DRAINAGE GEOCOMPOSITES:

APPLICATION DESIGN AND ENVIRONMENTAL ASPECTS

Date November 21, 2023

Speaker: Francesco Masola

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My name is Francesco Masola,
I come from Italy and
I have worked in MACCAFERRI since 2015.
I am based in Berlin (Germany) as
Technical Manager for Scandinavia, BeNeLux,
Germany, and Austria

E-mail: **f.masola@maccaferri.com**

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MACCAFERRI
Water management is crucial for the **long-term performance** of structures.
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Sand and gravel have been utilized as **drainage solutions** throughout History.

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How can **designers** achieve **efficiency without compromising affordability, sustainability**, and other critical factors?
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Maccaferri has the **solution**

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Texion®

MacDrain™

EFFECTIVE WATER MANAGEMENT

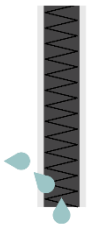
DRAINAGE GEOCOMPOSITE

Definition & Functions

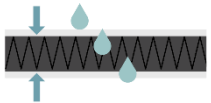
Maccaferri draining geocomposites are called **MacDrain**.

MacDrain geocomposites are made from a polymeric drainage core thermally bonded to a geotextile on one or both sides or to a waterproofing layer on one side. They provide several **main functions**:

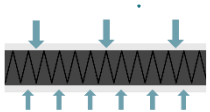
Drainage



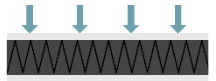
Filtration



Separation



Protection



MacDrain geocomposites can fulfill additional functions based on project requirements and specific site conditions.

FOCUS ON MACDRAIN W

MacDrain W

The core structure is flexible, with thickness ranging from 4 to 10 mm, a very high void ratio, and medium-high compressive resistance; due to the channel pattern, the flow capacity is much higher in the longitudinal direction than in the transversal direction.

NON-WOVEN GEOTEXTILE FILTER

GEOMAT WITH W-SHAPED

OUR PRODUCT

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MacDrain

FILTER - Water and gas can pass through it - Soil is retained

DRAINAGE CORE - It drains water and gas

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ADVANTAGES

- QUALITY ASSURED
- QUICK AND FAST INSTALLATION
- LONG TERM COMPRESSIVE CREEP
- COST SAVING
- ENVIRONMENTAL FRIENDLY

MacDrain

ADVANTAGES

Quality assured

QUALITY ASSURED

MacDrain W is designed to be highly durable, with a range of chemical and UV-resistant materials that ensure long-term performance and protection. The product is subject to continuous quality control and testing.

MacDrain

ADVANTAGES

Quality Assured

ASTM D4716/D4716M-22

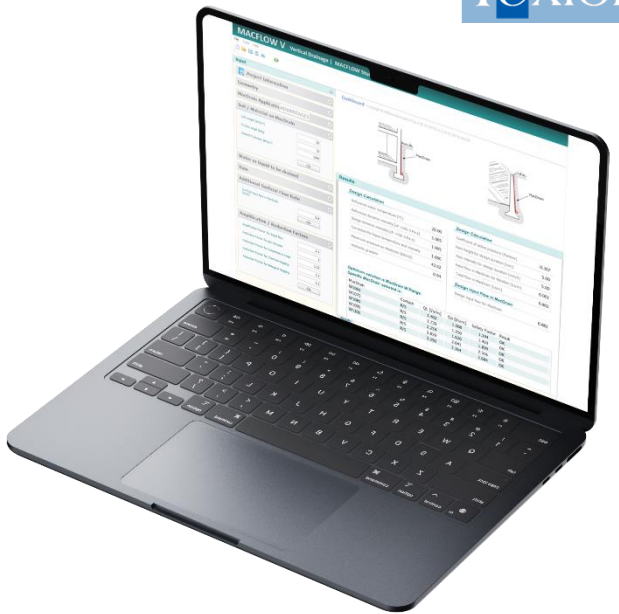
Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

ASTM D7931/D7931M-21a

Standard Guide for Specifying Drainage Geocomposites

ISO/TR 18228-4

Design using geosynthetics - Part 4: Drainage



ADVANTAGES

Quality Assured

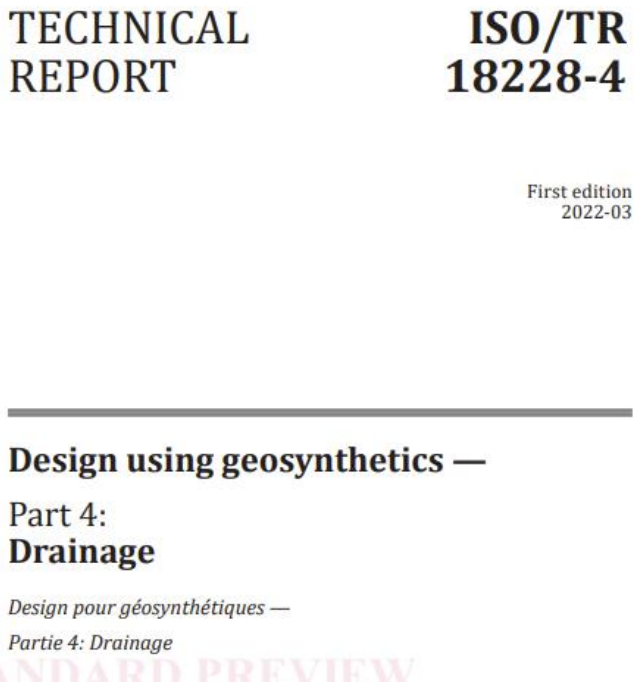
ISO/TR 18228-4 –
Published in March 2022

