Innovation and Experience

We have many years of experience helping our clients build roads and loading/parking areas using geogrids. We gladly work with engineers, contractors, developers and owners to show them how terrafix® Biaxial Geogrids can improve performance of their pavement structures. Call us today, we are here to help.

At terrafix®, we also design and supply steep slope and retaining wall systems. Just let us know the parameters of your project and we will show you a solution for almost any grade separation challenge. You can also check us out at www.terrafixgeo.com.

Canada’s leader of complete geosynthetic solutions

Since 1973, terrafix® has been dedicated to offering owners, engineers and contractors the correct choice of geosynthetic products and innovative technology. Long recognized as an innovator in the industry, terrafix® now offers services which include design assistance, factory fabrication and installation of a wide range of geosynthetic challenges.

terrafix® professional staff of salespeople, field technicians, project managers and engineers are available to assist clients in maximizing the benefits that our geosynthetic products and systems make possible. We provide you, the engineer, contractor, and owner with technically sound cost saving solutions to your challenges.

• Geosynthetic Clay Liners provide an excellent sealing layer to provide containment of liquids and solids.
• Geodrains provide effective collection and reliable flow capacity of fluids and gases found in various soil structures.
• Geogrids reinforce construction fill materials allowing berm, retaining wall and road construction at reduced cost.
• Geomembranes prevent leachate from contaminating the subsoil in sanitary and hazardous waste landfills.
• Geotextiles solve erosion, drainage, filtration and stabilization problems.
• Biodegradable erosion blankets help establish vegetation and prevent erosion from wind and rain.
• Silt fences help to contain silt runoff from construction sites.

Biaxial Geogrids
for superior soil reinforcement

Canada’s leader of complete geosynthetic solutions

To view our complete product line visit us at www.terrafixgeo.com

Biaxial Geogrids
for superior soil reinforcement

To view our complete product line visit us at www.terrafixgeo.com
**A cost effective solution**

terrafix® Biaxial Geogrids provide a simple, cost effective solution for soil reinforcement. Improve roadways, highways and other heavily trafficked areas with terrafix® Biaxial Geogrids.

Even when conditions are less than perfect, including: weak subgrades, contaminated soils, heavy loads, high granular costs and shallow-buried utilities, an engineered solution is possible.

terrafix® Biaxial Geogrids provide structural reinforcement of roads and parking areas through excellent stiffness and interlock capabilities.

terrafix® Biaxial Geogrids interlock with aggregate particles creating an enhanced composite material with higher performance characteristics. The profile shape and thickness of the structural ribs contribute to superior confinement and stabilization of the reinforced layer.

**Installation made easy**

**Preparation**
- Clear and excavate area to required elevation.
- Grade and compact area leaving surface as smooth as possible. Swamp land may be difficult to smooth grade or compact. For these areas, root mats are usually left in place to minimize subgrade disturbance.

**Geogrid Placement**
- Unroll Biaxial geogrid manually over the prepared subgrade (for subgrade improvement applications). For base reinforcement applications, the geogrid may be located higher in the pavement section for example, at the mid point of the aggregate layers.
- Overlap adjacent and end rolls between 0.3 m and 0.9 m depending on the subgrade strength.
- It is not necessary to mechanically join rolls together at the overlap joint. In cases of very soft subgrades, plastic cable ties can be used to help maintain the overlap and alignment during placement of granular cover.

**Fill Placement**
- Spreading of the aggregate fill can cause a wave to develop in front of the placement. This will usually dissipate at the end of the roll. If the wave becomes too large, the wave can be cut allowing the two-ends to overlap and lay flat. This is acceptable provided that sufficient overlap is accomplished.
- Do not drive tracked vehicles directly on the geogrid
- Where cutting of the geogrid is necessary, it is easily accomplished with a utility knife, circular saw or quick-cut saw.
- A minimum thickness of 150 mm is typically required for the first layer of granular base over the geogrid. Installations over very soft soils may require a significantly thicker initial lift to prevent over-stressing of the subgrade and Biaxial geogrid.
- Aggregate fill is typically end-dumped and spread over the geogrid. For competent subgrades it is possible to belly dump directly over the geogrid at very slow speeds.
- Over weak subgrades, trafficking of loaded trucks over the unfinished pavement system could cause excessive rutting on the base course layers. It may be advisable to over-build a lane for construction access.

