Technical information

Issued: May 2009

Reinforced Earth Walls

TerraTrel®

Reinforced Earth

Sustainable Technology

Construction of walls with TerraTrel® wire mesh facing

TerraTrel® is the welded, wire mesh faced Reinforced Earth retaining wall system. Reinforced Earth structures combine selected granular, engineered backfill with steel reinforcement and a modular facing system. This unrivalled combination creates a durable, mass gravity retaining wall. The technique is adaptable to retaining walls of any practical height. Reinforced Earth structures are capable of supporting their own weight together with very high dead and live loads imposed by associated structures and vehicles.

FRONT COVER: 10m high TerraTrel® Reinforced Earth retaining wall supporting the Princes Highway above Myrtle Gully, southern NSW.

THIS PAGE: A temporary wire wall is used at North Kiama Bypass, NSW, to stage the construction of the new overpass and TechSpan® rail tunnel.

FAR RIGHT PAGE (left to right, top to bottom): Backfilling of Air Tawar Barge Wharf quay wall, Indonesia.

Attaching REhas® strip to TerraTrel® panel, Jindabyne Spillway retaining wall, NSW.

Placing second course of panels, Jindabyne Spillway retaining wall, NSW.

Placing backfill to a dump wall for Iluka Resources. Waroona, WA.

Geotextile separates rock face and backfill on an Epping Road retaining wall, NSW.

Construction of an 18m high retaining wall and bridge abutment on the Ugie to Langeni road project, Eastern Cape, South Africa. Formwork ensures a neat finish and facilitates the installation of a safety barrier.

Why TerraTrel®?

- It is an alternative low-cost facing system for Reinforced Earth structures.
- The welded wire mesh panels, which are supplied in customised sizes, are lightweight to transport to remote sites.
- The panels are easily and rapidly erected without the use of heavy lifting equipment.
- Panels can be easily assembled and disassembled, making TerraTrel® ideal for temporary or staged works.
- Can be designed for permanent or temporary applications.
- Ability to adapt to deformations in the subgrade.
- Formwork is not required in order to establish the front face.
- Large savings in cost compared with more conventional structures.
- Structure can be built completely from behind therefore not interfering with access/traffic or obstacles in front of the wall.

TerraTrel® panel specification

Shape	Typically flat
Size	3m x 0.72m (permanent)
Weight	33.3kg (permanent)
Material	Galvanised or black steel
Finish	Crushed rock on permanent structures

TerraTrel® Reinforced Earth system components

Foundation
Excavated and proof rolled foundation serves as a flat starting surface for placing panels.

TerraTrel® facing panels
Panel size varies depending on application. Panels may be black or galvanised depending on design life.

Geotextile
Filter cloth 1500mm wide for separation between crushed rock and select backfill material for permanent TerraTrel® walls. For temporary structures, 1000mm filter cloth is used and it is placed directly behind the panel face to prevent the escape of select backfill.

Reinforcement
REhas® (Reinforced Earth High Adhesion Steel) strips are non-extensible and are unmatched for structural capacity and reliability. The REhas® strips are bolted to the panels at the horizontal joints, and can be easily skewed to avoid pile forms where necessary. Longer length strips can be achieved through joining on site. Reinforcing strips are connected to facing panels with M12 Grade 10.9 galvanised bolts, nuts and washers.

Backfill
Backfill complying with the Technical Specification shall be used in the Reinforced Earth block.

Where is TerraTrel® used?
Reinforced Earth technology has revolutionised construction with wide-ranging uses in transport, mining, industry, energy, water, and military infrastructure.

TerraTrel® is a Reinforced Earth wall system commonly used for retaining walls for road widening, embankment steepening, temporary ramps, staged bridge construction and environmental landscaping. TerraTrel® provides an alternative low-cost facing for Reinforced Earth structures and can be designed for both temporary and permanent applications.

Supply of materials and services
The Reinforced Earth Company (RECO) supplies the following:

- engineering and design of the Reinforced Earth structure;
- all facing panels and soil reinforcing strips;
- all nuts, bolts and washers;
- geotextile;
- TerraTrel® support brackets (two per panel – loaned to contractor);
- delivery of the above materials to site FOT (free on truck);
- on-site technical advice and guidance.

The contractor is responsible for supplying equipment for backfilling and compaction, as well as miscellaneous tools and small items for panel placement. Please refer to the comprehensive TerraTrel® construction manual available from RECO for specific items required.

Unloading and storage of components
Facing panels are bundled for transport with no more than twenty panels per bundle. Bundles should be stored on timber dunnage clear of the ground, adequately supported to prevent undue bending. Once ready for placement each unit is removed from the bundle and placed in the wall. The reinforcing strips are delivered in bundles up to 100 pieces with a maximum length of 7m. Longer strips, if needed, are joined on site. The strips must be bundled in a neat and orderly stockpile clear of the ground. Geotextile is supplied in rolls up to 150m long and is either 1000mm or 1500mm wide. Bolts, nuts and washers are supplied in bags and should be secured in a locked storage yard along with the geotextile.

