JUNCTION STRENGTH

The GMA(Geosynthetic Materials Association) based on 19 studies and conversations with State Agencies recommended junction strength to be between 8 lbs and 25 lbs per junction based on fill materials.(See article "Junction Strength Requirements for Roadway Design" in packet.

Synteen SF 11 Junction Strength   37.4 lbs MD
46.3 lbs XMD

Product Specification - Biaxial Geogrid BX1100

Tensar International Corporation reserves the right to change its product specifications at any time. It is the responsibility of the specifier and purchaser to ensure that product specifications used for design and procurement purposes are current and consistent with the products used in each instance.

Product Type:	Integrally Formed Biaxial Geogrid
Polymer:	Polypropylene
Load Transfer Mechanism:	Positive Mechanical Interlock
Primary Applications:	Spectra System (Base Reinforcement, Subgrade Improvement)

Product Properties

Index Properties	Units	MD Values[1]	XMD Values[1]
▪ Aperture Dimensions[2]	mm (in)	25 (1.0)	33 (1.3)
▪ Minimum Rib Thickness[2]	mm (in)	0.76 (0.03)	0.76 (0.03)
▪ Tensile Strength @ 2% Strain[3]	kN/m (lb/ft)	4.1 (280)	6.6 (450)
▪ Tensile Strength @ 5% Strain[3]	kN/m (lb/ft)	8.5 (580)	13.4 (920)
▪ Ultimate Tensile Strength[3]	kN/m (lb/ft)	12.4 (850)	19.0 (1,300)
Structural Integrity			
▪ Junction Efficiency[4]	%	93	
▪ Flexural Stiffness[5]	mg-cm	250,000	
▪ Aperture Stability[6]	m-N/deg	0.32	
Durability			
▪ Resistance to Installation Damage[7]	%SC / %SW / %GP	95 / 93 / 90	
▪ Resistance to Long Term Degradation[8]	%	100	
▪ Resistance to UV Degradation[9]	%	100	

Dimensions and Delivery

The biaxial geogrid shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 3.0 meters (9.8 feet) or 4.0 meters (13.1 feet) in width and 75.0 meters (246 feet) in length. A typical truckload quantity is 185 to 250 rolls.

Notes

1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D4759-02. Brief descriptions of test procedures are given in the following notes.
2. Nominal dimensions.
3. True resistance to elongation when initially subjected to a load determined in accordance with ASTM D6637-01 without deforming test materials under load before measuring such resistance or employing "secant" or "offset" tangent methods of measurement so as to overstate tensile properties.
4. Load transfer capability determined in accordance with GRI-GG2-05 and expressed as a percentage of ultimate tensile strength.
5. Resistance to bending force determined in accordance with ASTM D5732-01, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs (as a "ladder"), and of length sufficiently long to enable measurement of the overhang dimension. The overall Flexural Stiffness is calculated as the square root of the product of MD and XMD Flexural Stiffness values.
6. Resistance to in-plane rotational movement measured by applying a 20 kg-cm (2 m-N) moment to the central junction of a 9 inch x 9 inch specimen restrained at its perimeter in accordance with U.S. Army Corps of Engineers Methodology for measurement of Torsional Rigidity.
7. Resistance to loss of load capacity or structural integrity when subjected to mechanical installation stress in clayey sand (SC), well graded sand (SW), and crushed stone classified as poorly graded gravel (GP). The geogrid shall be sampled in accordance with ASTM D5818-06 and load capacity shall be determined in accordance with ASTM D6637-01.
8. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments in accordance with EPA 9090 immersion testing.
9. Resistance to loss of load capacity or structural integrity when subjected to 500 hours of ultraviolet light and aggressive weathering in accordance with ASTM D4355-05.

Comparison of Physical Properties

FLEXURAL STIFFNESS

5. Resistance to bending force determined in accordance with ASTM D5732-01, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs (as a “ladder”), and of length sufficiently long to enable measurement of the overhang dimension. The overall Flexural Stiffness is calculated as the square root of the product of MD and XMD Flexural Stiffness values.

