



Reinforced Earth Company

technology
applications
services



Reinforced Earth™ is based on a very simple concept. Here, the sand and pine needles in combination provide a natural and elementary model.

Based on this simple idea, a recognised process has been developed which continues to be used worldwide. Reinforcement in the form of steel or synthetic strips are placed within an embankment, linking granular material together by means of friction. The embankment, thus reinforced, becomes a self-supporting structure.



With well over 20 million square metres of **Reinforced Earth™** structures worldwide, and with hundreds of our structures in service in the United Kingdom, only the Reinforced Earth Company offers the experience of **Reinforced Earth™** technology. When combined with our advanced design methods, field construction techniques and our commitment to continued research and product development, this ensures that the Reinforced Earth Company remains at the forefront of this exciting and innovative technology.

In principle the concept of **Reinforced Earth™** is similar to reinforced concrete, that being an economical means of improving the mechanical properties of earth by reinforcing it with either steel or synthetic strips. Stresses generated within the backfill mass are transferred to, and resisted by, the reinforcing strips.

Construction is both simple and economical. Structures are built in successive lifts of soil and reinforcing strips. The reinforcing strips are attached to concrete facing units that protect the structure against erosion and provide a finished appearance.

The structure is stable during construction, allowing equipment to operate on top of any layer. Furthermore, the front face of the structure is unobstructed as construction operations are performed from the rear face.

A structure built using **Reinforced Earth™** is a strong and durable coherent gravity mass that can be engineered to support large loads as well as resist lateral earth pressures. **Reinforced Earth™** is suitable for a variety of applications including retaining walls, bridge abutments and a variety of marine, dam, industrial and special military structures.

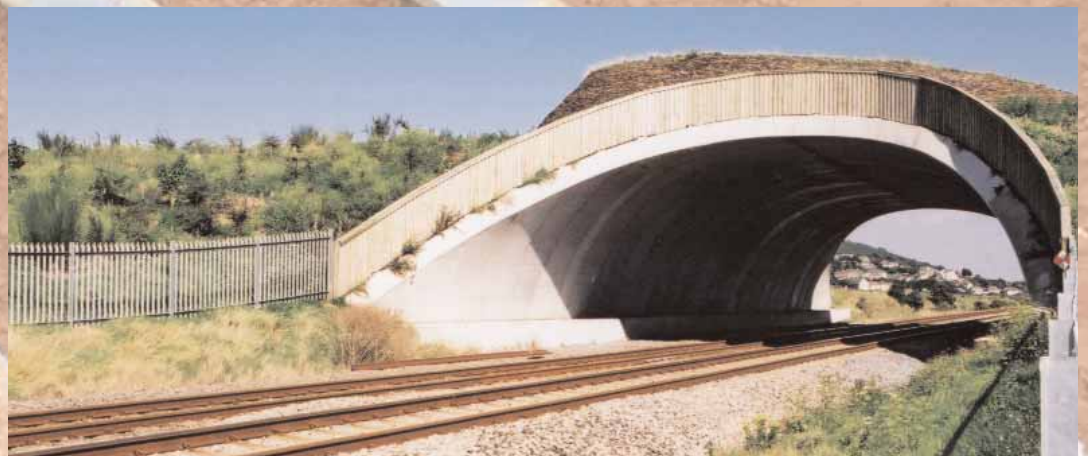


The use of **Reinforced Earth™** offers many advantages over alternative methods;

- **Lower construction costs.**
- **Speed of construction.**
- **Strength and stability.** **Reinforced Earth™** structures exert no concentrated stresses on the foundation soil, have high safety factors for external stability and are inherently flexible so they can tolerate significant differential settlements without compromising performance.
- **Ease of construction.** No specialised plant is required with construction of the **Reinforced Earth™** mass taking place from the backfill side, creating significant benefits on sites with space restrictions.

Reinforced Earth™ remains the preferred choice for many contractors and consultants due to its economic benefits, safety and reliability. The basic criteria are the speed and simplicity of construction combined with the low cost of materials. Once specified, owners of **Reinforced Earth™** structures have benefited from these cost savings over more traditional construction techniques.

The Company has also been able to develop related technologies such as **TechSpan®** concrete arches, a cost effective solution for the construction of bridges and tunnels in embankments, also allowing minimal traffic disruption during construction.