Construction summary
Site preparation
Site preparation involves excavation, proof rolling the foundation, installing drainage systems as required and establishing a wall control line for the first course of panels.

Initial courses of panels
Install posts along a control line (two per panel) and place the first course of panels and tie points – securing to props with tie wire. Place second row of panels and tie points, using temporary construction bars to maintain alignment during construction. Check vertical and horizontal alignments.

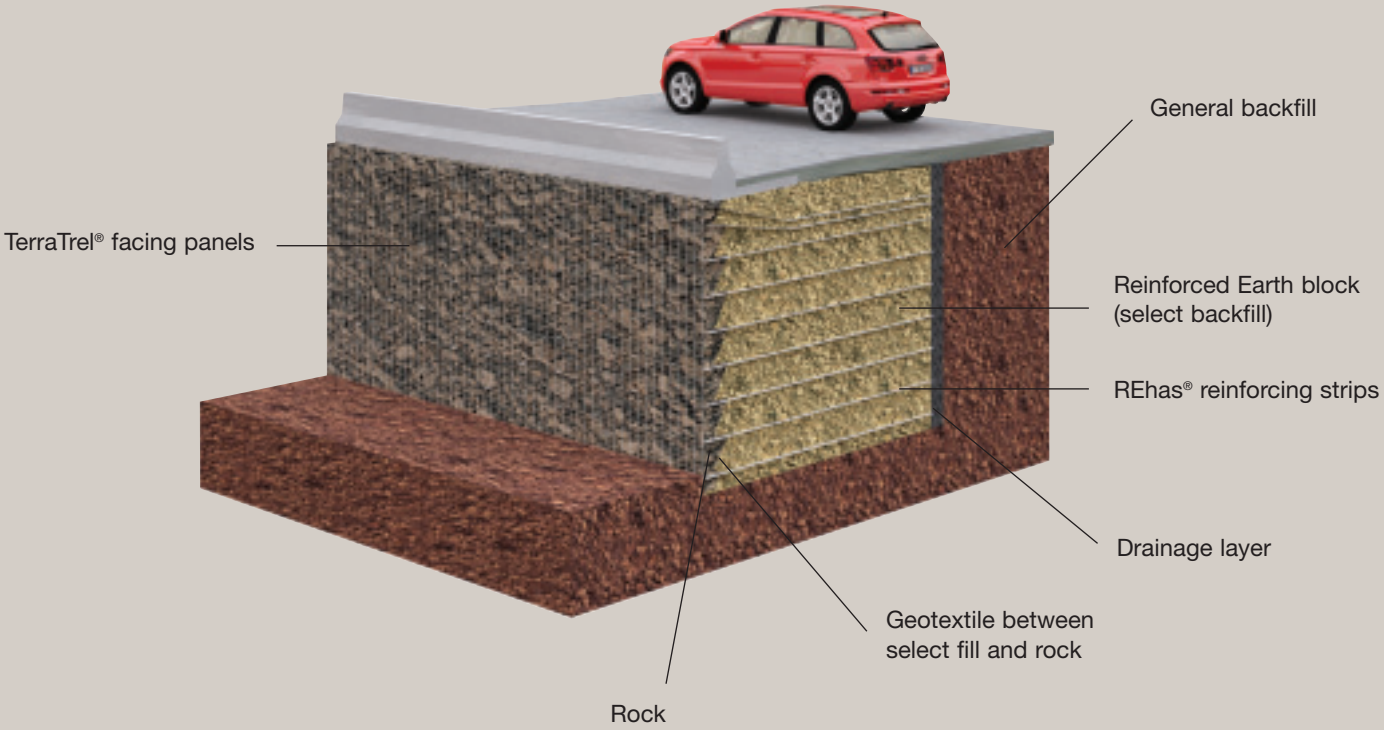
Secure reinforcing strips to the base of the first panel row and install geotextile so that select backfill does not encroach onto the crushed rock (permanent structures) or against the facing panel (temporary structures).

Place backfill in layers to achieve the required compaction. Hand compaction is carried out in the zone 1.5m from the back of the panels; the remaining area is compacted using heavy equipment.

Install next layer of facing panels, reinforcing strips, geotextile and backfill. Carefully backfill behind the facing with crushed rock (permanent structures) or select fill (temporary structures).

Subsequent courses of panels
The sequence is repeated for all remaining layers maintaining a regular check on vertical and horizontal alignments.

Completion of the wall
The top tie point is located approximately 100mm from the top of the wall. In some instances it may be required to drape the top two reinforcing strips (at a slope no greater than 4:1) to provide the specified minimum embedment depth.



Backfill

Placing and compaction of the select backfill

The select backfill is placed and compacted in layers. Steel tracked equipment should not come into direct contact with the reinforcing strips. Heavy equipment should not come within 1.5 metres of the wall face. Compact close to the wall with hand operated vibrating plates or rollers.

