



**EFFICIENT SOLUTIONS
FOR RAILWAY WORKS**

With increasing demand of railways in India, the challenge for civil engineers is to deliver rail infrastructure assets that:

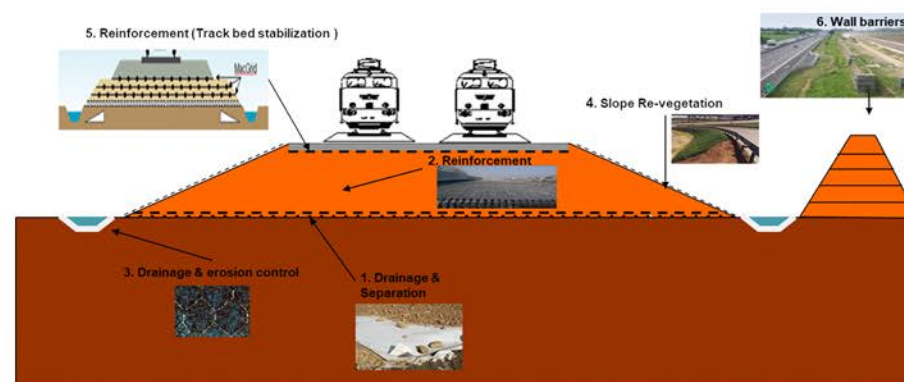
- M** Are more resilient
- M** Have superior performance
- M** Cost less to build and maintain
- M** Are better for the environment

Our products and solutions comply to the codal requirements in India and carefully considers RDSO guidelines.



Whether building a new railway asset or maintaining an existing one, Maccaferri can help clients, designers and contractors achieve these goals. Our experience enables us to combine products in new ways in order to maximise value for our clients and to enable the re-use of site-worn materials whenever possible delivering:

- M** Lower carbon footprint
- M** Lower consumption of imported materials



Railway Embankment Works

Trackbed Stabilization

Railway tracks undergo rapid deterioration in spite of repeated attempts at ballasting, or ballast cleaning which lead to poor track performance.

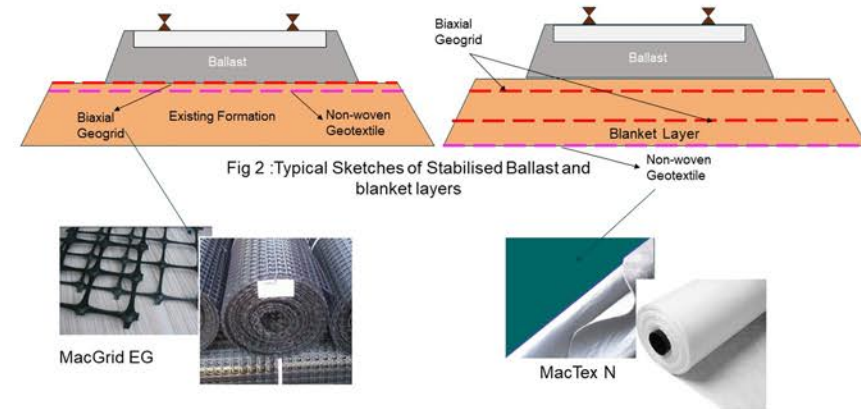
Overcoming these difficulties cost-effectively is a challenge. The solutions include:

M Sub-grade Improvement

MacGrid® are deformed or non-deformed geogrid like polymeric material formed by intersecting ribs joined at the junctions. Their fundamental working lateral confinement, tension membrane effect and friction. In the extruded grids a confining effect is created over the soil particles that lodge in the openings of the grid itself can be considered. Other than that, tension membrane effect and efficient load distribution help in stabilizing

MacTex® geotextiles are used to replace the traditional methods of:

- M** Separating and filtering two distinct soils or layers and preventing cross-contamination
- M** Protecting membranes or other vulnerable structures
- M** Improving the bearing capacity of weak soils
Non-woven geotextile **MacTex® N** ensures the filtration and separation of the material.



