Local Experience, World Expertise

TERRE ARMEE INTERNATIONALE
SUSTAINABLE TECHNOLOGY

The original TerraClass® structural facing

Dilovasi - Turkey

A40 motorway - France

CONTENT

Everlasting projects

Terre Armée Internationale

The value of Experience

The entities which constitute **Terre Armée Internationale (TAI)** concentrate an unequalled combination of expertise and accumulated experience in the fields of engineered backfills and soil-structure interaction.

For 50 years, the TAI entities have set the standards for mechanically stabilized earth structures and have been involved in more than 50,000 projects all over the world, making Terre Armée Internationale **the global industry leader.**

TAI's portfolio of techniques applies to a wide range of structures including retaining walls, bridge abutments, dykes, embankments, underpasses, cut and cover tunnels, arch bridges and steepened slopes **for an extended array of market segments**: roads and highways, environment, railways, hydraulic works, mining, industry, energy, commercial, housing or military.

TAI entities are committed to achieve excellence and professionalism. **Skills and knowledge sharing are placed at the heart of the Terre Armée Internationale organization**. By aiming at continuously reducing the environmental impact of its techniques and increasing the service life of the structures through the use of innovative technologies, **the TAI entities provide environmentally friendly solutions**, fully in line with the "Sustainable Technology" signature.

TAI is a subsidiary of **Soletanche Freyssinet**, the world's leading group of companies specializing in soils, structures and nuclear facilities.

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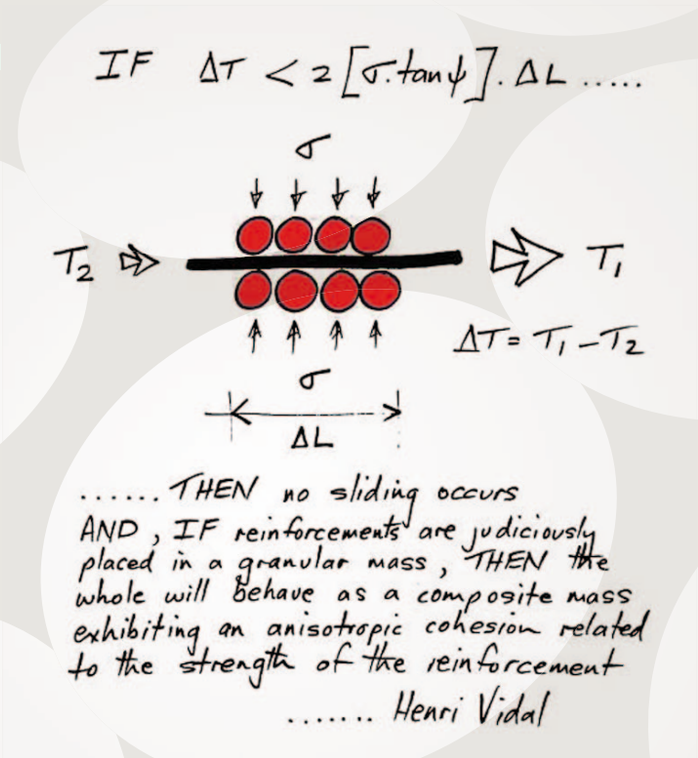


The innovation gene

It was the invention which revolutionized an entire industry...

