HYDRAULIC WORKS

Channelling works
Reno Mattresses and gabions are typically used to fully contain and protect the watercourse within a specific alignment.

Longitudinal structures
The design of the structure depends on the hydraulic forces expected; geosynthetics (MacMat® geomat range) and biodegradable geomats (Biomac® C range) for lower energy flows, to Reno Mattresses and gabions for demanding, high energy flows.

Weirs, culverts and transverse structures
By controlling and dissipating energy in focused locations, grade control structures reduce the hydraulic gradient of the river and hence the erosion forces. Gabion and Reno Mattress weir structures are flexible and simple to install. Water control structures guide flows into and out of culverts and often have two functions; hydraulic erosion protection and geotechnical stability. Gabions and Terramesh® System can retain headwalls and stabilise banks.

Waterproofing of reservoirs, lakes & channels
Our MacLine® impermeable membranes and geosynthetic clay liners are often used to contain water within hydraulic works. They prevent water from draining away or cross-contaminating ground water. It is often used in conjunction with MacTex® geotextiles and MacDrain® drainage geocomposites.

MAC.R.A. Suite
Our software is used to design channel protection and transverse structures. These enable the designer to rapidly perform preliminary hydraulic studies to evaluate the bank protection or the weir structure required.

RETAINING WALLS & SOIL REINFORCEMENT

Mass Gravity Retaining Walls
Tried and tested for over a century, our gabions are brought up to date with state-of-the-art manufacturing, corrosion resistance and design; thus offering good value, attractive and long-lasting retaining wall.

Reinforced Soil Walls & Slope Reinforcement
Reinforcing soils with geogrids enables them to perform better than in their unreinforced state; standing steeper, accommodating higher loads and settling less. Maccaferri geogrids including MacGrid® WG, ParaGrid® and ParaLink®. Terramesh® and Green Terramesh® combine the rapid installation of a modular system with the flexibility of soil reinforcement.

Vertical Walls with Concrete Facing
When only a narrow construction corridor is available, or a reinforced soil structure with a vertical face is required, MacRes® system can be used. Ideal for tall walls in mine works or infrastructure where working loads are high, MacRes® features corrosion-free ParaWeb® geostrip soil reinforcement, connected to large concrete facing panels. A more formal and urban architectural aesthetic is offered with our MacWall®.

Benefits of Soil Reinforcement:
- Maximise the opportunity to reuse site-won materials as structural backfill
- Embrace sustainability and reduce polluting truck movements
- Cost effective
- Wide variety of face finishes including vegetation, rock, concrete block and panel
- Accommodate differential settlements and seismic loads better than rigid solutions

MacSTARS
Our powerful software assists in the design of retaining walls and reinforced soil projects, optimising solutions to balance technical performance, environmental compatibility and architectural harmony.

"ParaLink and ParaGrid are amongst the most tried and tested geogrids in the world offering 120 year design life and high performance."

ROCKFALL PROTECTION & SNOW BARRIERS

Simple Drapery
Our steel wire double twist drapery mesh is flexible and conforms easily to the rock slope to contain loose and falling rock debris.

Surface Strengthening & Support
Featuring high tensile steel cables, our patented HEA Panels and Steelgrid® HR meshes offer high stiffness (load vs deformation) performance, ideal to limit rock detachment on critical slopes.

Dynamic Rockfall barriers
Installed on the slope to intercept falling rocks and boulders, Maccaferri's dynamic rockfall barriers offer an energy absorption capacity of 100 – 8600kJ. Patented energy dissipation systems absorb the kinetic energy efficiently with industry leading after impact residual height and deflection limit.

Debris Flow Barriers
Our Debris flow barriers are positioned within the anticipated path of debris flows or shallow landslides, often in natural gullies, channels or chutes on the slope.

Rockfall embankments
Scalable to suit the hazard, embankments are used where large or repeated impacts are expected including landslides, rockfalls, and avalanches. Featuring reinforced soil technology, they can often re-use site won materials in construction. Accepts impact energy capacities of over 20,000kJ.

Soil nailing
Our solutions include the use of soil nails in conjunction with HEA panels or Steelgrid® HR mesh, or with MacMat® R or MacMat® HS when slope revegetation is required.

Snow fences & Avalanche Protection
Certified by the Swiss Federal Institute for Snow and Avalanches, our snow nets stabilise the layer of snow at the avalanche initiation zone preventing it triggering.

MACRO Studio
Our flexible software enables engineers to design and optimise rockfall drapery and surface stabilisation solutions.

