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**MACCAFERRI**

# Engineering a Better Solution

Maccaferri's motto is 'Engineering a Better Solution'; We do not merely supply products, but work in partnership with our clients, offering technical expertise to deliver versatile, cost effective and environmentally sound solutions. We aim to build mutually beneficial relationships with clients through the quality of our service and solutions.

## 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.

## ORGANISATIONAL STRUCTURE

Officine Maccaferri is at the heart of the Maccaferri Industrial Group, a corporation with revenues of €1.2B, operating in mechanical engineering, real estate & construction, energy, food & agro-industry and tobacco.

Officine Maccaferri's vision is to become a leading international provider of advanced solutions to the civil engineering and construction market. With nearly 3000 employees, over 30 manufacturing facilities and local operations in 100 countries around the world, Maccaferri can truly claim to have a global presence with local focus.


## MACCAFERRI APPLICATIONS

 **RETAINING WALLS & SOIL REINFORCEMENT**

 **SOIL STABILISATION & PAVEMENTS**

 **DRAINAGE OF STRUCTURES**

 **FENCING & WIRE**

 **HYDRAULIC WORKS**

 **BASAL REINFORCEMENT**

 **TUNNELLING\***

 **AQUACULTURE NETS/CAGES**

 **ROCKFALL PROTECTION & SNOW BARRIERS**

 **COASTAL PROTECTION, MARINE STRUCTURES & PIPELINE PROTECTION**

 **LANDSCAPE & ARCHITECTURE**

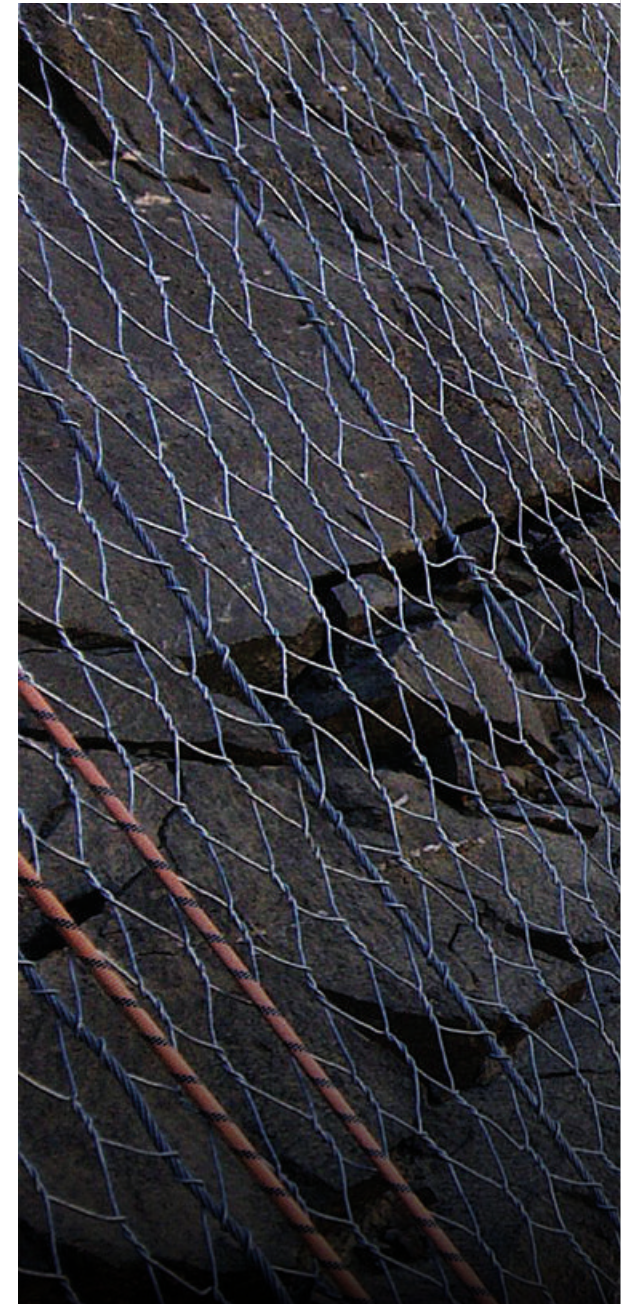
