

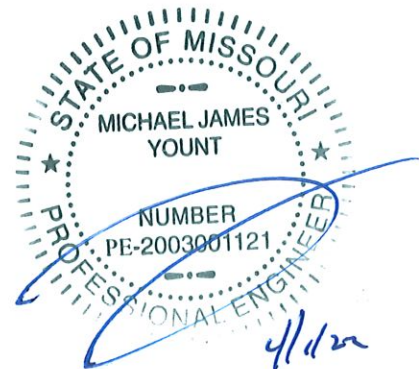
Modular Block Retaining Wall Calculations

MotoMart - Caledonia
8601 HWY DD
O'Fallon, MO 63368

Prepared By:

Engineering
Solutions, P.C.
5393 Old Baumgartner Rd
St. Louis, Mo. 63129
(314) 280-7748

Michael J. Yount, P.E.



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SRWall (Version 4) Report**Project Identification**

Project ID :
Project Name :
Owner :
Client :
Prepared By :
Company : **Retaining Wall Solutions, inc.**
Address : **5393 Old Baumgartner Rd, St. Louis, Mo. 63129**
Telephone : **314-842-8200**
Section :
Project File : **aaa RWS Clean.prj**
Vendor Data File : **GEOSTAR.vdf**
Date and Time : **06/05/2019 15:30:48**

Type of Structure : **Reinforced Wall**

Wall Geometry

Design Wall Height(ft) : **8.33**
Embedment Wall Height(ft) : **0.50**
Exposed Wall Design Height(ft) : **7.83**
Number of Segmental Wall Units : **10**
Wall Inclination(degrees) : **7.13**

Grades

Top Slope(degrees) : **0.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf) : **250.00**
Live Load Surcharge Setback(ft) : **3.00**
Dead Load Surcharge(Psf) : **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	1"-2" Clean	N/A	40.00	100.00
Retained Soil	Low Plastic Silty Clay	N/A	26.00	120.00
Leveling Pad Soil	1" clean or minus	N/A	38.00	100.00
Foundation Soil	Low Plastic Silty Clay	150.00	26.00	120.00

Segmental Unit Data

Segmental Unit Name	: Versa-Lok Mosaic
Cap Height (Inches)	: 0.00
Unit Height (Hu)(Inches)	: 10.00
Unit Width (Wu)(Inches)	: 12.00
Unit Length (Inches)	: 18.00
Setback (Inches)	: 1.25
Weight (Infilled)(lb)	: 150.00
Unit Weight (Infilled)(pcf)	: 120.00
Center of Gravity(Inches)	: 6.00

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
Geostar Technologies, LLC	HP200	3
Geostar Technologies, LLC	HP300	0
Geostar Technologies, LLC	HP500	0
Geostar Technologies, LLC	HP700	0

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
HP200	3373.00	1.55	1.10	1.25	1582.64	0.85	0.85
HP300	4650.00	1.55	1.10	1.25	2181.82	0.85	0.85
HP500	7952.00	1.55	1.10	1.25	3731.14	0.85	0.85
HP700	10688.00	1.55	1.10	1.25	5014.90	0.85	0.85

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
585.00	56.00	6000.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
HP200	1055.00	1799.00	1633.00	1800.00	1634.00
HP300	1235.00	2999.00	2553.00	3000.00	2554.00
HP500	1530.00	4199.00	3899.00	4200.00	3900.00
HP700	2445.00	5999.00	4475.00	6000.00	4476.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
HP200	585.00	56.00	6000.00
HP300	585.00	56.00	6000.00
HP500	585.00	56.00	6000.00
HP700	585.00	56.00	6000.00

Vertical Components

Vertical Components of Earth Pressures Used : No

Coefficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	: 0.155
Reinforcement Soil(Static)(Kah Horizontal Component)	: 0.146
Internal Modified Back Slope(Bint)	: 0.000
Orientation of failure plane from horizontal(degrees) for Internal Stability	: 59.139
Retained Soil(Static)(Ka)	: 0.292
Retained Soil(Static)(Kah Horizontal Component)	: 0.276
External Modified Back Slope(Bext)	: 0.000
Orientation of failure plane from horizontal(degrees) for External Stability	: 49.571

