Technical information

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Reinforced Earth Walls

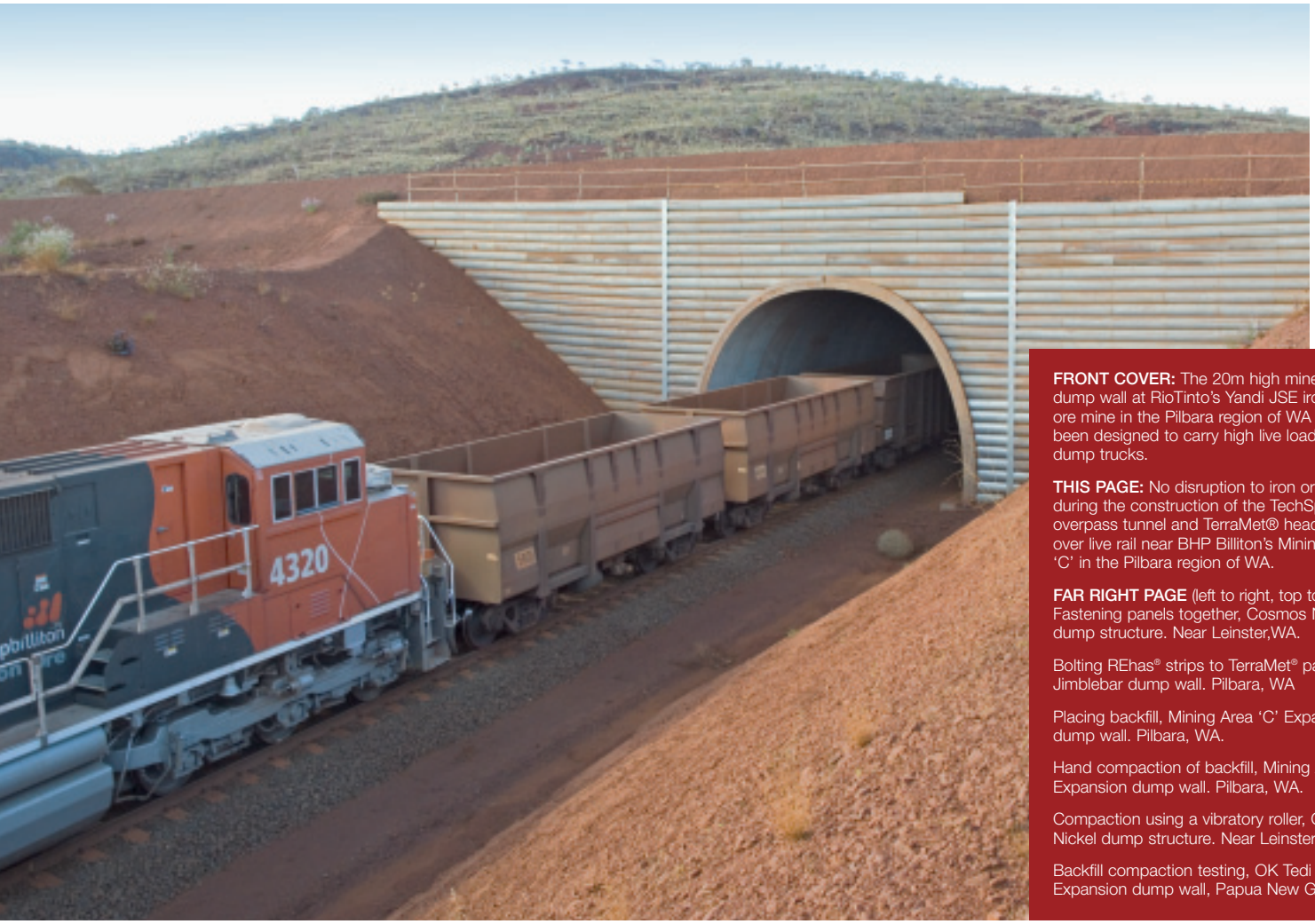
TerraMet®

Reinforced Earth

Sustainable Technology

Construction of walls with TerraMet® steel facing

TerraMet® is the semi-elliptical, steel faced Reinforced Earth retaining wall system. Reinforced Earth structures combine selected granular, engineered backfill with steel 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: The 20m high mine ROM dump wall at RioTinto's Yandi JSE iron ore mine in the Pilbara region of WA has been designed to carry high live loads from dump trucks.

