Engineering a better solution
Applications

Erosion protection

MACCAFERRI
About Maccaferri

MACCAFERRI is part of a worldwide industrial group with headquarters in Bologna, Italy. Traditionally known for its double twist wire Gabions and Reno Mattresses, Maccaferri has extended its product range significantly over the last decade. We now have exclusive distribution agreements with Colbond Geosynthetics, Acheson & Glover, Ten Cate Nicolon and Bidim enabling us to offer an unrivalled range of wire, geosynthetic and natural fibre products to the construction industry.

From offices in Oxford, Perth, Belfast and Dublin we can deliver a wide range of engineering solutions, supported by our in-house team of geotechnical and bio-engineering specialists, many of whom are Chartered Civil Engineers.

At Maccaferri we have long held a reputation for meeting demanding engineering challenges and delivering in-depth technical and design support for our products. Whatever you need, be it advice on a minor technicality or to discuss a major project application, please do not hesitate to contact us.

Erosion Protection

With our specialist knowledge and unrivalled product range Maccaferri can offer the most cost-effective solution to your erosion control problem whether for a river bank, road cutting or a coastal revetment.

On the following pages you will find information about our product range and examples of their use in demanding situations.
Embankments and Cuttings

The need for ever-steepener slopes, whether for the creation of road or rail infrastructure corridors, or a new retail development, can lead to difficulties with topsoiling. All too often topsoil layers are seen slumped at the base of newly constructed slopes.

Where a natural vegetated slope is required, erosion mats and soil cells provide a cost-effective method of retaining both soil and moisture, thereby promoting sustainable vegetation for long-term erosion protection. On rock slopes, where loss of rock fragments from the face is the prime concern, wire mesh solutions are usually the most appropriate. Whatever the situation, Maccaferri can offer the right engineering solution.

Soil Cells

Typically used on steep engineered cut or embankment slopes, soil cells provide permanent support to prevent topsoil slumping and a suitable and sustainable environment for plant growth.

Armater is shown being installed on a steep 1:1 embankment slope for the Channel Tunnel Rail Link Contract 440. Armater is a unique polyester “Soil Cell” product, forming open hexagonal cells that will retain the soil added after installation. With approximately nine cells per square metre, the cell walls are a standard 100mm deep. Anchorage is provided by a trench at the top, with pins and buckles used to provide further anchorage on the slope.

The natural passage of moisture through the soil is unimpaired by the completely permeable cell walls, so providing suitable growing conditions for plant life on an otherwise barren slope.

Geomac is a wire mesh alternative comprising a geotextile-lined Reno mattress suitable for receiving the topsoil growing medium.

Soil cells
• Armater
• Geomac

for further information go to www.maccaferri.co.uk
Erosion Mats

Erosion mats are used to encourage and promote growth on steep cut slopes and embankments. They retain soil and moisture to enable establishment of the root systems in the underlying sub-soil. Maccaferri offers a range of natural fibre, geosynthetic and double twist erosion mats and can advise on the most appropriate choice for any particular situation.

In most widespread use is Enkamat, an open three-dimensional mat of nylon filaments providing an artificial root reinforcement structure for both temporary and permanent support. Local erosion of the soil mantle on the cliffs above Roker Promenade, Seaburn, was halted using open Enkamat retained with an anchor trench and steel pins before being topsoiled. This provided sustainable root support and an improved vegetated surface. When required, turf can be pre-grown within Enkamat and delivered to site as Enkazon for an immediate greened up surface.

Where it is anticipated that natural root support will be available in the long term, Biomac, a natural fibre quilted coir mat, may be appropriate. Providing a completely biodegradable (typically over two or three years) solution, Biomac is shown here on a new embankment for the A40 Carmarthen Bypass, South Wales.

MacMat R combines the strength of PVC-coated double-twist woven wire mesh with a three-dimensional erosion mat made from extruded nylon filaments. A highly versatile product, and unique to Maccaferri, MacMat R provides effective erosion protection when laid on cut slopes or secured on steeper reinforced slopes with soil nails. It can also be used in shallow watercourses to promote vegetation growth and to produce natural looking bank protection.