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.61	> 1.50
FOS Overturning	2.21	> 2.00
FOS Bearing Capacity	4.09	> 2.00
Base Reinforcement Length (L)(ft)	5.00	
Base Reinforcement Ratio (L/H)	0.60	> 0.60

Detailed Result of External Stability Analysis

	Calculated
Total Horizontal Force (lb/ft)	1724.92
Total Vertical Force (lb/ft)	4166.67
Sliding Resistance (lb/ft)	2782.22
Driving Moment (lb-ft/ft)	5590.02
Resisting Moment (lb-ft/ft)	12369.79
Bearing Capacity (psf)	6497.71
Base Eccentricity (e)(ft.)	0.87
Eccentricity Ratio (e/L-2e)	0.27
Maximum Bearing Pressure (psf)	1587.65

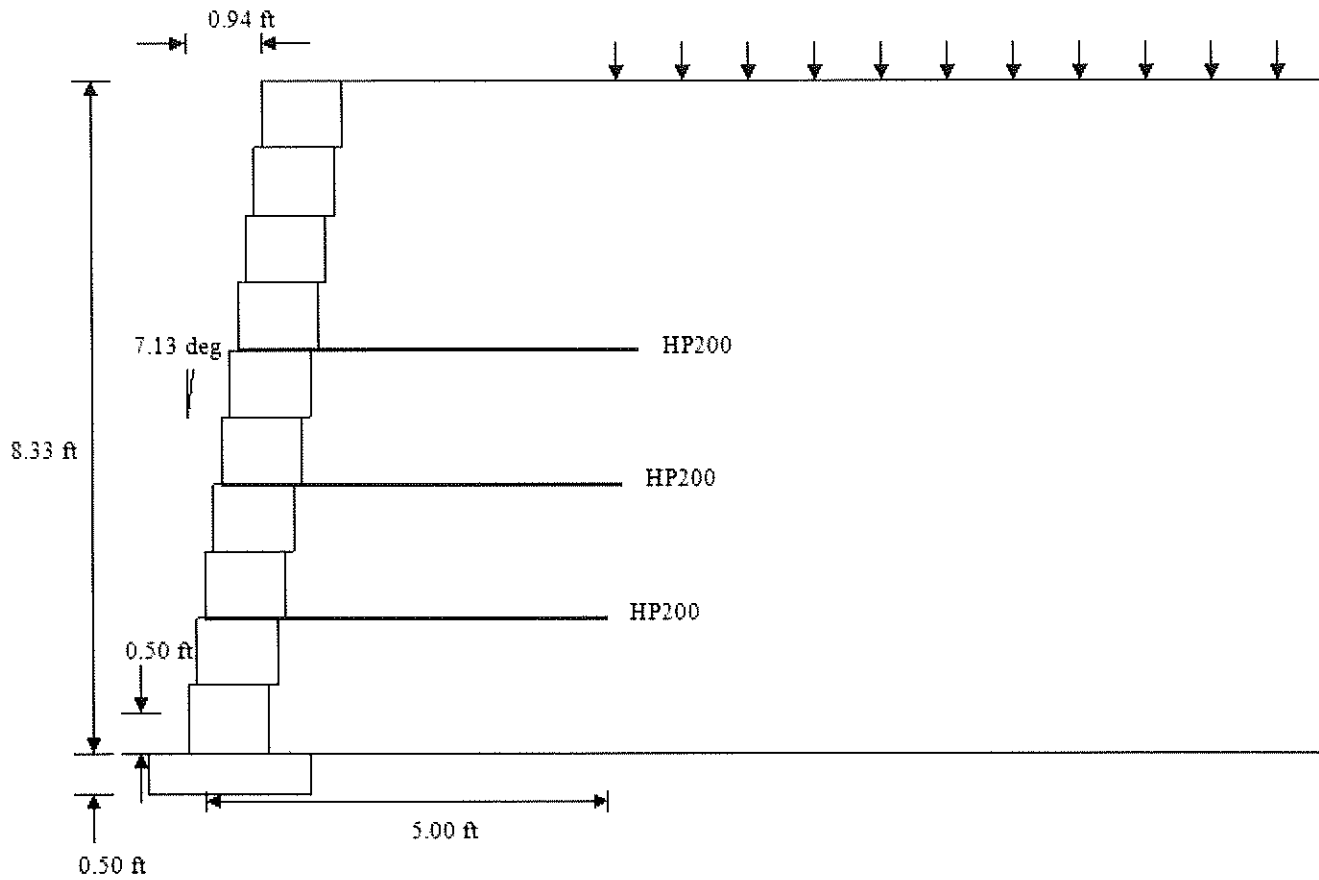
Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress ≥ 1.50	FOS Pullout ≥ 1.50	FOS Slide ≥ 1.50	Layer Spacing (ft) ≥ 2.00
7	HP200	5.00	5.00	1.64	5.68	2.79	5.14	OK
5	HP200	3.33	5.00	2.43	8.69	9.50	3.82	OK
3	HP200	1.67	5.00	3.21	4.53	8.73	3.07	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >= 1.50	FOS Connection >= 1.50
7	5.00	HP200	2.91	9.34
5	3.33	HP200		10.27
3	1.67	HP200		5.08

