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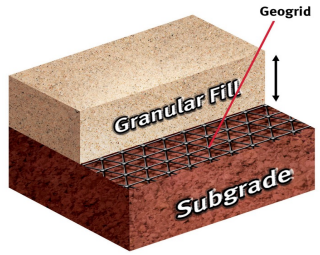
Presentation Outline

- Fundamentals of Geosynthetics
- Geosynthetic Mechanisms
- Subgrade Improvement
- Flexible Pavement
- Rigid Pavement
- Case Study

Mechanically Stabilized Layer (MSL)



Tensar.

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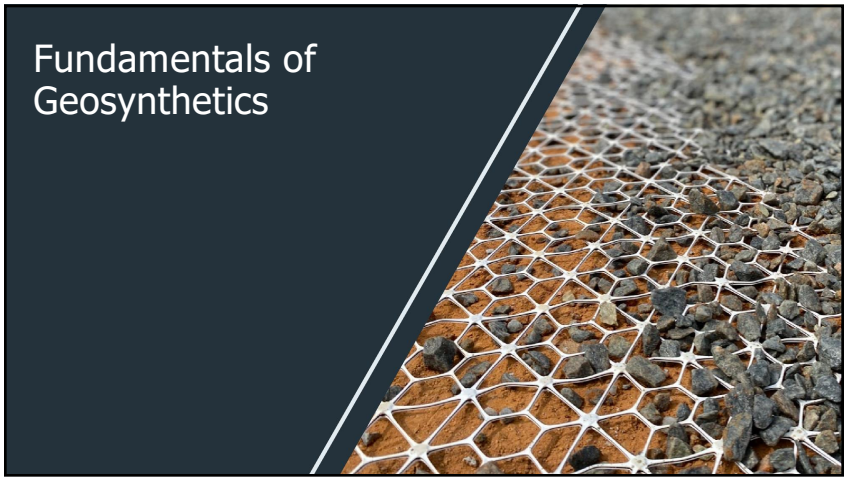

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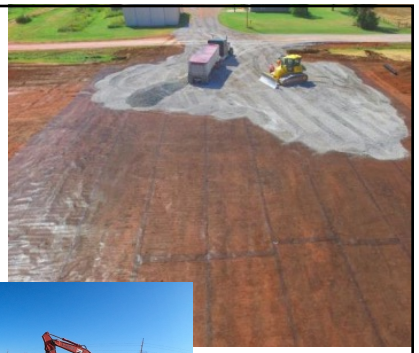
Basics of Geosynthetics

- Under granular or fine-grained soils
- Come in rolls, manually installed
- Soft or stiff subgrade
- One or more layers
- Used for Separation & Reinforcement



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Types of Geogrids

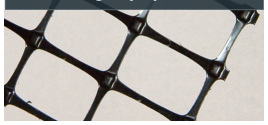
- Uniaxial Geogrid
  - Grade Separation – walls and slopes
  - PET & HDPE
- Bi-Axial, Multi-axial & Inter-axial Geogrids
  - Improve subgrades
  - Optimize sections
  - PET & polypropylene
- Inter-axial Geogrids
  - Co-extruded Polypropylene

Interaxial Geogrid (NX)

Uniaxial Geogrid (UX)

Multi-Axial Geogrid (TriAx)

Biaxial Geogrid (BX)



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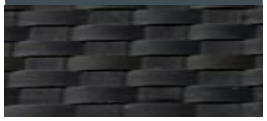
Types of Geotextiles

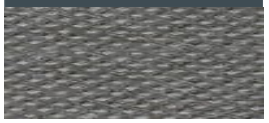
- Woven – separation & reinforcement
- Non-Woven, Polyspun, & Spunbond - separation