The Reinforced Earth Company Ltd, as part of the Freyssinet Group, has access to a wealth of resources on every continent, being the world leader in specialised civil engineering works involving construction and improvement of structures and soils.

RETAINED EARTH SYSTEMS

A system of prefabricated interlocking concrete facing panels, creating a durable and flexible facing to the **Reinforced Earth™** mass. **TerraClass™** combines the simplicity and speed of **Reinforced Earth™** construction with the availability and quality of a modular system.



APPLICATIONS

- Highway and railway structures
- Bridge abutments
- Industrial walls
- Marine structures - Seawalls, breakwaters, highway support structures adjacent to marine environments, and structures crossing river banks

ADVANTAGES

- Speed of construction.
- Simple method of construction, no need for specialist plant.
- Reduced loads on the foundation soils.
- Precast quality control over cast in-situ.
- Modular system means quick availability of panels.
- Less volume of concrete when compared to alternatives, thus reducing material costs.
- Inherently flexible structure allows settlements and movements to take place without compromising performance or appearance.
- Range of architectural panel finishes.
- Proven reliability even under adverse conditions.



Risca, Wales. UK.



Dun Laoghaire Harbour Breakwater, Ireland.

Reinforced Earth™ TerraClass™ panel systems have been designed to deal with the most demanding conditions and environments, from dams to projects situated in earthquake prone areas.

Marine structures can be designed whether in permanent or temporary contact with saltwater, and can be built to resist substantial tidal and wave forces. Paraweb synthetic soil reinforcement and non-metallic connections have been developed for such aggressive environments.



White City Development, London. UK.

ABUTMENTS

- Supporting full bridge loads.
- Reduces the need for piles or foundation improvements.
- Reduces maintenance requirements associated with differential settlements.
- Suitable for skewed bridge arrangements, open and closed spatial configurations.
- Substantial cost savings can be achieved.



Harford Rail Bridge, Norwich. UK.

TerraClass™ can be constructed on sites with restricted space requirements as the structure can be built from the rear side of the panels only. Construction programmes can be estimated accurately since all components are prefabricated and quality is assured. No specialised equipment is required, neither is there a need for expensive formwork.

Because our proprietary system has BBA accreditation, this allows a wider range of acceptable mechanical fill to be used within the structure than with other similar systems.

TerraClass™ is a simple and unique engineering solution developed with the emphasis on quality, the availability of standardised products and the simplicity of the construction process. **TerraClass™** offers time, labour and cost advantages over conventional solutions.

TechSpan®

PRECAST ARCH SYSTEMS

Segmental precast concrete **TechSpan®** arches offer proven reliable and cost effective solutions by producing a bespoke engineered product in which the design is a function of site specific requirements. The **TechSpan®** three pinned arch system is simple and quick to erect with minimal or no traffic disruption beneath the arch. Additionally, sections of the structure can be phased into operation whilst the remainder of the arch is completed.

When used in conjunction with other **Reinforced Earth™** systems, the arch backfilling operations can be combined with the construction of headwalls and wingwalls. Significant material and transport savings can be made over conventional structures, whilst still giving the same effective span and rise of the conforming scheme.