Wall Reinforcement Layout



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Wall Geometry

Design Wall Height(ft) : **5.83**
Embedment Wall Height(ft) : **0.50**
Exposed Wall Design Height(ft) : **5.33**
Number of Segmental Wall Units : **7**
Wall Inclination(degrees) : **7.13**

Grades

Top Slope(degrees) : **0.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf) : **250.00**
Live Load Surcharge Setback(ft) : **3.00**
Dead Load Surcharge(Psf) : **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
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Retained Soil	Low Plastic Silty Clay	N/A	26.00	120.00
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Foundation Soil	Low Plastic Silty Clay	150.00	26.00	120.00

Segmental Unit Data

Segmental Unit Name	: Versa-Lok Mosaic
Cap Height (Inches)	: 0.00
Unit Height (Hu)(Inches)	: 10.00
Unit Width (Wu)(Inches)	: 12.00
Unit Length (Inches)	: 18.00
Setback (Inches)	: 1.25
Weight (Infilled)(lb)	: 150.00
Unit Weight (Infilled)(pcf)	: 120.00
Center of Gravity(Inches)	: 6.00

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
Geostar Technologies, LLC	HP200	2
Geostar Technologies, LLC	HP300	0
Geostar Technologies, LLC	HP500	0
Geostar Technologies, LLC	HP700	0

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
HP200	3373.00	1.55	1.10	1.25	1582.64	0.85	0.85
HP300	4650.00	1.55	1.10	1.25	2181.82	0.85	0.85
HP500	7952.00	1.55	1.10	1.25	3731.14	0.85	0.85
HP700	10688.00	1.55	1.10	1.25	5014.90	0.85	0.85

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
585.00	56.00	6000.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity (lb/ft)
HP200	1055.00	1799.00	1633.00	1800.00	1634.00
HP300	1235.00	2999.00	2553.00	3000.00	2554.00
HP500	1530.00	4199.00	3899.00	4200.00	3900.00
HP700	2445.00	5999.00	4475.00	6000.00	4476.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
HP200	585.00	56.00	6000.00
HP300	585.00	56.00	6000.00
HP500	585.00	56.00	6000.00
HP700	585.00	56.00	6000.00

Vertical Components

Vertical Components of Earth Pressures Used : No

Coefficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	: 0.155
Reinforcement Soil(Static)(Kah Horizontal Component)	: 0.146
Internal Modified Back Slope(Bint)	: 0.000
Orientation of failure plane from horizontal(degrees) for Internal Stability	: 59.139
Retained Soil(Static)(Ka)	: 0.292
Retained Soil(Static)(Kah Horizontal Component)	: 0.276
External Modified Back Slope(Bext)	: 0.000
Orientation of failure plane from horizontal(degrees) for External Stability	: 49.571

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.80	> 1.50
FOS Overturning	2.38	> 2.00
FOS Bearing Capacity	5.27	> 2.00
Base Reinforcement Length (L)(ft)	4.00	
Base Reinforcement Ratio (L/H)	0.69	> 0.60