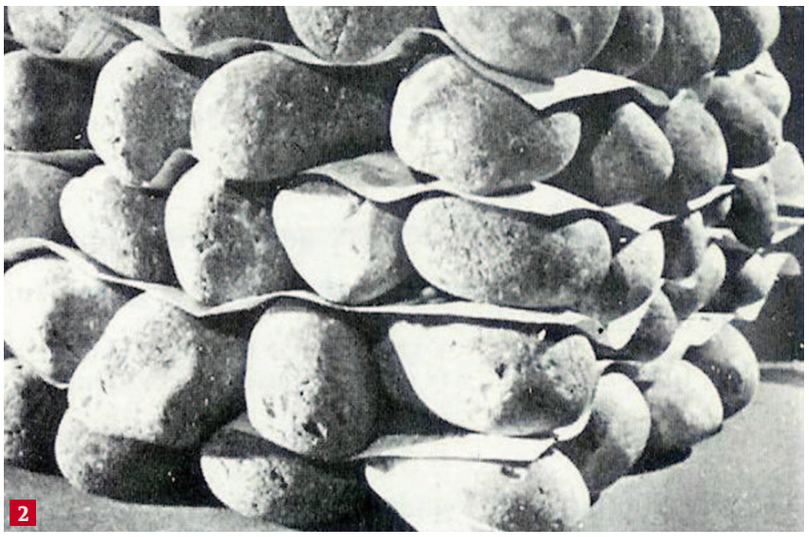
In the early 1960's, noted engineer and architect, **Henri Vidal**, introduced the Reinforced Earth® construction technique. Henri Vidal conceptualized this method and built the first full scale demonstration walls which quickly allowed **Reinforced Earth® to become recognized as one of the most significant developments in civil engineering during the second half of the 20th century**.

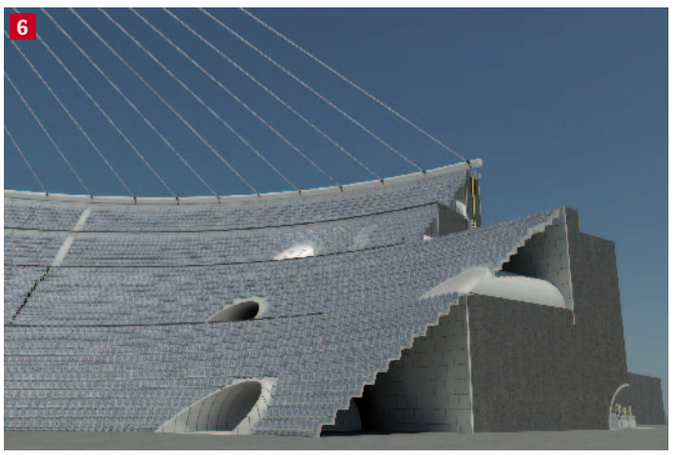
To realize his engineering vision, Henri Vidal rapidly introduced Reinforced Earth® worldwide through a network of companies which formed Terre Armée Internationale (TAI).

Since the early beginnings, TAI has based its development on continuous innovation, in short, **innovation is part of its DNA**. From the initial breakthrough, the Reinforced Earth® technique has been improved by numerous technological advances and 50 years later TAI perpetuates the pioneering spirit of its founder by implementing and investing substantially in an active research and development policy.

MAJOR INNOVATIONS BY TAI:

- The internationally recognized cruciform shaped precast concrete panels
- Reinforced Earth® pure abutments and integral abutments
- The Hot-rolled, High Adherence, ribbed steel strip (or HA strip)
- Vegetated facing systems for æsthetic benefits
- GeoMega® technology with fully synthetic connections between panels and geosynthetic strips
- EcoStrap™ geosynthetic strips for use in highly alkaline environments
- GeoTrel™ technology associating steel mesh facings to geosynthetic strips
- The HA GeoStrap® reinforcement, a geosynthetic strip with enhanced frictional capacity





