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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
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 |



SOIL STABILISATION & PAVEMENTS

INTRODUCTION: SOIL STABILISATION & PAVEMENTS

Whether constructing a gravel forestry track over soft soil or resurfacing a multi-lane highway, Maccaferri has the technical knowledge and wide product range to provide solutions for the rigorous demands of today's roads. Resources are becoming scarce and pavement owners require a longer service life for less money. By reducing materials and whole-life costs, Maccaferri's leading range of pavement and ground stabilisation products can help achieve these goals. Because every project is different, Maccaferri offers the widest range of products for asphalt and unbound layers, as well as drainage geocomposites to remove water from the pavement structure.

For nearly 140 years Maccaferri has been developing innovative, sustainable engineering solutions. Our teams are on hand to offer full technical support including analysis and design, product selection and installation supervision.

To assist in the design process, Maccaferri has developed a sophisticated software package, MacREAD. The software enables the design and optimisation of the full road structure including both unbound and bound layers, in standard and improved conditions through the addition of geosynthetics within the various layers.



“Reinforcement can produce a threefold increase in the service life of pavements by reducing fatigue.”



Reinforcing pavements over peat



Improving access over wet or soft ground

ASPHALT REINFORCEMENT PERFORMANCE

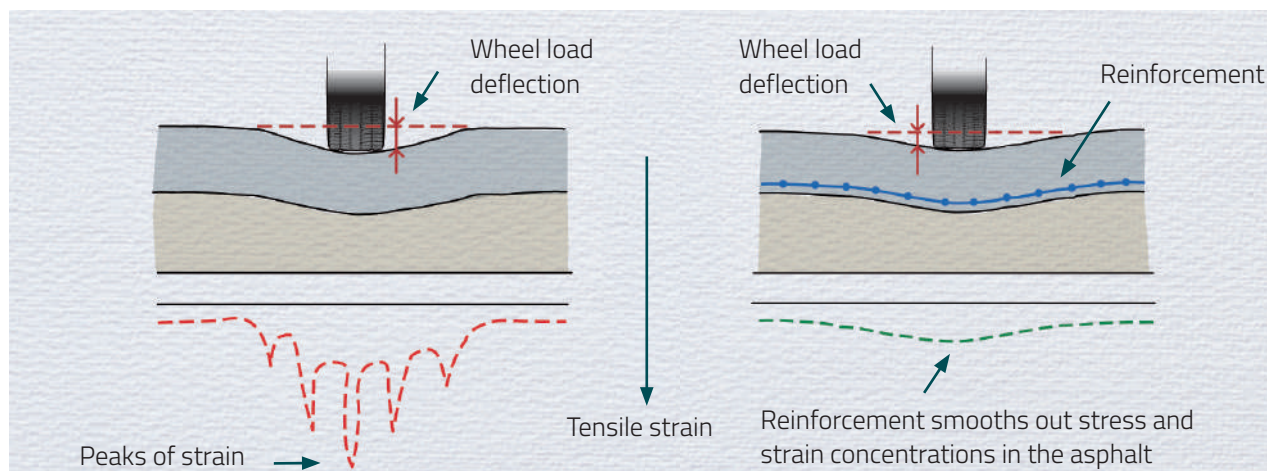
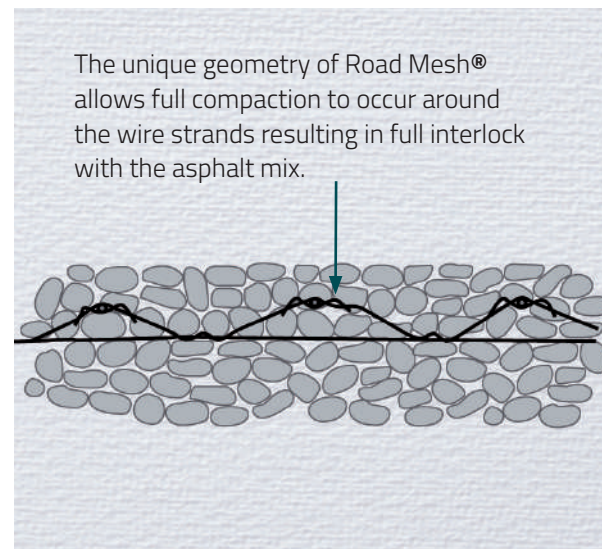
Reinforcement can produce a threefold increase in the service life of pavements by reducing fatigue, reflective, thermal and settlement cracking. Stress concentrations in the asphalt matrix are relieved and redistributed by the reinforcement.