Detailed Result of External Stability Analysis

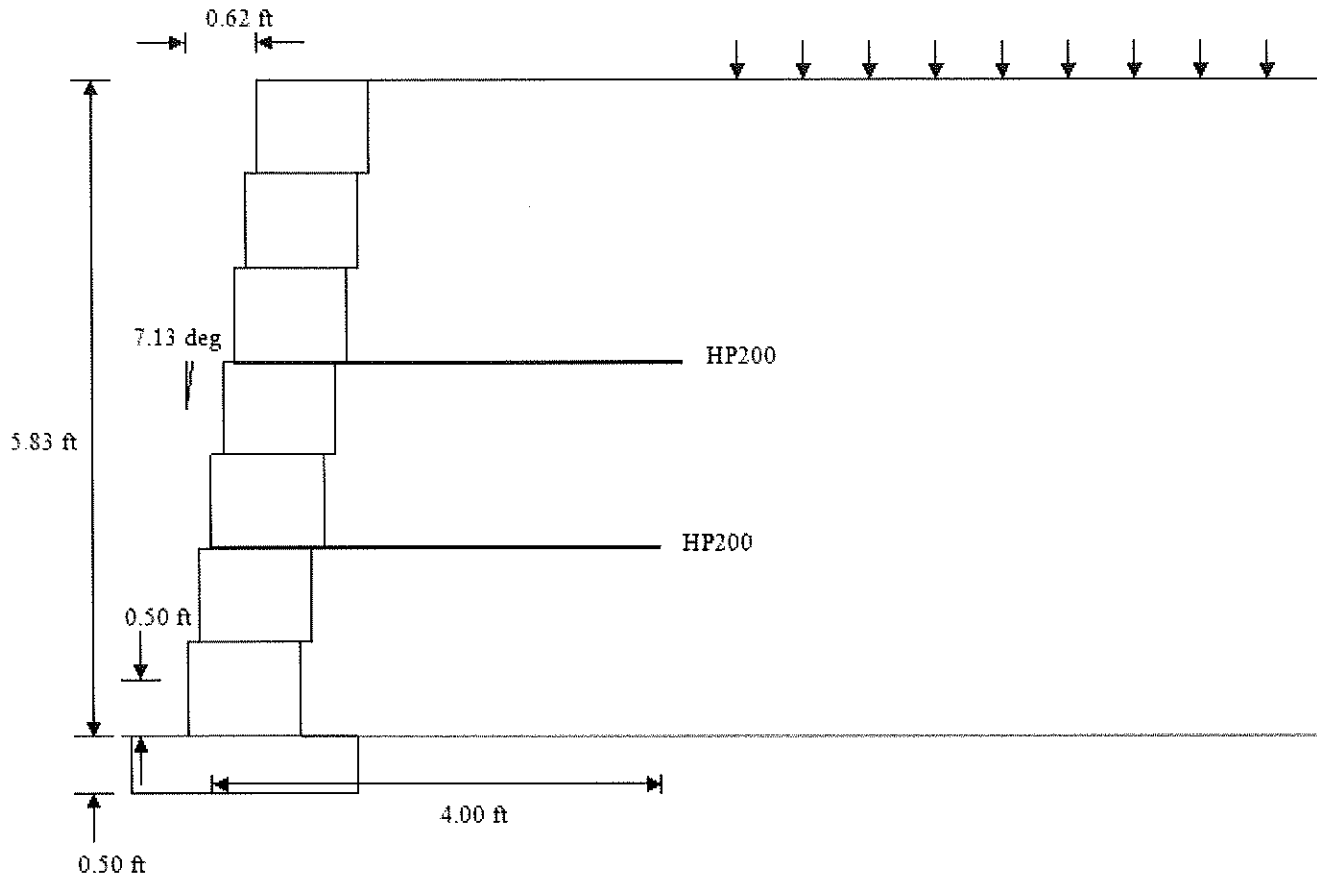
	Calculated
Total Horizontal Force (lb/ft)	965.96
Total Vertical Force (lb/ft)	2333.33
Sliding Resistance (lb/ft)	1738.04
Driving Moment (lb-ft/ft)	2269.55
Resisting Moment (lb-ft/ft)	5395.83
Bearing Capacity (psf)	6065.41
Base Eccentricity (e)(ft.)	0.66
Eccentricity Ratio (e/L-2e)	0.25
Maximum Bearing Pressure (psf)	1150.64

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.00
5	HP200	3.33	4.00	1.43	7.81	2.51	5.66	OK
3	HP200	1.67	4.00	2.21	6.13	5.08	3.86	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling ≥ 1.50	FOS Connection ≥ 1.50
5	3.33	HP200	4.76	14.21
3	1.67	HP200		7.27