1 The original Reinforced Earth® concept

2 Early illustration of the Reinforced Earth® principle

3 Pure bridge abutments with TerraTrel® system - France

4 First GeoMega® wall for railway application - The Netherlands

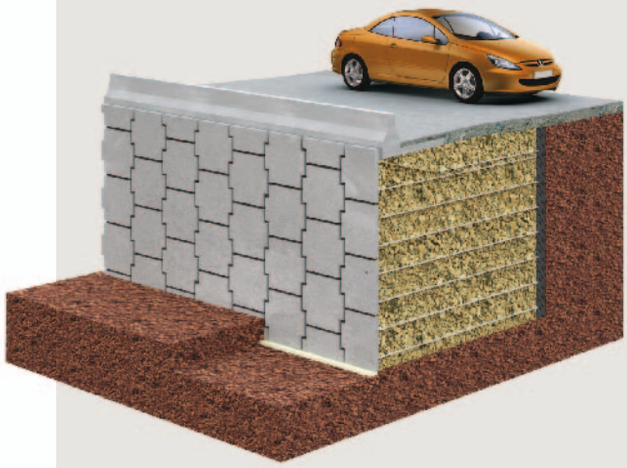
5 HA GeoStrap® reinforcement

6 Reinforced Earth® cooled stadium (patent pending)

Techniques

Reinforced Earth®

The original mechanically stabilized earth technique



Reinforced Earth® structures combine selected granular, engineered backfill with steel or synthetic tensile reinforcements and a modular facing system. This ideal combination creates a durable, mass gravity retaining wall.

This technique is adaptable to retaining walls of any practical height. It is also capable of supporting large dead and live loads imposed by associated structures, vehicles or machinery in addition to its own weight.

- Strength, flexibility and resilience
- Predictable longevity and cost effectiveness
- Adaptability to a wide range of environments
- Adaptability to æsthetics requirements

The original

Seattle Tacoma airport - USA

Rolleston dump wall - Australia

A75 motorway - France

Putty road - Australia

Blakefield South coal mine - Australia

CTRL420 - UK

Baku ring road - Azerbaijan

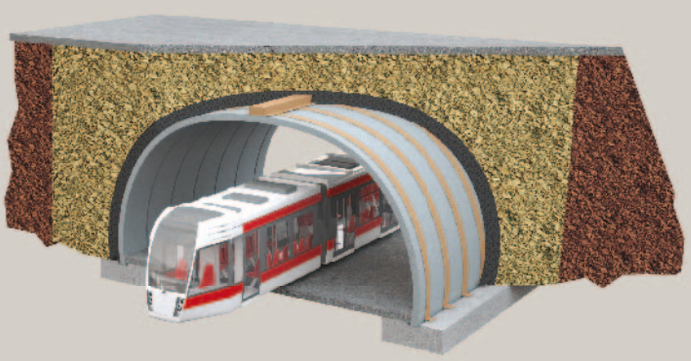
N1 widening - Johannesburg - South Africa

TechSpan®

The perfect arch, custom designed

TAI introduced the **TechSpan®** precast concrete arch system almost 25 years ago. The technique utilized TAI's knowledge of soils and finite element analysis to develop this three pin, two piece, funicular curved shaped arch.

- Custom designed
- Low impact and straightforward construction
- Optimized traffic clearance envelopes

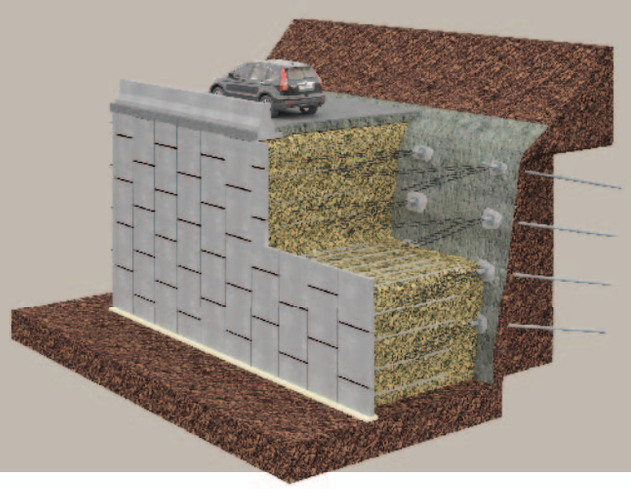


TerraNail™

A logical complementary development

Projects often combine fill and cut operations. Continuing with the innovative spirit, TAI offers the **TerraNail™** technique which allows building new Reinforced Earth® type walls connected to retaining structures such as slopes stabilized by nailing or existing retaining walls.

