



River training works

MACCAFERRI



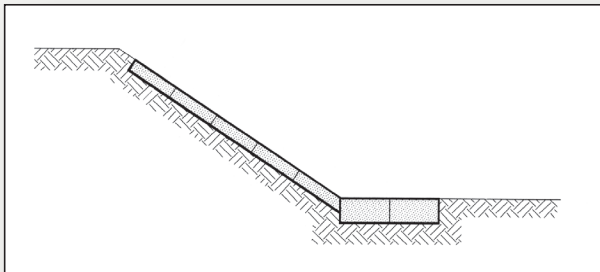
Maccaferri solutions for river training works and erosion control

- Channel linings
- Bank protections
- Weirs
- Groynes

Most of the towns and cities we know today have developed in areas that have been inhabited from ancient times. Meanders or islands in rivers have always been favourite sites for human habitations in order to take advantage of the availability of water and fertile land for farming. Thus began a relationship between man and the river which has been developing ever since. With the increase in population and the development of industry,

communication routes were required for trade and social exchange. It is difficult today to ignore the problems of flooding of low lying areas and the need to protect roads, railways or industrial buildings.

However, we must not forget that a natural watercourse is a living entity in continual development that should be protected, as far as possible.



Italy - Actual situation

For a well-balanced design of river works

By analysing the main factors which are important in the maintenance of a well-balanced river habitat, when looking at its restoration, it has to be chosen not only, which materials are to be used, but also to make a proper evaluation of design methodologies.

A natural river course is characterised both from plan and elevation and dictated by the need to maintain environmental bio-diversity. Design hypothesis and technical solutions can be a common denominator and bioengineering should not be considered as a list of techniques but as a global approach philosophy.

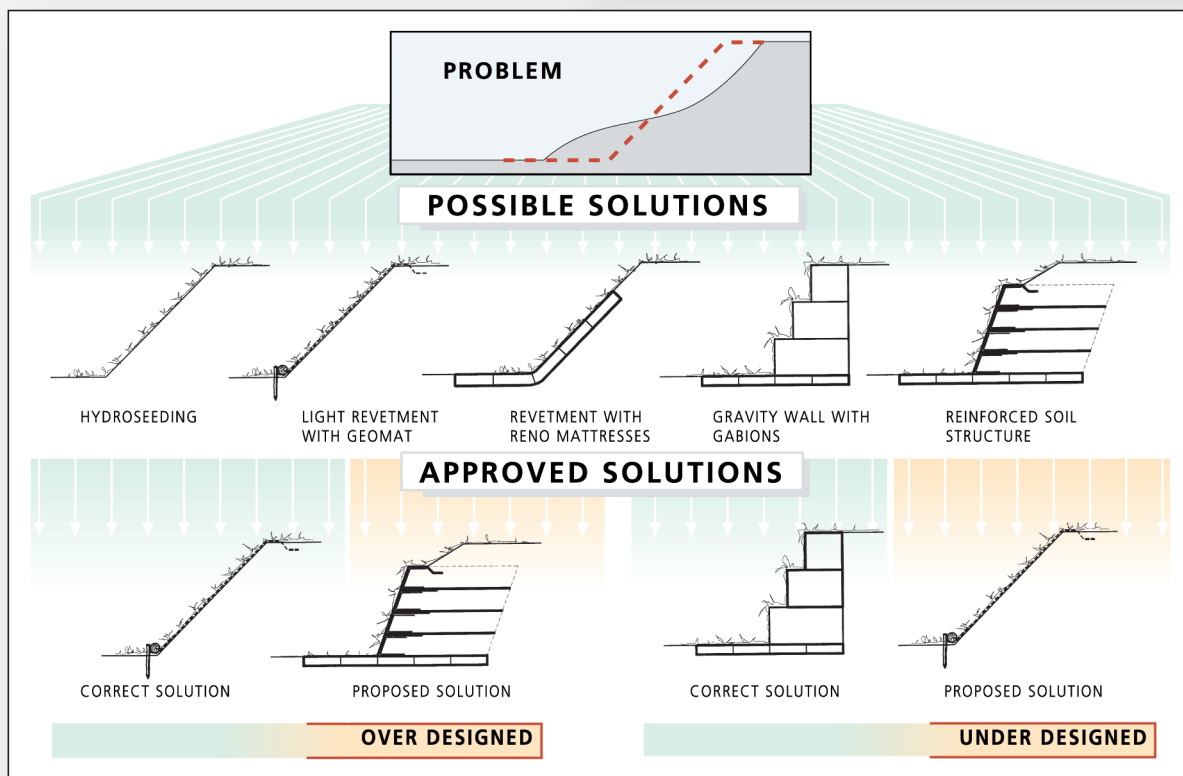
This means that solutions must relate to the problems, avoiding both technical and ethical mistakes, and without excess, all within a multidisciplinary approach where engineers, biologists, botanists and architects do not prevaricate each other.