Main points about the new ISO/TR 18228-4:

- Calculation of the input flow rate

- Design procedure for drainage geocomposites considering the long-term conditions (e.g. applications of reduction factors)

- Equivalence with a granular drainage layer


TECHNICAL REPORT

ISO/TR 18228-4

First edition
2022-03

Design using geosynthetics —

Part 4:
Drainage

Design pour géosynthétiques —

Partie 4: Drainage

ADVANTAGES

Quality Assured

ISO/TR 18228-4 – Published in March 2022

For all applications, the available flow rate of the geocomposites shall be obtained by applying a set of Reduction Factors (Cancelli & Rimoldi, 1989; Koerner, 1994) which take into account all the phenomena that may decrease the flow rate over the entire design life compared to the short term flow rate measured in the tests according to EN ISO 12958:2010 or ASTM D4716 - 08(2013) standard:

$$Q_a = \frac{Q_L}{RF_{in} \cdot RF_{cr} \cdot Rf_{cc} \cdot RF_{bc}}$$

where:

Qa = available long term flow rate for the geocomposite;
QL = short term flow rate obtained from laboratory tests;
RFin = Reduction Factor for the intrusion of filter geotextiles into the draining core;
RFcr = Reduction Factor for the compressive creep of the geocomposite;
RFcc = Reduction Factor for chemical clogging of the draining core
RFbc = Reduction Factor for biological clogging of the draining core

Once the design input flow Q_D has been calculated, the available input flow Q_a shall be calculated for one or more geocomposites. The final Factor of Safety FS_G afforded by the design with each geocomposite is given by:

$$\mathbf{FS_G = Q_a / Q_D}$$

Only those geocomposites for which $FS_G \geq 1.00$ are suitable for the project.

ADVANTAGES

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ISO/TR 18228-4 –
Published in March 2022

The Reduction Factors shall be set considering the specific conditions of each project, taking into consideration the experience and/or research on similar conditions of use.

Table 15 - Suggested range of values for the different RFs

Term	Description	Suggested range for MacDrain® geocomposites
RF_{in}	Reduction Factor for intrusion of the filter geotextiles into the draining core	1.0 – 1.5
RF_{cr}	Reduction Factor for thickness change due to compressive creep of the core	1.2 – 1.5
RF_{cc}	Reduction Factor for pore/volume reduction due to chemical clogging **	1.0 – 1.3
RF_{bc}	Reduction Factor for pore/volume reduction due to biological clogging**	1.0 – 1.3
Π RF	**Product of all Reduction Factors for the site-specific conditions**	**1.20 – 4.0**

* values can change according to the type of the core and also according to the type of filtering geotextile used

** values are related to the type of liquid / fluid to be drained and to its nature (clean water, polluted water, leachate, etc)

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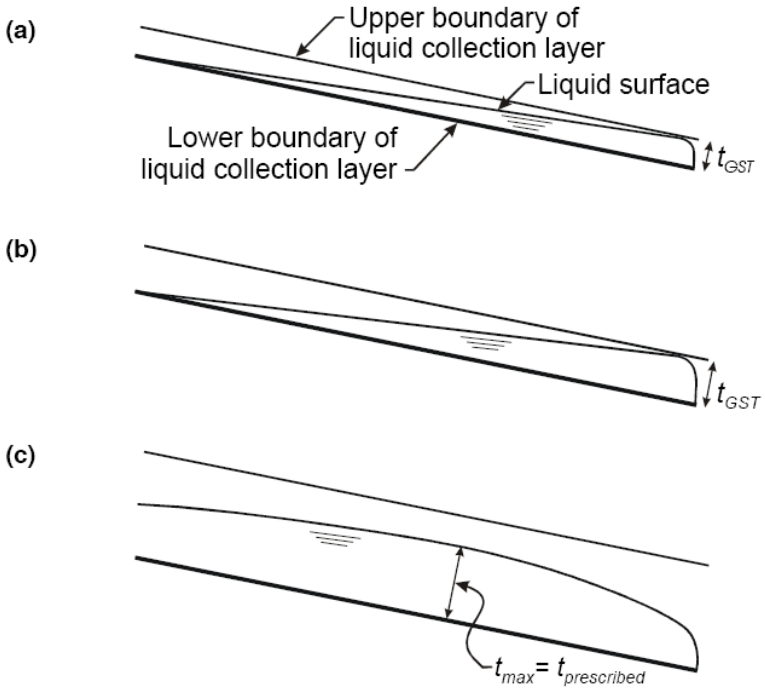
ISO/TR 18228-4 – Published in March 2022



Schematic representation of the shape of the liquid surface in liquid collection layers:

(a) case of a geosynthetic liquid collection layer at full capacity with unconfined flow;

(b) case of a thicker geosynthetic liquid collection layer, also at full capacity with unconfined flow;

(c) case of a granular liquid collection layer with the maximum liquid thickness equal to the prescribed liquid thickness.