Woven

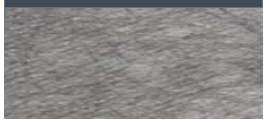


Non-Woven

Polyspun



Spunbond



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Geosynthetic Mechanisms

USACOE ETL 1110

- Improved Bearing Capacity
- Tensioned Membrane Effect
- Lateral Restraint

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Conference Swag

Ladies Rixford Polyfleece Jacket
Tensar

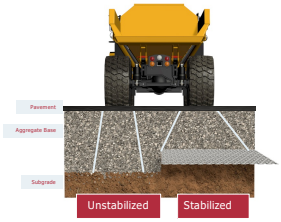
Renew rPET Computer Backpack

Titleist Pro V1X Golf Balls - Dozen
- Tensar

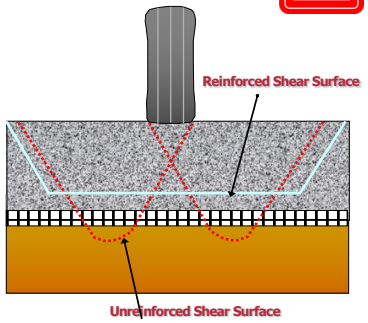
Ogio Caliber 2.0 Polo Shirt

8

Improved Bearing Capacity



Improved Load Spread – bearing capacity



Source: USACOE ETL 1110-1-189

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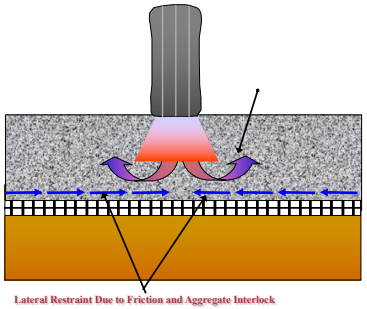
Lateral Restraint



Lateral Restraint – aggregate confinement

Source: USACOE ETL 1110-1-189

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Confinement of Aggregate Particles

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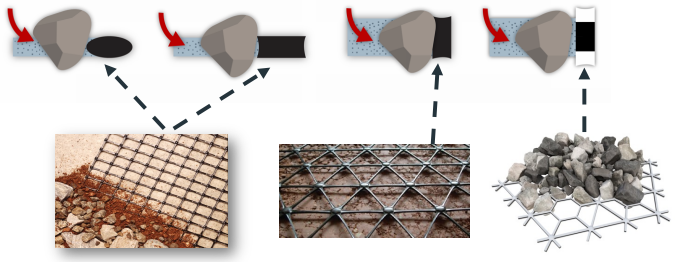

Tensar

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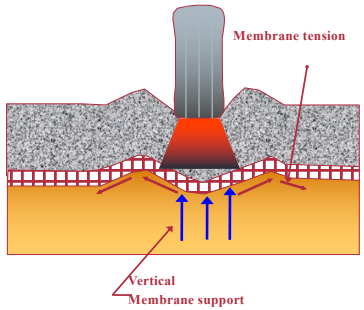
Tensioned Membrane Effect



Source: USACOE ETL 1110-1-189

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Box of Rocks Demo

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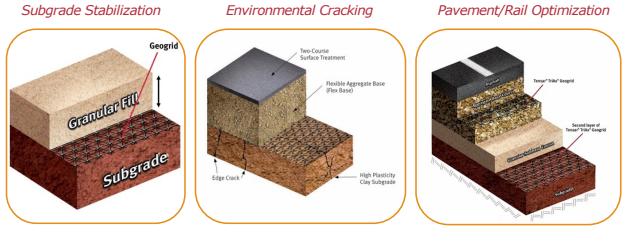
Mechanisms Differ for Application Types



- Bearing Capacity
- Tensioned Membrane
- Lateral Restraint
- Lateral Restraint
- Bearing Capacity

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Subgrade Improvement

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Soft Subgrades

"Roads wear out from the top down, but they fall apart from the bottom up."
~National Association of County Engineers

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Example – Subgrade Stabilization