**Compaction**
- Standard compaction practice is used unless soils are very soft. For these cases, it is recommended to use static (non-vibratory) compaction. In addition, compaction requirements are usually reduced for the initial lift.
- During construction, if excessive rutting occurs, additional fill should be added to strengthen the section. Rutting usually occurs due to insufficient aggregate fill thickness.

**Special Considerations**
- If the subgrade is prone to pumping and the aggregate fill layer cannot provide an adequate filter layer, then a non-woven geotextile should be placed directly on the subgrade prior to placing the geogrid.
- Light weight/low contact pressure equipment should be used when building over soft soils.
- Excavating through buried Biaxial geogrid is no problem. For utility cuts, a simple 1 m overlap repair is sufficient to restore the pavement section.
Biaxial Geogrids for Superior Reinforcement

Geogrids save time and money by:
- reducing aggregate fill thicknesses
- reducing sub-excavation
- simplifying construction
- extending service life of pavement
- reducing labour and equipment requirements

Improved Performance for
- Municipal roads
- Highways
- Railway ballast
- Site access roads
- Haul roads
- Parking lots
- Industrial shipping yards
- Foundation footings

Aggregate interlocks with geogrid apertures

Subgrade Improvement

Rigidity is Important!
- Researchers at the U.S. Army Corps of Engineers have undertaken full scale testing of various geogrid products and concluded that stiff geogrids outperform more flexible products.
- **terrafix® Biaxial Geogrids** are rigid, high tensile structures that offer superior granular interaction compared with other geogrids.
- **terrafix® Biaxial Geogrids** are produced from an extruded sheet of polypropylene which is then punched and drawn resulting in high junction strength and stiffness.

Soft subgrade soils can create a short term and a long term problem. If a permanent road is built over a soft soil without proper treatment of the subgrade, the road will face on-going performance issues. Likewise, even a temporary access road can incur unnecessary costs if it is not built properly.

Stiffening the aggregate base through the mechanism of interlocking will create a platform with enhanced load distribution.

The same way that a snowshoe distributes a person’s weight evenly over a large area, **terrafix® Biaxial Geogrids** reduce the stress applied to the subgrade.

Design Using the Giroud-Han Method
- Dr. J.P. Giroud and Dr. Jie Han have researched and published the most recent and innovative advancement in geosynthetic reinforced road design in the last 20 years. Their report can be found in the August 2004 edition of the ASCE Journal of Geotechnical and Geoenvironmental Engineering. See chart on Page 4.
- Using this method, road designers can account for:
  - variable base course strength
  - better performance from stiff, dimensionally stable geogrids
  - number of load cycles and desired performance
  - variable performance based on geosynthetic used

The resulting output is a reliable determination of the total required aggregate thickness for unpaved and “pre-paved” roads and working platforms. It is possible to realize aggregate reductions of up to 60%.

Rigidity is Important!
- Researchers at the U.S. Army Corps of Engineers have undertaken full scale testing of various geogrid products and concluded that stiff geogrids outperform more flexible products.
- **terrafix® Biaxial Geogrids** are rigid, high tensile structures that offer superior granular interaction compared with other geogrids.
- **terrafix® Biaxial Geogrids** are produced from an extruded sheet of polypropylene which is then punched and drawn resulting in high junction strength and stiffness.

Soft subgrade soils can create a short term and a long term problem. If a permanent road is built over a soft soil without proper treatment of the subgrade, the road will face on-going performance issues. Likewise, even a temporary access road can incur unnecessary costs if it is not built properly.

Stiffening the aggregate base through the mechanism of interlocking will create a platform with enhanced load distribution.

The same way that a snowshoe distributes a person’s weight evenly over a large area, **terrafix® Biaxial Geogrids** reduce the stress applied to the subgrade.

Design Using the Giroud-Han Method
- Dr. J.P. Giroud and Dr. Jie Han have researched and published the most recent and innovative advancement in geosynthetic reinforced road design in the last 20 years. Their report can be found in the August 2004 edition of the ASCE Journal of Geotechnical and Geoenvironmental Engineering. See chart on Page 4.
- Using this method, road designers can account for:
  - variable base course strength
  - better performance from stiff, dimensionally stable geogrids
  - number of load cycles and desired performance
  - variable performance based on geosynthetic used

The resulting output is a reliable determination of the total required aggregate thickness for unpaved and “pre-paved” roads and working platforms. It is possible to realize aggregate reductions of up to 60%.