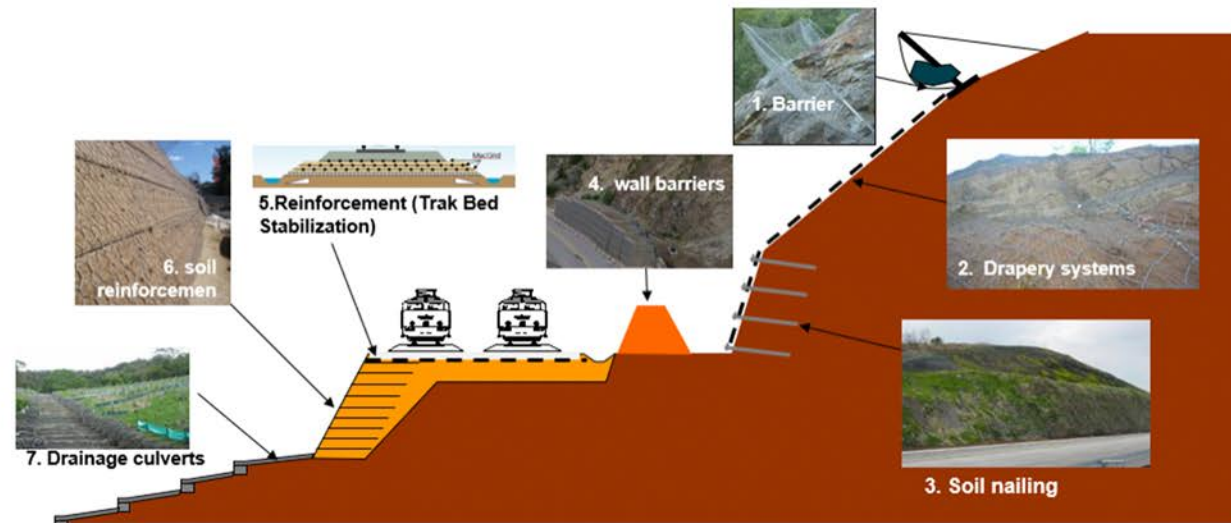
Sub-grade and Drainage

Excess, or uncontrolled water within soils can weaken them, causing numerous problems. The management of water behind retaining walls, inside the track formation and civil engineering structures, inside tunnels and in environmental capping solutions, is one of the most important aspects influencing the long term performance of that structure. The **MacDrain®** is a geo-composite for drainage, manufactured with a rigid or flexible polymeric core, providing a free conduit for water and fluid flow, from the adjacent materials. Geotextiles, or geomembranes, bonded to one or both sides of the core ensure filtration, separation, waterproofing and protection of the core. These can be used in place of more traditional drainage with sand and gravel or hand packed boulders to provide economical, environmental and technical advantages.

Rockfall Protection

Rockfall Protection

Rockfall protection and natural hazard mitigation systems are key elements in the security and safety of roads, railways, mining operations and infrastructure networks. Even small rockfalls or debris flows can obstruct infrastructure and have far-reaching economic effects beyond the immediate disruption. This also applies to buildings or other installations at risk of damage from rockfalls, debris flows or avalanches.



Solutions for cut slope stabilization

Our products include:

- M** Mesh systems- DT Mesh, **HEA Panels**, **Steel Grid® HR**, Ring Nets, **MacArmour®**
- M** Rockfall barriers- Dynamic Rockfall Barrier
- M** Debris Flow Barrier
- M** Rockfall embankments
- M** Snow fences and Avalanche protection measures
- M** Emergency measures- **ErdoX**
- M** **HelloMac** alert system



Rockfall Barrier to protect the tracks

Erosion Control

Soil slopes are subject to continuous erosion forces, whether natural or caused by man. Hydraulically applied Erosion Control Products (HECPs) control surface erosion and create an environment with growth medium which assists in accelerating vegetative establishment. These are applied in combination with seeds, fertilizers and other needed soil nutrients. HECP provide immediate erosion protection and protect surfaces from surface runoff moderately. Rolled Erosion Control Product (RECP) adds stiffness and possess more strength against erosive forces. Erosion control systems offer short-term (**Biomac**® biodegradable mats) or long-term (**MacMat**® geomats) protection of the slope surface.

For over a century, we have developed significant expertise in solving engineering problems within hydraulic works and the protection of coasts. These problems are characterised by the effect of moving water upon the land and structures connected to it; our solutions minimise or prevent these effects. These solutions have included our renowned Gabion, **Reno Mattress**® and **Reno Mattress Plus**.

