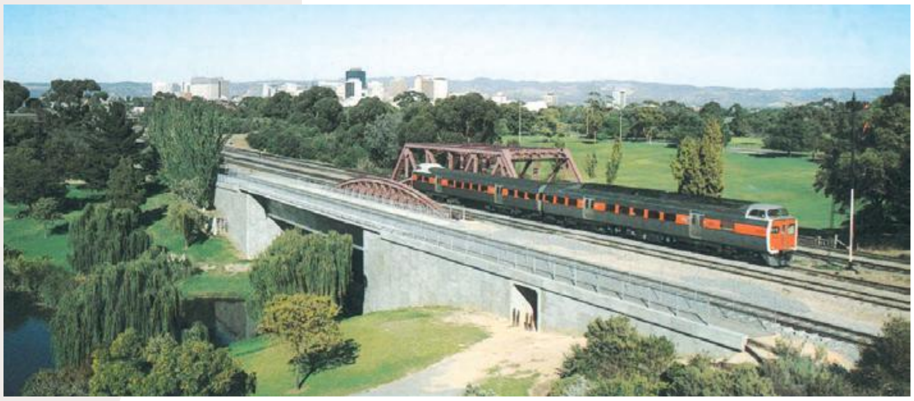
Railways

Reinforced Earth® and TechSpan® structures

REINFORCED EARTH
SUSTAINABLE TECHNOLOGY



Torrens River bridge abutements – Australia (1982)

It was only five years after the introduction of the Reinforced Earth® technique that it was first used to build structures near railway lines.

By the mid seventies, the civil engineering community had become more aware of the capabilities of this unique construction method, particularly in terms of mobile and dynamic load bearing capacity.

Engineers and projects owners began using the Reinforced Earth® method extensively to build structures under railway tracks. Hundreds of such structures have been designed and build since the construction of the first walls supporting a railway line in the USA in 1973.

TechSpan®, a precast arch system developped by Terre Armée Internationale from the end of the eighties also has applications for railway projects.

Reinforced Earth® and TechSpan® techniques bring all the answers to the legitimate concerns for safety governing railroad designs and exploitation.

The railway applications use the same technologies as those used for roads. However design is modified to take into account specific requirements concerning the surcharges or cœfficients of safety, especially for high speed trains.

Shikansen Ohmihachiman -Japan (1987)

Reinforced Earth® and TechSpan® methods are used for the construction of a wide range of railway related structures...

- retaining walls along railways
- bridge abutments spanning railway lines
- retaining walls and bridge abutments supporting the track beds
- rail tunnels beneath earthen embankments
- arch bridges supporting the track beds
- underpasses and culverts beneath earthen embankments supporting the track beds
- steep embankments for noise and collision protection

... and for all types of trains

- LRT
- MRT
- Regional
- Intercity
- High speed
- Freight

Retaining walls along railways

Daegu (South Korea)

SEA high-speed rail project (France)

In addition to its primary advantages of load bearing capacity, resilience, speed of construction and economy, Reinforced Earth® structures require very little space. This is a very important consideration when building walls parallel to a railway. Structures are not deeply founded, require no footing beyond the front face, and as a result, excavations do not encroach upon rail line beds. A Reinforced Earth® wall is built entirely from the backfill side, without scaffolding and without the necessity of any structure or equipement in front of the wall. It may therefore be placed right up to a clearance line or to a service road without any serious disruption of rail service.

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- Limited land use
- Minimal traffic disruption during construction

Bridge abutments spanning railway lines

Bozuyuk-Mekece (Turkey)

Vierzon (France)

The advantages of Reinforced Earth® walls are also obtained in Reinforced Earth® bridge abutments built on either side of existing railways. Traditional abutments often require rather deep foundations, the footing of which must be set within an excavation protected by steel shoring at the cost of slowing trains running alongside the excavation. These constraints are even more burdensome when the project is built on piles due to the space required for the drilling or driving equipment. By contrast, a Reinforced Earth® abutment, even one built on relatively poor soil, will typically be founded at a shallow depth, enabling the construction contractor to work outside the area influenced by the railway. Thus the construction of overpasses combining Reinforced Earth® abutments and bridge deck of prefabricated girders or beams create a minimum of inconvenience for train traffic. Depending on the sites conditions and owners' requirements the Reinforced Earth® structures can be pure or integral load bearing abutment, or mixed abuments.