This results in:

- M** Delayed initiation of cracks
- M** Slower crack growth
- M** Narrower crack width
- M** Wider spacing between cracks
- M** Deviation of cracks

Reinforcement also provides lateral restraint within the asphalt, which improves resistance to rutting and shoving.

With steel Road Mesh®, fibreglass or polyester geogrids MacGrid® AR and stress-relieving geotextiles MacTex® AR, Maccaferri provides a complete range of asphalt interlayer reinforcement solutions.



TYPICAL APPLICATIONS

Typical applications that benefit from the inclusion of asphalt reinforcement are: runways, highways, road widening, ports and wharves, uphill running lanes, junctions, industrial areas, mining, heavy vehicle turning-areas, bus lanes, trench reinstatement, overlaying concrete pavements, material handling and parking areas.

Key problems:

- M** Reflective cracking & thermal cracking
- M** Fatigue/"Crocodile" cracking
- M** Rutting and shoving
- M** Haunching failure
- M** High-axle loads
- M** Construction on weak sub-grades or peat soils
- M** Differential settlement
- M** Reduced construction layer thickness

Road Mesh® - Structural reinforcement of asphalt



Rutting and shoving



Fatigue cracking



Reflective cracking



UNBOUND PAVEMENT REINFORCEMENT & STABILISATION

Reinforcement placed within an unbound granular layer can reduce the layer thickness required by a third. Two mechanisms work to increase the elastic modulus and bearing capacity, resulting in improved resistance to deformation and rutting:

- M** Confinement mechanism minimising soil particle movement
- M** Tensioned membrane effect

Maccaferri's woven geogrids MacGrid® WG and extruded polymer grids MacGrid® EG, provide a complete solution to reinforcement and stabilisation of the unbound layers and can be used in conjunction with MacTex® geotextiles and geocomposites to form a separation barrier to prevent interlayer contamination.

The woven polypropylene and high tenacity polyester geotextiles MacTex® W1, MacTex® W2 and MacTex® C2 geocomposite are used to provide cost-effective separation and reinforcement of unbound roads on soft ground.

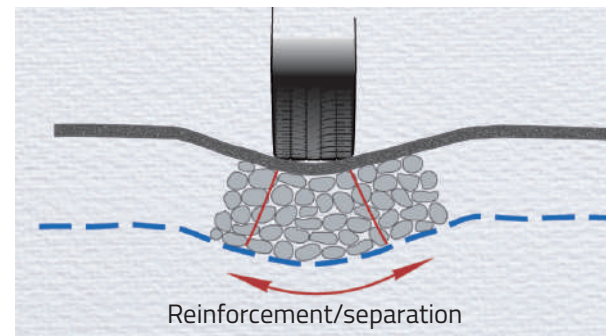
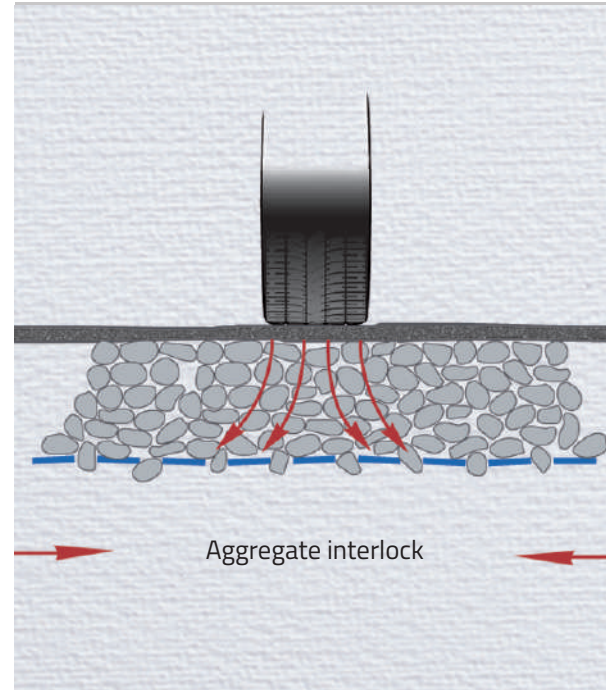
Key problems:

- M** Bearing capacity failure
- M** Differential settlement
- M** Rutting
- M** Wet/saturated ground
- M** Construction layer thickness
- M** Weak subgrades

Typical applications that benefit from the inclusion of reinforcement are mines, quarries, working platforms, agricultural roads, military, landfills, forestry roads, construction sites, haul roads, port areas, wharves and parking areas.

