Engineering a better solution
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion Control &amp; River Training</td>
<td>4</td>
</tr>
<tr>
<td>Retaining Walls &amp; Soil Reinforcement</td>
<td>6</td>
</tr>
<tr>
<td>Roads &amp; Pavements</td>
<td>8</td>
</tr>
<tr>
<td>Rockfall Protection</td>
<td>10</td>
</tr>
<tr>
<td>Mining Solutions</td>
<td>14</td>
</tr>
<tr>
<td>Coastal Protection &amp; Dewatering</td>
<td>16</td>
</tr>
<tr>
<td>Maccaferri Products</td>
<td>18</td>
</tr>
</tbody>
</table>
Consultancy and Partnership

Maccaferri's motto is ‘Engineering a better solution’; not merely supplying products, but working in partnership with clients, offering technical expertise to deliver versatile, cost effective and environmentally sound solutions. Maccaferri aims to build mutually beneficial relationships with clients through the quality of its service and solutions.

Organizational Structure

Maccaferri’s continued growth is based upon long-held values of innovation, integrity, excellent service and respect for the environment. Maccaferri’s vision is to become a leading international provider of advanced solutions to the civil engineering and construction market. Implementing a strategy of vertical integration, Maccaferri researches, manufactures, designs, supplies and constructs solutions within its target markets. With over 2000 employees, 30 manufacturing facilities and local operations in 100 countries around the world, Maccaferri can truly claim to have a global presence with a local focus.

Officine Maccaferri

Founded in 1879, Officine Maccaferri soon became a technical reference in the design and development of solutions for erosion control and retaining structures. Since then, through technological innovation, geographical expansion and focused diversification, Maccaferri offers solutions at a global level for a wide range of civil, geotechnical and environmental engineering applications. Maccaferri’s solutions range from coastal protection to reinforced soil structures and from rockfall mitigation to tunneling systems.
Slope Revetment

All natural slopes are subject to continuous erosion forces. Whether the slope has been recently formed, or is in its original natural state, some form of erosion protection may be required.

Maccaferri offers a range of slope revetment solutions to mitigate erosion. With the development of geosynthetic Turf Reinforcement Mats (MacMat®) and biodegradable Erosion Control Blankets (BioMac®) the variety of solutions has expanded greatly to offer a level of intervention appropriate to the erosion risk.

Soil Bioengineering

Maccaferri has a range of products that can be used in conjunction with soil bioengineering techniques to enhance the ecological aspect of the structures. Benefits of vegetation integration with non-living materials include:

- Erosion control and creation of hospitable conditions for the establishment of native plants
- Slower water velocities near banks, and sediment trapping
- Reinforcement of the soil as roots develop, adding significant shear resistance (on channel linings)
- Vegetated banks filter and slow storm water runoff, improving water quality
Maccaferri has over 130 years of expertise in river and stream protection, hydraulic works, and river training. For demanding, high energy flows, Reno Mattresses and gabions have always been the main component of river works such as linings, weirs, groins, sills and energy dissipation basins.

Maccaferri also provides solutions for lining and containment works for reservoirs, mine stilling basins, canals, attenuation and storage ponds as well as for golf courses and agriculture.

**Transverse-Drop Structures/Weirs**

Transverse works dissipate energy and therefore contribute to the stabilization of the bed material. Gabion weir and drop structures are used to control high energy hydraulic flows, carrying solids or sediments. These structures alter the hydraulic profile of the flow, reducing its energy and capacity to erode until a balanced condition is reached. The type and configuration of the weir is dependent upon hydraulic and topographic conditions. Maccaferri offers design software for channels, longitudinal and transverse structures. This enables the designer to rapidly perform preliminary hydraulic studies to evaluate the bank protection or the transverse weir required.

**Longitudinal Structures/Linings**

The canalization of a water course involves constructing a channel with a cross-section. This can be used to control the meandering of a river through a built up area, or in the vicinity of infrastructures. Where channels transport clean water flow through polluted ground, or vice-versa, the channels may be lined to make them impermeable.