 **CONCRETE FLOORING, PRECAST & OTHER USES\***

 **EROSION CONTROL**

 **ENVIRONMENT, DEWATERING & LANDFILLS**

 **SAFETY & NOISE BARRIERS**

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







MINING



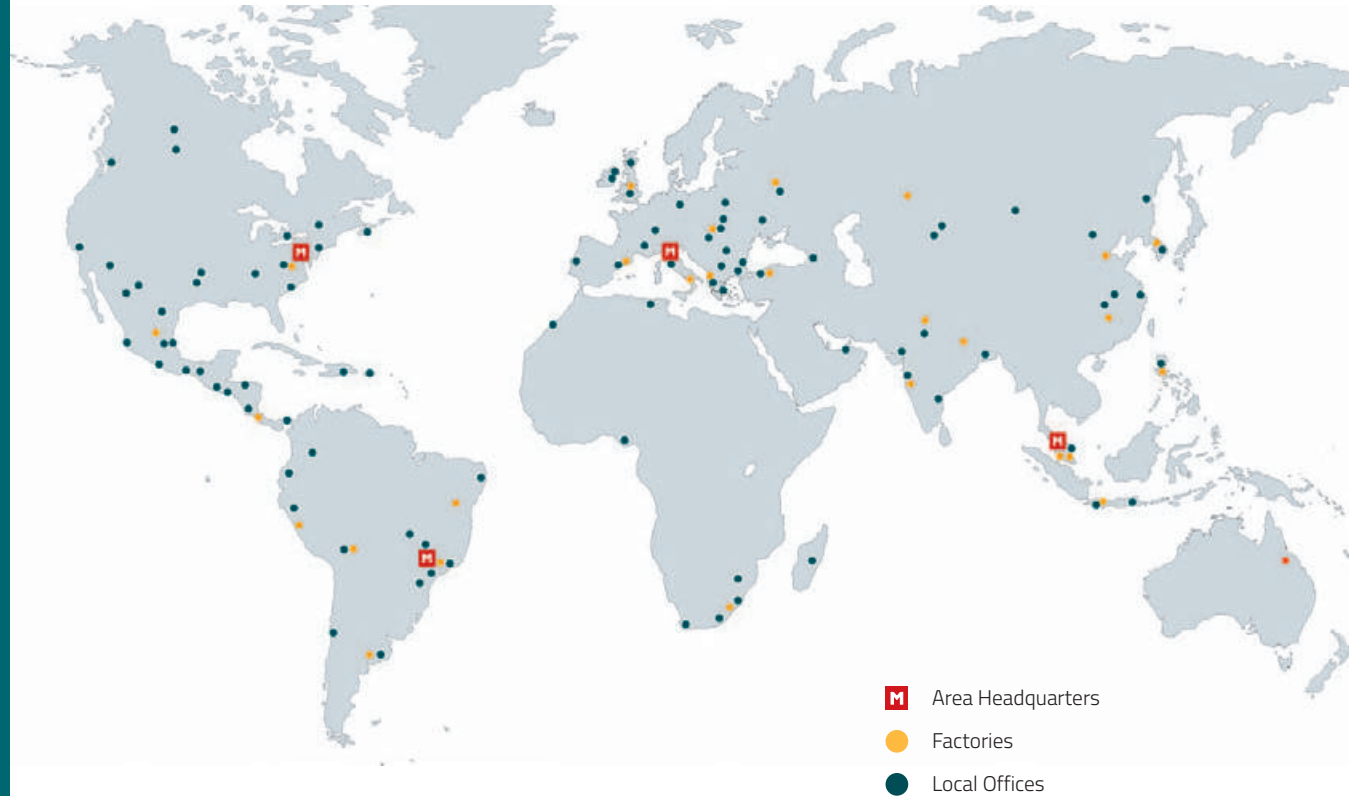
## INTRODUCTION: GLOBAL MINING SOLUTIONS

Founded in 1879, Maccaferri is a leader in innovative and sustainable solutions to overcome environmental, geotechnical and hydraulic erosion problems.

Our engineers offer technical support including:

- M Analysis
- M Design
- M Product selection and supply
- M Installation supervision

“Maccaferri is your partner at each stage of the project life cycle.”





Operating in over 100 countries and with 30 factories worldwide, you are never far from our engineering support and product availability; essential in time-critical or safety related mining projects.

Mine owners, operators, project managers, consultants and EPC contractors benefit daily from our specialist knowledge.



## DELIVERING STABILITY REDUCING RISK

**Quality Management and Control** in our manufacturing facilities and technical support services ensure you receive reliable, robust and safe solutions.