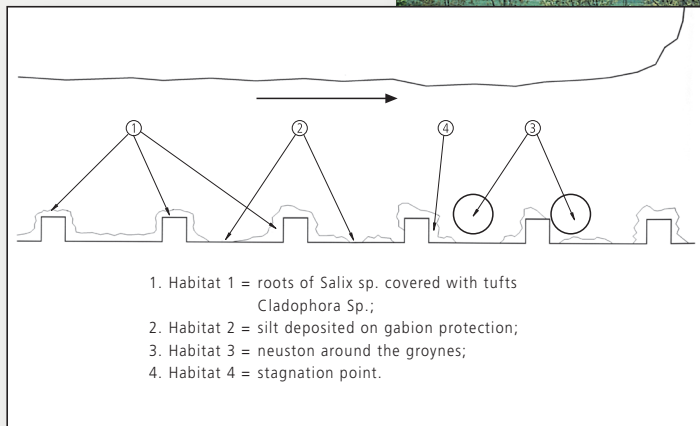
The solution must:

- supply the immediate required stabilisation;
- promote a positive evolution (re-naturalisation) of the new ecosystem created from the river training works.



U.K. (photo David Barker - Edenbridge U.K.)

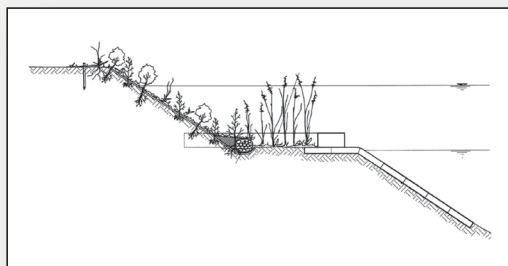




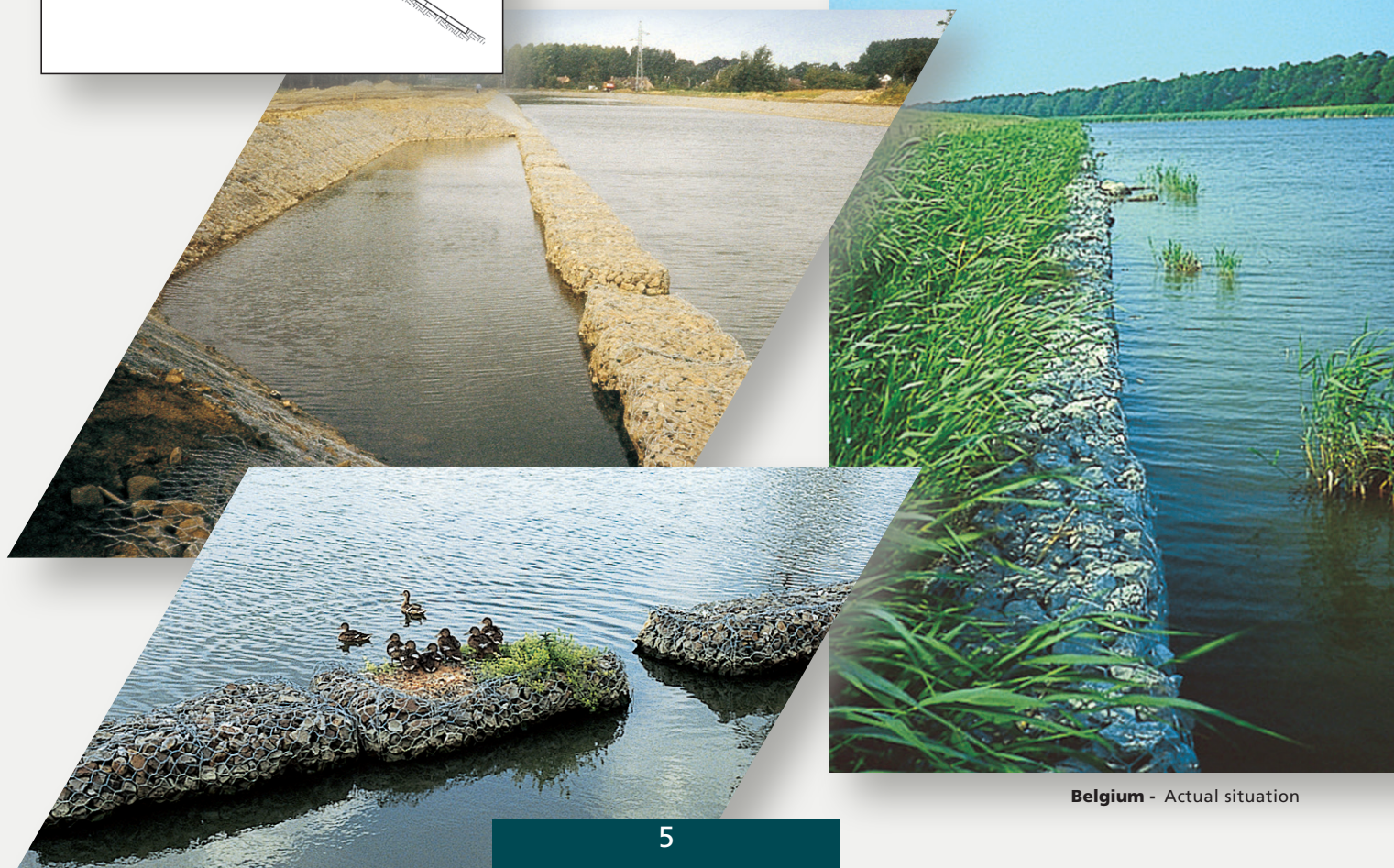
Microhabitat check schematisation
(Research on the environmental effects
by rivers sides with Gabion and Reno®
mattresses)-Italy 1993-1994.