THIS PAGE: No disruption to iron ore trains during the construction of the TechSpan® overpass tunnel and TerraMet® head walls over live rail near BHP Billiton's Mining Area 'C' in the Pilbara region of WA.

FAR RIGHT PAGE (left to right, top to bottom): Fastening panels together, Cosmos Nickel dump structure. Near Leinster,WA.

Bolting REhas® strips to TerraMet® panels, Jimblebar dump wall. Pilbara, WA

Placing backfill, Mining Area 'C' Expansion dump wall. Pilbara, WA.

Hand compaction of backfill, Mining Area 'C' Expansion dump wall. Pilbara, WA.

Compaction using a vibratory roller, Cosmos Nickel dump structure. Near Leinster WA.

Backfill compaction testing, OK Tedi Expansion dump wall, Papua New Guinea.

Why TerraMet®?

- The semi-elliptical, 0.35 x 3m panels are lightweight to transport to remote sites.
- The panels are easily and rapidly erected without the use of heavy lifting equipment.
- Up to 50 year design life is possible with regular maintenance and care.
- Ability to adapt to deformations in the subgrade.
- 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.

TerraMet® panel specification

Shape	Semi-elliptical
Size	0.35m x to 3m
Thickness	2.5mm
Weight	12.4kg/lineal meter
Material	Galvanised or ungalvanised steel
Architectural finish	No

TerraMet® Reinforced Earth system components

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

Semi-elliptical steel panels
0.35 x 3m semi-elliptical steel panels. Panels may be galvanised or ungalvanised depending on design life.

Jointing
A 2.5mm thick steel cover plate along with a layer of geotextile filter cloth prevents the loss of backfill particles through the vertical joints between the panels.

Reinforcement
REhas® (Reinforced Earth High Adhesion Steel) strips, galvanised or ungalavanised, 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 TerraMet® used?
Reinforced Earth technology has revolutionised construction with wide-ranging uses in transport, mining, industry, energy, water, and military infrastructure.

TerraMet® is a Reinforced Earth wall system commonly used for retaining wall, bridge abutment and mine ROM dump wall applications. It is lightweight to transport and is therefore commonly used on remote sites where a design life of up to 50 years is required.

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 reinforcing strips;
- all nuts, bolts and washers;
- geotextile;
- puller 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 backfilling and compaction, as well as miscellaneous tools and small items for panel placement. Please refer to the comprehensive TerraMet® construction manual available from RECO for specific items required.

Unloading and storage of components
Facing panels are bundled for transport with no more that five panels per bundle. Bundles should be stored on timber dunnage clear of the ground until required. Once ready for placement each unit is removed from the bundle and placed in the wall. The galvanised reinforcing strips are delivered in bundles of 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 750mm 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.

First and second courses of panels
Install posts along a control line (two per panel) and place the first course of panels with a 10mm joint between panels. Drive a suitable stake into the ground behind the panel to hold it in place. Check vertical and horizontal alignments.

Place the second course of panels on top of the first, ensuring that the courses are offset to prevent vertical alignment of joints from one course to the next. Fasten the panels together using supplied bolts, washers and coupling plates. Place the first layer of reinforcing strips, bolting them securely into position then backfill and compact to top layer of the first panel. Leave a working zone behind the panel which forms a wedge 600mm at the base then increases at a 1:1 ratio to about 975mm after one panel and 1350mm after two.