Wall Reinforcement Layout**Project Identification**

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Mosaic[®]

Design & Installation Guidelines




VERSA-LOK[®]
Retaining Wall Systems
Solid Solutions.™



Color Swatches



Pavers

Retaining Walls

BLENDED COLOR OPTIONS	
	Autumn Hickory Blend
	Bethany Ledge Blend
	Harvest Blend
	Mountain Gray Blend
	Terra Cotta Blend
	Timberwood Blend

SOLID COLOR OPTIONS	
	Classic Red
	Limestone
	Pecan
	Slate
	Wheat



Bethany Ledge

Charcoal Blend



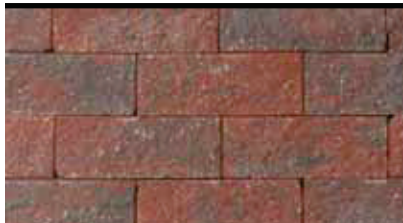
Sandstone Blend



Timberwood Blend



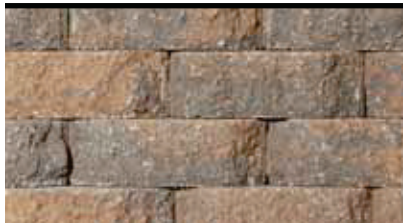
Terra Cotta Blend



Tan



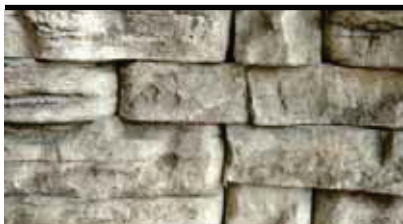
Desert Blend



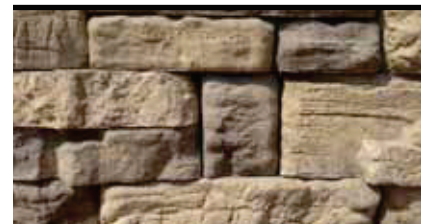
Limestone



Cedar Valley



Ozark Blend





Mirafi[®] 140N

Mirafi[®] 140N is a nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. 140N is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Grab Tensile Strength	ASTM D 4632	kN (lbs)	0.53 (120)	0.53 (120)
Grab Tensile Elongation	ASTM D 4632	%	50	50
Trapezoid Tear Strength	ASTM D 4533	kN (lbs)	0.22 (50)	0.22 (50)
Mullen Burst Strength	ASTM D 3786	kPa (psi)	1550 (225)	
Puncture Strength ¹	ASTM D 4833	kN (lbs)	0.30 (65)	
CBR Puncture Strength	ASTM D 6241	kN (lbs)	1.33 (300)	
Apparent Opening Size (AOS)	ASTM D 4751	mm (U.S. Sieve)	0.212 (70)	
Permittivity	ASTM D 4491	sec ⁻¹	1.8	
Permeability	ASTM D 4491	cm/sec	0.21	
Flow Rate	ASTM D 4491	l/min/m ² (gal/min/ft ²)	5500 (135)	
UV Resistance (at 500 hours)	ASTM D 4355	% strength retained	70	

¹ ASTM D 4833 has been replaced with ASTM D 6241

Physical Properties	Test Method	Unit	Typical Value	
Weight	ASTM D 5261	g/m ² (oz/yd ²)	163 (4.8)	
Thickness	ASTM D 5199	mm (mils)	1.4 (55)	
Roll Dimensions (width x length)	--	m (ft)	3.8 x 110 (12.5 x 360)	4.5 x 110 (15 x 360)
Roll Area	--	m ² (yd ²)	418 (500)	502 (600)
Estimated Roll Weight	--	kg (lb)	74 (164)	89 (197)

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GeoGrid.

The underlining principles of viable walls.



Dependable **GeoGrid**, available in a wide variety of strengths, and the finer-patterned **GeoFace** are Geostar's polyester grid lines. Connection tested with all major SRW products, this is the stuff viability is made of and technical data is readily available that proves it.

And both, like all Geostar products, are strategically positioned by purpose, price, proximity and performance.

We have what you need, you can afford it, we can get it to you, and you'll get more than you need from it.

