Appendix 10-2

Road Design Calculations

Unpaved Road & Subgrade Stabilization

Application Suggestion Summary

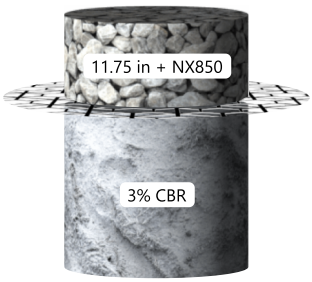
Tensar
A Division of CMC

Design	Typical Gravel Access Road	**Reference**	
Project	Mill Point Solar	**Location**	WJ5V+38 Glen, NY, USA
Customer		**Designer**	Patrick Martin
Company	TRC	**Date**	June 26, 2024

Design Methodology
The Lees Approach to Applied Mechanical Stabilization for stabilizing soft subgrades to support construction and in-service traffic by incorporating the true behavior of mechanically stabilized unbound aggregate layers subjected to dynamic stresses from vehicular loading.

Results

Stabilized
$19.38/yd^2



Unstabilized
$30.79/yd^2

	Stabilized	Unstabilized
Total thickness	11.75 in	26.75 in
Surface rut depth	0.6 in	1.35 in
Enhanced modulus, M_r	16,000 psi	
Required 18 kips ESALs	1,320	1,320
Subgrade protection level	IMPROVED	UNPROTECTED
Controlling design	Subgrade protection level	Bearing capacity

Total cost	$2	$3
Unit cost	$19.38/yd^2	$30.79/yd^2
Construction time	0 days	0 days
Dump truck visits	2	2
Fuel required	11 gal	11 gal
Water required	1 gal	2 gal
Carbon emissions	0 tonnes CO_2e	0 tonnes CO_2e

Parameters

Construction Traffic

Axle load	40 kip
Axle passes	1,200
Tire width	295 mm
Tire pressure	110 psi
Wheel configuration	Dual wheel
Wander	3 ft

In-Service Traffic

Axle load	32 kip
Axle passes	120
Tire width	295 mm
Tire pressure	110 psi
Wheel configuration	Dual wheel
Wander	3 ft

Aggregate

Unit weight	135 pcf
Surface rut depth	1.5 in
D_{100}	2 in
D_{50}	0.4 in

Subgrade

Soil type	Silt
Plasticity	Low (ML)
CBR	3%
Separation geosynthetic	No
Subgrade protection level	Improved
Design for waterbed effect	No

Dimensions

Project area	1 ft^2

Material Costs (Installed)

Aggregate cost	$20.00/ton

Geosynthetic Costs (Installed)

NX850	$5.85/yd^2

Grading Requirements

Grade offset	Meet existing grade
Excavation cost	$5.00/yd^3

Specification
To protect the performance and value achieved, a specification is generated/attached to accompany the completed design. The content of the specification provides the most effective protection to the achieved performance in a format that can be used within any project documentation.

Supporting Documents
To provide further support and advice for your completed Tensar design, documents relating to this application can be found in the "Resources" section of Tensar+. These include installation advice, background to the available value and project case studies.

Unpaved Road & Subgrade Stabilization

Application Suggestion Summary

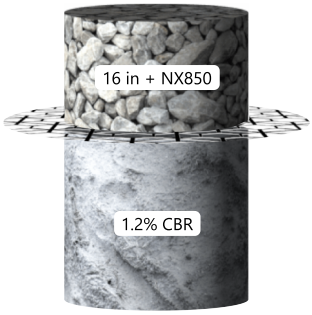
Tensar
A Division of CMC

Design	Stabilized Pervious Access Road - CBR 1.2	**Reference**	
Project	Mill Point Solar	**Location**	WJ5V+38 Glen, NY, USA
Customer		**Designer**	Patrick Martin
Company	TRC	**Date**	May 23, 2024

Design Methodology
The Lees Approach to Applied Mechanical Stabilization for stabilizing soft subgrades to support construction and in-service traffic by incorporating the true behavior of mechanically stabilized unbound aggregate layers subjected to dynamic stresses from vehicular loading.