A **Corporate Ethical Policy** brings transparency, respect and accountability to our operations and interactions with clients.

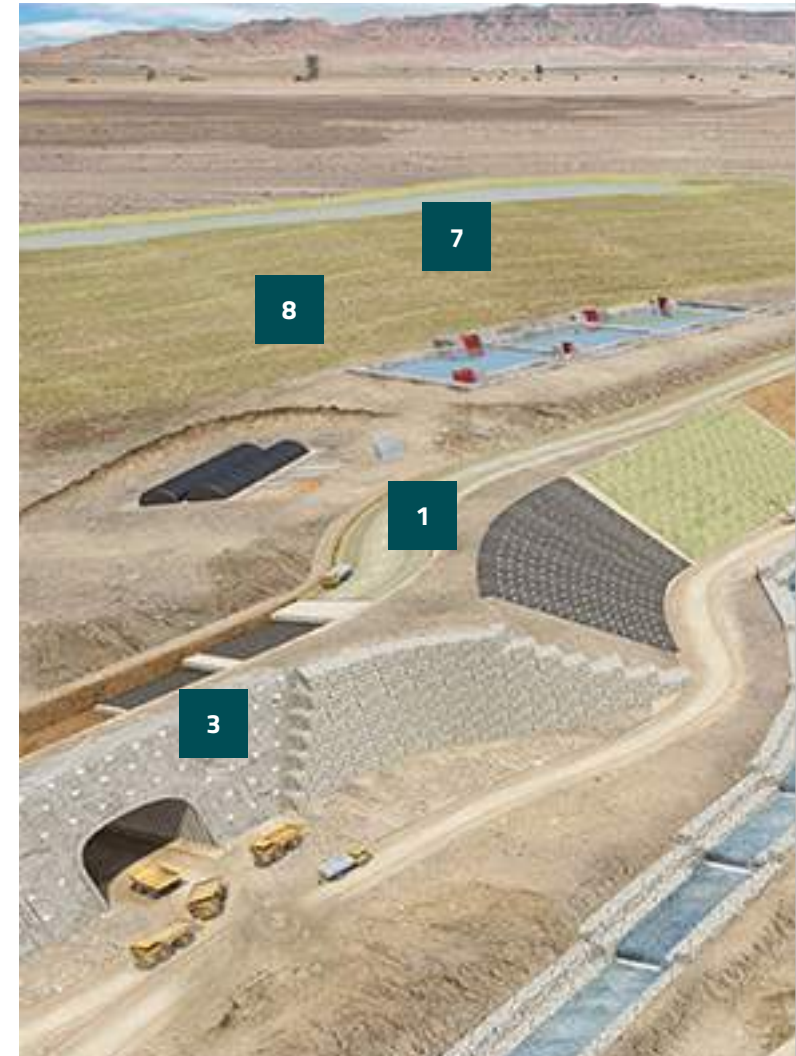
Finally, our products are certified in accordance with **internationally recognised standards** and we are members of key industry organisations.



\*Please refer to your local Maccaferri subsidiary for details of their current certifications. Not all factories have all certifications listed here.

Our Mining capabilities;

- 1 Haul roads and ground stabilisation
- 2 Storm water management
- 3 Mine portals and protection
- 4 Ore piles, reclaim tunnels and headwalls
- 5 Crusher and tip walls
- 6 Geohazards and rockfalls
- 7 Tailings impoundments
- 8 Heap leach facilities
- 9 Closure, reclamation & vegetation







# HAUL ROADS & BASAL REINFORCEMENT

A complete portfolio of geosynthetics engineered to stabilise, reinforce and drain mine access and haul roads, enables us to optimise the solution depending upon the specific ground conditions encountered.

High performance geogrids and textiles enable construction over even the most challenging ground conditions including voids.