Reducing the unbound layer thickness also reduces the carbon footprint of the solution; **less quarried aggregates and less transport required.**

Better resistance to rutting and deformation reduce maintenance on unbound roads; **less downtime and more efficient operations.**



PAVEMENT DRAINAGE LOCATION DEPENDENT

The pavement structure can be weakened by water within, beneath or adjacent to it. Maccaferri's MacDrain® drainage geocomposites are used to control and rapidly remove this water, enhancing pavement performance.

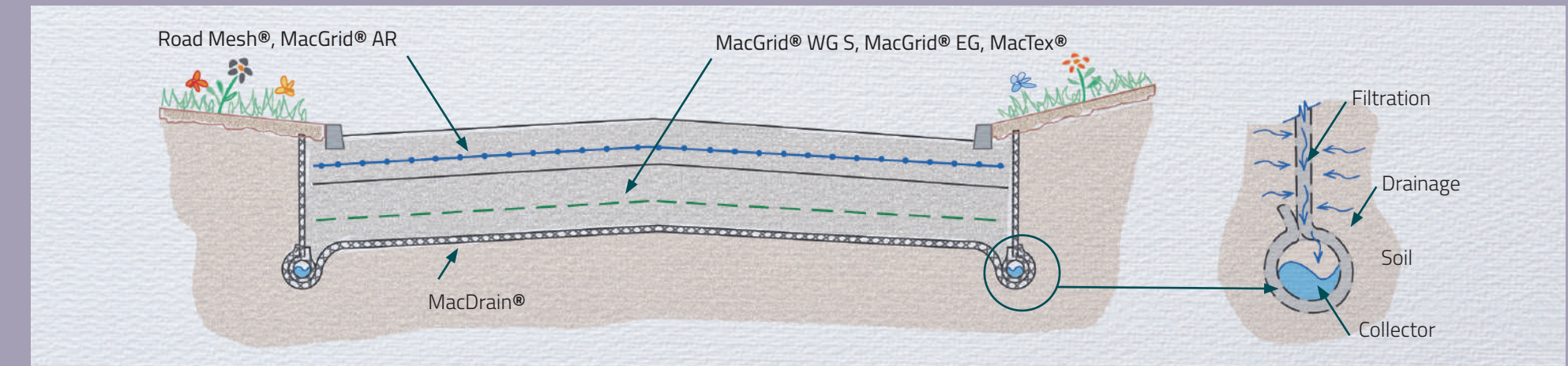
Selection of an appropriate drainage geocomposite is dependent upon its intended location within the pavement, the materials it will be in contact with and the drainage capacity required. Performance requirements will be different for an unbound pavement in a monsoon region, to an asphalt pavement in an area susceptible to ground frost.



"MacDrain® geocomposites can be used in place of more traditional drainage with sand and gravel to provide economical, environmental and technical advantages."

Traditional roadside trench drains can often be replaced with MacDrain® drainage geocomposites, reducing excavation, backfill material volume and cost when compared with alternative standard solutions.

Additionally, by reducing the large volumes of quarried granular materials normally used in highway drainage, the speed of installation and the carbon footprint of the structure are also greatly improved.



PRODUCT RANGE
& SELECTION MATRIX

Maccaferri offers a range of solutions to meet your pavement needs. Our products are CE marked and many have local conformance certification.

Please contact your nearest Maccaferri office for product selection advice, data sheets and project specific technical assistance. For global contact details, please visit www.maccaferri.com