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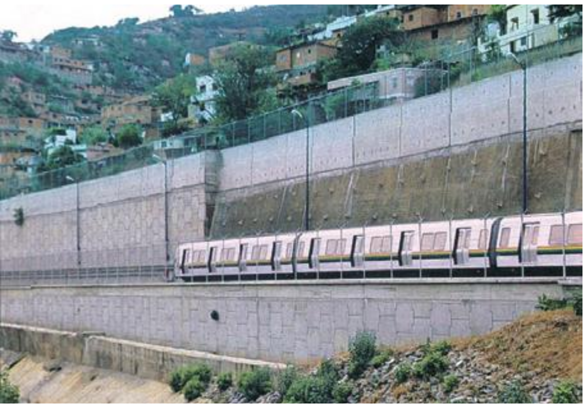
- Rapid construction
- Economy in foundation works

Retaining walls supporting the track beds

Kyung Bu – high speed train (South Korea)



Caracas MRT (Venezuela)

Snider Diamond grade separation (Canada)

Reinforced Earth® retaining walls are used in many countries to support high speed and heavy railways, as well as metro and light rail transit lines.

The technology is similar to roadway applications except the design of the retaining structures is adapted to comply with the safety requirements, especially for high speed railways. Railways loads differ from highway loads in regards to intensity, frequency and associated vibrations. The 40 year experience of the Reinforced Earth companies worldwide provides an uncomparable return regarding highly loaded structures The inextensibilty of the steel strip soil reinforcements, recommended for structures supporting railways, is the guarantee of minimal deformations under high loads. Structures beneath the tracks are designed to accommodate sudden braking decelerations.

Reinforced Earth® structures absorb the vibrations induced by passing trains inherently well as evidenced by numerous tests conducted in the USA, France and Germany.

Reinforced Earth® structures have often been used, particularly in Japan, for widening railway embankments. Since the system is versatile and built in successive layers, the Reinforced Earth® technique is well suited for the construction of new structures against, and even above existing embankments.

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- Absorption of vibrations
- Minimal deformations under high load

Charlotte LRT (USA)

Bridge abutments supporting the track beds

Whiskey Island Marina (USA)

Zinnia Road – Marlboro, Gauteng (South Africa)

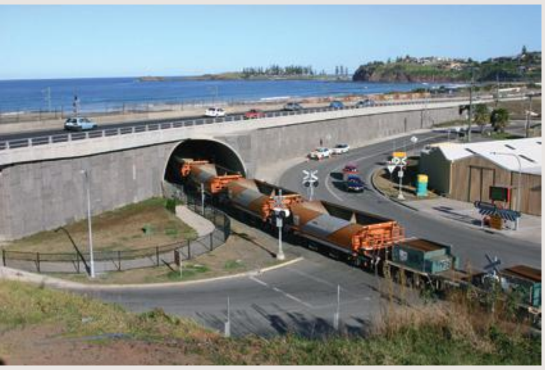
Among its many earth-retaining and load-supporting applications, the Reinforced Earth® method has gained world wide acceptance as an economical and technically superior construction method for bridge abutments. This eliminates the need for pile supports or other costly foundation improvements.

Reinforced Earth® railroad bridge abutments have been built in several countries since 1975. These are designed to withstand the heavy bearing pressure and braking stresses transmitted through the track bed. The deck is directly supported by the Reinforced Earth® structures. The latter are built simultaneously with the approach embankments. With proper fill quality and compaction, a regular longitudinal profile is obtained, even in the case of poor foundation soils.