Maccaferri's solutions:

- M** Haul road subgrade improvement
- M** Subgrade drainage
- M** Access over soft soils
- M** Access over voids



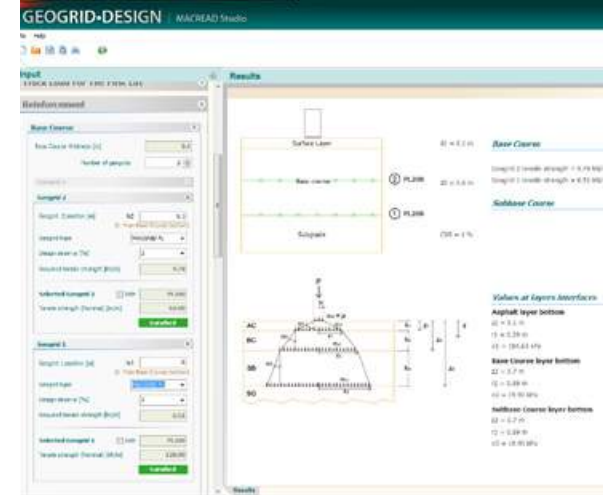
“MacREAD state-of-the-art design software enables the optimisation of the solution.”

### Stabilisation:

Better haul-road **quality** translates into improved haul truck **efficiency** and reduced vehicle wear and tear.

Our geosynthetics ensure your mine roads rut less, carry greater loads, require less maintenance and perform better.

Furthermore, MacDrain® geocomposites are used to control and remove unwanted water from within the haul road construction which would otherwise weaken it.



**Reinforcement:**

High strength ParaLink<sup>®</sup>, MacGrid<sup>®</sup> and MacTex<sup>®</sup> products enable construction, or provide access, over voids and soft ground whilst controlling differential settlement.

Rather than simply stabilising soils, these high strength - low strain geosynthetics reinforce the foundations of the infrastructure above.



**South Africa**



**Russia**



Our ParaLink<sup>®</sup> geogrid is the toughest and one of the most tried and tested grids in existence, making it ideal for use in mine projects where performance and reliability are critical.



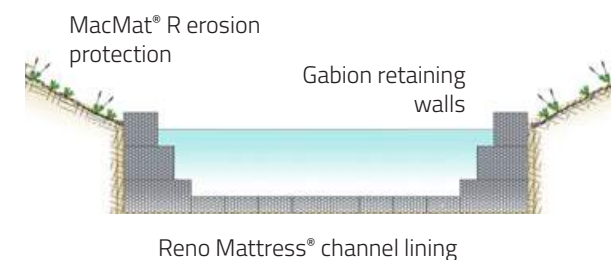
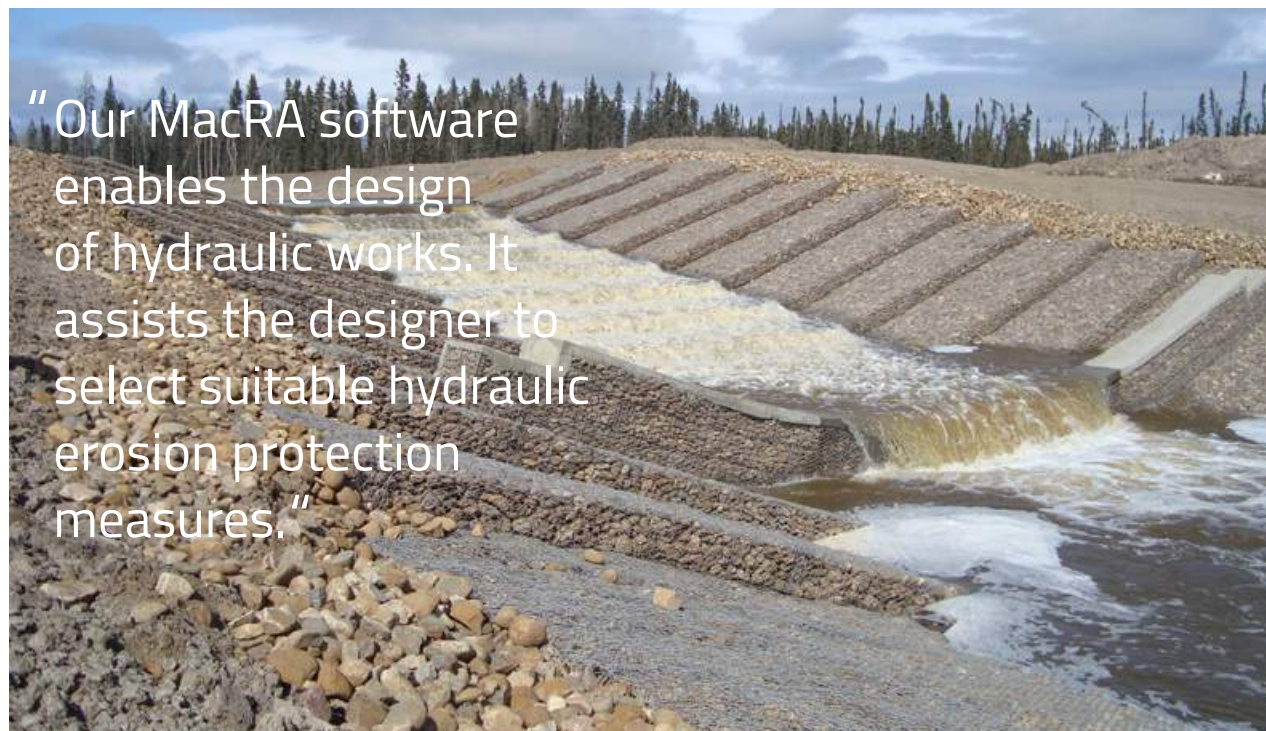
## STORM WATER MANAGEMENT