Italy - Actual situation



Belgium



Belgium - Actual situation

A system of softwares for hydraulic and environmental design

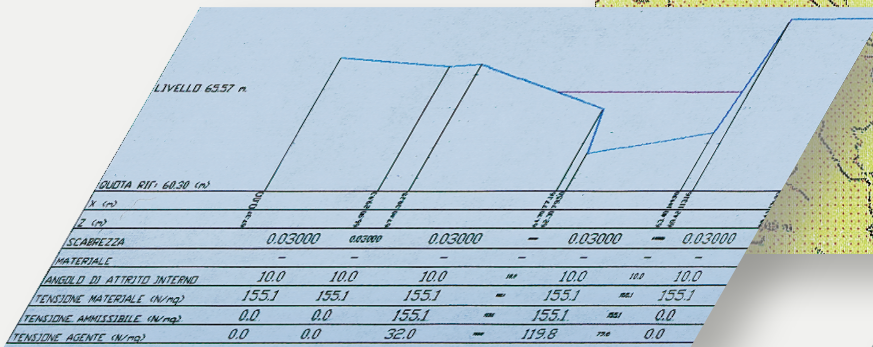
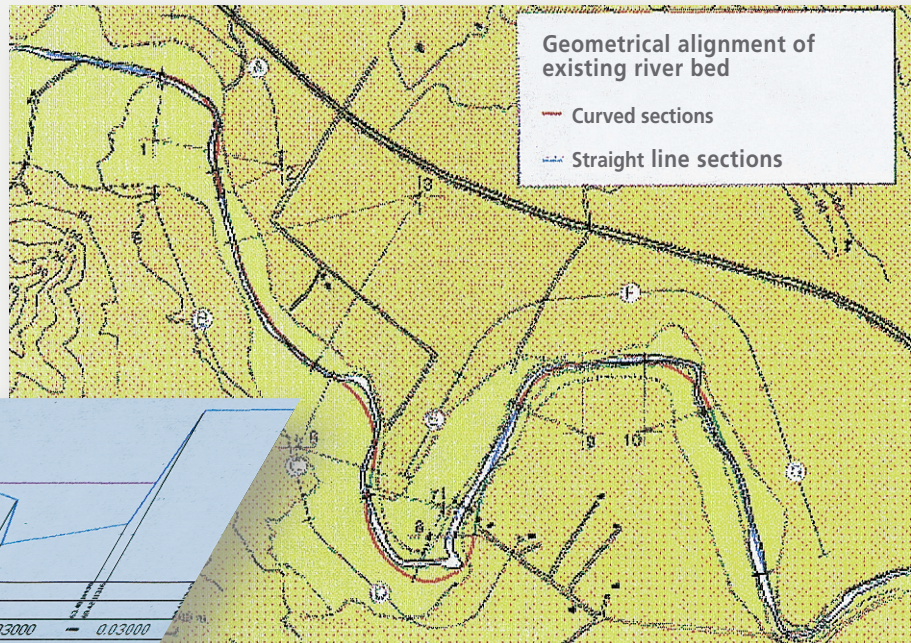
The solutions exposed in the previous pages have to be chosen on the basis of quantitative analysis and not only qualitative or subjective ones.

This is the reason why our company has promoted laboratory, field and bibliographical researches, on the basis of which, a series of specific software have been created