Reno Mattresses and gabions, together with synthetic or biodegradable erosion protection mats, are often applied to the banks and, if required, to the channel bed to maintain the channel function.
Retaining Walls & Soil Reinforcement

Reinforced Soil Slopes & MSE Walls

Modifying soil slope profiles beyond their natural angle of repose, can lead to slope instability. This situation can arise when reducing the footprint of a new highway embankment, or to gain development area on a sloping site.

Maccaferri geogrid reinforcements, used in conjunction with the soil, enable the soil to perform better than it would in its unreinforced state. Maccaferri geogrids enable soils to accommodate greater loads and stand at steeper angles. The geogrids are laid horizontally within the compacted soil mass during construction, reinforcing it due to their high tensile strength, low strain and good interaction with the soil.

Maccaferri reinforced soil slopes and MSE walls are ideal for soils which have poor bearing capacity; the structure accommodates differential settlement far better than more rigid solutions. This is also a great benefit in seismic zones.

Our unsurpassed range of geogrid reinforcements, including MacGrid® WG, Paragrid and Paralink with strengths up to 1,350kN/m (92,504 lb/ft), maximizes the opportunity to reuse on-site materials as backfill to a reinforced slope. This saves on the export and import of materials from the site, embracing sustainability and reducing polluting truck movements. With
Gravity Walls

The stability of mass gravity retaining walls relies upon the structural integrity of the units, and their filled mass, to support or contain unstable earth slopes. In order to select the optimum Maccaferri retaining wall solution, key considerations include:

- The geotechnical parameters of the retained and foundation soils
- The presence of water and hydrostatic loads
- External loads from structures and live or seismic loads
- The simplicity and speed of construction

Certified by many authorities worldwide and manufactured in compliance with ASTM A975, Maccaferri double twist mesh gabions offer strength and high drainage capacity. Long-term stability and client reassurance are provided as these structures are capable of absorbing differential settlement and deformations.

Maccaferri gabions are available with a range of corrosion protection coatings to suit expected exposure conditions and design life requirements.
Reinforcement technology within roads and pavements creates a more dynamic system among the variables in the environment. Reinforcement increases the service life of roads and highways by reducing fatigue, reflective, thermal and settlement cracking.

Reinforcement relieves and redistributes stress concentrations in the pavement:
- Reducing reflective cracking into overlays
- Improving load distribution
- Improving the bearing capacity of the pavement structure
- Increasing resistance to rutting and shoving

The capability of the reinforcement to withstand loads will depend both on the type of reinforcement and the surrounding bituminous material. Discontinuities will inevitably lead to cracks in the asphalt.

Maccaferri offers a wide range of asphalt pavement reinforcement products from Road Mesh and double twisted hexagonal steel wire mesh, used to structurally reinforce pavements, to MacGrid® geogrids and MacTex® geocomposite fabrics. With the extensive product line at Maccaferri, flexibility is our strength.
Basal Reinforcement

Every construction site poses unique challenges due to soil conditions. The solution to challenges in the construction of unbound roads, including forestry tracks, mine haul roads, construction sites and parking areas, lies within the appropriate use of geosynthetics within the unbound layers:
- Increase the load bearing capacity of the structure
- Increase the life of the structure
- Reduce the thickness of the granular layer
- Reduce rutting

The Maccaferri in-house design team utilizes a combination of classical design methods and state-of-the-art software to select the appropriate Maccaferri geogrids and geotextiles to meet project demands, optimizing the structure and cost efficiency.

Pavement Drainage

The ever-increasing value of space requires a sound solution for drainage control. Poor drainage control within a structure or surrounding ground can weaken the foundation or lead to roadway closures.

The selection of an appropriate drainage solution depends on a number of factors:
- The overburden expected
- The expected flow discharge required
- The type of material/soil to be drained (clean, contaminated, etc.)
- Hydraulic gradient
- Dimensions of the area to be drained

MacDrain® geocomposites are designed to replace costly traditional drainage materials such as gravels and sands. Geotextiles, attached to the drainage core on one or both sides, stop the materials or soils being drained from clogging the drainage core or collection pipes.

Sinkhole Remediation

One of the most challenging situations in the geotechnical domain is the sinkhole. Some areas are subject to the sudden formation of cavities or natural depressions caused by mining subsidence, or where natural voids can occur. In these circumstances, it is necessary to introduce innovative reinforcement, typically at the base of the embankment, to prevent the sudden failure of the foundation or sinkholes.