Effective storm water management requires a deep knowledge of hydraulic works, water control structures and attenuation ponds.

Our expertise in hydraulic structures started in 1879. Combinations of solutions are often required to implement the **mine drainage plans** in the most efficient way, whilst providing robust protection.

Maccaferri's solutions:

- M** Channeling works
- M** Longitudinal bank protection
- M** Weirs and drop-structures
- M** Culverts
- M** Dams
- M** Waterproofing of ponds and channels







Surfaces that are vulnerable to hydraulic erosion can be protected through a range of solutions including Reno Mattresses, MacMat® R and gabions.

MacLine® impermeable geomembranes contain polluted run-off in channels, preventing contamination of ground water.

Steel plate structures form highly efficient culverts and other storm water facilities.



Reno Mattress lining to storm water channel, Kyrgyzstan



## MINE PORTALS & PROTECTION

We are a trusted provider of solutions to **improve safety** by protecting slopes and preventing falling debris or rocks posing a hazard to life and mine infrastructure.

By offering both temporary and permanent counter-measures, operators can select from a graded range of interventions to suit the risk level.

Our **revolutionary** steel arches minimise worker-time spent at the decline excavated face enhancing safety.

Maccaferri's solutions:

- M** Steel tunnels & arches
- M** Shotcrete\*
- M** Soil nailing
- M** Slope erosion protection
- M** Simple rockfall drapery
- M** Surface strengthening & support
- M** Dynamic and debris flow barriers



Australia







## ORE PILES, RECLAIM TUNNELS & HEADWALLS

Our retaining walls and soil reinforcement technology is also applicable in reclaim tunnels and headwalls. These **cost-effective** structures can often reuse on-site materials as structural fill embracing **sustainability**.

Soft soils beneath ore piles and reclaim tunnels can cause differential settlement which can be overcome with basal reinforcement.

Our flexible modular gabion walls are simple to construct and can be installed with minimal specialist labour.

Maccaferri's solutions:

-  Mass gravity retaining walls
-  Reinforced soil walls and slopes
-  Steel plate tunnels
-  Basal reinforcement





## CRUSHER & TIPWALLS

As one of the earliest champions of soil reinforcement, our expertise has been refined on some of the **tallest reinforced soil** crusher and tip wall structures in the world. This experience also extends to earthworks to support conveyor and other materials handling systems.

Maccaferri's solutions:

- M** Mass gravity retaining walls
- M** Reinforced soil walls and slopes
- M** Vertical walls with concrete facing panels
- M** Vertical drainage works



Our soil reinforcement systems including Terramesh® and MacRes® are combined with our ultra-tough and high strength ParaLink® geogrids to deliver vertical faced structures able to accommodate the massive loads from haul trucks.

The MacSTARS software is used to design these reinforced soil structures, retaining walls and slopes.



Ghana

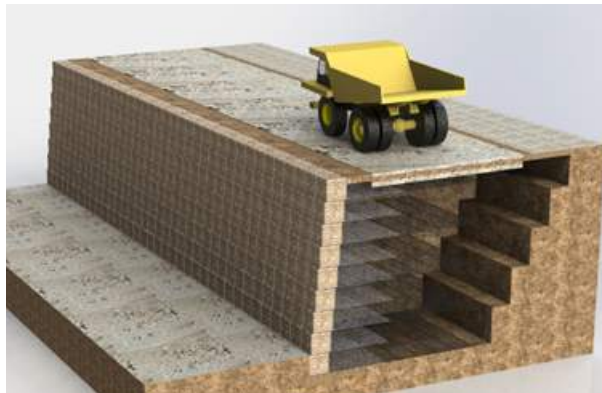




## MATERIALS HANDLING

Terramesh® and ParaLink® reinforced soil structures are amongst the most cost effective in the industry as they are flexible and rapid to construct. We endeavour to reuse on-site materials as structural backfill to the walls, thereby saving cost and time. Our wide range of geogrids enables us to tailor a solution appropriate to the soil types encountered on your project.

