Soil Reinforcement

Material Compound
The use of different polymers in the manufacturing process of the Maccaferri Geogrids, develops high-performance geogrids. Polyester ensures high-tensile strength at low-strain values; polymeric coatings ensure protection against installation damage and hazardous environments.

Long-term Design Strength
The quality of ParaLink™, ParaGrid™, ParaDrain™ and MacGrid® WG increases the performance of the reinforcement enabling the reduction of the safety factor values.

Creep
Creep is due to viscous deformation and it happens during the design-life of the structure. Maccaferri geogrids are characterised by creep value lower than 2% at 120 years, in accordance with most of the design guidelines.

Drainage
Water is one of the causes of failure for soil reinforcement structures due to loss of friction and overburden horizontal pressure. MacDrain® used at the back of the structure prevents water seeping into the structure and allows the water to flow away, reducing the possibility of water pressure.

Poor Quality Structural Soil
The availability of good structural soil could compromise the effectiveness of a soil reinforcement structure. ParaDrain™ allows the construction of soil reinforcement structures using poor geotechnical and residual materials, such as clay or ashes, due to an integrated drainage system that reduces the excess of pore water pressure.
**Basal Reinforcement**

**PRODUCT:**

**PARALINK®**

**Over Soft Soil**

Embankments on soft foundations develop high localised loading in short-term until shear strength of foundations are developed. To reinforce the foundation, a very high-strength reinforcement is required and Paralink™, with its high-strength and low-reduction factors is therefore an ideal reinforcement in such applications.

**Basal Reinforcement on piles or areas prone to subsidences due to voids**

Long-term reinforcement applications can be designed in the case of construction over areas prone to subsidence due to voids or in combination with piled foundations. In both cases the Paralink™ reinforcement guarantees long-term structural behaviour and meets the design requirements. Paralink™ materials have been used in such applications since the 1980's and there is a large database of successful applications demonstrating the efficiency and high-value performance of Paralink™ geogrids; Paralink™ is BBA Certified for use as a basal reinforcement in important structures such as highway embankments.
Pavement

Asphalt Reinforcement
The design of a flexible pavement might require a considerably thick asphalt layer which becomes uneconomical. The use of MacGrid® AR in this bound layer can reduce the thickness or increase the lifetime of the pavement at the equivalent design load.

Ground Stabilisation
Ground Stabilisation through the use of geosynthetics in a pavement layer allows the reduction of the thickness of the base or the sub-base. Geosynthetics can also increase the lifetime of the pavement or allow the use of a weaker fill material. MacGrid® EG and MacGrid® WG improve the performance of the pavement through lateral confinement and load distribution.

Separation and Drainage
The traffic load will cause any fine particle in the in-situ soil to migrate upwards in the structural material reducing quality of the pavement. MacTex® W or N, with their separation function can be placed at the interface to prevent this migration. MacDrain® assures both a separation function and a high flow-rate, assuring a dry pavement layer if water is present in the in-situ soil.
Drainage

Management of liquids such as water behind a wall, under a slab or earth-embankment is one of the most important aspects of drainage. The replacement of common gravel media with geocomposite for drainage allows a faster installation and an easier quality control.

Consolidation Treatments

It is best to ensure that consolidation of soft saturated foundation soil has decreased to a tolerable minimum before movement-sensitive structures such as a road or rail embankment are constructed. The aim of placing MacTex® N or W on the foundation layer is to filter the water into the gravel media but prevent ingress of the soft foundation soil. The entire drainage system can be replaced by the MacDrain® family of products due to the high performance under heavy loading.

Behind retaining structures or in tunnels

Saturated ground conditions should always be avoided for retaining structures. Pore pressure can be easily dissipated using MacDrain® behind the retaining structure.

In tunnels, where there is a necessity to overcome groundwater-seepage through the rock, MacDrain® can be placed between the rock face and the concrete tunnel-lining which ensures high in-plane flow rates.