That innovative reinforcement is Maccaferri’s high strength, low strain Paralink. This reinforcement meets the most stringent design criteria and has been used successfully for many years in sinkhole application. Maccaferri’s expert technical team is ready to help develop a solution for sinkhole challenges.
Simple Drapery

Maccaferri’s Simple Rockfall Drapery Systems are used to control falling debris on slopes, preventing the debris from falling onto roads, railways or areas where loss of life or property damage is possible. As surface debris loosens and falls, it is forced to work its way between the mesh/cable panels of the drapery system and the ground surface until it reaches the base of the slope where it can be removed.

Maccaferri simple rockfall drapery systems are constructed by suspending double twisted hexagonal steel wire mesh and/or cable net panels from an upslope up to downslope on the protected area. The panels are usually draped freely over the ground surface to extend to a specified length downslope. The panels may be fastened to the base of the slope in order to contain fallen debris.

Secured Drapery

Protection against rockfall is frequently carried out with mesh facing and patterned nails; this system is known as Secured Drapery. Secured drapery can also be referred to as pinned drapery, or surficial consolidation. Secured drapery is aimed at improving rock face stability.

The stability of the exposed rock face, reinforced with nails, is obtained by the contribution of steel mesh. The function of the mesh in the secured drapery system is to stabilize the material between the nails by limiting rock movement. The steel mesh facing has a flexible structural behavior, within the limits of its intrinsic deformability, and works in unison with the passive action of the nails.

Secured drapery intervention is typically recommended where the number of unstable blocks is too large and/or the maintenance cost is too high or the location is difficult to access. This allows the nailing of each single rock, so that the surficial portion of the slope can be compared to a continuous unstable thickness.
Barriers/Catch Fences

Barriers/Catch Fences are positioned to intercept and stop falling rocks and boulders. Maccaferri’s rockfall fences are supplied in “kit form” for a specific height, length and energy absorption capacity.

Maccaferri supplies rockfall barriers/catch fences with energy absorption capacities of 500kJ to 5,000kJ, featuring a unique, compression energy absorption device. This simple, yet effective device, maintains its performance throughout the design life of the structure. Unlike traditional ‘friction brake’ devices, Maccaferri’s compression tube brake is very easy to visually inspect as it progressively crushes as the fence is impacted. Also, it does not corrode or become clogged with grit over the life of the fence, potentially reducing the effectiveness of the barrier.

Above: A rockfall barrier that has been powder coated to blend with the environment.

Hybrid Barriers/Attenuators

Hybrid Barriers, or Attenuators, combine rockfall barrier technology with the advantages of simple drapery to form an efficient passive system. The upper section of the rockfall hybrid barrier absorbs the energy of the rock impact and the draped mesh guides the rock down the slope.

The energy of the falling rock is partially dissipated by the rockfall hybrid barrier as it impacts the mesh panel. The falling rock is then contained and slowed between the mesh and ground surface as it continues to fall towards the bottom of the slope.

The raised post at the upper section allows rocks from above to be caught within the system, providing extra protection. Due to lower maintenance costs, the hybrid barrier, or rockfall attenuator, is a cost effective solution.
Soil Nailing

Maccaferri’s Soil Nailing is a technique that can be used either as a remedial measure, for unstable natural soil slopes, or for steepening new or existing soil slopes. With soil nailing, the slope is reinforced by the insertion of reinforcing steel anchor bars. Anchors are installed using drilling techniques, and are usually fully grouted and installed with regular spacing across the slope face. Surficial stability can be achieved by using a flexible reinforcing mesh, or a rigid concrete revetment may be used to stabilize the soil between the steel plates.

Typically this type of system provides global stability by improving the soils shear strength while vegetation is established, which provides surface erosion protection.

Rockfall Embankments

Rockfall Embankments are used to stop rockfall and debris from falling onto roads, railways or where there is possible loss of property or life. Maccaferri’s rockfall embankments are made of pre-assembled products such as Green Terramesh®, Terramesh®, gabions or a combination of these products.

This passive system is an ideal solution when it is not possible to intercept falling rocks or prevent them from detaching, due to the slope being too large, or inaccessible.