**MacRes® concrete faced reinforced soil structures are used for crusher walls where rock is scarce.**



Terramesh® reinforced soil



MacRes® concrete faced reinforced soil structure



Malaysia



## GEOHAZARDS & ROCKFALL PROTECTION

Geohazards and rockfalls threaten the **operational efficiency**, assets, infrastructure and most importantly, the **safety** of operatives within a mine.

Maccaferri has extensive experience in the prevention and control of geohazards.

Maccaferri's solutions:

- M** Simple rockfall drapery
- M** Surface strengthening & support
- M** Dynamic & debris flow barriers
- M** Rockfall embankments
- M** Soil nailing
- M** Slope erosion protection
- M** Soil veneer stabilisation

We offer a complete range of solutions including simple drapery meshes which **safely contain** falling debris, **super-stiff** meshes capable of preventing the detachment of rocks and rockfall embankments with almost limitless energy absorption capacity.

Suspended drapery systems specific to the mining industry, control and capture falling debris.





Certified in accordance with **ETAG 027**, our dynamic rockfall catch fences are available with energy absorption capacities up to **8600kJ**. They feature a patented compression braking system, enabling the barrier to progressively absorb the rockfall impact.

Our SteelGrid® HR, HEA Panels and Ring Nets offer **robust and reliable** protection from geohazards.

Rockfall embankments offer resistance to multiple high energy rockfall impacts reducing maintenance costs.

“ MacRO Studio software enables engineers to design suitable rockfall interventions.”



Turkey



Peru



## TAILINGS IMPOUNDMENTS & HEAP LEACH FACILITIES

Our geotechnical, geomembrane and de-watering portfolio offers the mine planner great flexibility with the site layout; soil reinforcement technologies reduce the footprint required for tailings structures and modern geomembranes reduce the thickness of the impermeable containment layers.

Maccaferri's solutions:

- M** Mass gravity retaining walls
- M** Reinforced soil walls and slopes
- M** Vertical drainage works
- M** Lining systems
- M** De-watering
- M** Construction over soft soils
- M** Construction over voids



Philippines

Containment structures often require a package of geosynthetics that operate in sympathy with each other; a MacLine® geomembrane to provide the impermeable lining, MacTex® geotextiles to protect the membrane from damage and a MacDrain® geocomposite to facilitate drainage through the system. Selecting from one solution provider reduces the risk of product incompatibility and under performance.





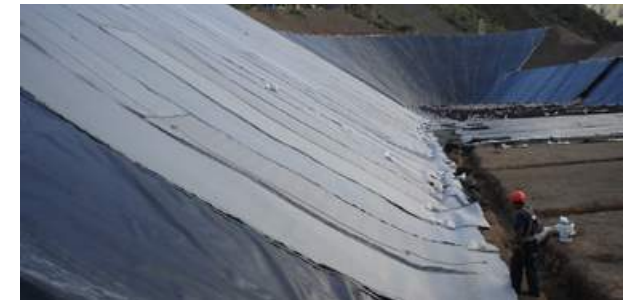
The high loads and extreme conditions of these facilities demands deep experience of geosynthetics to ensure performance, **safety** and **environmental compliance**.

The bearing pressure from stockpile overburden can require ParaLink® mining geogrids to reinforce the ground and reduce the risk of differential settlements of the foundation.

MacTubes provide a space and time efficient mechanism for dewatering slurries. The geotextile walls act as a filter, retaining the solid particles within the tube which can then be disposed of more efficiently.



**Brazil**



Our team of engineers and design software can assist the project team with;

- Calculations for heap slope stability
- Drainage capacity of geocomposites under high surcharge loads
- Reduction of differential settlement of foundation



## CLOSURE, RECLAMATION & VEGETATION

The closure of the mine and the **reinstatement** of the ecosystem is one of the most important activities in the life of the mine. We offer impermeable capping and drainage systems to prevent surface water entering the deposits.