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ISO/TR 18228-4 –
Published in March 2022

Chapter: 12.5.2 Equivalence for water flow on slopes

It is important to consider that, when comparing the drainage capacity of geosynthetic drains with those of granular drainage materials, ***the comparison should be made on the same base: since the flow rate of geocomposites is evaluated at the end of their design life, even the permeability of the drainage aggregate should be evaluated in situ at the end of its design life***, not as a laboratory value on fresh, clean material placed under ideal conditions.

As shown by Giroud et al (2000), based on preceding work by Giroud et al. (1992) and Giroud and Houlihan (1995), in unconfined flow conditions, the maximum thickness of liquid in a granular soil layer, hmax (m), is given by the following formula:

$$h_{max} = j \frac{\sqrt{\tan^2 \beta + 4 q_h / K_{lt}} - \tan \beta}{2 \cos \beta} L_h$$

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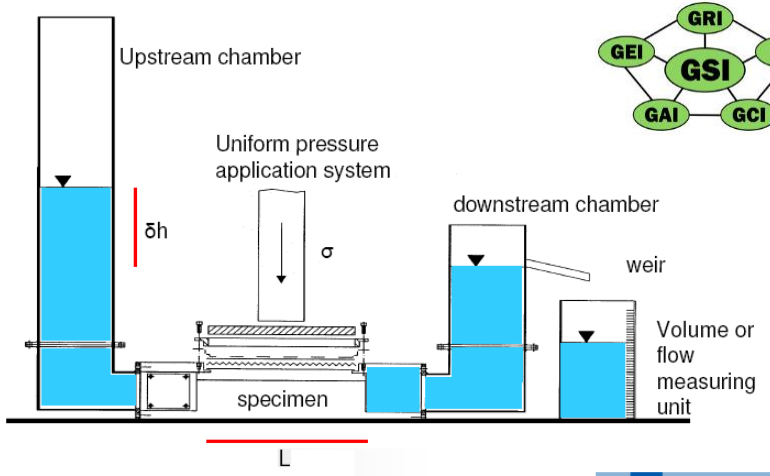
Quality Assured - ASTM D4716

ASTM INTERNATIONAL

Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

SCOPE

Determine the **flow rate per unit width** within the manufactured plane of geosynthetics under **varying perpendicular compressive stresses and a constant head.**



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ADVANTAGES

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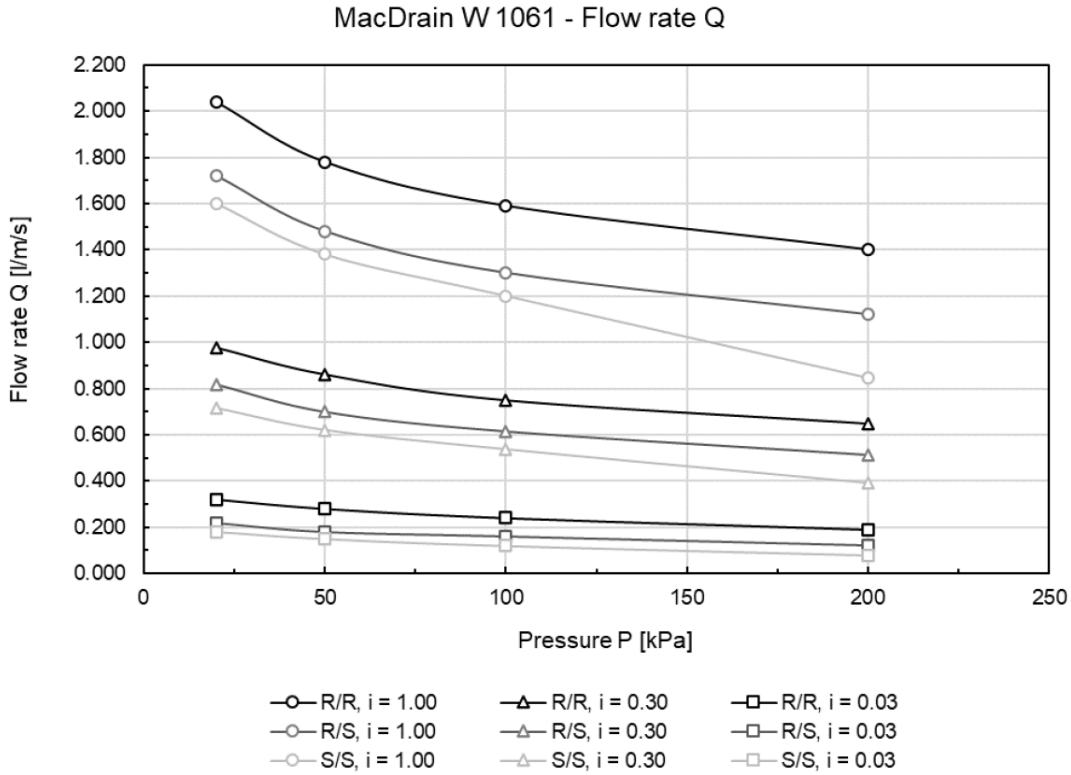
Quality Assured

ASTM D4716/D4716M-22

Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head



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ADVANTAGES

Quick and fast installation

QUICK AND FAST INSTALLATION

The product is also quick and easy to install, with a range of connection and anchoring systems that enable quick and efficient implementation, ensuring that it meets or exceeds the required performance.

