

Reinforced Earth Walls

TerraClass®



Reinforced Earth

Sustainable Technology

Construction of walls with TerraClass® precast concrete facing

TerraClass® is the cruciform-shaped, concrete faced Reinforced Earth retaining wall system. Reinforced Earth structures combine selected granular, engineered backfill with steel or synthetic tensile reinforcements 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: Reinforced Earth TerraClass® bridge abutments at the Granard Road underpass on Brisbane's Ipswich Motorway were duplicated in 2005.

THIS PAGE: 16m high mine ROM dump wall, Rolleston, QLD.

FAR RIGHT PAGE (left to right, top to bottom):
Installing initial course of panels, Mt Owen dump wall, NSW.

Joining REhas® steel soil reinforcement strips, for the 21m high Blackwater CHPP dump wall, QLD.

Spreading backfill, Rolleston dump wall, QLD.

Various types of compaction, Rolleston dump wall, QLD.

Backfill compaction testing, Millenium Coal Mine dump wall, WA.

Architectural sandstone ashlar panels are used on bridge abutments on the Port River Expressway, SA.



Why TerraClass®?

- Segmental precast concrete panels are easily erected and have high durability.
- The panel is easily customised with architectural finishes.
- Two lifting points per panel, giving greater safety during handling and construction.
- Thick sturdy joint system.
- Flexible bearing pads prevent spalling.
- Suitable for a 100-year design life as requested by most road authorities.
- Suitable for vertical or inclined walls.
- High resistance to static and dynamic loads.
- Ability to adapt to deformations in the subgrade and accommodate significant foundation settlements.
- Rapid erection.
- 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.

TerraClass® panel specification

Shape	Cruciform
Size	Based on a 1.5m square module
Thickness	140mm (plain finish)
Weight	0.756 tonne (plain finish)
Material	Precast concrete
Architectural finish	Possible

TerraClass® Reinforced Earth system components

Concrete levelling pad (non structural)

100mm (d) x 400mm (w) pad of unreinforced concrete cast in place serves as a flat starting surface for placing panels.

Precast concrete facing panels

Full size panels are used for the majority of the wall. Alternating panels in the initial course are half height panels. Specially detailed panels are used for the top course as required by the geometry of the structure.

Geotextile

Geotextile filter cloth prevents the loss of fine backfill particles through the vertical and horizontal joints between the panels.

Reinforcement

Galvanised steel. REhas® (Reinforced Earth High Adhesion Steel) strips are non-extensible and are unmatched for structural capacity and reliability. Steel soil reinforcement, when coupled with the complying select fill, can be designed for 100 years service life or longer if required. The REhas® strips bolt to the tie points cast in to the rear of the facing panels, 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.

Synthetic. GeoStrap® strips are made from high tenacity tendons contained in a linear low-density polyethylene sheath. The type of GeoStrap® is optimised according to site conditions and structure type. Most commonly used, GeoStrap® with polyester yarns is ideal for structures that may be affected by a corrosive environment (ie acidic or saltwater). GeoStrap® is supplied in rolls, and is easily cut on site to the design length by the contractor. GeoStrap® synthetic reinforcement, together with Omega connections and facing panels creates the GeoMega™ fully synthetic solution.

Backfill

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

Where is TerraClass® used?

Reinforced Earth technology has revolutionised construction with wide-ranging uses in transport, mining, industry, energy, water, and military infrastructure.

TerraClass® is a Reinforced Earth wall system commonly used for retaining wall, bridge abutment and mine ROM dump wall 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, bearing pads and soil reinforcing strips;
- all nuts, bolts and washers;
- geotextile;
- spacer bars (on loan to the 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 panel lifting, backfilling and compaction, as well as wedges, clamps and miscellaneous tools and small items. Please refer to the comprehensive TerraClass® construction manual available from RECO for specific items required.