Following several years of instability in a road cutting along the A1 trunk road at Morpeth, Northumberland, the most cost effective solution chosen for a 100m section featured soil nails installed at 2m centres into an existing 1:2 slope and faced with MacMat R.
Rockfall Netting

On unprotected rock slopes subjected to weathering, spalling of small rock fragments is inevitable. Some form of structural restraint is often required and Maccaferri offers a range of double twist wire products to meet this need.

Maccaferri’s traditional flexible Rockfall Netting has been used on rock slopes around the world. The PVC-coated double-twist wire mesh is typically fixed to a stable rock slope using mechanical or resin anchors. Rockfall netting may also be used in conjunction with a sprayed concrete facing when required. Where it is desirable to encourage plant growth MacMat-R, comprising double twist wire mesh incorporating a three dimensional mat of nylon filaments, can be used. It offers the ability to trap fine material so as to encourage vegetation, usually in combination with sprayed hydro-seeded mulch. MacMat R is also suitable for use as face protection on soil nailed slopes.

“Maccaferri double twist wire Rockfall Netting is both flexible and strong and has been used around the world to protect road and rail infrastructure from disruption caused by rockfalls and natural slope degradation”
Rivers, Lakes and Channels

The natural erosion of river banks, lake shores and channels is an ongoing process and if left unchecked can result in geotechnical failure, often affecting road and rail infrastructure and pedestrian footpaths. Protection against erosion is typically provided in the form of a shallow **Revetment** or where undercutting has occurred, forming a vertical bank, in the form of a **River Wall** providing both geotechnical support and erosion protection.

Maccaferri has a wide range of double twist wire, geosynthetic, and natural fibre solutions available to meet these needs.

### Revetments

A combination of **Reno Mattresses** and **Gabions** was used here on the River Esk, near Edinburgh to combat severe bank erosion and provide permanent geotechnical support to the threatened footpath.

The use of heavy erosion mats can also be appropriate in high energy environments as shown here by the use of **Enkamat A20** being installed for the diversion of Gores Brook, part of the Channel Tunnel Rail Link project at Dagenham, Essex. Enkamat A20 is a flatback Enkamat with an asphalt filler applied at the factory through which grass and reeds can easily penetrate and is often used in river diversions where sharp turns are necessary and scour erosion could occur if left unprotected. Enkamat A20 was chosen here for its flexibility and ease of installation even underwater, where a simple overlap provides continuity.

Where energy levels are lower, **Enkamat (Flatback)** can be used. It is filled with a ballasting layer of 2mm-6mm gravel to ensure it is in good contact with the soil it is protecting - a fundamental requirement for erosion mats to work properly.

As illustrated in the sketch above, Enkamat (Flatback) and Enkamat A20 can be used together for cost-effective overall bank protection. Both systems provide a durable reinforced root zone for long term protection.
“In river systems, erosion energy can vary significantly and is a function of wave height, velocity and storm duration. Maccaferri has the product range and the experience to deliver the right solution.”

Erosion attack is primarily a function of water flow velocity and wave height resulting from natural currents and wind borne waves or from boat wash. An indication of the choices of erosion protection systems available as a function of erosion energy is provided on the illustration above.

A new commercial development required the diversion of Allan Water, at Blackford, Scotland. The completely new watercourse is shown here, one year after construction. Where a combination of MacMat-R, Biomac, Bentomat and marginal plants has helped to restore the natural burn function with high ecological value. The stream has a central low flow channel, reeds on a wetland shelf and a grassy slope to contain the water in high flow conditions. By working closely with the client and his engineering team, Maccaferri created a permanent solution that ensured the ecological value of the stream was maintained.