- High load bearing capacity
- Uniform bearing pressure at foundation level

Rail tunnels under earthen embankments and cut and covers

Mandurah (Australia)



North Kyama (Australia)

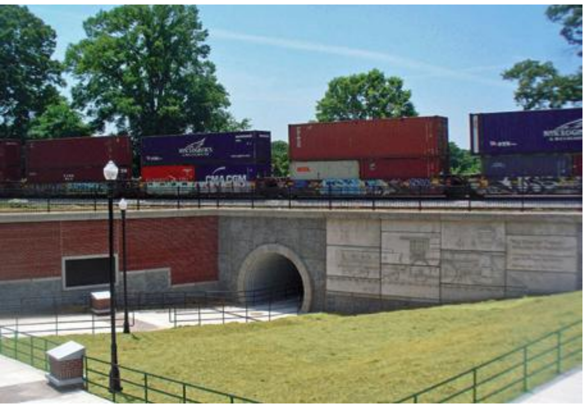
CTRL (United Kingdom)

TechSpan® arches are frequently used for the construction of railway tunnels in earthen embankments or in cut and covers. This construction method, involving a strong soil-structure interaction, associates three-pin prefabricated concrete arches to a select backfill. The main advantages of TechSpan® technique are the material and structural quality, the rapidity of installation and the adaptability to the specific requirements of each project.

TechSpan® method is especially efficient when building the structures over existing rail tracks under traffic when closure is not an option. Reinforced Earth® is a logical complementary technique for the construction of the spandrel walls.

- Optimized traffic clearance envelopes
- Custom designed

Site integration functionalities



Kennesaw (USA)

Saint Etienne de Montluc (France)

Haan Gruiten (Germany) – Reinforced Earth walls with sound absorbing facing

The most successful civil engineering projects are those which combine excellent performance with attractive appearance. Even on smaller scale projects, owners, architects, engineers and landscape architects are interested in demonstrating their professional capabilities by designing structures which æsthetically integrate into their environments and enhance their surroundings. Reinforced Earth® structures offer limitless æsthetic possibilities, this construction method being a unique combination of high level engineering, straight forward constructability and architectural versatility.
To facilitate the integration of railways into populated areas, Reinforced Earth® structures have been built with sound absorbing facings.

- Architectural flexibility
- Attractive appearance combined with technical performance

San Carlos, Ralston-Holly (USA)

Protective embankments

Hörselgau (Germany)

The Reinforced Earth® method can be used to build embankments along railways to provide protection against environmental nuisances such as noise or visual pollution. Such structures can also be efficient safety barriers against collisions especially in the case of corridors combining high speed railways and highways, due to the inherent resilience of the Reinforced Earth® technique. To optimise the land use and consumption of materials the faces of the embankments can be vertical or steepened, with mineral or vegetated facings.

- Shock absorbing capacity
- Ease of construction

Reinforced Earth®, the Value of Experience

LGV Rhin-Rhone (France)

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 substantially widened its scope of applications to beyond just roads in the last 30 years, demonstrating its advantages in other markets. Structures associated to railway projects have been designed and supplied by companies of the global Terre Armée Internationale network on five continents since 1973.

For railway owners and engineers the Reinforced Earth® technique simultaneously provides unique key benefits:


Durability samples

- ***Strength*** – significant load bearing capacity
- ***Resilience*** – effective absorption of vibrations and an exceptional response to seismic events
- ***Durability*** – high quality materials, proven track record and ease of inspection
- ***Adaptability*** – to geotechnical, environmental and architectural site conditions
- ***Low impact*** – rapid construction, limited land use, no traffic disruption and reduced environmental footprint

Chosing a Reinforced Earth® solution means getting the best of:


Pilbara (Australia)

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

With TechSpan® technique, the same philosophy is pursued with the inherent advantages of:

- engineered backfills
- precast construction components

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

REINFORCED EARTH
since 1970

To contact a regional manager and learn more about RECo products and services please visit
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