All proven.

geostar
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GeoGrid Product Data

FaceGrid™

HP Polyester GeoGrid Styles

Materials	Symbol	Test Method	MG100		HP200		HP300		HP500		HP600		
			kN/m	lbf/ft	kN/m	lbf/ft	kN/m	lbf/ft	kN/m	lbf/ft	kN/m	lbf/ft	
Polymer	—	—	PET/PET		PET/PET		PET/PET		PET/PET		PET/PET		
Coating	—	—	PVC		PVC		PVC		PVC		PVC		
Tensile Properties			kN/m		kN/m		kN/m		kN/m		kN/m		
MD-Ultimate Strength ¹	T _{ULT}	ASTM D 6637	21.6	1480	50.2	3437	70.3	4815	117.1	8025	128.6	8809	
MD-Creep Limited Strength	T _L	ASTM D 5262	13.5	925	32.4	2217	45.3	3106	75.6	5177	82.9	5683	
CMD-Ultimate Strength ¹	T _{ULT}	ASTM D 6637	21.4	1465	29.2	2000	29.2	2000	29.2	2000	29.2	2000	
Reduction Factors													
Creep Reduction Factor	RF _{CR}	ASTM D 5262	1.60	1.60	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	
Durability Reduction Factor (3 < pH < 9)	RF _D	ASTM D 2455	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	
Installation Damage Reduction Factor	RF _{ID}	ASTM D 5818											
Soil Type 1 (Sand, Silt & Clay, D50<6mm)			1.2	1.2	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	
Soil Type 2 (0.75" minus angular aggregate, D50<6mm)			1.30	1.30	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	
Soil Type 3 (1.5" minus angular aggregate, D50<20mm)			1.40	1.40	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	
Design Strength Properties			kN/m		kN/m		kN/m		kN/m		kN/m		
Long Term Design Strength ²	LTDS	—											
T _{ULT} / RF for Soil Type 1			10.2	701	28.0	1920	39.3	2690	65.4	4483	71.8	4921	
T _{ULT} / RF for Soil Type 2			9.4	647	26.7	1833	37.5	2567	62.4	4279	68.5	4697	
T _{ULT} / RF for Soil Type 3			8.8	601	23.5	1613	33.0	2259	55.0	3765	60.3	4133	
Design Interaction Properties													
Coefficient of Interaction	C _i	ASTM D 6706											
Soil Type 1			0.6 - 0.7		0.7 - 0.8		0.7 - 0.8		0.7 - 0.8		0.7 - 0.8		
Soil Type 2			0.7 - 0.8		0.8 - 0.9		0.8 - 0.9		0.8 - 0.9		0.8 - 0.9		
Soil Type 3			0.9 - 1.1		0.9 - 1.0		0.9 - 1.0		0.9 - 1.0		0.9 - 1.0		
Coefficient of Direct Sliding	C _{ds}	ASTM D 5321											
Soil Type 1			0.7		0.7		0.7		0.7		0.7		
Soil Type 2			0.8		0.8		0.8		0.8		0.8		
Soil Type 3			0.9		0.9		0.9		0.9		0.9		
Scale Correction Factor	α		—		—		—		—		—		
Physical Properties	Units		Test Method		SI	US	SI	US	SI	US	SI	US	
	SI	US											
MD-Aperture Size	mm	in	Measured	2.54	0.10	21.59	0.85	21.59	0.85	20.32	0.80	20.32	0.80
CMD-Aperture Size	mm	in	Measured	2.54	0.10	20.83	0.82	20.32	0.80	19.05	0.75	18.29	0.72
Packaging													
Roll Width	m	ft	Measured	2.9	9.5	2.5	8.2	2.5	8.2	2.5	8.2	2.0	6.56
Roll Length	m	ft	Measured	72.2	237	67.0	220.0	67.0	220.0	67.0	220.0	83.8	275.0
Area Per Roll	m ²	yd ²	Measured	209.2	250.2	167.5	200.3	167.5	200.3	167.5	200.3	167.5	200.3
Weight Per Roll	kgs	lbs	Measured	57.5	127	56.0	122.0	61.0	134.0	61.0	189.0	100.0	221.0

¹ The values reported are calculated as the mean value minus two standard deviations. Statistically, the values yield a 97.7% degree of confidence that any sample of fabric tested will exceed the value reported.

² Long Term Design Strength is LTDS or TAL = T_{ULT} / (R_{FCR} x R_{FD} x R_D).