Composite Subgrade Strength: CBR≈5, Mr≈7500psi or k-value≈170pci

1,200 passes of an 18-kip axle on a subgrade CBR 1.4%, Mr≈2000psi or k-value≈50pci

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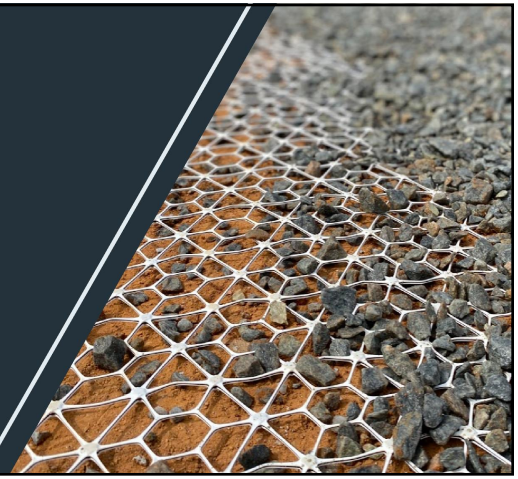
Flexible Pavement



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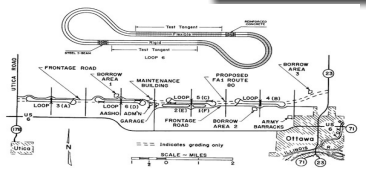
AASHTO 93 Flexible Pavement Design



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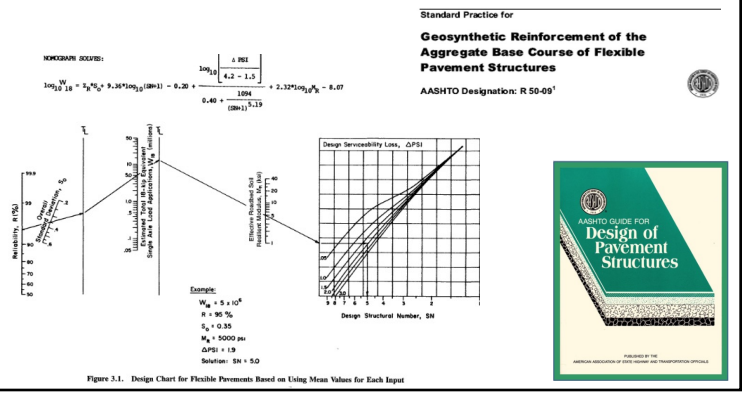
AASHTO '93 Flexible Pavement Design



Standard Practice for

Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures

AASHTO Designation: R 50-09[1]

NOMOGRAPH SOLVES:

$$\log_{10} W_{18} = Z_R S_o + 9.36 \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2-1.5}\right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \log_{10} M_R - 8.07$$

Example:
$W_{18} = 5 \times 10^6$
$R = 95\ \%$
$S_o = 0.35$
$M_R = 5000$ psi
$\Delta PSI = 1.9$
Solution: $SN = 5.0$

Design Serviceability Loss, ΔPSI

Design Structural Number, SN

Figure 3.1. Design Chart for Flexible Pavements Based on Using Mean Values for Each Input

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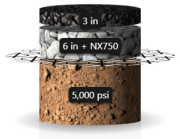
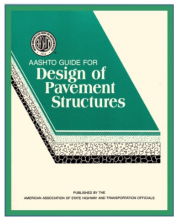
AASHTO '93 Flexible Pavement Design

Stabilized	Unstabilized
116,900 ESALs	116,900 ESALs
$32.17/yd^2	$38.85/yd^2



Stabilized	Thickness	Coeff.	SN
HMA layer 1	3 in	0.400	1.200
Aggregate base (NX750)	6 in	0.300	1.800
Structural number (SN)			3.000

Unstabilized	Thickness	Coeff.	SN
HMA layer 1	4 in	0.400	1.600
Aggregate base	10 in	0.140	1.400
Structural number (SN)			3.000



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Example - Pavement Optimization