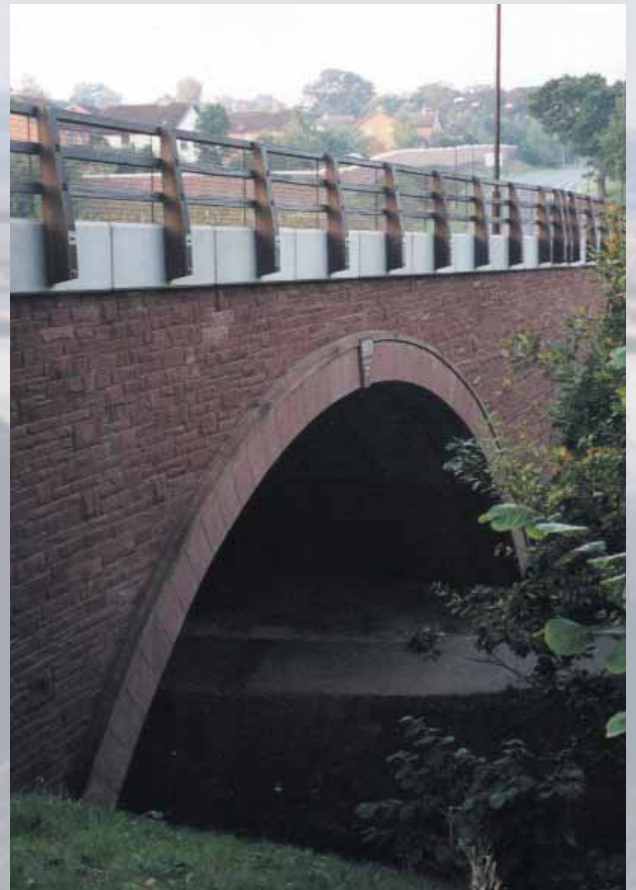


APPLICATIONS

- Water culverts
- Road and rail bridges
- Mining and industrial access tunnels
- Environmental underpass schemes

ADVANTAGES

- Speed of construction.
- Simple, rapid and safe construction. With less disruption to traffic over live road and rail reducing the costs of expensive closures.
- State of the art design methods allow optimisation of arch geometry to reduce costs and minimise in-service bending moments.
- Higher quality control of precast elements over cast in-situ.
- Versatile and unique precasting methods, allowing various shapes to be cast improving aesthetics and lowering costs.
- No scaffolding or formwork requirements.
- Comprehensive technical design service and professional construction assistance.
- Optional portal geometry, oblique and truncated ends.
- May be used in combination with other **Reinforced Earth™** techniques and products to provide a total project solution.
- Removes the need of costly maintenance when used as an alternative to rigid frame conventional bridges.



*Dingle Brook Bridge, Warrington. UK.
Winner: CONSTRUCT Structures Group Construction Industry
Award for Innovation 1998*



Gloucester Business Park, Gloucester. UK.

The innovative aspect of **TechSpan®** is to utilise a precast product with a sophisticated and individual design approach, incorporating a search for the optimum arch geometry and individually suited to the various loading situations for each structure. The arch is designed by a finite element method, including checks on all construction stages.

TechSpan® projects are rigorously analysed and strategically planned by our project team to ensure every opportunity is taken to reduce costs and programme time. Spans of over 20 metres and fills of up to 35 metres are achievable over the arch.



Contract 420, Channel Tunnel Rail Link, Kent. UK.

TechSpan® is built by assembling the prefabricated concrete elements in a staggered and symmetrical manner, such that the elements support each other during erection and backfilling sequences. The procedure allows a rapid and safe installation, reducing the disruption to the flow of traffic, which proves especially efficient for railway or hydraulic applications.

TechSpan® elements locate into a keyway cast in a simple foundation. There is minimal need for in-situ work after the elements are erected and, due to their form, **TechSpan®** arches are easier to waterproof than more conventional structures.



*Millennium Coastal Park Land Bridges, Llanelli. UK.
Winner: 1998 George Gibby Award by the Institute of Civil Engineers South Wales Association.
Shortlisted: 1999 British Construction Industry Awards*

TechSpan® elements are used for other innovative solutions such as bridge strengthening schemes and as permanent formwork systems, which avoid traffic disruption and costly re-routing of services within the bridge deck.

Thousands of **TechSpan®** arch structures are currently in service worldwide, These unique structures stand as testimonials to project programme reductions and cost savings.

Facings and Finishes

The Reinforced Earth Company continues to develop a range of facing treatments allowing our clients more options. The simplicity and adaptability of the **Reinforced Earth™** system caters for this range of finishes to meet both structural and aesthetic considerations.

TerraTrel™

Utilising the **Reinforced Earth™** technology with a galvanised steel mesh facing to provide an extremely versatile and economic solution, **TerraTrel™** is an ideal system for transport infrastructure and commercial developments where programme schedules are typically constrained by access or limited possession times.