Asphalt layers			
Product	Benefit	Grid size & strength	
Road Mesh®	Steel wire hexagonal mesh with transverse steel bars. Road Mesh® provides the highest level of protection against rutting, shoving, fatigue, thermal, reflection and settlement cracking.	80x100 mm Strength: 40 – 60kN/m	
MacGrid® AR	Glass fibre or polyester woven geogrid with coating. With high tensile strength and high modulus of elasticity at low elongation, MacGrid® AR is a cost-effective solution for preventing cracks in the upper pavement layers.	12.5 mm or 40 mm Strength: 50 – 200kN/m	
MacGrid® AR G	Glass fibre or polyester woven geogrid with coating and geotextile backing. MacGrid® AR G is impregnated with bitumen to provide crack prevention and efficient installation.	12.5 mm or 40 mm Strength: 50 – 200kN/m	
MacTex® AR	Non-woven needle-punched polypropylene geotextile impregnated with bitumen to provide a waterproofing and stress relieving membrane.	Strength: 8kN/m	
Unbound layers			
MacGrid® EG S	Extruded polypropylene biaxial geogrids. MacGrid® EG controls deformation and rutting, enabling the thickness of granular layers to be reduced.	38 mm Strength: 15 – 40kN/m	
MacGrid® WG S	Woven polyester geogrids with polymer coating. MacGrid® WG provides cost-effective, long-term control of deformation and rutting with soft subgrades or high axle loads.	20 – 35 mm Strength: 20 – 300kN/m	
MacTex® W1/W2	Woven polypropylene (W1) and polyester geotextiles (W2) provide separation and reinforcement for construction on soft ground.	Strength: (W1): 20 – 110kN/m (W2): 40 – 880kN/m	
MacTex® N/H	Non-woven needle-punched propylene geotextiles. MacTex® N/H are used to separate granular materials preventing interlayer contamination.	Strength: 6 – 35kN/m	
Drainage			
MacDrain®	Drainage geocomposites with a polymeric drainage core and non-woven geotextile filter on one or both sides to stop the core clogging with soils.	Drainage core and textile performance selected to suit application.	

PROBLEM VERSUS
SOLUTION

A successful implementation starts with the clear identification and prioritisation of the problems to be addressed. Often, the optimum solution is found by combining different systems, each one delivering specific technical and cost benefits.

0 = In conjunction with other reinforcement products
* = MacGrid® ARG

Problem	Solution						
	Asphalt			Unbound			
	Road Mesh®	MacGrid® AR	MacTex® AR	MacGrid® EG	MacGrid® WG	MacTex® W1/W2	MacTex® H/N
Reflective cracking	+++	+++					
Fatigue cracking	+++	++					
Thermal cracking	+++	+					
Rutting & shoving	+++	+					
Road widening	+++	+					
Haunching failure	+++	++					
Differential settlement	++	+		+++	+++	++	+
Overlay of concrete pavements	+++						
Reducing layer thickness	++	++		+++	+++	+	++0
Bearing capacity failure				+++	+++	+	++0
Wet/saturated ground				++	++	++	++0
High axle loads	+++	+		++	++		
Asphalt layer "waterproofing"		+	+++				
Stress relief		+++	+++				



Road Mesh® provides lateral restraint to the asphalt which improves resistance to rutting and shoving

RESEARCH & DEVELOPMENT

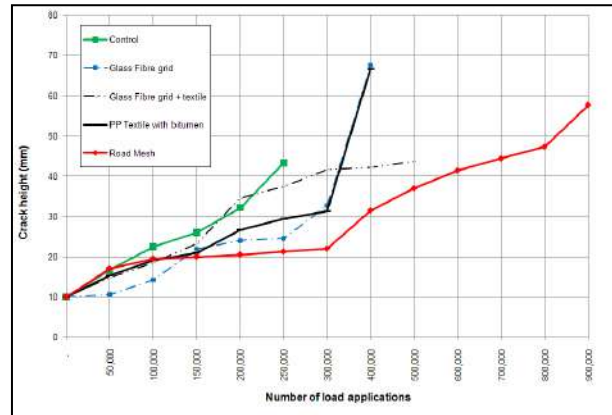
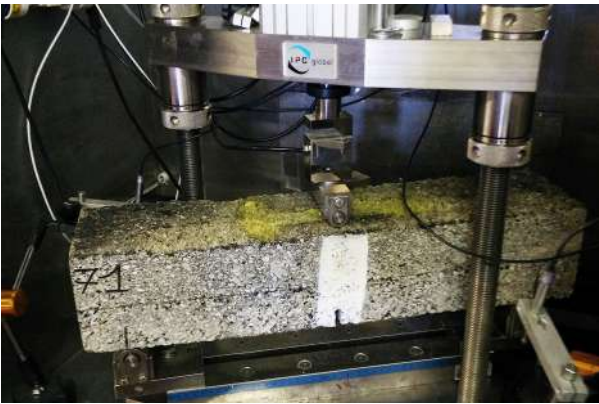
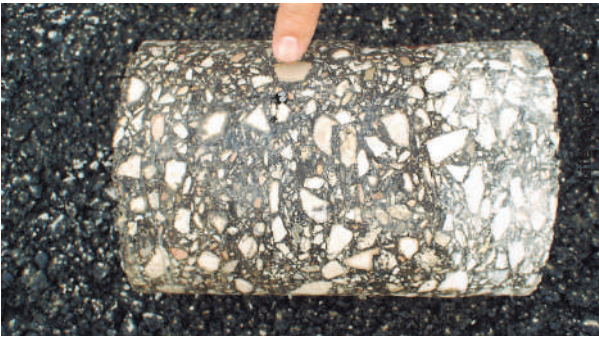
Maccaferri's pavement products have been developed through an extensive programme of international research.