Sub-surface Drainage

Sub-surface drainage normally consists of a permeable drainage media and a filter. MacTex® N or W geotextile can be used as a filter depending on the grading of the in-situ soil material. Geocomposite for drainage MacDrain® can replace the entire sub-surface drainage due to the drainage core which ensures that water flows away and it is encased in a geotextile which filters the water through the core.
Erosion Control

Relying solely on vegetation growth for erosion control is very unpredictable and unreliable as it is extremely difficult to achieve 100% vegetation coverage. It often leaves exposed areas vulnerable to erosion. Furthermore, vegetation can die, reducing the erosion control capability.

PRODUCT:

Integration with soil-nailing system

In a soil-nailing system, careful and accurate trimming of the slope face is critical if a good-quality finish of the slope-face is to be achieved. MacMat®-R is reinforced with a double-twisted steel mesh that resists the loads imparted by the nail-heads and head plates, avoiding failure by puncturing or rupturing.

Protection of sloped surfaces

The most critical situation for sloped surfaces is when vegetation has not yet grown and the surface is exposed to wind and rain. MacMat® and MacMat®-R with its three-dimensional structure increases the soils resistance to erosion by providing immediate protection of the exposed areas and protecting the seeded topsoil from washing out before vegetation has established itself. A good anchoring at the top of the slope, ensures a long-lasting erosion control system.

Integration with shotcrete or guniting systems

Shotcrete and guniting are the solutions when a vertical cut or steep slope requires permanent erosion protection. MacMat®-R is flexible and thus easier to install than rigid welded mesh panels; and it has a more natural rock-like finish because it follows the embankment profile.

River & Channel Lining

For flow velocity less than 2m/s, geosynthetics erosion control can replace traditional lining, offering easy handling and installation. MacMat® and MacMat®-R is suitable for such applications, because it has three-dimensional permanent erosion control.

Integration with soil-nailing system

In a soil-nailing system, careful and accurate trimming of the slope face is critical if a good-quality finish of the slope-face is to be achieved. MacMat®-R is reinforced with a double-twisted steel mesh that resists the loads imparted by the nail-heads and head plates, avoiding failure by puncturing or rupturing.

Protection of sloped surfaces

The most critical situation for sloped surfaces is when vegetation has not yet grown and the surface is exposed to wind and rain. MacMat® and MacMat®-R with its three-dimensional structure increases the soils resistance to erosion by providing immediate protection of the exposed areas and protecting the seeded topsoil from washing out before vegetation has established itself. A good anchoring at the top of the slope, ensures a long-lasting erosion control system.

Integration with shotcrete or guniting systems

Shotcrete and guniting are the solutions when a vertical cut or steep slope requires permanent erosion protection. MacMat®-R is flexible and thus easier to install than rigid welded mesh panels; and it has a more natural rock-like finish because it follows the embankment profile.
De-watering processes require a vast area and often take time to complete, influencing the effectiveness of a mine-shaft or a landfill. The pumping of the slurry or sludge into MacTube® under high pressure, which combined with the product’s ability to contain the soil and release the water, increases the process’s efficiency by reducing the de-watering time. In addition, the ability of stacking MacTube®s one on top of another, facilitates the de-watering processing and provides a small footprint which is advantageous when space is limited.

Coastal Protection

The requirement to minimise the impact to the environment all along the coastlines, has increased the demand for environmentally-friendly structures to protect the shoreline. MacTube® is easily installed, and is filled with sand from the area. The dimensions range up to 3m high and 50m long. This facilitates its use as underwater breakers, groynes and core-dunes. The composite geotextile develops high-tensile strength, long-lasting abrasion-resistance, and facilitates the growth of a sustainable ecosystem.
<table>
<thead>
<tr>
<th></th>
<th>Soil Reinforcement</th>
<th>Basal Reinforcement</th>
<th>Asphalt Reinforcement</th>
<th>Ground Stabilisation</th>
<th>Separation</th>
<th>Erosion Control</th>
<th>Drainage Under Embankments</th>
<th>Sub-surface Drainage</th>
<th>Drainage Behind Retaining Structure</th>
<th>De-watering</th>
<th>Coastal Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>MACTEX N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACTEX W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARALINK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARAGRİD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARADRAIN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACGRID WG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACGRID EG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACGRID AR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACDRAIN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACMAT-R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACMAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACTUBE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Material specific for that indicated application.
- Material that might be used for the indicated purposes.