Unloading and storage of components

Panels are transported to site in stacks of maximum five high. Blocks are used to separate each panel. The galvanised 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 500 or 750mm wide. Bolts, nuts, washers and bearing pads 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, pouring an unreinforced concrete levelling pad 400mm wide x 100mm deep and establishing a wall control line for the first course of panels.

Initial course of panels

Using temporary props (for bracing), clamps (for panel alignment) and wedges (to achieve lean-back) place first three half panels on the levelling pad. Then alternate between placing a full panel between half panels and placing another half panel. Ensure the correct joint width and follow survey marks to get correct panel spacing. Check panels are level using the control line. Geotextile is then installed on vertical joints on the backfill side of the structure. Next place and compact backfill to the first row of tie points, install the reinforcing strips by bolting to the panel, backfill and compact

up to the next row of tie points, continue up to the top of the half panels.

Second and subsequent courses of panels

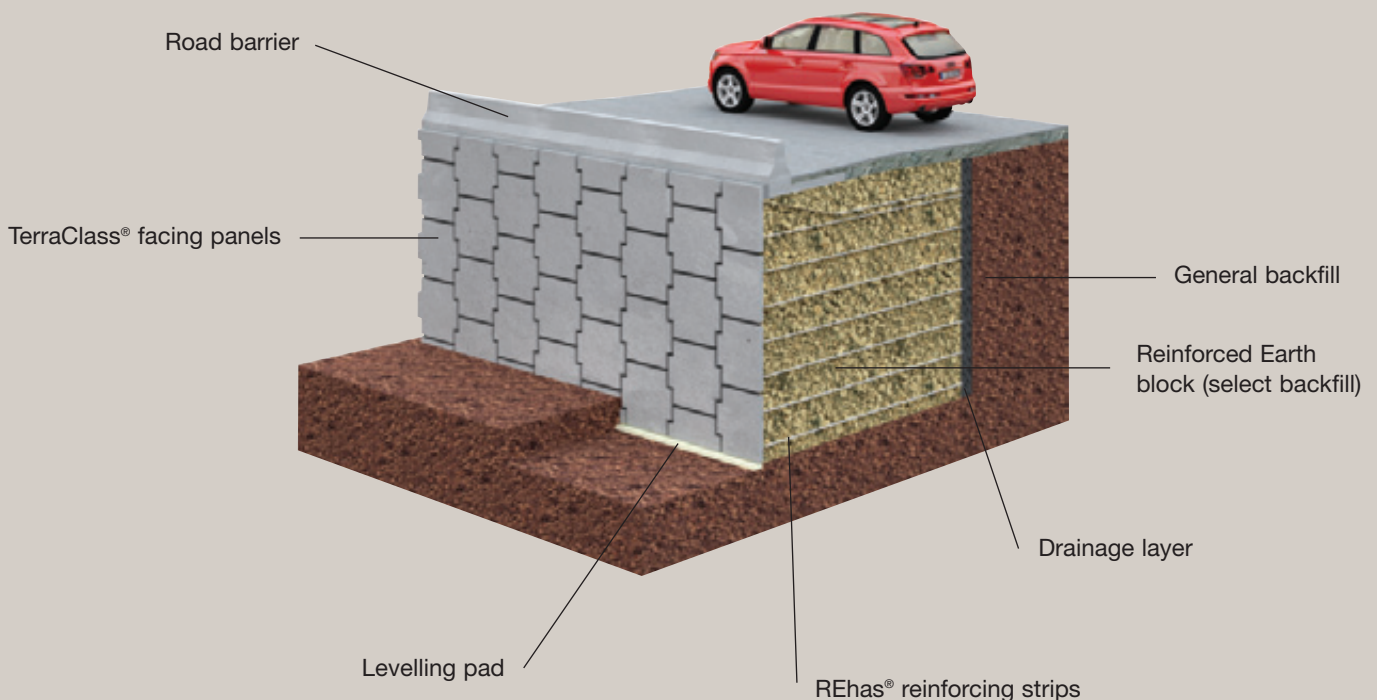
Working from the inside face of the wall, remove the first two clamps and, using bearing pads to separate the new course of panels, place a full height panel onto the half panel. Horizontal joints are then covered with geotextile. Repeat procedure and when course is complete, backfill to next row of tie points, check wall alignment and required lean back, place next layer of reinforcing strips, backfill to top of full panels in initial course and remove bracing from initial course. Repeat this step for each additional course.