MacDrain

ADVANTAGES

Quick and fast installation

Quick and **easy** unrolling system

ADVANTAGES

Quick and fast installation

For a number of **different applications**

ADVANTAGES

Long term compressive creep

LONG TERM COMPRESSIVE CREEP

One of the main advantages of MacDrain W is its compressive strength. It provides significant drainage characteristics with high resistance to compressive loads, minimizing compressive creep.

MacDrain

ADVANTAGES

Long term compressive creep

ASTM D7406-20

Standard Test Method for Time Dependent (Creep) Deformation Under constant Pressure for Geosynthetics Drainage Products.

ASTM D 7361-07

Standard Test Method for Accelerated Compressive Creep of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method

ISO 25619-1

Geosynthetics — Determination of compression behaviour — Part 1: Compressive creep properties

LONG TERM TESTED COMPRESSIVE CREEP

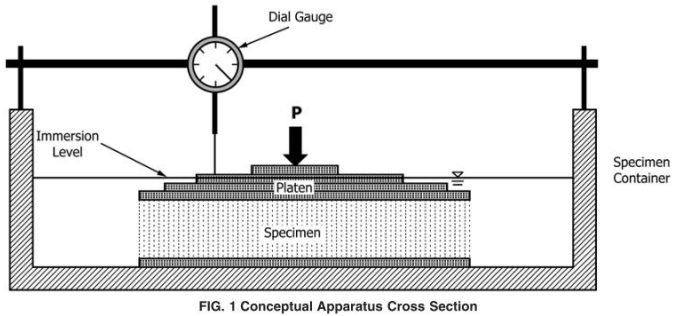

FIG. 1 Conceptual Apparatus Cross Section

ADVANTAGES

Cost saving

COST SAVING

The use of MacDrain instead of a traditional solution with mineral fills (gravels, sand) results in significant cost reductions, such as material cost, transportation, and overall efficiency.

MacDrain

ADVANTAGES

Cost saving

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MACDRAIN W

VS

MINERAL SOLUTION

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ADVANTAGES

Cost saving

ADVANTAGES

Environmental friendly

MacDrain W is designed to be highly durable, with a range of chemical and UV-resistant materials that ensure long-term performance and protection. The system is subject to ongoing quality control and testing, ensuring that it meets or exceeds the required performance.

ENVIRONMENTAL FRIENDLY

MacDrain

ADVANTAGES

Environmental friendly

MACCAFERRI

Texion®

MACDRAIN W

MINERAL SOLUTION

GWP GLOBAL WARMING POTENTIAL

2.33 kg/CO_2 **2.67 kg/CO_2**

TRASPORATION

1 Truck of MacDrain W equals approximately 150 Trucks of Sand/Gravel

QUARRYING

0.5 m^3

of aggregates saved
per linear meter

NOTES: 1) GWP of gravel is taken from epditaly.it; 2) estimation based on the assumption that a truck (30 t capacity) can carry 5,500 sqm of MacDrain while it can carry 18-20 m3 of aggregates 3) the thinkness of the aggregate layer is 50 cm

ADVANTAGES

Environmental friendly - MacDrain W vs Mineral Solutions

MACDRAIN W

MINERAL SOLUTION

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ADVANTAGES

MACCAFERRI

Environmental friendly

Life Cycle Assessment studies aim at weighing emissions and impacts of a solution, starting from the raw materials to the construction and delivery of the finished system.

We conducted a detailed LCA study on our MacDrain Series to provide reliable and comparable information on the environmental impacts of our solutions, reducing energy and material consumption.

EPD®

THE INTERNATIONAL EPD® SYSTEM

Certification number S-P-01470

Click on the link to find more information

EPD MACDRAIN

or use the QR code!

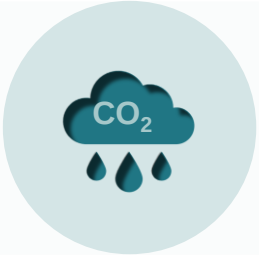
Texion®

ADVANTAGES

Environmental friendly

The **environmental performance** is assessed with the following impact category indicators:

Global warming potential (GWP) measures how much heat a greenhouse gas traps in the atmosphere up to a specific time horizon relative to carbon dioxide.



Acidification Potential provides a measure of the decrease in the pH value of rainwater and fog, which has the effect of ecosystem damage.