By combining Reinforced Earth® and TerraNail™ construction techniques, the continuity of facing and structural behaviour is ensured.



Applications

Transport infrastructures
Roads, motorways and railways

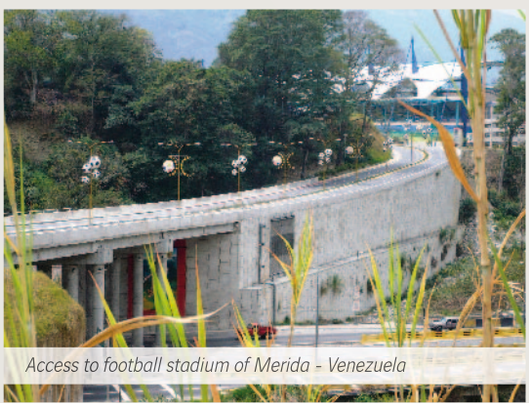
The **Reinforced Earth®**, **TechSpan®** and **TerraNail™** techniques are widely used in infrastructure projects. They are appropriate for a wide range of structures:

- Single or tiered roadway retaining walls
- Access ramps
- Bridge abutments
- Steepened slopes
- Cut and cover tunnels
- Arch bridges
- Underpass and flyover arches

The versatility of the techniques easily accomodate the use of high level engineering solutions combined with challenging æsthetic and geometrical requirements. The short construction time and the minimum disruption of traffic make them a sensible choice for the owners and engineering consultants.