Results

Stabilized
$25.32/yd²



Unstabilized
$39.33/yd²

	Stabilized	Unstabilized
Total thickness	16 in	33.25 in
Surface rut depth	0.6 in	1.9 in
Enhanced modulus, M_r	16,000 psi	
Required ESALs	1,320	1,320
Subgrade protection level	IMPROVED	UNPROTECTED
Controlling design	Subgrade protection level	Bearing capacity

Total cost	$3	$4
Unit cost	$25.32/yd²	$39.33/yd²
Construction time	0 days	0 days
Dump truck visits	2	2
Fuel required	11 gal	11 gal
Water required	1 gal	3 gal
Carbon emissions	0 tonnes CO_2e	0 tonnes CO_2e

Parameters

Construction Traffic

Axle load	40 kip
Axle passes	1,200
Tire width	295 mm
Tire pressure	110 psi
Wheel configuration	Dual wheel
Wander	3 ft

In-Service Traffic

Axle load	32 kip
Axle passes	120
Tire width	295 mm
Tire pressure	110 psi
Wheel configuration	Dual wheel
Wander	3 ft

Aggregate

Unit weight	135 pcf
Surface rut depth	2 in
D_{100}	3 in
D_{50}	1.2 in

Subgrade

Soil type	Silt
Plasticity	Low (ML)
CBR	1.2%
Separation geosynthetic	Yes
Subgrade protection level	Improved
Design for waterbed effect	No

Dimensions

Project area	1 ft²

Material Costs (Installed)

Aggregate cost	$20.00/ton

Geosynthetic Costs (Installed)

NX850	$5.85/yd²

Grading Requirements

Grade offset	Meet existing grade
Excavation cost	$5.00/yd³

Specification
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Supporting Documents
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Load Support Calculation Summary
Soil Stabilization Using the GEOWEB System

Unpaved Road and Soft Subgrade Stabilization

Project Name:	Mill Point Solar	**Company:**	TRC
Calculation Name:	Stabilized Pervious Access Road - CBR 1.2	**Designer:**	Patrick Martin
Project Location:	Glen, NY	**Title:**	Lead Civil Engineer
Client:	TRC	**Date:**	2024-05-22 13:50:58

Calculation Method: Bearing capacity evaluation methods consistent with Koerner (2012) and Avesani (2013), including combined effects of lateral confinement, tension membrane effect, and stress dispersion for a GEOWEB®-reinforced layer underlain by a geotextile, with hoop stress analysis for verification of system mechanical properties.

Calculation Parameters

Layer Type

Wear Surface Thickness (in):	2
GEOWEB®-Stabilized Layer (in):	8
Base Layer Thickness (in):	0
Geotextile Type:	Enhanced Woven (4,800 lbs/ft)

Subgrade Below GEOWEB®

CBR (%):	1.2

GEOWEB® Infill

Type:	Open Graded Aggregate
Unit Weight (lb/ft^3):	120
Friction Angle:	30°

Required Information

Traffic Load Rating:	AASHTO H/HS25
Wheel Load (lbf):	20000
Tire Pressure (psi):	125
Desired Factor of Safety:	1

Results

Bearing Capacity Enhancement

Distributed Stress on Subgrade (psi):	30.83	Acceptable
Allowable Subgrade Stress (psi):	35.94	
Calculated Factor of Safety:	1.17	

Hoop Stress Check (Genuine GEOWEB® Mechanical Properties)

Perforated Cell Wall:	9.64	FoS, Cell Wall Rupture	System Components Meet Load Requirements
Internal Junctions (Seams):	14.02	FoS, Resistance to Peel	
	21.04	FoS, Resistance to Shear	
	16.65	FoS, Resistance to Separation	
Mechanical Junctions (ATRA® Key):	3.29	FoS, Resistance to Peel	
	5.48	FoS, Resistance to Shear	
	4.25	FoS, Resistance to Separation	

Notes

1. Refer to the Geoweb Construction Resource Package for a complete description of installation and construction methods. Contact Presto for product selection and to confirm cell size and material gauge.
2. Install above-referenced geotextile type in accordance with Manufacturer recommendations including overlaps based on sub grade CBR.
3. Geoweb panels shall be connected with ATRA keys at each interleaf and end to end connection. Use anchors to keep panels open for infill as required.
4. Infill Materials: Sand should be course-grained. Aggregate size shall be maximum of 1/3 the depth of the Geoweb cells. Engineered fill is a mixture of aggregate and topsoil that allows for a vegetated driving surface. On-site salvaged material should be granular with a particle diameter no greater than 1/3 the depth of the Geoweb cells. In all cases, fines should be limited to less than 10%. Contact Presto Geosystems if there are questions about the use of specific materials.