The degree of compaction required is stated in the project specification, but in any case should not be less than 95 percent of the maximum dry density (Standard Compaction).

The backfill should never be placed with a moisture content higher than Optimum Moisture Content.

Choice of select backfill

A Reinforced Earth wall requires a select, non-plastic, granular backfill material for dry land structures (see table below).

Physical characteristics

The grading curve for select backfill must be within the limits of the non-shaded zones shown in the diagram below.

In the first instance, material with less than 15 percent of a sample passing a 75 micron sieve is acceptable without further physical testing provided the whole sample passes a 150mm sieve if Cu is greater than 2.

Chemical and electrochemical properties

The pH value, as determined by the Australian Standards, should lie between 5 and 10.

The electrical resistivity, as determined by the Australian Standards, should be greater than 50-ohm metres. If the resistivity is between 10 and 50 ohm metres then the material is acceptable only if:

- the chloride (Cl-) content is less than 200mg per kg (0.02 percent); and
- the sulphate (SO) content is less than 1000mg per kg (0.10 percent).

Details of the selection criteria can be obtained from RECO.

Earth backfill, which does not meet the standard criteria, may be acceptable subject to design review and additional testing. All backfill which is proposed for use in Reinforced Earth structures should be tested to confirm that the criteria specified is satisfied and test results should be sent to RECO for approval.

NOTE: The chemical and electrochemical properties stated describe the standard requirements of RECO for the Reinforced Earth Structure using steel soil reinforcement. In the event of any conflict with the Head Contract Specification, the Head Contract Specification shall govern provided that the minimum requirements of RECO are met.

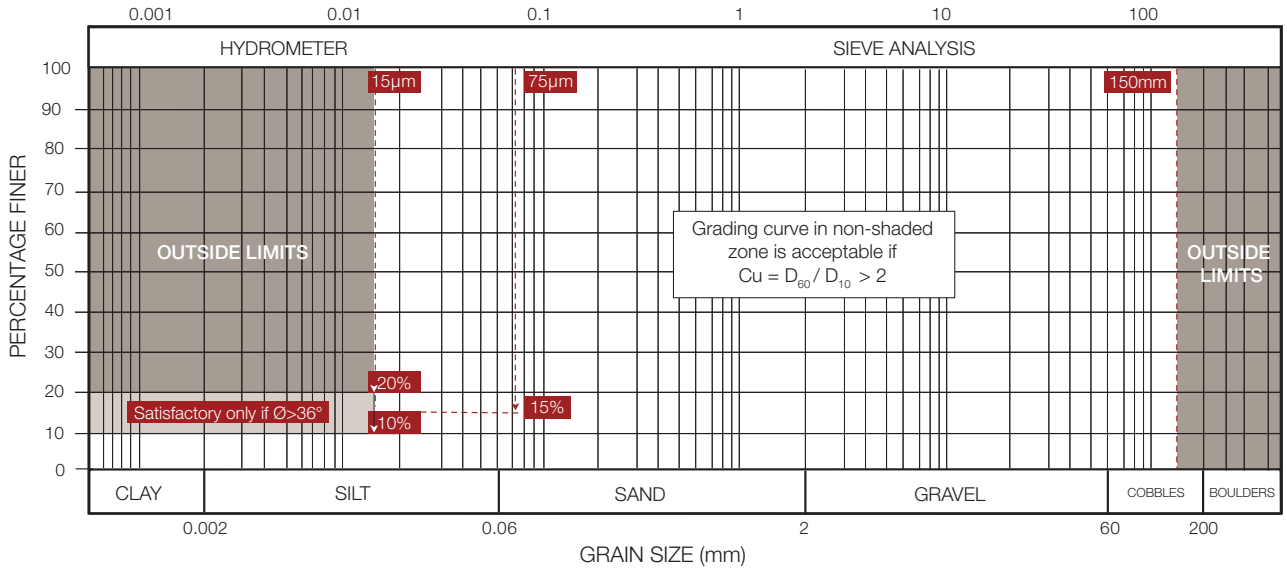
Crew size and production rates

A typical wall erection crew averages three men and a foreman. Construction rates for Reinforced Earth structures generally depend on the rates at which backfill can be placed and compacted, the complexity of the wall geometry and vehicle access.

If the site and backfill materials are accessible, the daily production rate can generally be estimated as follows:

- determine the average daily rate of backfill placement and compaction. Include general backfill as well as the select backfill within the Reinforced Earth block;
- divide the backfill rate (expressed in volume per day) by the average width of backfill to be placed, from the panels to the rear limit of backfilling. This determines the average face area of wall that backfilling will allow to be placed in a day.

Experience has shown that a typical four-man crew will construct on average 30 to 50m^2 of wall area per eight hour shift, providing that backfilling and compaction keep pace with panel and strip placement.



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