Eutrophication Potential provides a measure of nutrient enrichment in aquatic or terrestrial environments, which leads to ecosystem damage.

Particulate Matter is defined as a mixture of solid and liquid particles of organic and inorganic substances resulting from human activities and suspended in the atmosphere.

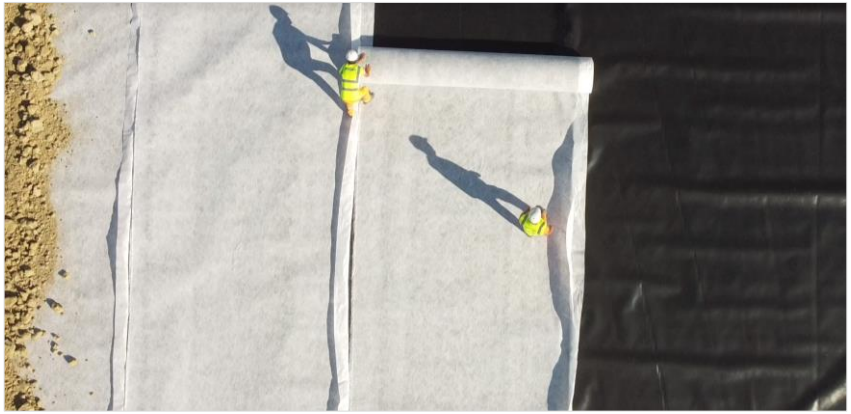
Click on the link to find more information

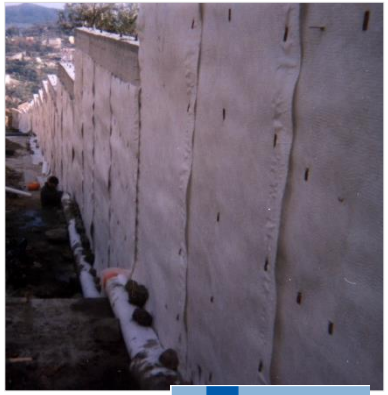
EPD MACDRAIN

or use the QR code!

MAIN APPLICATION OF MACDRAIN W

- Retaining wall drainage
- Horizontal drainage for transportation sector
- Anti capillary layer
- Against frost heave
- Draining trenches
- Sport fields
- Leachate collection and gas ventilation in landfills
- Tunnel applications
- Roofing / Noise barrier / Foundation
- Vertical walls





REUSE OF WASTE AND SITE WON MATERIALS

THE NEGATIVE IMPACT OF IMPORTED FILLS

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IMPORTED FILLS

- Expensive to quarry and becoming more so as tax penalties increase
- Environmentally unacceptable as quarrying damages the countryside
- Costly and environmentally unacceptable to transport
- Not necessary since marginal fills can be used

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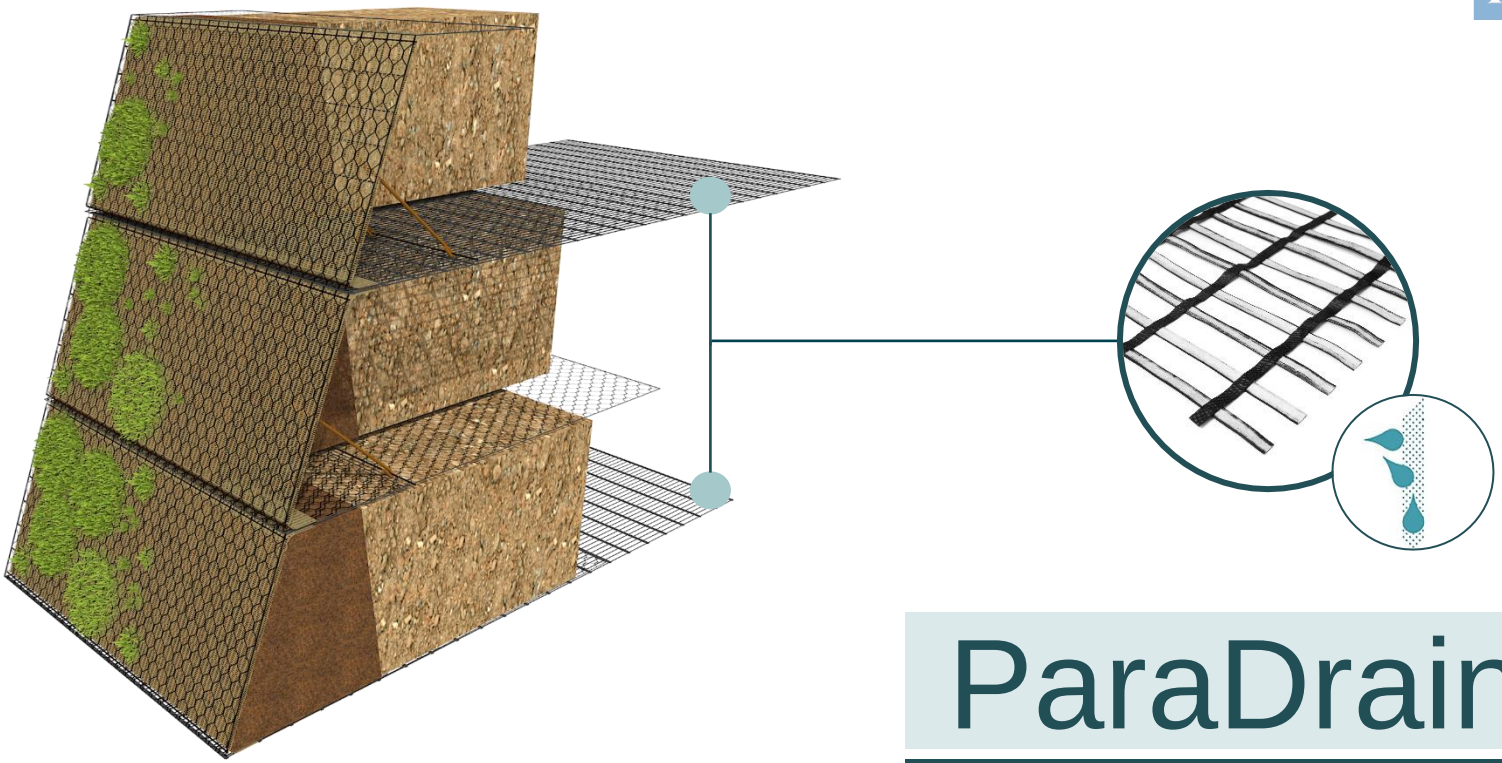
THE BENEFITS OF REUSING IN SITU SOIL