Limitations

Unpaved Road & Subgrade Stabilization

Application Suggestion Summary

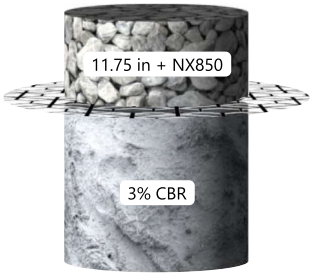
Tensar
A Division of CMC

Design	Stabilized Pervious Access Road - CBR 3.0	**Reference**	
Project	Mill Point Solar	**Location**	WJ5V+38 Glen, NY, USA
Customer		**Designer**	Patrick Martin
Company	TRC	**Date**	May 23, 2024

Design Methodology
The Lees Approach to Applied Mechanical Stabilization for stabilizing soft subgrades to support construction and in-service traffic by incorporating the true behavior of mechanically stabilized unbound aggregate layers subjected to dynamic stresses from vehicular loading.

Results

Stabilized
$20.43/yd^2



Unstabilized
$31.27/yd^2

	Stabilized	Unstabilized
Total thickness	11.75 in	26.25 in
Surface rut depth	0.6 in	2 in
Enhanced modulus, M_r	16,000 psi	
Required ESALs	1,320	1,320
Subgrade protection level	IMPROVED	UNPROTECTED
Controlling design	Subgrade protection level	Bearing capacity

Total cost	$2	$3
Unit cost	$20.43/yd^2	$31.27/yd^2
Construction time	0 days	0 days
Dump truck visits	2	2
Fuel required	11 gal	11 gal
Water required	1 gal	2 gal
Carbon emissions	0 tonnes CO_2e	0 tonnes CO_2e

Parameters

Construction Traffic

Axle load	40 kip
Axle passes	1,200
Tire width	295 mm
Tire pressure	110 psi
Wheel configuration	Dual wheel
Wander	3 ft

In-Service Traffic

Axle load	32 kip
Axle passes	120
Tire width	295 mm
Tire pressure	110 psi
Wheel configuration	Dual wheel
Wander	3 ft

Aggregate

Unit weight	135 pcf
Surface rut depth	2 in
D_{100}	3 in
D_{50}	1.2 in

Subgrade

Soil type	Silt
Plasticity	Low (ML)
CBR	3%
Separation geosynthetic	Yes
Subgrade protection level	Improved
Design for waterbed effect	No

Dimensions

Project area	1 ft^2

Material Costs (Installed)

Aggregate cost	$20.00/ton

Geosynthetic Costs (Installed)

NX850	$5.85/yd^2

Grading Requirements

Grade offset	Meet existing grade
Excavation cost	$5.00/yd^3

Specification
To protect the performance and value achieved, a specification is generated/attached to accompany the completed design. The content of the specification provides the most effective protection to the achieved performance in a format that can be used within any project documentation.

Supporting Documents
To provide further support and advice for your completed Tensar design, documents relating to this application can be found in the "Resources" section of Tensar+. These include installation advice, background to the available value and project case studies.

Load Support Calculation Summary
Soil Stabilization Using the GEOWEB System

Unpaved Road and Soft Subgrade Stabilization

Project Name:	Mill Point Solar	**Company:**	TRC
Calculation Name:	Stabilized Pervious Access Road - CBR 3.0	**Designer:**	Patrick Martin
Project Location:	Glen, NY	**Title:**	Lead Civil Engineer
Client:	TRC	**Date:**	2024-05-22 14:44:29

Calculation Method: Bearing capacity evaluation methods consistent with Koerner (2012) and Avesani (2013), including combined effects of lateral confinement, tension membrane effect, and stress dispersion for a GEOWEB®-reinforced layer underlain by a geotextile, with hoop stress analysis for verification of system mechanical properties.