In low-energy water margin situations, established plants can often provide erosion protection as well as ecological value. Coir Logs, made from biodegradable coconut fibre give short-term protection against soil erosion during the plants’ establishment phase. They are shown here being installed on the water margin at Stevenage Lakes, Hertfordshire and on the Trent / Mersey Canal near Stone, Staffordshire, as low-grade bank support.

for further information go to www.maccaferri.co.uk
River Walls

Where erosion has undermined the riverbank to form a near vertical slope (typically in higher energy environments) both geotechnical support and erosion protection are required. Maccaferri offers a range of durable double twist wire solutions that can provide the necessary support and protection whilst complementing the natural surroundings. An example of such a structure, at the Bridge of Allen, Perthshire, is shown here some years after construction.

Gabion river walls used for high energy environments are typically founded upon upon a Reno Mattress to prevent the wall from being undermined. Where sediment loads are high, stub groynes may be added to dissipate energy in the form of eddy currents and hence limit the erosive effect on the main structure. This often results in sediment deposition at the base of the wall further protecting the gabion structure and promoting plant growth for enhanced environmental and ecological value.

Canalised lowland rivers, especially in urban situations that are suffering chronic bank erosion, can be reinstated with a much lighter system. At Shebdon Bridge in Staffordshire, MacMat-R was used in combination with sheet piles and walings to provide boat moorings whilst also encouraging plant growth and ultimately producing a softer bank feature. MacMat R with a Biomac liner allows soil to be retained as backfill to the vertical sheet pile face. The three-dimensional matrix of synthetic filaments is dense enough to control soil migration but sufficiently open to allow plants to grow through it.

Gabion river wall, Bridge of Allen

Double Twist Wire Mesh

Maccaferri double twist wire mesh is produced in our factories around the world. It is made from drawn steel wire coated with ‘Galfan’, a zinc/aluminium/mischmetal alloy, for long term corrosion protection. It is also available with a polymeric coating for even greater durability. Double twist wire mesh is used in our Gabions, Reno Mattresses, Rockfall Netting and MacMat-R.

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Coastal revetments

Erosion energy in the coastal and estuarial environment is substantially greater than that encountered inland. Layers of large stone or “riprap” have been used for coastal protection over many years; they provide a rough surface combined with significant run-up lengths to dissipate erosion energy.

Since the introduction of geosynthetics, it has been possible to greatly extend the design life of riprap construction significantly by placing a geosynthetic filter-cloth beneath the stone layer. This is now widely accepted as being highly effective in preventing “wash-out” of the underlying soil, which can otherwise lead to failure of the stone layer under the aggressive action of the sea.

**Geolon**, our polyester, high density polyethylene and polypropylene woven fabrics can be made in almost endless variations to meet the specific parameters for a given project such as tensile strength, puncture resistance, permeability, and aperture size. The properties of the filter-cloth can therefore be matched to the soil characteristics to prevent washout, but without clogging the filter.

In addition to “riprap” support by these woven fabrics, originally developed for projects along the Dutch coast, a unique **Geotube** system has been developed for use in sea defence construction. Shown here at the Royal North West Norfolk Golf Club where their practice ground was at risk of flooding, Geotubes, filled with locally won sand were used as the core to a new coastal defence.

**Reno Mattresses** were used in combination with **Gabions**, shown here during installation, to protect the Eden course at St Andrews Golf Course, on East Fife coast. Both comprise PVC coated Galfan double twist wire mesh for maximum durability.

For further information go to [www.maccaferri.co.uk](http://www.maccaferri.co.uk)
**Product Guide**

**Solutions for Embankments and Cuttings, Rivers, Lakes and Coastal Revetments**

**Armater**
Armater is a synthetic soil cell system for holding a depth of soil on a steep slope without slumping. It has a honeycomb structure produced by stitching stiff, durable strips of non-woven polyester.

**Bentomat**
Bentomat is a reinforced geosynthetic clay liner (GCL). Natural sodium bentonite is integrated into a non-woven needle-punched geotextile matrix to form a 5mm thick impermeable barrier (1 x 10^-11 m/s). Easy to install and ready to landscape.

**BioMac**
BioMac is a degradeable quilted coir soil blanket, which protects the soil for two or three seasons against surface erosion during the establishment phase of seeding and planting. Can be supplied ready seeded.