MACRA

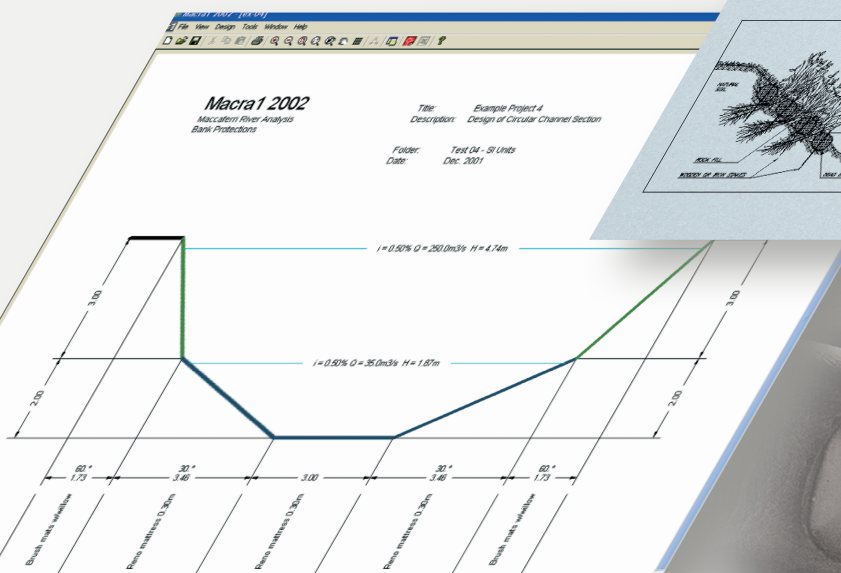
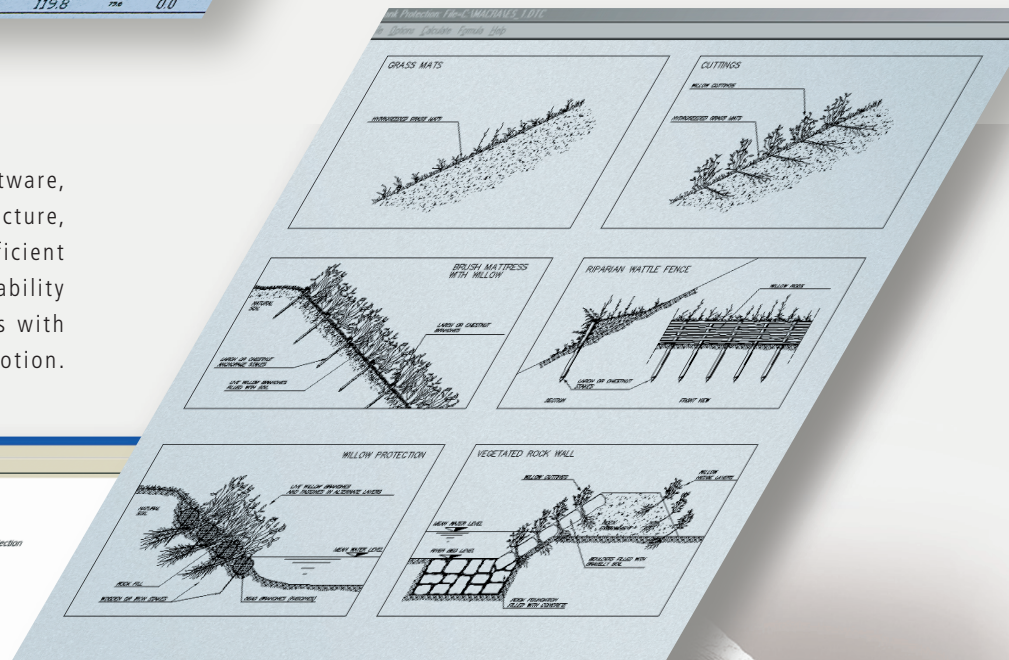
(By EHS Bologna - Italy)

The MACRA software, working in an Autocad format, allows the engineer to design the river training works in a stretch of river under the hypothesis of a steady flow, taking into account the actual river geometry, roughness and flow normally present in a natural watercourse.