Mbabane bypass road - Swaziland

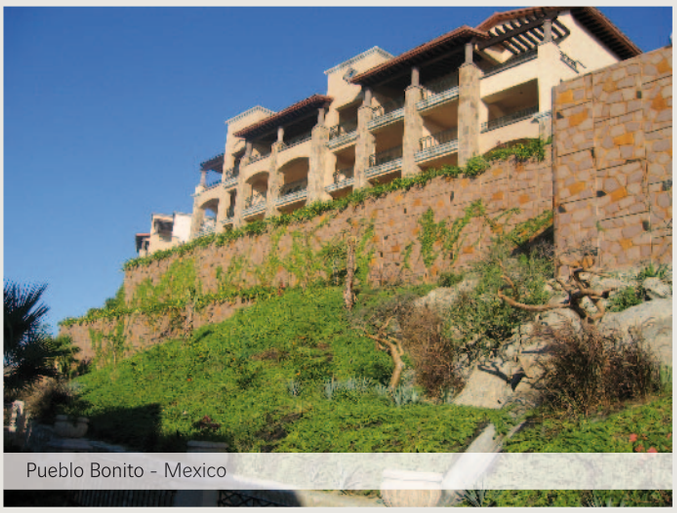

Tenerife - The Canary Islands - Spain


Access to football stadium of Merida - Venezuela


LRT - Charlotte - USA

New Acland mine - Australia

Storage of hazardous materials - USA



Pueblo Bonito - Mexico

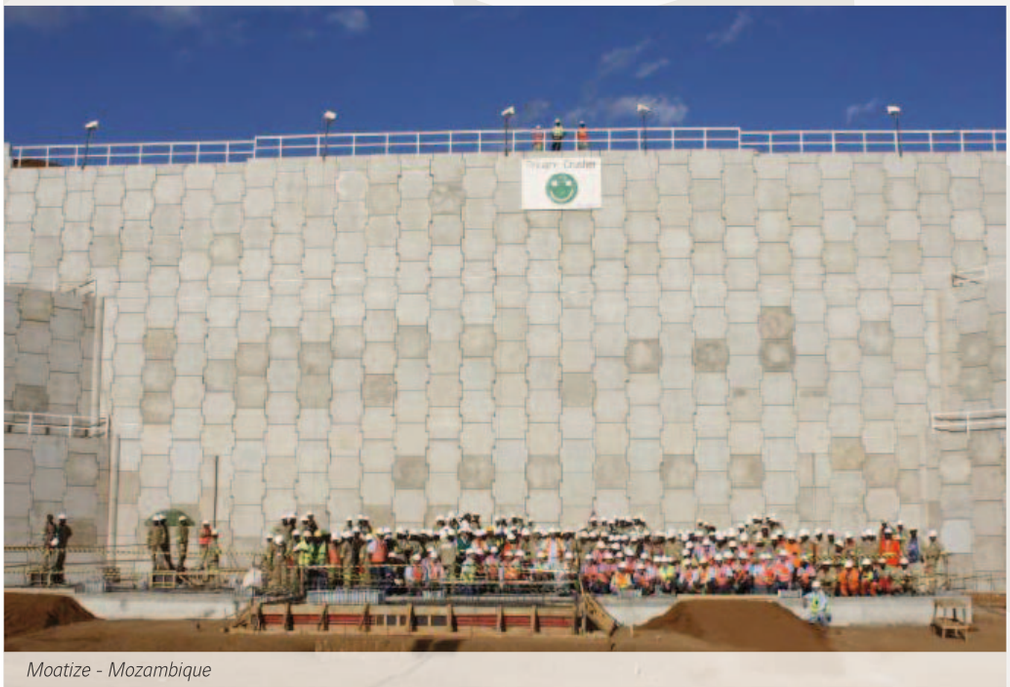
Lake Lenexa Dam - Kansas - USA

Structures for a wide range of market segments

The extension of the use of **Reinforced Earth®** and then of **TechSpan®** and **TerraNail™** to a wide range of market segments was a logical step after performances have been established in conventional applications.

TAI techniques apply to the construction of structures for:

- Industry, mining and energy
- Water ways, rivers works, dams and reservoirs
- Harbours, marinas and marine works
- Commercial and housing
- Military
- Risk mitigation



Moatize - Mozambique

A community of experts for your projects

The value of experience

When entities from Terre Armée Internationale (TAI) embark on projects, they have one goal, to offer their clients an unsurpassed level of service in a timely and cost-effective manner. **Their engineers and technicians will provide their assistance at every stage of the project:**

- Conception and feasibility
- Design
- Sourcing and supply
- Construction
- Maintenance
- Upgrade

The close knit community of Terre Armée Internationale experts worldwide enables the projects stakeholders, owners, consulting engineers, architects and main contractors, to benefit from the experience collectively accumulated by the TAI entities for half a century.

TAI representations around the world

Terre Armée Internationale has a presence in 40 countries on five continents. This global organization allows the deeply rooted local entities to benefit from the worldwide expertise and support.

Social commitment: Engineers Without Borders

Seydisfjordur & Isaflordur avalanche barrier - Iceland

Trekkopje reservoir - Namibia

Use of recycled construction materials - France

Sustainable development

As a member of **Soletanche Freyssinet**, Terre Armée Internationale (TAI) joins the Group's sustainable development policy by adopting collective guidelines wherever TAI operates.

In this context and as a leader in its industry, **Terre Armée Internationale integrates the sustainable development aspects to its activities by:**

- **Reducing the environmental and social impacts of construction**

  TAI techniques bring substantial reductions in materials when compared to more traditional construction methods. This logically converts into **lower emissions of CO_2**. Reinforced Earth® retaining walls and optimized TechSpan® arches allow to save 30 to 40 % in materials compared to cast in place reinforced concrete structures.

  With the recently developed EcoStrap™ reinforcements, it is possible to **use recycled construction materials** for the backfill, thus reducing the depletion of natural resources and the negative impact of transportation.

  TAI is constantly looking for solutions that provide better quality, in other words **increased service life** for its Reinforced Earth®, TechSpan® and TerraNail™ structures. The intrinsic characteristics of these techniques make them structurally highly durable. For example the ductility of Reinforced Earth® structures is a strong and proven benefit to mitigate the consequences of earthquakes.