Calculation Parameters

Layer Type

Wear Surface Thickness (in):	2
GEOWEB®-Stabilized Layer (in):	8
Base Layer Thickness (in):	0
Geotextile Type:	Enhanced Woven (2,600 lbs/ft)

Subgrade Below GEOWEB®

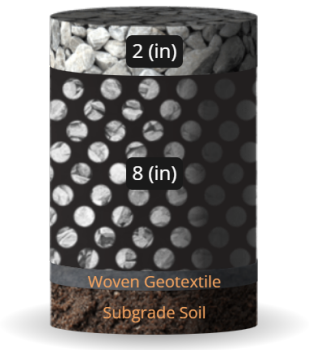
CBR (%):	3.0

GEOWEB® Infill

Type:	Aggregate
Unit Weight (lb/ft^3):	120
Friction Angle:	30°

Required Information

Traffic Load Rating:	AASHTO H/HS25
Wheel Load (lbf):	20000
Tire Pressure (psi):	125
Desired Factor of Safety:	1.3



Results

Bearing Capacity Enhancement

Distributed Stress on Subgrade (psi):	30.83	Acceptable
Allowable Subgrade Stress (psi):	78.12	
Calculated Factor of Safety:	2.53	

Hoop Stress Check (Genuine GEOWEB® Mechanical Properties)

Perforated Cell Wall:	9.64	FoS, Cell Wall Rupture	System Components Meet Load Requirements
Internal Junctions (Seams):	14.02	FoS, Resistance to Peel	
	21.04	FoS, Resistance to Shear	
	16.65	FoS, Resistance to Separation	
Mechanical Junctions (ATRA® Key):	3.29	FoS, Resistance to Peel	
	5.48	FoS, Resistance to Shear	
	4.25	FoS, Resistance to Separation	

Notes

1. Refer to the Geoweb Construction Resource Package for a complete description of installation and construction methods. Contact Presto for product selection and to confirm cell size and material gauge.
2. Install above-referenced geotextile type in accordance with Manufacturer recommendations including overlaps based on sub grade CBR.
3. Geoweb panels shall be connected with ATRA keys at each interleaf and end to end connection. Use anchors to keep panels open for infill as required.
4. Infill Materials: Sand should be course-grained. Aggregate size shall be maximum of 1/3 the depth of the Geoweb cells. Engineered fill is a mixture of aggregate and topsoil that allows for a vegetated driving surface. On-site salvaged material should be granular with a particle diameter no greater than 1/3 the depth of the Geoweb cells. In all cases, fines should be limited to less than 10%. Contact Presto Geosystems if there are questions about the use of specific materials.

Limitations

Unpaved Road & Subgrade Stabilization

Application Suggestion Summary

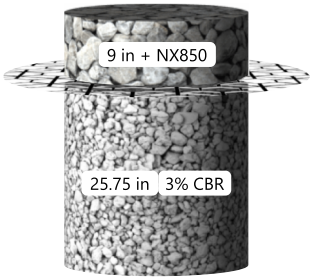
Tensar
A Division of CMC

Design	Vegetated Turnaround	**Reference**	
Project	Mill Point Solar	**Location**	WJ5V+38 Glen, NY, USA
Customer		**Designer**	Patrick Martin
Company	TRC	**Date**	May 23, 2024

Design Methodology
The Lees Approach to Applied Mechanical Stabilization for stabilizing soft subgrades to support construction and in-service traffic by incorporating the true behavior of mechanically stabilized unbound aggregate layers subjected to dynamic stresses from vehicular loading.