Often, embankments are made with mechanically reinforced earth systems, enabling builders to use local material, reduce the footprint of the structure, and create a vegetated embankment face, which minimizes the system’s environmental impact.

The effectiveness of Maccaferri’s Terramesh® System goes hand-in-hand with rapid construction time. The double twisted hexagonal steel wire mesh fascia unit and soil reinforcement structural elements are pre-assembled during the manufacturing process, thereby dramatically reducing the number of operations performed on-site.
Avalanche Protection

The inhabitants of mountainous areas have always been affected by the risk of avalanches. The need to live alongside this threat has led to attempts to mitigate the risk by constructing intricate systems of artificial structures. Maccaferri’s snow nets are designed to stabilize the layer of snow at the potential avalanche detachment zone, thereby preventing the triggering effect of an avalanche.

Geological Hazard Protection

Geological hazards/debris flows are typically mobile liquefied landslides containing a variety of material from fine particles to large boulders and tree branches. They are caused by excessive water on slopes, from rainfall, glacier melts or similar. The likelihood of geological hazards/debris flows is increased when vegetation and other surface protection has been removed from vulnerable slopes, perhaps by wildfire or clearing. Geological hazards/debris flows tend to be channelled by the topography.

Maccaferri’s debris flow barriers are similar to rockfall barrier/catch fences, but work in a totally different way. The rockfall barrier stops rocks with a dynamic load, whereas debris flow barriers work for both dynamic and static loads. Ring nets are ideal in these structures as they have inherent energy absorption capacity, which reduces the loads that are transferred to the compression brakes.

For wildfire applications, the barriers are designed to be in place until vegetation is re-established on the vulnerable slopes above. The barrier can then be removed leaving the foundation intact. They can be reinstalled if risks from geological hazards/debris flows increase in the future.
Underground Mines

Operating underground encompasses the necessary processes and applications of specific techniques to extract valuable minerals. Maccaferri offers numerous solutions to line tunnels and control the loose and falling debris that can occur during mining operations. Depending on the specific risks, these solutions include double twisted hexagonal steel wire mesh, ParaRib polymer meshes, or fiber reinforced shotcrete.

Open Pit Mines

To maximize extraction volume and minimize the space for infrastructure, slopes within open pit mines can be steep, causing material to detach and affect mine safety and operations. Maccaferri addresses this problem with a range of high performance steel meshes and rockfall catch fences that range from a few kilojoules to 20,000 kJ.

Crusher Walls

Maccaferri offers reinforced soil and retaining structure solutions for crusher and hopper walls. Wherever possible, the reuse of on-site structural backfill is used with Maccaferri’s geogrids for reinforced soil, reducing costs and material waste. Maccaferri’s wall systems offer vertical structures with a tough fascia and geogrids that have strengths up to 92,500 lb/ft, accommodating even the heaviest of vehicles.
### Infrastructure

Effective access ramps, haul roads, surface water control structures and drainage systems are important to the uninterrupted performance of a mine. Whether a weak haul road requires sub-grade stabilization with geogrids, an outfall structure requires erosion protection or a run-off ditch needs lining, Maccaferri has a product that can help.

### Mine Reclamation

The closure and reinstatement of the ecosystem is one of the most important activities in the lifecycle of the mine. Maccaferri offers impermeable capping and drainage systems to prevent surface water from entering the deposits. The rapid re-establishment of vegetation and soil erosion protection systems complete closure operations. Maccaferri’s wide range of synthetic and biodegradable soil stabilization and erosion protection solutions facilitate mine reclamation.

### Waste Containment

The safe storage of tailings, waste, leachates and toxic materials is a significant operation within mines. Maccaferri’s range of solutions include geosynthetic membranes, geogrids and drainage geocomposites. These are used in heap leach pad liners, evaporation ponds and lagoon liners. Containment dykes often feature geogrid reinforced soil or gabion retaining structures; also, major dump zones can be supported on basal reinforced platforms.

### Dewatering

MacTube® geotextile containers are used for dewatering, mine tailings, sludge ponds or slurries. They are specifically designed to retain solid particles within the tube, while the filtrate fluids are released through the fabric. The drained solid residue can be left to dry before disposal in a controlled manner.