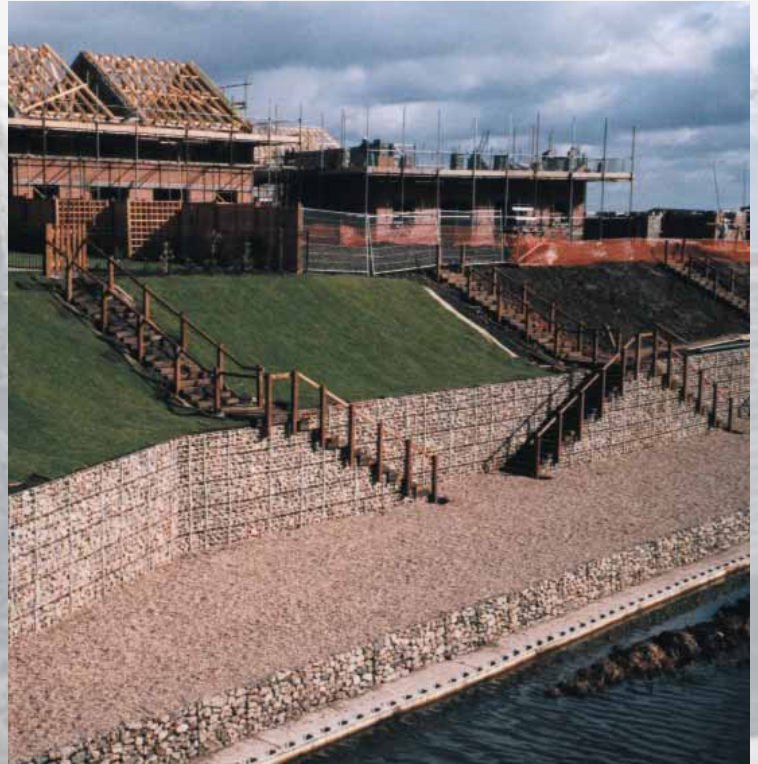


APPLICATIONS

- Permanent and temporary works
- Retaining structures and bridge abutments
- Environmental landscaped slopes
- Where significant foundation settlement is expected
- As a replacement for sheeting or shoring works

ADVANTAGES

- All the performance advantages of a **Reinforced Earth™** structure combined with the economy of a wire mesh facing.
- Lightweight components that are easily installed without the use of costly plant equipment, particularly suitable for restricted situations.
- Flexibility of facing elements allows complex geometry to be considered, including curved alignments, sloping or stepped treatments.
- Variety of finishes available including grass, stone, or masonry clad to match existing structures.
- Easily cut and modified on site to suit geometrical constraints.



Brindley Urban Village, Smethwick. UK.



Avalanche Barrier. Neskaupstaður. Iceland

TerraTrel™ elements are modular, inexpensive and lightweight, they are supplied as one standardised type allowing easy handling, a rapid construction rate and simple connections. In common with all **Reinforced Earth™**, the structure supports itself during construction, and build operations can be performed from the rear face only.

TerraTrel™ is ideal for forming temporary walls in conjunction with **TerraClass™** to allow for staged construction of bridges or retaining wall schemes, in addition temporary structures may be dismantled quickly if necessary, and reconstructed elsewhere.



Bridge Abutments. Corby Eurohub Terminal. UK.



TerraQuad

TerraQuad is an alternative prefabricated concrete panel facing system specially developed to accommodate tight curvatures and high expected settlements, the simple rectangular shape allows a greater degree of flexibility in panel movement at the face, although still forming a positive interlocking bond between elements.



TerraBlock

Developed for environmentally sensitive, small-scale applications such as residential, commercial and landscaped areas, **TerraBlock** structures form pleasing, organic shapes with a high quality natural, rustic finish.

A modular blockwall split-face system, dry laid and resembling a masonry wall in appearance with a simple, secure connection between the reinforcing strip and block. Construction is similar to other **Reinforced Earth™** techniques where blocks are interlocked and laid in a bonded fashion.

Services and Innovation

The Reinforced Earth Company Ltd, a member of Freyssinet, part of the VINCI group, the worlds leading company in construction and associated services has a wealth of knowledge and experience to provide total engineering solutions for our clients.

The Reinforced Earth group has over 1000 staff, each contributing to more than 35,000 **Reinforced Earth**™ structures being completed in over 50 countries.

Commitment to our clients allows the Reinforced Earth Company Ltd to assist in their requirements at all stages of the project.



Dingle Brook Bridge, Warrington. UK

Our commitment continues throughout the lifespan of structures, which may include live instrumentation, monitoring and feedback responses from the project team members and end users.



*Ro-Ro Ramp, Second Severn Crossing. UK.
High Commendation: British Construction Industry Awards 1993.*

A variety of architectural finishes are available including ribbed, masonry effects and geometrical patterns.



Church Lane Overbridge, Bishop's Stortford. UK.

Reinforced Earth™ structures consistently demonstrate superior structural performance, ease and speed of construction, and lower costs compared to alternatives.



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