Wovens, Nonwovens & Grids
Manufacturing, Properties & Capabilities
Definitions

- Geosynthetics
- Geotextile
- Geogrid
- Interlayers
Geosynthetics

generic for all *synthetic* materials used in geotechnical engineering applications, including

textiles, grids, nets, membranes & composites
Geotextiles

any permeable textile used in any geotechnical engineered system

a.k.a.
Filter Fabric, Filter Cloth, Filter Paper, Construction Paper
Geotextiles

- Nonwoven - textile structure produced by mechanical, chemical, thermal, or solvent bonding and/or interlocking of fibers
- Woven - textile structure produced by interlacing two or more yarns, fibers, or filaments
- Knit - textile structure produced by inter-looping ends of yarn
Geogrid

A gridlike polymeric material formed by intersecting ribs joined at the junctions used for reinforcement with foundation, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of a human-made project structure or system.
How does a geogrid work?
Profiles

- **Unreinforced**
  - 3,000 axle passes

- **BiAxial Geogrid**
  - 10,000 axle passes

- **TriAxial Geogrid**
  - 10,000 axle passes
Full-Scale Accelerated Testing of Multi-axial Geogrid Stabilized Flexible Pavements
Constructed over Very Stiff Soils

Based on 0.3 inches total surface deformation

**Control Section**

<table>
<thead>
<tr>
<th>ESALs</th>
<th>Cars</th>
<th>Buses</th>
<th>Dump Trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>220,000</td>
<td>187,000,000</td>
<td>36,048</td>
<td>20,227</td>
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</table>

**Tensar TriAx TX5 Geogrid**

<table>
<thead>
<tr>
<th>ESALs</th>
<th>Cars</th>
<th>Buses</th>
<th>Dump Trucks</th>
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</thead>
<tbody>
<tr>
<td>811,200</td>
<td>689,520,000</td>
<td>132,920</td>
<td>74,583</td>
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**Tensar TriAx TX8 Geogrid**

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<th>ESALs</th>
<th>Cars</th>
<th>Buses</th>
<th>Dump Trucks</th>
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<td>1,050,000</td>
<td>892,500,000</td>
<td>172,048</td>
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</table>

*Values Extrapolated. TX8 section never reached 0.31 inches total deformation*
Geosynthetic Product Properties
Geosynthetic Properties

- **Product test values are listed as “Typical” or “MARV”**
  - Typical value refers to the average or mean value
    - In general, 50% fall above and 50% fall below the published value
  - MARV is Minimum Average Roll Value
    - Statistically 97.5% of values fall **above** the published value
Typical

$N = \text{Number of occurrences of a specific test value}$

$\approx 2.3\%$

$\text{MARV} (97.7\%)$

$\text{confidence level considering both sides}$

Minimum value

Value of test result

Point of inflection

Average value (mean value, $\bar{X}$)

Standard deviation $S$

Standard deviation $S$
Functions of Geosynthetics in Soils

- Separation
- Confinement
- Reinforcement
- Filtration
- Drainage
Geotextile placed between dissimilar materials so that the integrity of both can remain intact or be improved.
Separation

Maintains integrity & functioning of two dissimilar materials

“10 lbs of stone placed on 10 lbs of mud = 20 lbs of mud”
Prevents fine grained soil from contaminating the load bearing aggregate base course layer.
Confinement

Geosynthetic improvement of the ability to resist lateral movement of the aggregate.
Confinement

Prevents lateral movement of aggregate
- Geotextile: Friction
- Geogrid: Interlock
Reinforcement

Improvement of the system strength created by the introduction of a geosynthetic into a soil/aggregate system
Reinforcement

- Introduce a tensile element
- Improve bearing capacity
- Fine-grained silts & clays

Unreinforced shear surface
Reinforced shear surface
Drainage

Fabric to soil system that allows for free liquid flow (but no soil loss) across or through the plane of the fabric over an indefinitely long period of time.
Filtration & Drainage

Filtration: Movement of liquid **through** the geosynthetic

Drainage: Movement of liquid **within the plane** of the geosynthetic
Filtration

The ability of a geotextile to prevent excessive migration of soil particles, while maintaining the free flow of liquid through the filter layer.
1. **Moisture barrier**

**Slow down crack propagation**

**Provide bond**

**Maintain millability & recyclability**
Fiberglass: How it Works

NEW EXTENDED LIFE ASPHALT SURFACE
### Effects of Water on Pavements

**Interlayer Functionality**

**Loss of Base Load Bearing Capacity**

- **Water intrusion through pavement into base:**
  
  **33-67%**
  
  Federal Highway Admin. (FHWA) RD 73-14, states; “between 33 and 67% of storm water infiltrates through the pavement”
  
  - **Asphalt** from 33% - 50%
  
  - **Concrete** from 50% - 67%

- **Pavement cracks increase base degradation:**
  
  Cracks significantly increase water penetration and base degradation, leading to loss of load bearing capacity.
Moisture Comparison

Street Paved without Interlayer - “Surface Saturated Pavement”
Temperature 57°F, Humidity 82%
Moisture Comparison

Street Paved with Engineered Paving Mat
Temperature 57°F, Humidity 82%
Pavement Interlayers Work

Installed 2005

With Geosynthetic Interlayer

Without Geosynthetic Interlayer
Innovative Geosynthetics for Roads
Functions of Geosynthetics

- Separation
- Confinement
- Reinforcement
- Filtration
- Drainage
## Functions Provided By Geosynthetics

<table>
<thead>
<tr>
<th>Type</th>
<th>Separation</th>
<th>Reinf.</th>
<th>Filter</th>
<th>Drainage</th>
<th>Conf.</th>
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<tbody>
<tr>
<td>Non Woven</td>
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<td>No</td>
<td>Yes</td>
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<td>RS-Series</td>
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Comparing Option 1 - Unreinforced to Reinforced

Unreinforced

5"

ACC1

10"

ABC

364,275 ESALs

Reinforced

5"

ACC1

6.5"

ABC

Mirafi RS380i

364,275 ESALs
Comparing Option 2 - Unreinforced to Reinforced

Unreinforced

5"

5"

10"

10"

ACC1

ABC

364,275 ESALs

Reinforced

5"

5"

10"

10"

ACC1

ABC

Mirafi RS380i

1,610,492 ESALs
Mirafi® RS380i – Reduce Section Cost
Mirafi® RS380i – Reduce Section Cost

Original Section:
36” stone @ $15.00 / ton = $27.00 / SY

Geosynthetic Reinforced Section:
RS380i @ $4.25 / SY (installed) = $4.25 / SY
18” stone @ $15.00 / ton = $13.50 / SY
Total Section = $17.75 / SY

Savings = $9.25 / SY (34%)
H₂Ri High Strength Wicking Geotextile
Nylon wicking fibers (blue) are:

Hygroscopic (pull water)
Hydrophilic (retain water)
Deep grooved fibers (4DG)
Questions?