### Products for Mining

- Anchors
- B Zero Tondo
- BioMac®
- Chemicals & Accessories
- Debris Flow Barriers
- Double Twist Mesh
- Enviroleaf®
- Fiberglass Reinforcement
- FibroMac™
- Synthetic Fibers
- Gabion
- Gabion Mattress
- Green Gabion®
- Green Terramesh®
- HEA Panels
- Hybrid Barrier
- MacBag®
- MacDrain
- MacELB
- MacGrid® EG
- MacGrid® WG
- MacLine
- MacMat®
- MacMat® R
- MacTex®
- MacTube®
- Para Product
- Reno Mattress
- Ring Net Panels
- Road Mesh
- RockMesh®
- SteelGrid®
- Rockfall Barriers
- Rockfall Embankments
- Sack Gabions
- Shotcrete Additives
- SteelGrid® HR
- Terramesh® System
- Terrawall®
- Tunneling Drainage
- Water Log
- Wirand®
- Steel Fibers
Coastal Protection

Dune Restoration
Hydraulically filled with sand, Maccaferri’s geotextiles are an effective solution for dune restoration and stabilization of berm crest elevation. Maccaferri geotextiles are easy to install both above and below the water surface; they can improve storm damage vulnerability of upland infrastructure and increase the life cycle of maintenance re-nourishment. As a “soft” armored structure, they offer minimal impact to the environment while providing a cost effective alternative to a “hard” structure.

Habitat Restoration/Island Creation
Maccaferri products offer innovative solutions for applications including habitat restoration, restoration of lost land, island wave attenuation for marina protection, and dredge disposal containment. Our products can be used in a variety of environmental restoration applications, including wetlands, bays, and estuaries.

Dredging & Dewatering
Maccaferri products such as the MacTube® and MacBag® provide an efficient, cost effective and environmentally sound alternative for the disposal, containment, and re-use of dredged material. From channel maintenance dredging to removal of contaminated sediments and stormwater containment, Maccaferri’s geotextile containers provide the ability to readily consolidate sediment on-site and in the field with quality assured performance of high-strength woven geotextile fabric. For dewatering applications, Maccaferri’s geotextile containers increase efficiency and reduce dewatering time by adding environmentally safe polymers to aid in coagulation of solids and in the release of water.
Shoreline Stabilization

Shoreline stabilization is an important and ever-changing aspect in the coastal environment, particularly for protection of upland infrastructure and vulnerability to storms and coastal flooding.

Maccaferri offers a wide range of products for the construction of various coastal solutions such as groins, breakwaters, revetments, and retaining walls, as well as technical design assistance.

Maccaferri can offer clients a graded range of hydraulic erosion protection techniques from soil bioengineering and low energy solutions, to robust high-energy capacity revetments.

Emergency Works

Maccaferri offers a variety of emergency works products, which are designed with ‘Emergency Permits’ in mind, protecting life and property from almost certain future storm events. Maccaferri emergency works products are designed for integration with a long term solution and are removable should a more viable long term solution alternative be implemented.

Reef Restoration

Maccaferri offers innovative solutions for artificial reef applications, including habitat restoration and mitigation of impacted natural reef. Our worldwide experience in ballasted filter mattresses for stabilization and scour protection is unparalleled.

Maccaferri’s mattress systems can also be used in combination with our signature gabion reef unit design, which can be used in place of standard limestone boulder units – providing a more cost effective, complex habitat for marine growth. Our technical engineering staff will work with you to ensure that the stability of the structure will meet the environmental conditions to provide optimum performance.
Anchors

Steel rock bolts for ground support

BFM

Ballasted Filtering Mattress (BFM) is a pre-fabricated composite marine mattress system used in and around water

BioMac®

An Erosion Control Blanket (ECB) well-suited to the relatively short-term challenges of establishing vegetation in low to moderate erosion applications

Envirolog®

Double twist wire mesh basket lined with a 100% coconut (coir) blanket

Gabion

A basket manufactured from 8 x 10 double twist mesh in compliance with ASTM A975

Gabion Mattress

A long mattress manufactured from 8 x 10 double twist mesh

Hybrid Barriers

Rockfall barrier structure supporting a high energy simple drapery to attenuate rock impacts

MacBag®

Polypropylene bags inert to biological degradation and resistant to most naturally encountered chemicals, alkalis and acids