SOIL STABILISATION & PAVEMENTS

Asphalt Pavement Reinforcement
Maccaferri offers a wide range of asphalt pavement reinforcements to reduce whole-life costs; Road Mesh® structurally reinforces the pavement and provides lateral restraint whilst MacGrid® AR geogrids inhibit reflective cracking in overlays. Stress concentrations in the asphalt matrix are relieved and redistributed by the reinforcement.

Sub-grade Improvement
Maccaferri's geosynthetics including MacGrid® and MacTex® work with the unbound granular layers extending its life by preventing bearing capacity failure and excessive rutting. Additionally, MacGrid® EG and WG can reduce the thickness of the construction layers cutting the carbon footprint.

Sub-grade and Pavement Drainage
Removing unwanted water from the beneath or adjacent to the road increases its performance. MacDrain® drainage geocomposites replace traditional granular drainage stone with reliable, lab-tested hydraulic performance. They reduce excavation and drainage gravel volumes saving client's money and carbon footprint.

MacREAD
Our software is used to optimise the road structure, including both unbound and bound layers, in standard and improved conditions through the addition of geosynthetics within the various layers.

BASAL REINFORCEMENT

Construction over soft soils
Embankments constructed on cohesive or alluvial soils may be subject to settlement and geosynthetics are often used to meet the service life and serviceability settlement requirements of the project including:
- ParaLink® high strength-low strain geogrids to reinforce the embankment foundations
- ParaGrid® and MacGrid® geogrids
- MacTex® W1 and W2 woven geotextiles to reinforce and separate the foundation materials
- MacDrain® vertical wick drains to accelerate the consolidation of the soil
- MacTex® H geotextiles to separate poor strata from better quality embankment construction materials

Piled embankments
ParaLink® or MacGrid® WG geogrids offer high strength with low strain characteristics and when used in conjunction with piles can replace an embankment foundation slab. These geogrids, with design lives in excess of 120 years, work with the soils, absorbing the forces from the embankment above and transferring them vertically into the piles.

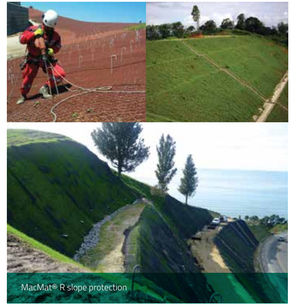
Construction over voids
There is a risk of catastrophic failure due to sudden settlements in locations prone to mining subsidence, natural voids or solution features. Paralink® geogrid reinforced soil foundations are used to prevent the most serious effects of these phenomena.

EROSION CONTROL

Slope Protection
Soil slopes are subject to continuous erosion forces, whether natural or caused by man. Erosion control systems offer short-term (Biomac® biodegradable mats) or long-term (MacMat® geomats, Reno Mattresses®) protection of the slope surface. In addition to providing immediate protection from the erosion forces, these systems are designed to facilitate the re-establishment of vegetation on the slope.

Soil Veneer Applications
When placing soil onto surfaces with a low friction angle, there is the risk that the soil will slump down the slope. This is common when capping landfills, on the banks of lakes, or simply where a layer of soil is required to revegetate a sterile slope.

Geosynthetics including MacMat® and our reinforced MacMat® R geomats, selected according to the thickness and tensile strength required, provide a griplayer which supports the soil veneer. Working with our engineers, it is even possible to provide a soil veneer within landfills. This approach is common in landfill capping applications where MacMat® R is used in conjunction with geosynthetic membrane liners MacLine®, MacLine® GCL and drainage geocomposites MacDrain®.

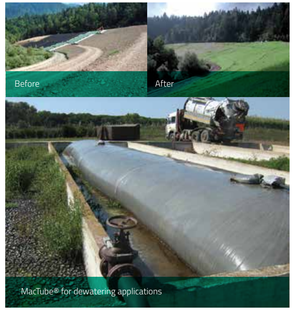


ENVIRONMENT, DEWATERING & LANDFILLS

Lining systems – base and capping
Our solutions can combine natural and geosynthetic materials to achieve the required safety levels and waste regulations and also to optimise construction efficiency.

Reinforcement of marginal soils & waste
We help operators to maximise storage volumes in existing facilities through the use of geogrid reinforced soil structures. These are used within landfill cells to successfully increase cell capacities delivering environmental and cost benefits. Heavy duty ParaLink® geogrids are also used in piggybacking works to reduce differential settlements when an existing waste facility is re-engineered to accept more waste.

Dewatering
The dewatering and drying of sludge is a technology with low environmental impact and cost. MacTube® geosynthetic tubes are filled in-situ with natural or contaminated fluid sludges. The fluid drains through the specifically designed fabric walls, leaving the solid residue within the tube which is easier and more cost effective to dispose of.