Maccaferri's solutions:

- M** Soil reinforcement
- M** Capping systems
- M** Slope erosion protection
- M** Soil veneer stabilisation
- M** Channeling works
- M** Weirs and drop-structures
- M** Culverts
- M** Waterproofing, reservoirs & ponds

Rapid re-establishment of vegetation and soil erosion protection systems complete the closure operations. Maccaferri's wide range of man-made and biodegradable soil stabilisation and erosion protection solutions facilitate this.

Where challenging soil conditions limit vegetation, our soil amendment technologies and mulches bind the soil and enhance growth.

Storm water structures may also be required to contain and manage the run-off, preventing erosion damage and ensuring the long-term stability of the site.



Turkey



Zhangjiakou, China, Before



Zhangjiakou, China, After





Peru





## GLOBAL EXPERIENCE: LOCAL KNOWLEDGE

### GOLDEX MINE

Val D'Or, Quebec, Canada  
2007



Client	Agnico - Eagle Mines Ltd.
Contractor	SNC - Lavalin
Designer	Journeaux Bedard & Assoc. Inc
Solution	Basal reinforcement of ore stockpile pad
Product	ParaLink®

### BOZYMCHAK GOLD MINE

Bozymchak Field, Zhalalabskya Kyrgyzstan  
2013



Client	Kazakhmys Gold Kyrgyzstan
Contractor	LLC "Izhenernya Zashita"
Designer	Kazakhmys Gold Kyrgyzstan
Solution	Tailing discharge canal
Product	Reno Mattress® 17 cm & 30 cm thick

### KATANGA MINE

Katanga, South Africa  
2014



Client	Sandvik
Contractor	Katanga Mining Ltd.
Designer	MSA
Solution	Crusher wall
Product	Terramesh®



### PINJARRA CONVEYOR

Pinjarra, Western Australia  
2006



Client	Alcoa
Contractor	PRA Global
Designer	URS Australia
Solution	Rockfall protection drapery system
Product	HEA Panels, DT Mesh

### TAILINGS DAM SANTA MARIA

La Libertad, Peru  
2010



Client	Compañía Minera Poderosa
Contractor	Compañía Minera Poderosa
Designer	Compañía Minera Poderosa
Solution	Soil reinforcement
Product	Gabion, Terramesh® System, MacGrid®, MacTex®

### SHU KONGPING MINE

China  
2012



Client	Xing Fa Group
Contractor	Geological Survey & Foundation
Designer	Maccaferri China
Solution	Channeling works/Erosion control
Product	Gabions, MacMat® R



## TRUSTED FROM CONCEPT TO CLOSURE

### GLOBAL PRESENCE - LOCAL KNOWLEDGE

Our goals are aligned with yours: to deliver high value, quality solutions that embrace safety, environmental compatibility and sustainability.

A connected network of Maccaferri engineers share Knowledge Capital worldwide, so that however your project team is spread, we can support you.

The service we provide ranges from a simple feasibility or comparison between alternative solutions, to a full design and installation supervision.

Owning and controlling our factories means that we can even customise products for clients, increasing technical and cost efficiency.

### SOLUTION DEVELOPMENT

- M** Design information sheet
- M** Site consultations
- M** Solution selection
- M** Proposal drawings
- M** Engineering estimates



### DESIGN ASSISTANCE

- M** Software design analysis
- M** Contract drawings
- M** Specifications

### FABRICATION & INSTALLATION

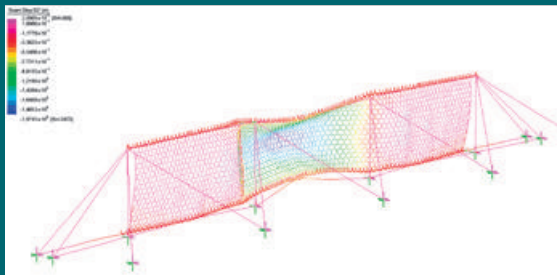
- M** Pre-construction services
- M** Structural / Fabrication submittals
- M** Logistical coordination
- M** Site assistance
- M** Construction services



## INNOVATION TESTING & COMPLIANCE

We believe it is innovation and engineering that keeps us at the forefront of our market sectors.

Our R & D facilities, headquartered in Bolzano, Italy, continuously advance our solutions, products, manufacturing and design technology.



Working with noted universities and respected independent laboratories we validate, test and certify our systems in compliance with local and international standards. This conformance provides reassurance to clients that our systems are proven.