In addition to providing immediate protection from the erosion forces, these systems are designed to facilitate the re-establishment of vegetation on the slope.



Retaining walls and soil reinforcement

Gabion structures are cages which are engineered from double twisted hexagonal woven steel wire mesh. Delivered flat-packed, these are assembled and then filled with stones at the project site. They form flexible, permeable and monolithic structures such as retaining gabion wall, channel linings, hydraulic control structures and erosion protection.

Maccaferri gabion baskets are made from high quality steel wire, which is heavily galvanised to provide long term corrosion protection. An additional protective polymeric coating like **PoliMac®** is also applied on gabions for more aggressive environments, or where a longer design life is required.

In order to reinforce the structure, all mesh panel edges are selvaged with a wire having a greater diameter.

Reinforcing soils with geogrids enables them to perform better than in their unreinforced state; standing steeper, accommodating higher loads and settling less. This is useful when reducing the footprint of a new railway embankment, or to gain development area on a sloping site. Maccaferri geogrids including **MacGrid®** WG, **ParaGrid®** and **ParaLink®** are high-strength, low-strain grids with excellent soil interaction.



Reinforced soil wall with gabion fascia



Terramesh walls



MacRes® System

Maccaferri renowned **Terramesh®** System is a modular system used to form rock faced reinforced soil walls (also known as Mechanically Stabilised Earth) and embankments. It has been used globally on some of the most significant infrastructure schemes, including what is believed to be the tallest reinforced soil structure in the world at 74m high.

It consists of pre-assembled units of double twisted wire mesh. The facing section of the unit is formed by connecting a back panel and diaphragms to the main fascia unit, thus creating the rectangular shaped cells used for stone confinement. The wire mesh reinforcement, fascia and lid are all one continuous panel of mesh. **Terramesh®** System units are supplied in standard lengths, requiring no cuts on site. Used in conjunction with our polymeric geogrids, we can offer super-tall hybrid structures; we have completed numerous walls over 30m high in seismic zones. **Green Terramesh** enables vegetation to be established on reinforced soil slopes.

When only a narrow construction corridor is available, or a reinforced soil structure with a vertical face is required, Maccaferri **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®** segmental blockwork faced reinforced soil wall. Our **MacRes®** system is BBA certified

Hydraulic Works

Management of water in the vicinity of the permanent way is an important technique to limit its detrimental effects. Hydraulic works including channelling and river bank protection are common problems we solve with our range of hydraulic works solutions.

M Reno Mattress

M Gabions

Basal Reinforcement

Trains have to traverse on poor ground conditions. Embankment on soft soils can fail due to a variety of reasons like foundation soil failure, slide of embankment fill on underlying soft soil and excess of displacement.

The reinforcement counteracts the horizontal thrust of the embankment fill and the need for raking piles along the extremities of the foundation can be eliminated. Basal mattresses also help by improving the bearing capacity of the load bearing soil layer to a certain extent by proper distribution of the load through the reinforced thickness.

ParaLink® acts as a basal reinforcement. **ParaLink®** geogrids are planar structure consisting of **ParaGrid HF** a monoaxial array of composite geosynthetics strips. Each single longitudinal strip has a core of high tenacity polyester yarn tendons encased in a polyethylene sheath; the single strips are connected by cross laid polyethylene strip which give a grid like shape to the composite. It is CE certified for reinforcement applications and approved by BBA to comply with the requirements as per BS8006-1.



Gabion retention structure



ParaLink® laying for basal reinforcement

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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.

GLOBAL ENGINEERS MACCAFERRI GROUP PROFILE

In the second half of the 19th century, we invented Gabions and dramatically changed the civil engineering landscape. We are still changing today. We work every day to find better solutions for our clients at every degree of latitude and longitude. Our worldwide network grows through innovation and diversification of sectors of activity and through an increasing range of high quality and environmentally friendly products and applications.

OFFICINE MACCAFERRI GROUP PROFILE

Founded in 1879, our Group soon became a worldwide reference in the design and development of advanced solutions, with offices in over 70 countries and 30 factories worldwide.

Our mission is to pursue excellence through continuous improvement, while delivering to customers engineered solutions that are innovative, advanced and environmentally friendly. We are committed to outstanding safety, quality and sustainability, to create value for all stakeholders as well as our communities.



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

 INDUSTRIAL
MANUFACTURING