MacDrain

A three-dimensional geocomposite forming a system to draw and transfer water from the surrounding soils to drainage pipes

MacLine

High density polyethylene geomembrane produced from specially formulated, virgin polyethylene resin

MacMat®

A three dimensional matrix of polypropylene filaments used as a Turf Reinforcement Mat (TRM)

MacMat® R

A geocomposite Turf Reinforcement Mat (TRM) reinforced with double twist mesh

Reno Mattress

A gabion type structure manufactured from 6 x 8 double twist mesh with more planar area and relatively small thickness and in compliance with ASTM A975

Ring Net Panels

High energy absorption ring panels with wire strand rings on a four point interlocking pattern

Road Mesh

A double twist mesh reinforced with steel rods across the weave direction

Sack Gabion

Cylindrical baskets made of 8 X 10 double twist mesh

Snow Net

Snow blanket stabilization barrier

SteelGrid® HR

Woven composite, made of steel wire and straight steel wire ropes, woven together during the production of double twist mesh

Water Log

Densely packed coconut coir fibers contained within tubular netting of synthetic or coir yarn and planted with aquatic plants
Products

**Chemicals & Accessories**
- Grouting compounds for soil consolidation and conditioning

**Grouting compounds**
- Manufactured from 8 x 10 double twist mesh with different fascia inclination. Front face panel is lined with 100% coconut (coir) blanket for vegetation

**Green Gabion®**
- Emergency Lift Bags composed of woven high-tenacity polypropylene (PP) yarns for use in emergency situations for infrastructure protection

**MacELB**
- Woven and non-woven geotextiles manufactured from resisters and engineered for use in a wide variety of applications

**MacTex®**
- MacGrid® EG
  - Biaxial geogrid composed of one layer of high strength extruded biaxial oriented polypropylene

**MacGrid® EG**
- Polypropylene tubes inert to biological degradation and resistant to most naturally encountered chemicals, alkalis and acids

**MacTube®**
- Rockfall Embankments
  - A reinforcement soil structure used in rockfall protection where revetments are not possible

**Rockfall Barrier**
- Rockfall Embankments
  - A reinforcement soil structure used in rockfall protection where revetments are not possible

**Para Product**
- High tenacity, multifilament polyester yarns placed in tension, then co-extruded with polyethylene to form polymeric strips

**Rock Mesh®**
- High tenacity, multifilament polyester yarns placed in tension, then co-extruded with polyethylene to form polymeric strips

**SteelGrid®**
- High tenacity, multifilament polyester yarns placed in tension, then co-extruded with polyethylene to form polymeric strips

**MacGrid® WG**
- Uniaxial geogrid composed of high tenacity polyester multifilament yarns

**MacGrid® EG**
- High energy absorption cable panels with variable cable diameters and mesh openings containing double wire knotted junctions

**HEA Panel**
- High energy absorption cable panels with variable cable diameters and mesh openings containing double wire knotted junctions

**Double Twist Mesh**
- HITEC approved, environmentally friendly modular system used for reinforced soil slope embankments

**Green Terramesh®**
- HITEC approved MSE wall system, consisting of gabion fascia units with integral soil reinforcing woven wire mesh tails

**Terramesh® System**
- An MSE system consisting of welded panels and fascia, manufactured with integral soil reinforcing woven wire mesh tails

**Terrawall®**
- Variety of geocomposites for drainage, filtering and protection

**Tunneling Drainage**
- A barrier structure with a containment panel system to stop and retain rocks

**Rockfall Embankments**
- A barrier structure with a containment panel system to stop and retain rocks

**Debris Flow Barriers**
- Containment panel systems with or without structural barrier elements, designed to stop and retain rocks and smaller debris

**Double Twist Mesh**
- Double twisted hexagonal steel wire mesh

**Products**
- Chemicals & Accessories
- Debris Flow Barriers
- Containment panel systems with or without structural barrier elements, designed to stop and retain rocks and smaller debris
- Double Twist Mesh
- Green Gabion®
- Green Terramesh®
- High energy absorption cable panels with variable cable diameters and mesh openings containing double wire knotted junctions
- Terramesh® System
- Terrawall®
- Tunneling Drainage
- Variety of geocomposites for drainage, filtering and protection