Completion of the wall

Drape the top layers of reinforcing strips to achieve the specified minimum embedment depth. After backfilling top course panels remove all clamps and install capping units if necessary.

Erection tolerances

Constructed wall tolerances should conform to project specifications. However, RECO recommends that the overall vertical tolerance of the wall (plumbness from top to bottom) must not exceed 5mm per metre of wall height up to a maximum of 100mm over the total wall height. Local variations measured with a 4.5m straight edge should not exceed 25mm.



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 testing provided the whole sample passes a 150mm sieve if C_u is greater than 2.

Chemical and electrochemical properties

The pH value, as determined by the Australian Standards, should lie between 5 and 10 for galvanised steel reinforcements. For polyester reinforcements pH shall be between 4 and 9.

For galvanised steel reinforcements 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. Backfill requirements using synthetic soil reinforcement may differ.

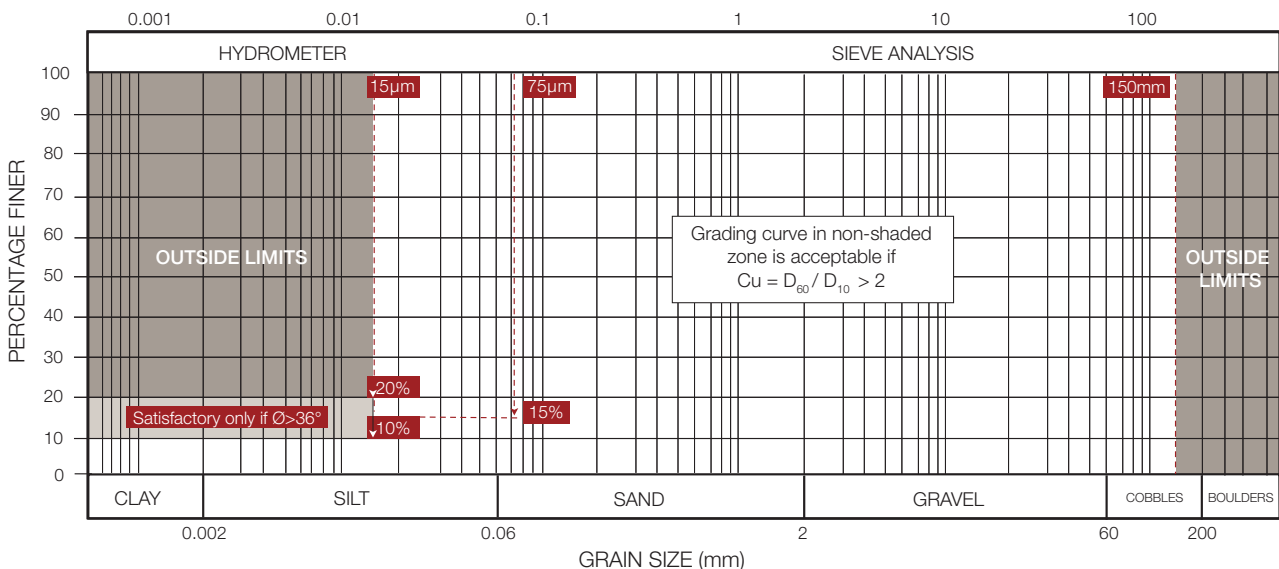
Crew size and production rates

A typical wall erection crew averages four men and a foreman. Construction rates for Reinforced Earth structures 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 five-man crew will construct on average 30 to 50m² of wall area per eight hour shift, providing that backfilling and compaction keep pace with panel and strip placement.



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