COASTAL PROTECTION, MARINE STRUCTURES & PIPELINE PROTECTION

Pipeline Protection
Sarmac® bituminous mattresses and ACBM (Articulated Concrete Block Mattresses) ballast and protect underwater pipelines and cables. They are flexible, deformable and impact resistant.

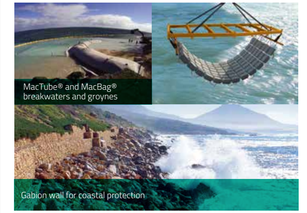
Breakwaters & Groynes
Replacing the traditional rubble mound core material with MacTubes® to speed up construction and reduce breakwater overall costs. The range also includes unique Ballasted Filtering Mattresses for use beneath marine structures.

Dune Reconstruction
Our solutions to reconstruct and preserve existing dunes with material availability and ease of implementation. MacTubes® and MacBags® are ideal where there is a readily available supply of sand; whilst gabions and Reno or Marine mattresses are alternatives where rocks or other material is available.

Quays, piers and Jetties
Free-draining gabions and Reno Mattresses® with tough and durable PoliMac® coatings provide flexible solutions in port areas.

Seawalls and Shoreline Structures
MacTube®, MacBag®, gabions and Reno Mattresses® provide longitudinal shoreline protection and rehabilitation.

Seagrass Meadows and Reef Reconstruction
Reinforced MacMat® geomats provide root anchorage for vulnerable seagrasses as they attempt to colonise sea beds. A similar approach, often in combination with MacBags® and MacTubes® is used in the reconstruction of reef zones, damaged by storms.



Officine Maccaferri S.p.A.
Via J.F. Kennedy, 10
40069 Zola Predosa (Bologna) - Italy
T: +(39) 051 643 6000
E: info@hq.maccaferri.com
maccaferri.com

Gruppo Industriale Maccaferri

OFFICINE MACCAFERRI GROUP PROFILE

Founded in 1879, Officine Maccaferri soon became a technical reference in the design and development of solutions for hydraulic works and retaining structures.

Since then, through technological innovation, geographical expansion and focussed diversification, Maccaferri now offers solutions at a global level for a wide range of civil, geotechnical and environmental engineering applications.

MACCAFERRI APPLICATIONS

- RETAINING WALLS & SOIL REINFORCEMENT
- DRAINAGE OF STRUCTURES
- HYDRAULIC WORKS
- TUNNELLING*
- ROCKFALL PROTECTION & SNOW BARRIERS
- LANDSCAPE & ARCHITECTURE
- EROSION CONTROL
- SAFETY & NOISE BARRIERS
- SOIL STABILISATION & PAVEMENTS
- FENCING & WIRE
- BASAL REINFORCEMENT
- AQUACULTURE NETS/CAGES
- COASTAL PROTECTION, MARINE STRUCTURES & PIPELINE PROTECTION
- CONCRETE FLOORING, PRECAST & OTHER USES *
- ENVIRONMENT, DEWATERING & LANDFILLS

DRAINAGE OF STRUCTURES

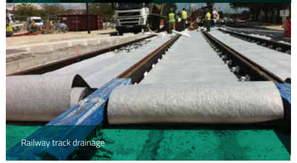
Vertical Drainage Works
Effective drainage of the soils behind retaining structures, piled walls and within slopes is important to ensure the long-term performance of that asset. Lab tested MacDrain® geocomposites offer reliable and long-term drainage capacity unlike gravel drains which can become clogged by fines in suspension within the ground water.

Consolidation by Drainage Systems
Slope and ground instability can be caused by ineffective management of the water within them. Removing that water stabilises and consolidates the soils. MacDrain® within drainage trenches, linked to collection systems rapidly removes unwanted ground water.

Planar and Horizontal Drainage
Providing a reliable drainage path beneath structures and sports pitches removes water which could affect the performance or lifespan of the structure above. Even when placed near-horizontally, MacDrain® provides good drainage function.

Our MacFLOW software resolves water-management challenges by enabling the design of the optimal MacDrain® drainage solution. The best value solution should not only address technical and economic issues, but also the environmental benefits and the speed and efficiency of installation.

Sports pitch drainage



Railway track drainage

LANDSCAPE & ARCHITECTURE

Both functional and eye-catching, gabions have a rich history world-wide for their use as architectural features.

The only limit is the imagination and landscape architect's creativity in the use of the mesh or gabion. Gabions, geogrids, Terramesh® and Green Terramesh® were used as the core in many landscape architecture projects to provide an intimate and reflective area offering sound proofing, privacy and beauty.