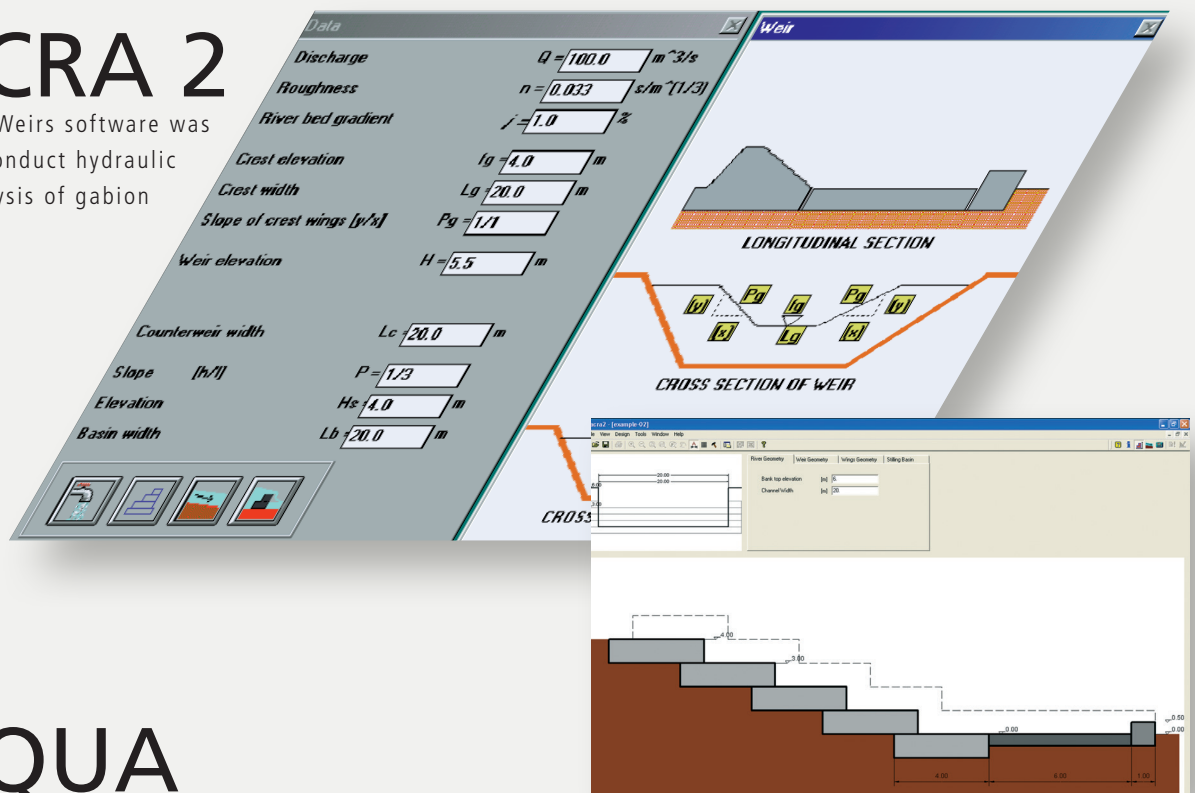
MACRA 1

The MACRA1/Bank Protection software, which uses a Windows type structure, provides engineers with a rapid and efficient tool, with which to conduct the stability analysis of watercourses cross-sections with respect to both water flow and wave motion.



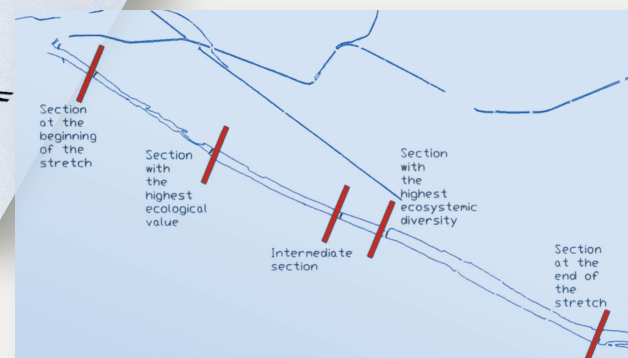
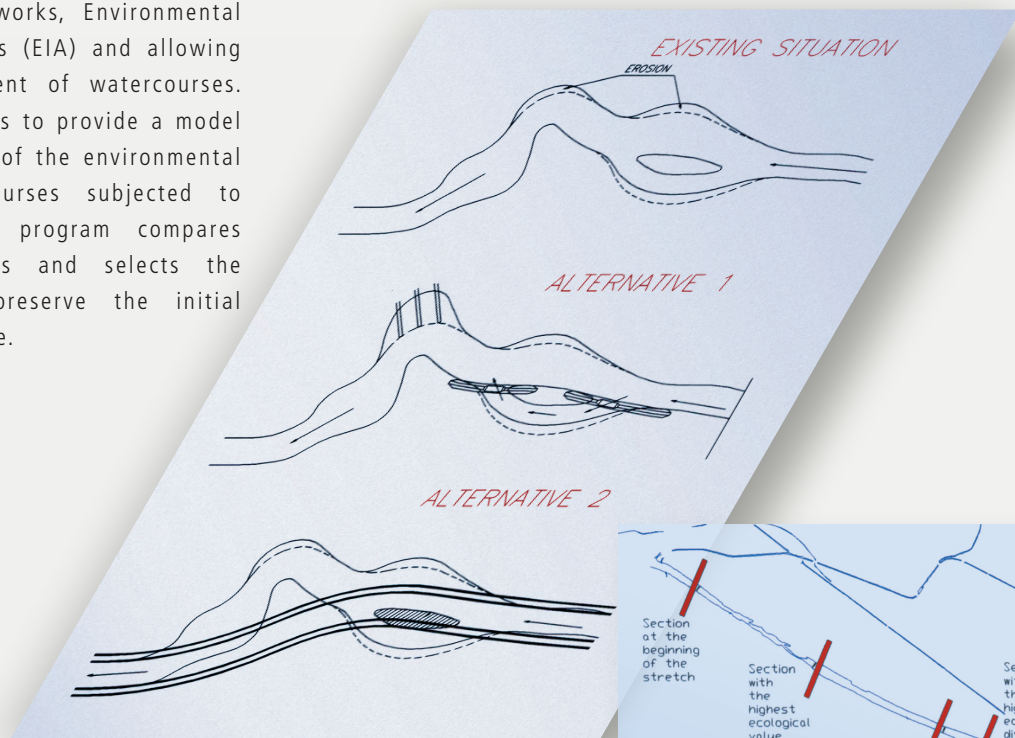
MACRA 2

The MACRA2 / Weirs software was developed to conduct hydraulic and static analysis of gabion weirs.