Smart Road, Virginia Tech, USA: Full-scale field trials showed Road Mesh® produced a 72% decrease in strain and a fatigue life improvement of up to 120%.

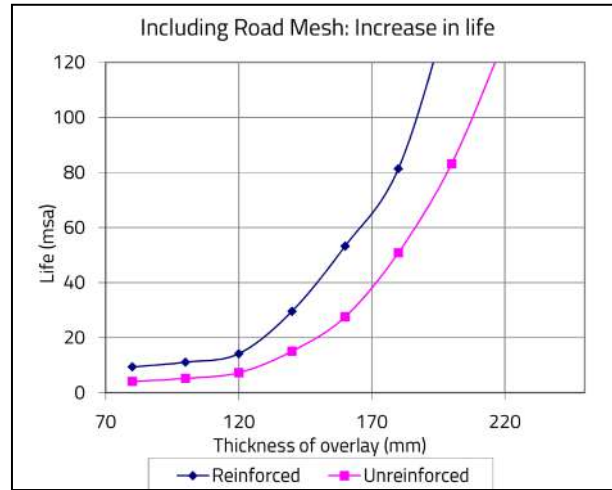
Nottingham University, UK: Beam bending tests showed Road Mesh® can reduce thermal cracking, extend the service life of asphalt overlay by three times and halve the depth of rutting.

ISMES, Italy: Cyclic loading showed Road Mesh® can extend the service life of asphalt pavements by three times.

Bologna University, Italy: Three Point Bending Test evaluation of a testing method for the laboratory characterisation of reinforced bituminous pavements.



Comparison between various asphalt reinforcements.



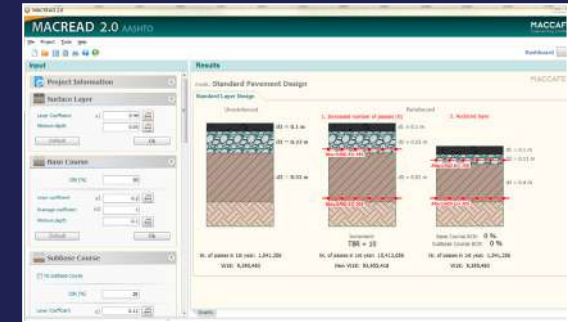
Life extension with Road Mesh®



Maccaferri uses state of the art design software and innovative design approaches within the MacREAD software package, to optimise the reinforcement and the required thickness of the pavement layers.

- As reinforced pavements require less maintenance, whole life costs are lower:
- Reduced materials
 - Reduced vehicle movements
 - Reduced roadworks & traffic congestion
 - Reduced carbon footprint

DESIGN & INSTALLATION



Installation		Recycling
Road Mesh®	Can be laid on milled surfaces. Stretched, rolled and secured with asphalt blinding or nails. Requires a minimum of 70 mm asphalt cover. Can be trafficked during installation by site vehicles.	Mill down to 15 mm above the mesh. Locate mesh and pull out with hydraulic excavator. Recycle as galvanised wire.
MacGrid® AR/AR G MacTex® AR	Secured to smooth asphalt surfaces with bituminous bond coat or self-adhesive backing. Cannot be trafficked during installation. Requires 40 mm asphalt cover.	Mill out and recycle with asphalt.
MacGrid® EG/WG MacTex® MacDrain®	Installed in the granular layers (geogrid), or on soft ground (geotextile).	Recycle as polyester/ polypropylene.

SPREADING THE LOAD PROJECT EXAMPLES

A selection of world-wide projects featuring asphalt and unbound pavements.

Asphalt pavements and unbound pavements:

1. Road Mesh®: **Major highway, China**
2. MacGrid® AR: **Urban highway, Mexico**
3. MacGrid® AR: **Highway, Nigeria**
4. MacGrid® EG: **Mine access, South Africa**
5. MacGrid® AR: **Airport runway, Mexico**
6. MacGrid® WG: **Working platform, UK**
7. Road Mesh®: **Interstate highway, Slovakia**
8. MacGrid® WG: **Industrial road, Brazil**



"Because every project is different, we offer the widest range of products available for reinforcing asphalt and unbound layers."