Results

Stabilized
$16.21/yd^2



Unstabilized
$30.79/yd^2

	Stabilized	Unstabilized
Total thickness	9 in	26.75 in
Surface rut depth	1.45 in	1.4 in
Enhanced modulus, M_r	16,000 psi	
Required ESALs	1,224	1,224
Subgrade protection level	ADEQUATE	UNPROTECTED
Controlling design	Bearing capacity	Bearing capacity

Total cost	$2	$3
Unit cost	$16.21/yd^2	$30.79/yd^2
Construction time	0 days	0 days
Dump truck visits	2	2
Fuel required	11 gal	11 gal
Water required	1 gal	2 gal
Carbon emissions	0 tonnes CO_2e	0 tonnes CO_2e

Parameters

Construction Traffic

Axle load	40 kip
Axle passes	1,200
Tire width	295 mm
Tire pressure	110 psi
Wheel configuration	Dual wheel
Wander	3 ft

In-Service Traffic

Axle load	32 kip
Axle passes	24
Tire width	295 mm
Tire pressure	110 psi
Wheel configuration	Dual wheel
Wander	3 ft

Aggregate

Unit weight	135 pcf
Surface rut depth	1.5 in
D_{100}	1.5 in
D_{50}	0.5 in

Subgrade

Soil type	Gravel
CBR	3%
Separation geosynthetic	No
Subgrade protection level	Adequate

Dimensions

Project area	1 ft^2

Material Costs (Installed)

Aggregate cost	$20.00/ton

Geosynthetic Costs (Installed)

NX850	$5.85/yd^2

Grading Requirements

Grade offset	Meet existing grade
Excavation cost	$5.00/yd^3

Specification
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Supporting Documents
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Load Support Calculation Summary
Soil Stabilization Using the GEOWEB System

Unpaved Road and Soft Subgrade Stabilization

Project Name:	Mill Point Solar	**Company:**	TRC
Calculation Name:	Vegetated Turnaround	**Designer:**	Patrick Martin
Project Location:	Glen, NY	**Title:**	Lead Civil Engineer
Client:	TRC	**Date:**	2024-05-17 15:59:23

Calculation Method: Bearing capacity evaluation methods consistent with Koerner (2012) and Avesani (2013), including combined effects of lateral confinement, tension membrane effect, and stress dispersion for a GEOWEB®-reinforced layer underlain by a geotextile, with hoop stress analysis for verification of system mechanical properties.

Calculation Parameters

Layer Type

Wear Surface Thickness (in):	2
GEOWEB®-Stabilized Layer (in):	6
Base Layer Thickness (in):	0
Geotextile Type:	Enhanced Woven (2,600 lbs/ft)

Subgrade Below GEOWEB®

CBR (%):	3.0

GEOWEB® Infill

Type:	Engineered Infill - Vegetated Surface
Unit Weight (lb/ft^3):	120
Friction Angle:	30°

Required Information

Traffic Load Rating:	AASHTO H/HS25
Wheel Load (lbf):	20000
Tire Pressure (psi):	125
Desired Factor of Safety:	1.3

Results

Bearing Capacity Enhancement

Distributed Stress on Subgrade (psi):	51.25	Acceptable
Allowable Subgrade Stress (psi):	78.12	
Calculated Factor of Safety:	1.52	

Hoop Stress Check (Genuine GEOWEB® Mechanical Properties)

Perforated Cell Wall:	9.50	FoS, Cell Wall Rupture	System Components Meet Load Requirements
Internal Junctions (Seams):	12.92	FoS, Resistance to Peel	
	19.37	FoS, Resistance to Shear	
	15.34	FoS, Resistance to Separation	
Mechanical Junctions (ATRA® Key):	3.82	FoS, Resistance to Peel	
	6.86	FoS, Resistance to Shear	
	5.19	FoS, Resistance to Separation	

Notes

1. Refer to the Geoweb Construction Resource Package for a complete description of installation and construction methods. Contact Presto for product selection and to confirm cell size and material gauge.
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3. Geoweb panels shall be connected with ATRA keys at each interleaf and end to end connection. Use anchors to keep panels open for infill as required.
4. Infill Materials: Sand should be course-grained. Aggregate size shall be maximum of 1/3 the depth of the Geoweb cells. Engineered fill is a mixture of aggregate and topsoil that allows for a vegetated driving surface. On-site salvaged material should be granular with a particle diameter no greater than 1/3 the depth of the Geoweb cells. In all cases, fines should be limited to less than 10%. Contact Presto Geosystems if there are questions about the use of specific materials.

Limitations