REUSE OF IN SITU SOIL

- They are cheap. They can even be a positive source of income in some situations;
- They are usually readily available;
- Their use results in reduced haulage and the consequent environmental impact of this;
- Their use results in reduced quarrying which helps to preserve the environment.

THE SOLUTION: PARADRAIN™

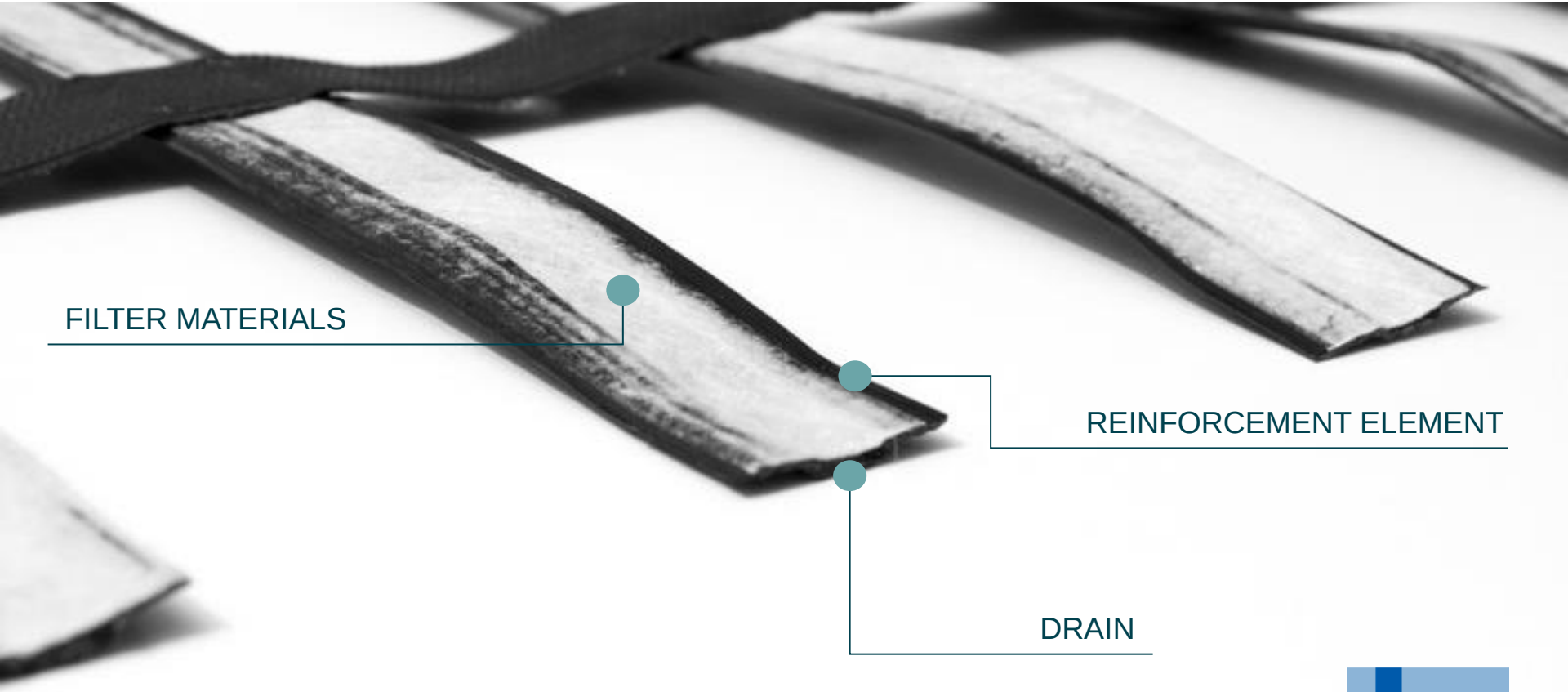


ParaDrain™

The geogrid that drains while reinforcing

THE SOLUTION: PARADRAIN™

THE SOLUTION: PARADRAIN™



A SELF WATERING VEGETATED SLOPE USING PARADRAIN™

MACCAFERRI

Burlington, Ontario
Canada

A natural-looking solution was constructed within a forested area to stabilize a failing slope.