Conventional Design	Maximum Life	Minimum Material Cost	Equivalent Cost
Unstabilized	Stabilized	Stabilized	Stabilized
91,600 ESALs	576,600 ESALs	98,600 ESALs	318,800 ESALs
$38.85/yd^2	$42.58/yd^2	$32.09/yd^2	$37.52/yd^2

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Grain Cart Vs ESAL

Pavement Design Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 3/22/2018

Design Name :	TX8 STABILIZED
Design Type :	Roads
Pavement Type :	Flexible
Road Type :	Road
Terrain Type :	Flat
Analysis Type :	CBR
Depth of Frost (in) :	0
Wander Width (in) :	33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Asphalt	Asphalt	NFS	Manual	8	0	0	0
Base	Unbound Crushed Stone	NFS	Compute	6.01	0	0	50
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	3.75

Traffic Information

Pattern Name : MAHASKA COUNTY

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
AXLE, 73.4 KIPS	73381	3300	3300
AXLE, 73.4 KIPS	73381		3300
PCASE Equivalent Single Axle Loads			2.24E+10

1 Axle pass of a Kline Grain Cart = 1400 ESAL's

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Concrete Pavements Need…

- Uniform support
- Improved resistance to load deformation
  - Effect on LOS

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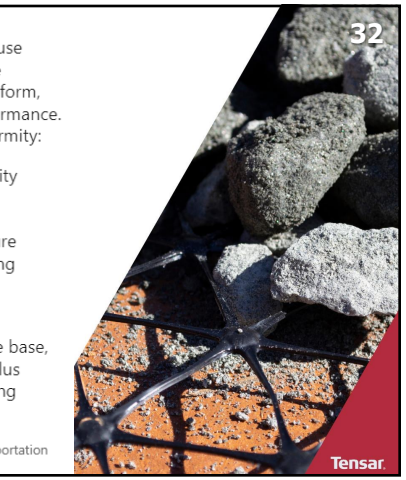
Uniformity of Support

Non-uniformity in the base and subgrade may cause performance and maintenance issues for concrete pavements, including poor joint performance. Uniform, stable soil is the key to long term pavement performance. Common causes of subgrade and base non-uniformity:

- Variable soil type, moisture content and density
- Poor grading and compaction
- Pumping and rutting
- Gaps/voids underneath the pavement structure
- Differential frost heave and subgrade softening
- Expansive soils
- Cut/fill transitions

Using InterAx geogrids improves uniformity of the base, providing better uniformity of stiffness and modulus retention over time, resulting in a better performing concrete pavement.

Source: "Technology News" Iowa State University Center for Transportation Research and Education. September-October 2003.



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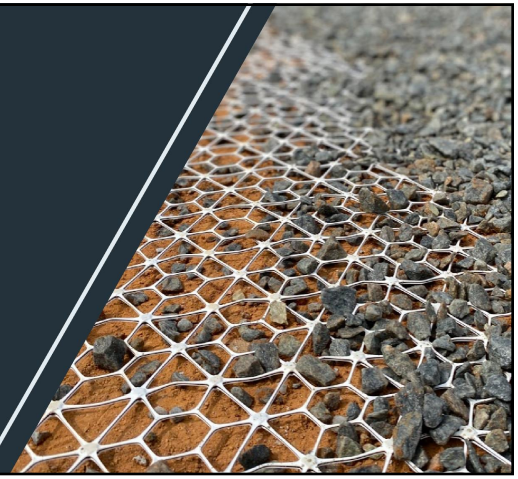
Case Study



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Subgrade Stabilization Example Project 1

- Nebraska DOT US-385
- Weak soil CBR:0.3%
- Shallow groundwater

Tensar.

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Subgrade Stabilization Example Project 1

- Nebraska DOT US-385
- NX850 geogrid
- 36in. (900mm) on-site sand

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Valuable
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Versatile
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Thank You!
Questions?

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