SUSTAINABLE TECHNOLOGY

SUSTAINABLE DEVELOPMENT

SUSTAINABLE DEVELOPMENT POLICY

Soletanche Bachy and Freyssinet joined forces in 2009. The merger aimed to bring together the values and skills the two companies have in common and that have marked their national and international development: professionalism and integrity in the exercise of their construction and engineering activities, specialist technical expertise, a culture of innovation and creativity, and the capacity to manage operations right across the world.

The companies that make up the Soletanche Freyssinet group believe that their shared values and skills can help their clients, and civil society in general, tackle the economic, environmental and social challenges facing them. They are equally convinced that these challenges represent an excellent opportunity for international growth.

OUR COMMITMENTS

As leader in our business sectors, we undertake to incorporate sustainable development into three areas of our business: the way we operate, the solutions we offer clients, and our role as employer and stakeholder in society.

We are therefore adopting the collective guidelines set out below. They must be applied at all sites where we operate, using mechanisms suited to local environments.

MANAGE RISKS AND REDUCE THE ENVIRONMENTAL AND SOCIAL IMPACTS OF OUR ACTIVITIES

- **Continuously strengthen our Quality, Health & Safety and Environment culture**, in terms of managing risks, complying with procedures, encouraging more responsibility and improving behaviour; in particular:
  - pursue the development of Quality, Health & Safety and Environment management policies and systems;
  - incorporate QHSE and social risk analysis in the decision-making process for our projects.
- **Reduce the environmental and social impacts of our activities**, in particular by concentrating our efforts on preventing pollution, protecting natural resources, managing and recycling waste and reducing our greenhouse gas emissions.
- **Include environmental criteria in the structural design stage** by developing decision-support tools that use methodologies for carbon footprint calculation and life cycle analysis, and thereby help to optimise the proposed solutions.

PROVIDE OUR CLIENTS WITH PROJECT SUPPORT: CREATE VALUE AND ANTICIPATE FUTURE NEEDS

- **Improve performance levels for our products and services** and offer technical alternatives with economic, environmental and social added value while taking into account the issue of structure lifespans.
- **Continue to develop innovative services and technologies** and provide solutions in areas such as new energies, protection against natural and industrial risks, and the management and treatment of soil, water and waste.
  We will look to our Research & Development activities to help us work towards these goals, as well as to our partnerships with universities, research organisations and other stakeholders engaged with these issues internationally.

CONSOLIDATE OUR SOCIAL AND CIVIC ENGAGEMENT

- **Help our employees find fulfilment in their work**, using tailored training programmes and promoting integration, diversity and equal opportunities in the workplace.
- **Encourage behaviour that reflects a spirit of solidarity, teamwork, integrity and loyalty** towards the company and fellow employees in order to disseminate and transmit skills and technical expertise.
- **Contribute to the social environment at the sites where we operate** by employing local staff and supporting solidarity-based initiatives.

Bruno Dupety

SOLETANCHE FREYSSINET

- **Promoting solutions for environmental applications and improving the quality of life**

TAI's techniques are well adapted to environmental applications such as the protection against natural disasters and industrial hazards, the stabilization of slopes and the construction of water reservoirs. For example Reinforced Earth® dykes have been constructed in Iceland to provide protection against avalanches.

The most successful civil engineering projects are those which combine excellent performance with attractive appearance. With this respect the Reinforced Earth® technique offers limitless æsthetic possibilities for a **perfect integration of the structures in their environment**, whether in natural surroundings or in cities. The possibility of using noise absorbing facings on Reinforced Earth® walls provides additional benefits for the quality of life.

- **Consolidating its social and civic engagement**

The Group has an innovative, forward-looking social policy. Every year, TAI devotes 5% of its turnover to train its employees in order to give each individual the opportunity to acquire new skills.