MAQUA

MAQUA is a software developed in a Windows format, supporting the design of river training works, Environmental Impact Assessments (EIA) and allowing for the management of watercourses. MAQUA's purpose is to provide a model for the evaluation of the environmental value of watercourses subjected to intervention. This program compares design alternatives and selects the one shown to preserve the initial environmental value.



Longitudinal structures

The term longitudinal structures is used to define structures with their length parallel to the river flow. These structures are often built on existing natural banks and they usually extend for a considerable distance.

They are used for a variety of purposes, such as:

- erosion control
- control of meanderings
- containment of the normal flow channel
- flood protection



Italy



Italy



Italy - Actual situation

Revetments

When an erosion process that does not affect the global stability creates slope instability, then revetments can be a possible solution.

The choice of the most suitable type of revetment must be made on the basis of a comparison between the acting stresses (in terms of shear stresses and not only water velocities) and the serviceability limits of the material used.

The approach to be considered must always be made under the term of Bioengineering, based on a combination of live and inert materials where the limitations of both must be taken into consideration.



Italy



Brunei



Italy



Italy



Italy



Italy - Actual situation

Gabion gravity structures

A bank stabilisation may involve the construction of a retaining structure that should not only effect the natural filtration between the watercourse and the bank, but must also guarantee the required consolidation.

Furthermore, the presence of subgrades and banks, that are normally saturated or which have unpredictable erosion phenomena, make the application of flexible structures a necessity. They must be able to withstand differential settlement without losing their structural integrity.

Gabion structures are the ideal solution on account of their flexibility, natural drainage capacity due to the stone filling, and high structural resistance.



Italy



Italy



Italy



Italy



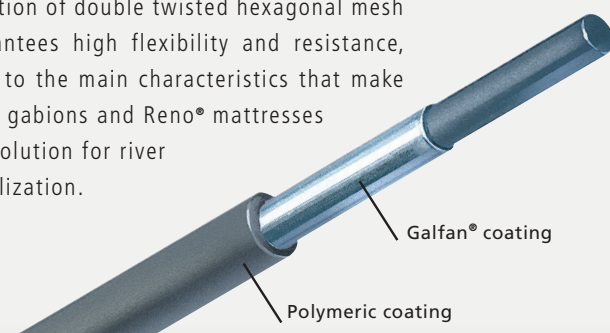
Italy



Italy

Maccaferri gabions are fabricated from high quality steel wire where long term durability is guaranteed by galvanising with a zinc/aluminium-MM alloy (Galfan®), that can be further protected by a polymeric coating and all of which comply with the highest international standards.

The utilisation of double twisted hexagonal mesh also guarantees high flexibility and resistance, all adding to the main characteristics that make Maccaferri gabions and Reno® mattresses the ideal solution for river bank stabilization.



Italy

Gabion gravity structures



Italy

A gabion apron extends horizontally into the bed so that it adjusts to possible scouring thereby providing an adequate foundation for the protective structures built upon it.

A properly sized apron should extend horizontally into the river bed beyond the vertical front face of the protection by 1.5 to 2 times the maximum depth of expected scour. This ensures that under maximum scour conditions, the apron will fold down into the scour hole without being too steep or allowing the surface to take up a "quilted" or undulating profile.



U.K.



Greece

The wall must be founded at a level that is not affected by water scour problems. Generally a direct foundation of this type is only advisable where the river bed material is un-erodible or when it consists of solid rock.

It is also appropriate in mountainous regions and especially in the wilder torrents where the heavy bed load could damage elements such as aprons protruding into the stream bed.



Italy



It is not always possible to build the foundations of river bank improvements in the dry.

In these cases a platform can be built of dumped rock or cylindrical gabions, and the vertical portion of the protective structure can be conveniently built on top.

If the platform is built of loose rocks it is particularly important to choose a rock size to ensure the stability of the super-structure.

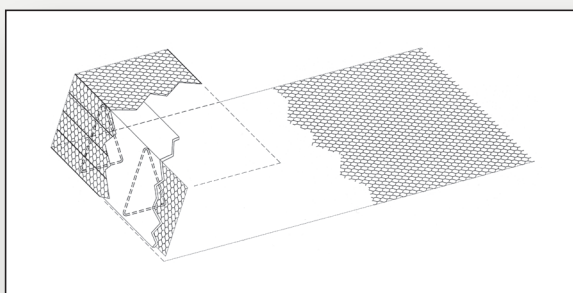
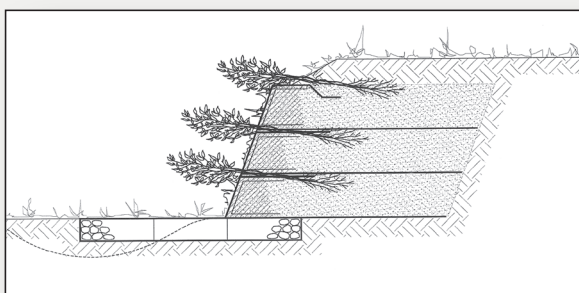