APERTURE STABILITY

6. Resistance to in-plane rotational movement measured by applying a 20 kg-cm (2 m-N) moment to the central junction of a 9 inch x 9 inch specimen restrained at its perimeter in accordance with U.S. Army Corps of Engineers Methodology for measurement of Torsional Rigidity

Recently Introduced Geogrid Specifications

- The design community has recently been introduced to a new configuration of base/subgrade reinforcement geogrids – triaxial aperture geogrids.

Triaxial Geogrid Specifications

Index Properties	Longitudinal	Diagonal	Transverse	General
▪ Rib pitch[2], mm (in)	40 (1.60)	40 (1.60)	-	
▪ Mid-rib depth[2], mm (in)	-	1.8 (0.07)	1.5 (0.06)	
▪ Mid-rib width[2], mm (in)	-	1.1 (0.04)	1.3 (0.05)	
▪ Nodal thickness[2], mm (in)				3.1 (0.12)
▪ Rib shape				rectangular
▪ Aperture shape				triangular

Structural Integrity	
▪ Junction efficiency[3], %	93
▪ Aperture stability[4], kg-cm/deg @ 5.0kg-cm [2]	3.6
▪ Radial stiffness at low strain[5], kN/m @ 0.5% strain (lb/ft @ 0.5% strain)	300 (20,580)

High Strength Geotextiles

Synteen high-strength geotextiles are available in two polymers:

Polyester

- SC4800 – SC52K
- Tensile Strengths up to 60,000 lb/ft

Polypropylene

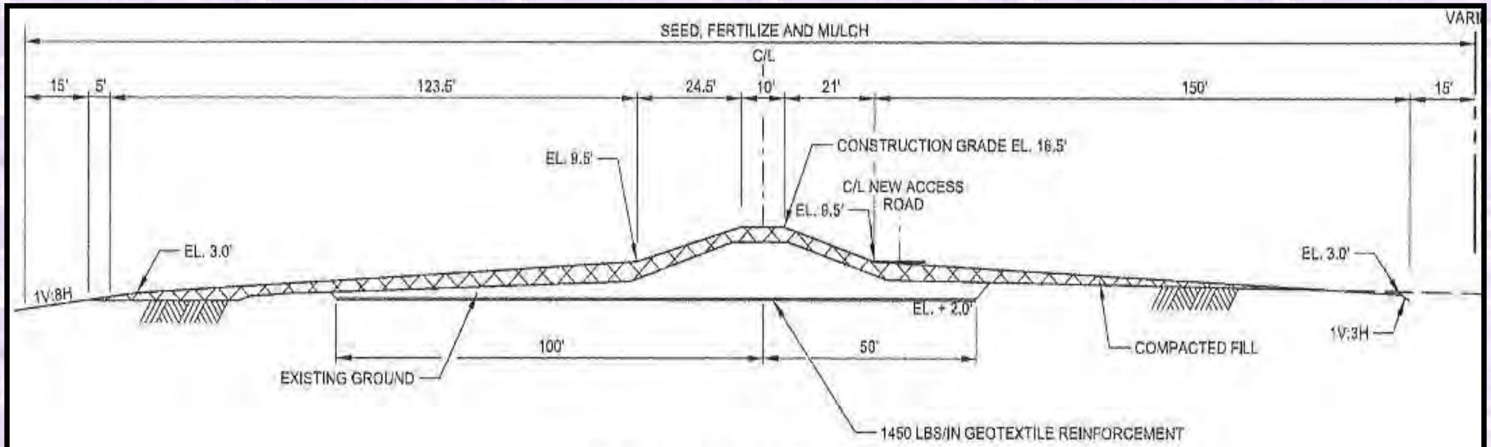
- SP300 – SP500
- Tensile strengths up to 4,800 lb/ft

High Strength Geotextiles

A permeable geosynthetic comprised solely of textiles which perform several functions in geotechnical engineering applications including:

- Reinforcement
- Separation
- Drainage
- Filtration
- Protection

Levee Repair



TYPICAL LEVEE SECTION-1
LEVEE CONSTRUCTION TO EL. 16.5'
DURING HURRICANE SEASON

Questions?

Questions?