Furthermore, TAI is keen to employ local personnel and to promote integration, diversity and equal opportunities, seeing them as guaranteed means of developing corporate spirit, cohesion and sharing know-how worldwide.

Always attentive to its surroundings, TAI also supports joint initiatives from its employees for local development and education. For instance, The Reinforced Earth Company (USA) supports **Engineers Without Borders**, in order to create a more stable and prosperous world by providing basic necessities such as clean water, power sanitation and education to address people's basic needs.

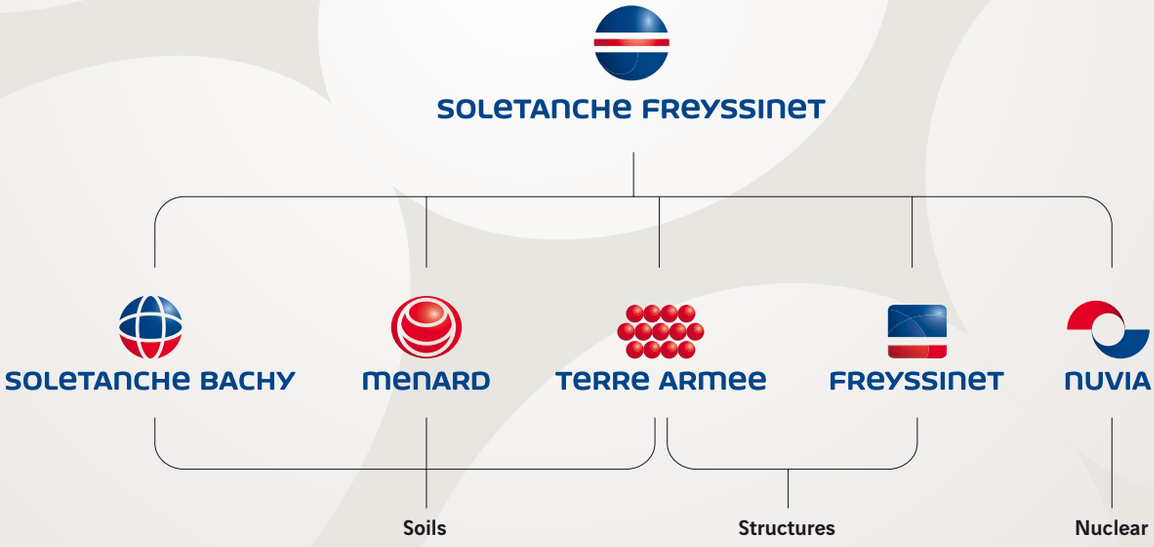
ENGINEERS WITHOUT BORDERS USA

Terre Armée Internationale,

Member of Soletanche Freyssinet

SOLETANCHE FREYSSINET is the world's leading group of companies specializing in soils, structures and nuclear facilities.

- Turnover of **€2.2 billion**;
- **17,000 employees**;
- Present in **100 countries on 5 continents**;
- Involved in **most major construction projects** around the world;
- Constant innovation with **over 350 inventions** protected by **more than 1,500 patents**.



SOLETANCHE FREYSSINET EXPERTISES

Soils

SOLETANCHE BACHY has the widest range of expertise available in the field of foundations and soil technologies. Soletanche Bachy specializes in geotechnical processes, special foundations, underground work, soil improvement and soil remediation.

MENARD has become a benchmark through its exclusive soil reinforcement and improvement methods, which allow for building on previously unbuildable ground.

TERRE ARMEE, half way between soils and structures, is the world leader in mechanically stabilized earth (MSE) retaining structures and precast arches in underground structures.