Rigidity is Important!
- Researchers at the U.S. Army Corps of Engineers have undertaken full scale testing of various geogrid products and concluded that stiff geogrids outperform more flexible products.
- **terrafix® Biaxial Geogrids** are rigid, high tensile structures that offer superior granular interaction compared with other geogrids.
- **terrafix® Biaxial Geogrids** are produced from an extruded sheet of polypropylene which is then punched and drawn resulting in high junction strength and stiffness.

Soft subgrade soils can create a short term and a long term problem. If a permanent road is built over a soft soil without proper treatment of the subgrade, the road will face on-going performance issues. Likewise, even a temporary access road can incur unnecessary costs if it is not built properly.

Stiffening the aggregate base through the mechanism of interlocking will create a platform with enhanced load distribution.

The same way that a snowshoe distributes a person’s weight evenly over a large area, **terrafix® Biaxial Geogrids** reduce the stress applied to the subgrade.

Design Using the Giroud-Han Method
- Dr. J.P. Giroud and Dr. Jie Han have researched and published the most recent and innovative advancement in geosynthetic reinforced road design in the last 20 years. Their report can be found in the August 2004 edition of the ASCE Journal of Geotechnical and Geoenvironmental Engineering. See chart on Page 4.
- Using this method, road designers can account for:
  - variable base course strength
  - better performance from stiff, dimensionally stable geogrids
  - number of load cycles and desired performance
  - variable performance based on geosynthetic used

The resulting output is a reliable determination of the total required aggregate thickness for unpaved and “pre-paved” roads and working platforms. It is possible to realize aggregate reductions of up to 60%.
Base Reinforcement

Even flexible pavements with relatively firm subgrades often fail prematurely due to progressive lateral displacement and weakening of the base course. Eventually the result is rutting and cracking of the pavement surface.

terrafix® Biaxial Geogrids confine the aggregate layer and maintain the structural capacity of the pavement system better than any other geosynthetic material. In base reinforcement applications, lateral spreading of the base course granular particles is the critical failure mechanism. By including a layer of terrafix® Biaxial Geogrids, the base course is laterally confined resulting in increased pavement life and a possible decreasing of the base thickness.

Increased pavement life can be calculated through consideration of the Traffic Benefit Ratio (TBR). TBR is the ratio of cycles to failure of a geogrid-reinforced section versus an unreinforced section of the same thickness. The U.S. Army Corps of Engineers have undertaken full scale independent testing of various geosynthetic materials. TBR values of up to 4.7 for stiff, dimensionally stable geogrids were realized in this study.

Once the TBR has been determined, it can be multiplied by the design ESAL's for a particular unreinforced pavement section to determine the influence of adding the geogrid. Heavy trafficked pavement thicknesses can be reduced by up to 50%.

### Table: Geogrid Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Unit</th>
<th>SQUARE</th>
<th>RECTANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aperture Size</td>
<td></td>
<td>mm</td>
<td>39 (1.54)</td>
<td>39 (1.54)</td>
</tr>
<tr>
<td>Ultimate Tensile Strength</td>
<td>D6637</td>
<td>kN/m (lb/ft)</td>
<td>16 (1096)</td>
<td>19 (1302)</td>
</tr>
<tr>
<td>Tensile Strength At 2% Strain</td>
<td></td>
<td>kN/m (lb/ft)</td>
<td>8.3 (548)</td>
<td>9.1 (610)</td>
</tr>
<tr>
<td>Tensile Strength At 5% Strain</td>
<td></td>
<td>kN/m (lb/ft)</td>
<td>11.5 (788)</td>
<td>13.2 (856)</td>
</tr>
<tr>
<td>Junction Strength</td>
<td>GB-GC2</td>
<td>kN/m (lb/ft)</td>
<td>15.5 (1062)</td>
<td>18.2 (1235)</td>
</tr>
<tr>
<td>Aperture Stability</td>
<td></td>
<td>%</td>
<td>2% min</td>
<td>2% min</td>
</tr>
<tr>
<td>Radial Stiffness At Low Strain</td>
<td></td>
<td>psi</td>
<td>8.2</td>
<td>9.1</td>
</tr>
<tr>
<td>Flexural Stiffness / Rigidity</td>
<td>D7748</td>
<td>kN/m (lb/ft)</td>
<td>284.9 (19529)</td>
<td>329.9 (22612)</td>
</tr>
<tr>
<td>Multi Axial Tensile Test</td>
<td>ASTN D5617</td>
<td>psi</td>
<td>15.6</td>
<td>16.6</td>
</tr>
<tr>
<td>Venetian Pressure @ RUPTURE</td>
<td></td>
<td>psi</td>
<td>10.6</td>
<td>13.2</td>
</tr>
<tr>
<td>Break Resistance Strain</td>
<td></td>
<td>%</td>
<td>10.6</td>
<td>13.2</td>
</tr>
<tr>
<td>Average deflection @ Rupture</td>
<td></td>
<td>mm (in)</td>
<td>10.6</td>
<td>13.2</td>
</tr>
<tr>
<td>Interfacing</td>
<td></td>
<td>%</td>
<td>10.6</td>
<td>13.2</td>
</tr>
<tr>
<td>Carbon Black</td>
<td></td>
<td>%</td>
<td>2% min</td>
<td>2% min</td>
</tr>
<tr>
<td>Resistance to UV Degradation</td>
<td>D4355</td>
<td>%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Roll Widths Available</td>
<td>ft</td>
<td>13, 19.5</td>
<td>13, 19.5</td>
<td></td>
</tr>
<tr>
<td>Roll Length</td>
<td></td>
<td>ft</td>
<td>50m (164ft)</td>
<td>50m (164ft)</td>
</tr>
</tbody>
</table>