There are many design options available to the landscape architect from retaining to free standing landscaping walls; low with trailing plants, or built with curves, sharp angles or coloured rock fill. Rock filled gabion units are also popular as cladding on buildings and other structures, to provide a natural-looking aesthetic statement.

Gabion cladding

SAFETY & NOISE BARRIERS

Increasing urbanisation brings people and infrastructure into closer proximity. We provide solutions to this, addressing potential conflicts and providing solutions to mitigate the risks of safety and noise. Simple to construct reinforced soil bunds or gabion walls can provide acoustic and visual screening.

Vehicles accidentally leaving highways or railways, can be stopped before they threaten people or property. The impact knowledge is founded in our experience of rockfall and debris flow embankments.

Defence and Security; today's hostile threats are as likely to affect civilians as well as service personnel. Our force protection bastions were first used in WW1 and the original philosophy remains true today with our Defencell MAC™; to provide rapid-to-deploy effective troop protection from blast, ballistic or vehicular attack. In addition, our MacSafe® fence can prevent hostile vehicle intrusion.

MacSafe® on Promenade des Anglais, Nice, France
© Robert Palomba Photographe

Defencell MAC™ force protection

TUNNELLING

Consolidation
Our fiberglass reinforcements stabilise the excavation, preventing its collapse and enhancing the overall safety conditions. The reinforcements are suitable for both sequential and full-face excavation (e.g. ADECO-RS and the like). Special systems, including our P.E.R. Ground™ system, are available to overcome challenging ground conditions and achieve high anchoring performance.

Fibreglass reinforcement bars for concrete can be used within temporary underground structures such as diaphragm walls and the 'soft eye' breakthrough.

Primary Lining
Our patented B.Zero Tondo™ Tunnel Support System provides efficient first stage support. The unique tubular steel-arch ribs are filled with pumped concrete in-situ and offer greater structural efficiency than traditional steel-arch supports. Installed in conjunction with the remote control 3-Arm Handler, operatives are removed from the dangers of the excavated face, dramatically enhancing the safety conditions.

Final Lining
Our steel fibre reinforced concrete (SFRC) solutions enable the reduction (and sometimes elimination) of traditional steel bar reinforcement. Micro polymer fibres within the concrete significantly increase fire resistance by reducing spalling phenomena.

In 2014, Maccaferri and Bekaert enter a global sales and distribution joint venture: Bekaert Maccaferri Underground Solutions serves all the markets except China, Hong Kong, Argentina, Brazil, Paraguay, Peru and Uruguay. In these countries the companies act independently.

B.Zero Tondo™ Tunnel Support System

CONCRETE FLOORING, PRECAST & OTHER USES

In mainland China and Hong Kong, Argentina, Brazil, Paraguay, Peru and Uruguay only, we offer Steel Fibre Reinforced Concrete (SFRC) for use within industrial flooring, slabs and precast products.
Maccaferri Wirand steel fibres and Fibromac micropolymer fibres are used to improve the performance of concrete whether precast, poured in-situ or used as shotcrete:

- From brittle to ductile behaviour, reducing weak points
- From compressive strength to flexural structural performance
- Enhanced structural performance and 'buildability'

Warehouses and industrial slabs
Our Wirand® steel fibre reinforcement enhances the performance of concrete slabs and industrial floors once cracks initiate, bridging the cracks and controlling their width.

Precast concrete
Wirand (SFRC) and Fibromac™ polymer fibres increase the durability, ductility and the shear, impact and fire resistance of the resulting concrete.

Fibres used to improve concrete performance

FENCING & WIRE

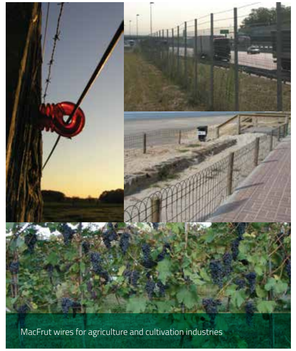
It was wrought iron fences and gates which gave birth to the Maccaferri company nearly 500 years ago.

Today we offer fencing solutions including safety, security, protection and durability through the combination of modern materials and components. Modular construction and design standardisation are also key elements of our fences.

Our fencing systems are used to:

- Protect or secure infrastructure
- Contain livestock
- Enclose buildings and other facilities

We are not only a major user of coated steel wire in our mesh products, we are also a manufacturer of wire. We supply wire as a raw material for a wide range of other industries.



MacFrut wires for agriculture and cultivation industries

MACCAFERRI

Engineering a Better Solution