ParaDrain™ in combination with TerraMesh™ Green, acting both as a geogrid reinforcement and as a drainage channel.

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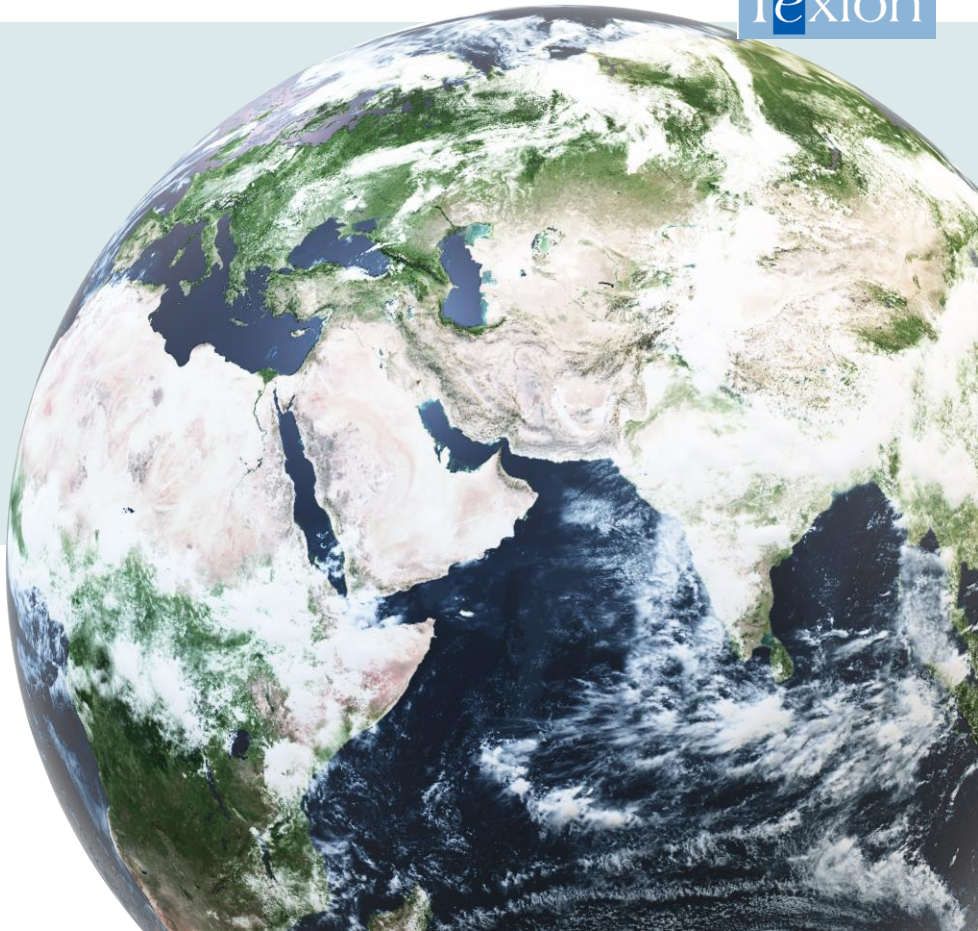
THE SOLUTION: PARADRAIN

OUR BEST PROJECT AROUND THE WORLD

In its

140 years of experience

Maccaferri has carried out thousands of projects around the world.

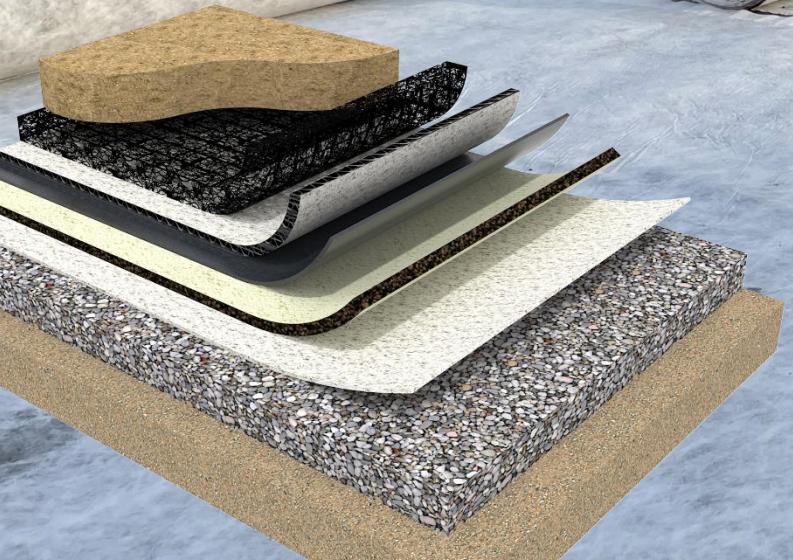


Reclamation intervention of the sin national interest area of Micorosa *(Brindisi, Italy)*