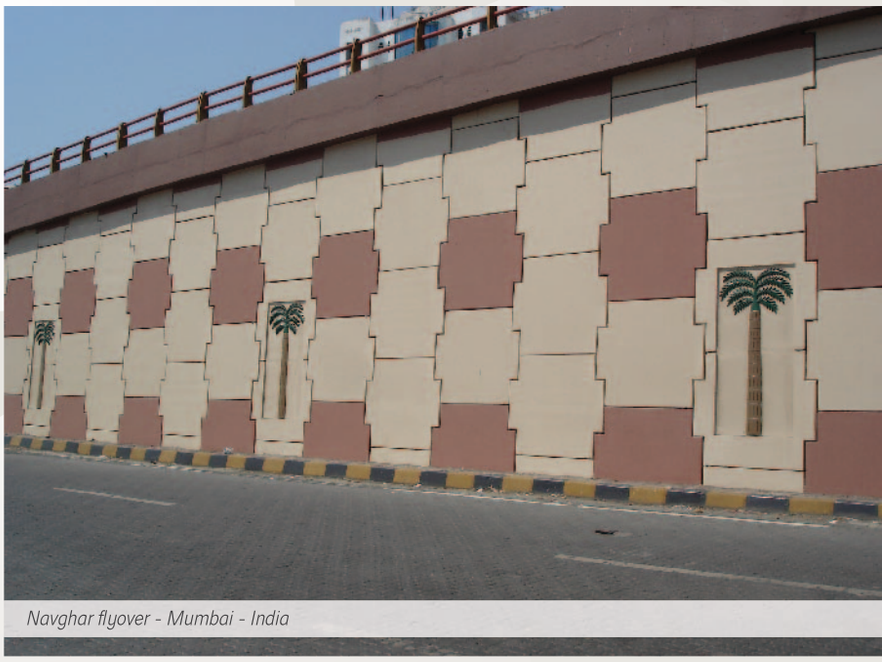
Structures

FREYSSINET has developed a unique skill set in the design, building, repair, reinforcement and maintenance of structures. Its services cover all types of civil engineering structures, from major bridge or tunnel projects to nuclear containment vaults, tanks, silos, hydraulic structures, buildings, etc.

Nuclear

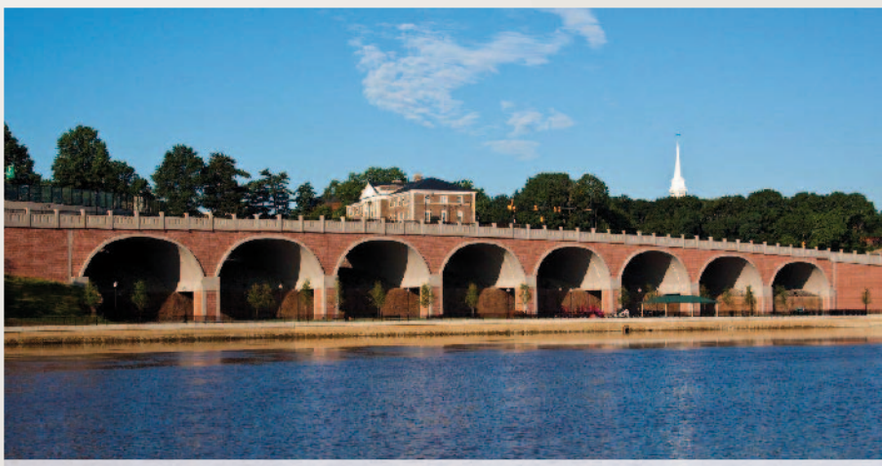
NUVIA is involved in every life cycle stage of nuclear facilities, from construction, maintenance, operation and service life extension, to decommissioning.

Brisbane - Australia



Navghar flyover - Mumbai - India

Morzine - France



George street bridge - New Brunswick - USA

TAI

Bewehrte Erde

Reinforced Earth

Terra Armada

Terra Armata

Terre Armée

Tierra Armada

テールアルメ

"Our experience,
Your success"

TERRE ARMEE INTERNATIONALE
SUSTAINABLE TECHNOLOGY

www.terre-armee.com

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