**Coir Logs**
Coir Logs are densely packed coconut coir fibres, typically 30cm diameter, contained within tubular netting of synthetic or coir yarn. Planted with aquatic plants, they provide permanent erosion protection at the water’s edge.

**Eco Shutter**
Tightly woven willow provides a stiff, organic shutter panel typically placed behind wooden uprights. Live plant material is introduced behind to promote establishment of a sustainable natural environment.

**Enkamat**
A three dimensional matrix of entangled polyamide filaments which provides permanent reinforcement to grass roots, and serves to contain the top layer of soil. Enkamat has a pedigree of over 30 years’ standing.

**Enkazon**
Cultivated turf pre-grown in an open Enkamat matrix. Enkazon has all the advantages of Enkamat but with full strength from day one. Can be quickly installed and pegged even to very steep slopes or spillways.

**Enkamat (Flatback)**
A three dimensional matrix of polyamide filaments with a flat filament layer beneath. Designed to accept 2mm-6mm gravel ballast, these mats are particularly useful in live watercourses against scour action.

**Enkamat A20**
Enkamat (flatback) factory filled with bitumen bound 2mm-6mm gravel chippings. This heavy, permeable, mat provides protection against scour in rivers, and yet allows full vegetative cover to grow through it.

**Enkamat-W**
Enkamat stitched to a woven reinforcing fabric. The woven fabric can be selected to suit specific requirements and consists of either polypropylene or polyester with strengths up to 200kN/m.

**Gabions**
Flexible gravity retaining walls of interlocking 150-200mm stone contained in flexible wire mesh box units of various sizes. The drawn wire double twist mesh is PVC coated Galfan for long term corrosion protection.

**Geolon**
A wide range of heavy woven polypropylene fabrics, used as reinforcement and filter layer beneath stone “Rip-Rap”. Superior strain characteristics minimise settlement and wash-out.

**GeoMac**
GeoMac is a Reno Mattress, filter fabric lined, ready to be filled with stone, soil and seeds. The principal use is to provide a green finish to a slope revetment, where conventional soil cells are not suitable.

**Geotubes**
Synthetic tabular bags made from strong porous woven polypropylene fabric. Custom made up to 3 metres diameter, Geotubes are pump-filled with sand slurry and provide a stable basis for new embankments, breakwaters etc. Particularly useful for tidal working.

**Loopmat**
With tensile strength of 9kN/m, the woven coir yarns permit soils to be restrained under tension during plant establishment. The looped pile upper surface provides enhanced surface sediment entrainment and accelerates the natural plant colonisation process. It is suitable for low energy river environments, with erosion protection extending for three to four seasons.

**MacMat-R**
A three dimensional matrix of polypropylene filaments, reinforced with flexible double-twist woven steel mesh. Used as an erosion mat on road embankments, often as the facing on soil nailed slopes, and for bank protection in rivers, MacMat-R is versatile, durable and easy to handle.

**Marginal plants**
Dense plant growth can provide erosion protection against scour energy, modest wave action and rainfall. They also provide natural habitat.

**Nicospan**
A woven geotextile with pre-formed sleeves. Used with timber posts to create low height, vertical bank support, Nicospan is easy to install at the water’s edge. Provides low-cost support for river banks.

**Reno Mattress**
Reno Mattresses are made from PVC coated Galfan double twist woven wire for long life. Interlocking stones are packed into the enclosing mesh to form a 300mm deep mattress. They are typically used as scour aprons for gabion river walls or as shallow bank revetments and often vegetate naturally.

**Rockfall Netting**
Heavy-duty double-twist steel mesh for use on steep or vertical applications. Anchored to the rock face, it serves as a containment system against rock fragments falling from the slope.

Unrivalled range of products - unrivalled engineering resource

for further information go to [www.maccaferri.co.uk](http://www.maccaferri.co.uk)
Erosion Protection

Working with the world’s leading suppliers of specialist erosion products for rivers, road embankments and coastline protection, Maccaferri offers an unbeatable range for all situations, often combining products to provide project specific solutions.