Reclamation intervention of the sin national interest area of Micorosa *(Brindisi, Italy)*

Application: Drainage for garage building – Charleroi Hospital - Grand Hôpital de Charleroi

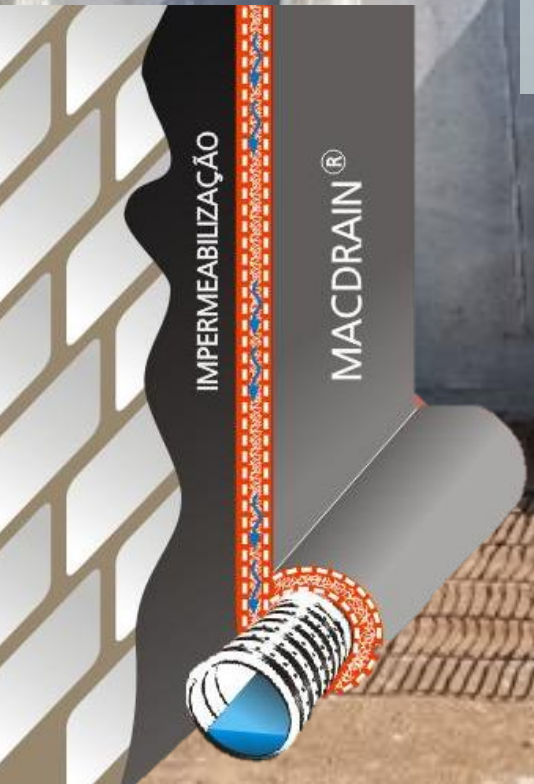
Application: Drainage for garage building – Charleroi Hospital - Grand Hôpital de Charleroi



Danxia smelting plant project

(Danxia, China)

Application: Vertical Walls



Securing The Planas Dam

(Pujaut, France)

Application:
Anti capillary layer in embankments

Slope Management project of Shaanxi Danfeng Senior Middle School

(Shaanxi, China)

Application:
Retaining walls drainage

MACDRAIN™ W FOR THE SDGs

Environmental Sustainability

MACCAFERRI

MATERIAL SAVINGS

OUTSTANDING PERFORMANCE

FASTER INSTALLATION

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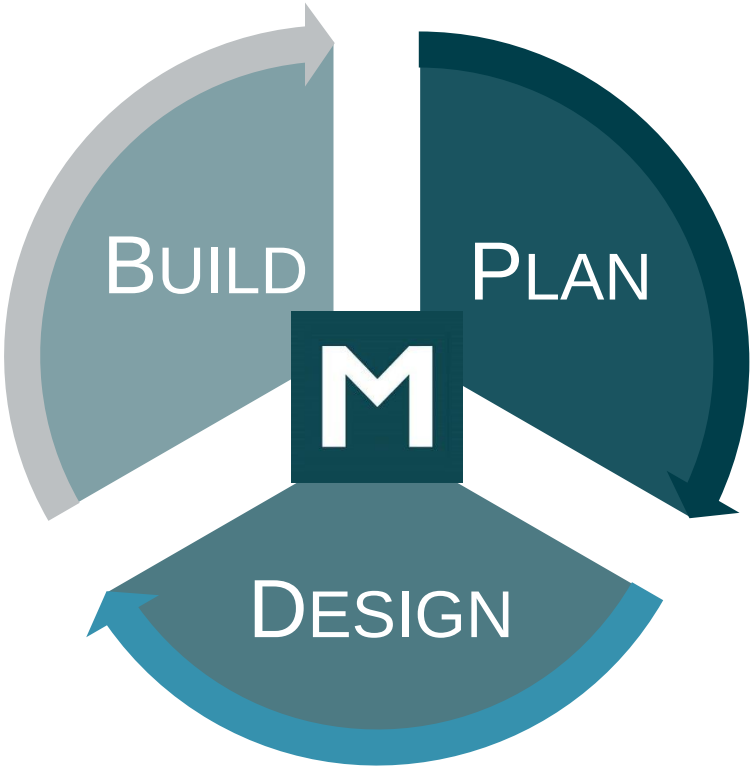
360° SUPPORT FOR YOUR PROJECT

Maccaferri is always side by side with engineers, architects and builders



Our **geotechnical, hydraulic & environmental engineering experts** can support you through all the project phases.

To Bring Home:

- Technical Support
- Innovative and Sustainable Solutions
- Construction Skills
- Team Working
- Wide portfolio of solutions

BELGIAN GEOSYNTHETICS SOCIETY

THANK YOU

For any further info please contact the Maccaferri office which is closer to you or visit Maccaferri website on maccaferri.com and our partner´s website https://www.texion.be/

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