Even flexible pavements with relatively firm subgrades often fail prematurely due to progressive lateral displacement and weakening of the base course. Eventually the result is rutting and cracking of the pavement surface. **terrafix® Biaxial Geogrids** confine the aggregate layer and maintain the structural capacity of the pavement system better than any other geosynthetic material.

In base reinforcement applications, lateral spreading of the base course granular particles is the critical failure mechanism. By including a layer of **terrafix® Biaxial Geogrids**, the base course is laterally confined, resulting in increased pavement life and a possible decreasing of the base thickness.

Increased pavement life can be calculated through consideration of the Traffic Benefit Ratio (TBR). TBR is the ratio of cycles to failure of a geogrid-reinforced section versus an unreinforced section of the same thickness. The U.S. Army Corps of Engineers have undertaken full-scale independent testing of various geosynthetic materials. TBR values of up to 4.7 for stiff, dimensionally stable geogrids were realized in this study.

Once the TBR has been determined, it can be multiplied by the design ESAL's for a particular unreinforced pavement section to determine the influence of adding the geogrid.

Heavy trafficked pavement thicknesses can be reduced by up to 50%.
Subgrade Improvement

Rigidity is Important!

Researchers at the U.S. Army Corps of Engineers have undertaken full scale testing of various geogrid products and concluded that stiff geogrids outperform more flexible products.

terrafix® Biaxial Geogrids are rigid, high tensile structures that offer superior granular interaction compared with other geogrids.

terrafix® Biaxial Geogrids are produced from an extruded sheet of polypropylene which is then punched and drawn resulting in high junction strength and stiffness.

Soft subgrade soils can create a short term and a long term problem. If a permanent road is built over a soft soil without proper treatment of the subgrade, the road will face on-going performance issues. Likewise, even a temporary access road can incur unnecessary costs if it is not built properly.

Stiffening the aggregate base through the mechanism of interlocking will create a platform with enhanced load distribution.

The same way that a snowshoe distributes a person’s weight evenly over a large area, terrafix® Biaxial Geogrids reduce the stress applied to the subgrade.

Design Using the Giroud-Han Method

Dr. J.P. Giroud and Dr. Jie Han have researched and published the most recent and innovative advancement in geosynthetic reinforced road design in the last 20 years. Their report can be found in the August 2004 edition of the ASCE Journal of Geotechnical and Geoenvironmental Engineering. See chart on Page 4.

Using this method, road designers can account for:
- variable base course strength
- better performance from stiff, dimensionally stable geogrids
- number of load cycles and desired performance
- variable performance based on geosynthetic used

The resulting output is a reliable determination of the total required aggregate thickness for unpaved and “pre-paved” roads and working platforms. It is possible to realize aggregate reductions of up to 60%.
A cost effective solution

**terrafix® Biaxial Geogrids** provide a simple, cost effective solution for soil reinforcement. Improve roadways, highways and other heavily trafficked areas with terrafix® Biaxial Geogrids.

Even when conditions are less than perfect, including: weak subgrades, contaminated soils, heavy loads, high granular costs and shallow-buried utilities, an engineered solution is possible.

**terrafix® Biaxial Geogrids** provide structural reinforcement of roads and parking areas through excellent stiffness and interlock capabilities.

**terrafix® Biaxial Geogrids** interlock with aggregate particles creating an enhanced composite material with higher performance characteristics. The profile shape and thickness of the structural ribs contribute to superior confinement and stabilization of the reinforced layer.