Brazil

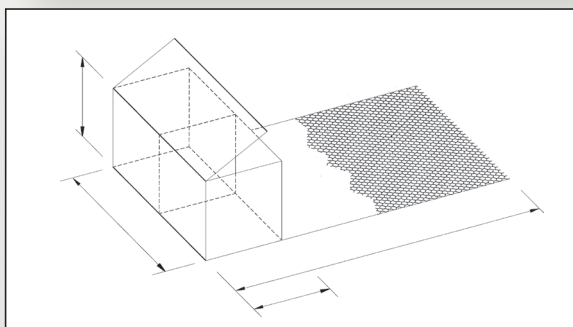
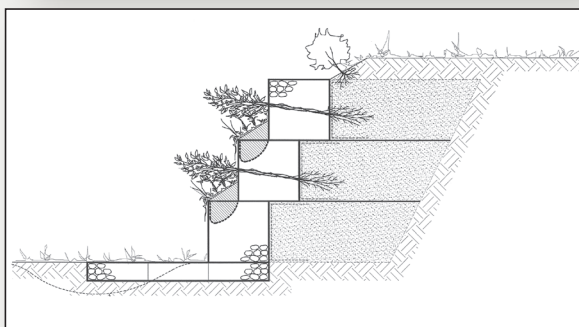
Reinforced soil structures

The development of new technologies such as reinforced soil structures using the combined strength of the soil and the reinforcing elements has opened up new methods for the stabilisation of riverbanks. The double twisted wire mesh Terramesh® System (made with polymer coated Galfan® wire) has greatly extended Maccaferri's experience in the field of revetments and gabions.

The Terramesh® System are structures whose components are pre-determined and completely pre-assembled during the production phase. Each element has two main properties: the first is to reinforce soils, and the second is to stabilise the face. The ordinary Terramesh® has an external face similar to stone filled gabions. The Green Terramesh® has a face lined with a geomat that retains uncompacted vegetable soil.



**Green
Terramesh®**



**Terramesh®
System**

Italy



Italy



Italy - Actual situation



Italy

Gabion weirs

Gabion weirs are classified in three types according to the shape of their downstream face at the centre of flow:

- vertical weirs
- stepped weirs
- sloped weirs

The vertical weir is certainly the simplest type, and it is often used for small weirs in a system controlling a reach of a stream.

Since this means that the gabion mesh is protected against abrasion and impact by heavy bed material carried in spate conditions, it is a type recommended for training works on mountain torrents.



Italy



Italy



Austria



In the design of vertical weirs, maximum attention must be paid to the dissipation of the kinetic energy of the cascade which is allowed to scour the bed thus forming a pool. Here the energy is dissipated in the cushion of water and in the formation of a hydraulic jump.

A secondary weir is placed at the downstream end of the pool to control the formation of the jump and to restrict the extension of the pool downstream.

The latter is necessary to ensure that the main structure is not undermined.

Italy





Italy

Venezuela



Venezuela



Burkina Faso



Italy



Italy
Actual situation

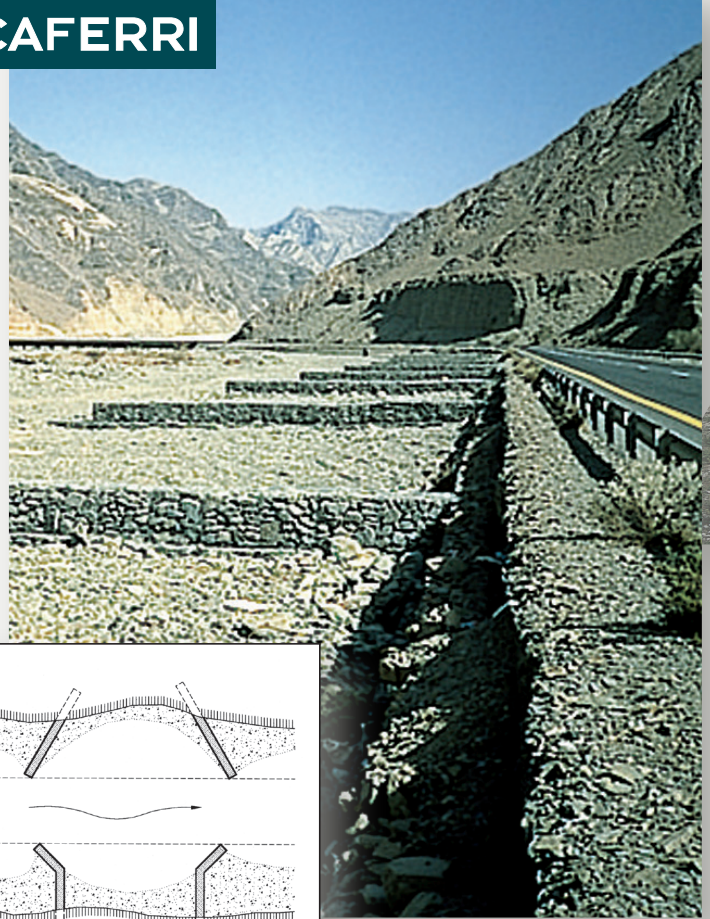
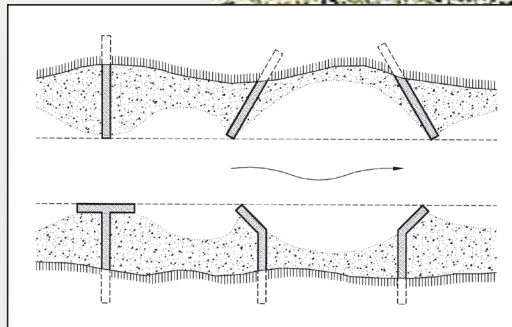
Gabion groynes

