

Reinforced Earth[®], the Value of Experience

When it was invented almost 50 years ago, nobody could foresee the great success of the Reinforced Earth[®] technique. It is now recognized as a major innovation in the field of civil engineering. The Reinforced Earth[®] method has widened its scope of applications to beyond just roads in the last 30 years, demonstrating its advantages in other markets. Reinforced Earth[®] structures have been designed and supplied by companies of the global network of Terre Armée Internationale for marine applications.

Choosing a Reinforced Earth[®] solution allows owners and engineers to benefit from:

- the longest experience in the field of mechanically stabilized earth structures
- a global network of innovative companies deeply rooted in their markets
- tailored engineered solutions adapted to complex situations
- the widest range of reliable and sustainable materials
- a complete independence from manufacturers of reinforcing materials

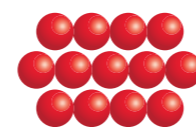
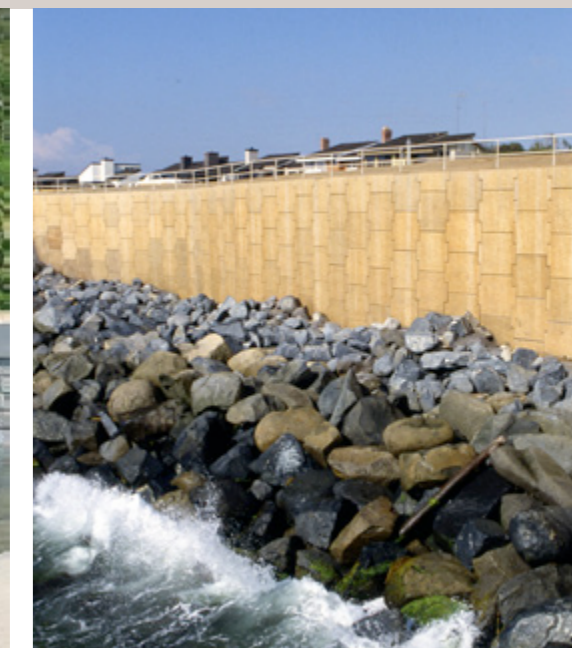


Our goal is to create, design and supply innovative techniques to the civil engineering industry with a strong commitment to excellence in design, service and public welfare.

Sustainable Technology

Ports & coastal works

Reinforced Earth[®] applications for hydraulic works



REINFORCED EARTH

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REINFORCED EARTH
SUSTAINABLE TECHNOLOGY

Oceans and seas cover nearly 71% of our planet surface and almost 60% of the world's population live on or close to seashores. The continuous development of coastlines on all continents is driven either by economic factors such as international trade or by various social and demographic trends. Seas and oceans are potential sources of natural hazards which go from erosion to storms, tidal waves or raising water levels that can make them highly destructive.

Drawing on their global expertise and track record, Reinforced Earth entities worldwide bring tailor-made solutions and provide support at all stages of the projects, fulfilling the demanding requirements of marine applications.

Reinforced Earth®... and the sea

The Reinforced Earth® technique has been used for 35 years to build marines structures either on coastlines or in harbors. The design and construction materials used in marine environments must allow for the risks associated with this special environment. Performance characteristics that have made Reinforced Earth® solution universally accepted in traditional civil engineering applications can be easily adapted to the requirements of marine projects.

Marine structures are *intermittently or continuously exposed to seawater*. The GeoMega® system, based on the use of GeoStrap® or EcoStrap™ soil reinforcements in combination with polymeric connections set in concrete facing panels is *perfectly adapted to the seawater environment*.

Reinforced Earth® marine structures are designed and built *to resist the combined forces of water and waterborne debris* which can be highly destructive during storms, as well as other environmental stresses such as *waves or driven pack ice*. Structures often include *panels designed for functional requirements such as wave deflectors*.

Reinforced Earth® panels combined with *appropriate backfill materials ensure adequate drainage*, especially if the structure is subject to tides with high amplitudes or storm surges.

Sea Walls

Roads, motorways and railways, are often constructed along the seacoast just above the maximum high tide level. When the seacoast is so narrow that new construction or widening of existing communication link encroach on the sea, retaining structures are required and the Reinforced Earth® technique is perfectly adapted to such applications.

Reinforced Earth® marine structures have generally been constructed under dry condition or during periods of low tides. Experience has proven that structures in sheltered sites or harbors can be submerged during the initial stages of construction without any damage to wall construction.

The use of large size Z-shaped panels allows for *rapid construction*, providing *additional protection against adverse weather conditions and extreme tidal fluctuations*.



Gaspé peninsula, Quebec (Canada)



Cork (Ireland)



Beacon Island, Galveston, Texas (USA)



Sydney Airport (Australia)



Swansea (United Kingdom)



Sydney Airport (Australia)



Miyazaki Port (Japan)

Breakwaters and jetties

The *inherent characteristic of resilience to dynamic loads* makes Reinforced Earth® solutions particularly well suited for breakwater and jetty structures. As in traditional marine construction, and depending on the site conditions, the exposed side of these structures can be protected by rip rap, tetrapods or any other appropriate mean.

Quays

Reinforced Earth® structures can be designed to *withstand the heavy loads* imposed by railroad locomotives and freight cars, as well as by a traveling crane and the *stresses generated by bollards or other docking means*. Thus the technique is particularly suitable for the construction of quays in commercial harbors.

Channels and slipways

The advantageous properties of Reinforced Earth® system have also been used to build ancillary harbor structures such as slipways or channels, either temporary or permanent.

Marinas

The Reinforced Earth® method is well known to combine strong technical and operational benefits with aesthetic properties while providing speed of construction and substantial cost savings. Therefore it is an excellent solution for the construction of marinas, providing *the perfect answer to owners, local communities and users*.

Watertight marine structures

The GeoMega® system can be combined with a waterproofing membrane on the back face of the panels (patent pending). This allows the use of Reinforced Earth® solution for structures which need to be watertight such as dry docks or protection levees against cyclonic storms or sea water surges.



Dun Laoghaire (Ireland)



Bing Bong wharf (Australia)



La Collette (Jersey Island)



Severn River estuary (United Kingdom)



Langkawi (Malaysia)



Haniara Copra Wharf (Solomon Islands)

Reinforced Earth® applications for harbors and coastal works



- Suitability of soil reinforcing and facing materials to environmental and site conditions
- Rapid construction
- Structural flexibility on moderately compact or heterogeneous foundation soils
- Reduced land use and site impact during construction
- Exceptional response to seismic events
- Lower CO₂ impact than conventional techniques
- Use of natural or recycled materials
- Durability
- Ease of inspection, maintenance and upgrading
- Compatibility with internal waterproofing geomembranes