**terrafix® Biaxial Geogrid load distribution**

**terrafix® Biaxial Geogrids** provide optimum performance by adding tensile strength to the aggregate’s ability to distribute loads in all directions.

The end result is a stabilized composite layer with high radial stiffness and superior conical load distribution.

Installation made easy

**Preparation**
- Clear and excavate area to required elevation.
- Grade and compact area leaving surface as smooth as possible. Swamp land may be difficult to smooth grade or compact. For these areas, root mats are usually left in place to minimize subgrade disturbance.

**Geogrid Placement**
- Unroll Biaxial geogrid manually over the prepared subgrade (for subgrade improvement applications). For base reinforcement applications, the geogrid may be located higher in the pavement section for example, at the mid point of the aggregate layers.
- Overlap adjacent and end rolls between 0.3 m and 0.9 m depending on the subgrade strength.
- It is not necessary to mechanically join rolls together at the overlap joint. In cases of very soft subgrades, plastic cable ties can be used to help maintain the overlap and alignment during placement of granular cover.

**Fill Placement**
- Spreading of the aggregate fill can cause a wave to develop in front of the placement. This will usually dissipate at the end of the roll. If the wave becomes too large, the wave can be cut allowing the two-ends to overlap and lay flat. This is acceptable provided that sufficient overlap is accomplished.
- Do not drive tracked vehicles directly on the geogrid.
- Where cutting of the geogrid is necessary, it is easily accomplished with a utility knife, circular saw or quick-cut saw.
- A minimum thickness of 150 mm is typically required for the first layer of granular base over the geogrid. Installations over very soft soil may require a significantly thicker initial lift to prevent over-stressing of the subgrade and Biaxial geogrid.
- Aggregate fill is typically end-dumped and spread over the geogrid. For competent subgrades it is possible to belly dump directly over the geogrid at very slow speeds.
- Over weak subgrades, trafficking of loaded trucks over the unfinished pavement system could cause excessive rutting on the base course layers. It may be advisable to over-build a lane for construction access.

**Compaction**
- Standard compaction practice is used unless soils are very soft. For these cases, it is recommended to use static (non-vibratory) compaction. In addition, compaction requirements are usually reduced for the initial lift.
- During construction, if excessive rutting occurs, additional fill should be added to strengthen the section. Rutting usually occurs due to insufficient aggregate fill thickness.

**Special Considerations**
- If the subgrade is prone to pumping and the aggregate fill layer cannot provide an adequate filter layer, then a non-woven geotextile should be placed directly on the subgrade prior to placing the geogrid.
- Light weight/ low contact pressure equipment should be used when building over soft soils.
- Excavating through buried Biaxial geogrid is no problem. For utility cuts, a simple 1 m overlap repair is sufficient to restore the pavement section.
Innovation and Experience

We have many years of experience helping our clients build roads and loading/parking areas using geogrids. We gladly work with engineers, contractors, developers and owners to show them how terrafix® Biaxial Geogrids can improve performance of their pavement structures. Call us today, we are here to help.

At terrafix®, we also design and supply steep slope and retaining wall systems. Just let us know the parameters of your project and we will show you a solution for almost any grade separation challenge. You can also check us out at www.terrafixgeo.com.

Canada's leader of complete geosynthetic solutions

Since 1973, terrafix® has been dedicated to offering owners, engineers and contractors the correct choice of geosynthetic products and innovative technology. Long recognized as an innovator in the industry, terrafix® now offers services which include design assistance, factory fabrication and installation of a wide range of geosynthetic challenges.

terrafix® professional staff of salespeople, field technicians, project managers and engineers are available to assist clients in maximizing the benefits that our geosynthetic products and systems make possible. We provide you, the engineer, contractor, and owner with technically sound cost saving solutions to your challenges.

- Geosynthetic Clay Liners provide an excellent sealing layer to provide containment of liquids and solids.
- Geodrains provide effective collection and reliable flow capacity of fluids and gases found in various soil structures.
- Geogrids reinforce construction fill materials allowing berm, retaining wall and road construction at reduced cost.
- Geomembranes prevent leachate from contaminating the subsoil in sanitary and hazardous waste landfills.
- Geotextiles solve erosion, drainage, filtration and stabilization problems.
- Biodegradable erosion blankets help establish vegetation and prevent erosion from wind and rain.
- Silt fences help to contain silt runoff from construction sites.

To view our complete product line visit us at www.terrafixgeo.com