By "groynes" we mean a structure which protrudes into the river bed, with the aim of moving the flow away from the side of the river on which the groynes are built. Gabion structures are suitable for every kind of groyne.

They can be subjected to strain without losing their effectiveness due to movement and they can conform to all variations in river bed levels.

They become an integral part of the river bank and of the riverbed on which the gabions are built.

In cases of a well built combinations of gabion defences and groynes, the works are destined to disappear under the deposition of silts which will become further stabilised by plant colonisation.



Saudi Arabia



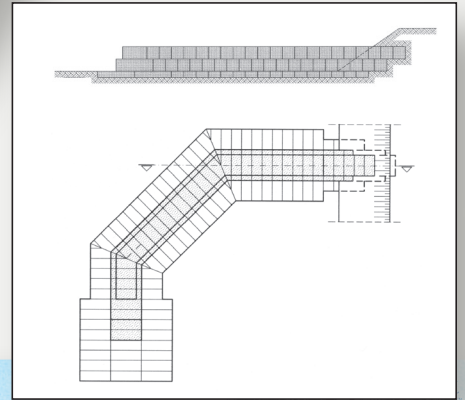
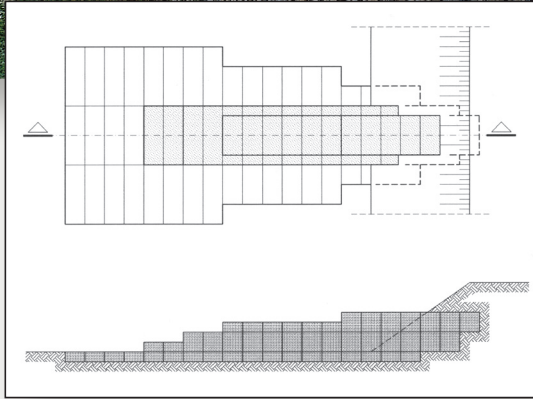
Brazil



Italy



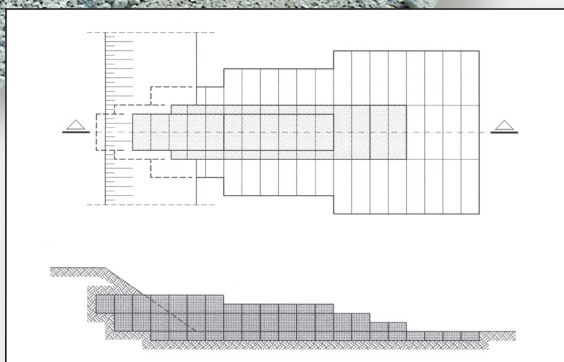
Italy



Malawi - Actual situation



Italy



Italy

Officine Maccaferri Group Profile

Founded in 1879, **Officine Maccaferri** soon became a technical reference in the design and development of solutions for erosion control 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 and environmental engineering** applications.

Consultancy and Partnership

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 is at the heart of the Maccaferri Industrial Group. Its continued growth is based upon long-held values of innovation, integrity, excellent service and respect for the environment.

Maccaferri's vision is to become a leading international provider of advanced solutions to the civil engineering and construction market. Implementing a strategy of vertical integration, Maccaferri researches, manufactures, designs, supplies and constructs solutions within its target markets. The capability of the business continues to expand due to a strategic plan to open new markets and grow existing ones; Maccaferri now offers advanced engineered solutions from **beach nourishment to reinforced soil structures** and from **rockfall mitigation to tunnelling systems**. With over 2000 employees, 26 manufacturing facilities and local operations in 100 countries around the world, Maccaferri can truly claim to have a global presence with local focus.

Maccaferri: Engineering a better solution



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Maccaferri
Industrial
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