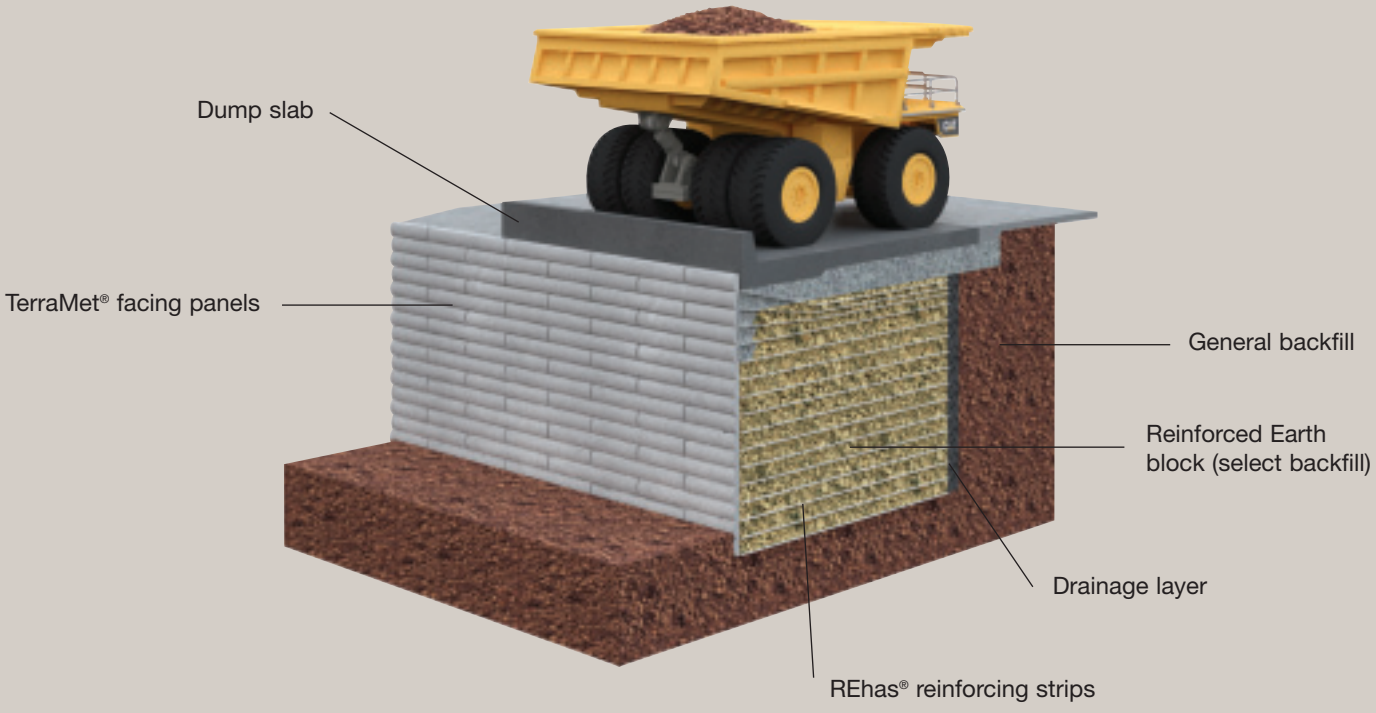
A galvanised steel cover plate and geotextile is then installed on vertical joints on the first course of panels. Next place and compact backfill on top of the reinforcing strips, bolted to the second course of panels.

Hand compaction is carried out in the first 1500mm from the back of the panels; the remaining area is compacted using heavy equipment.

Subsequent courses of panels
Place the third row of panels, installing the cover plates and geotextile on the second row and repeat the process outlined above. Panels from this level require layback to compensate for any forward movement during compaction and ‘puller bars’ are used in this operation. The sequence is repeated for all remaining layers maintaining a regular check on vertical and horizontal alignments.

Completion of the wall
Drape the strips at the top of the wall to the specified minimum embedment depth.

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 10mm per metre of wall height up to a maximum of 200mm over the total wall height. Local variations measured with a 4.5m straight edge should not exceed 50mm.



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 (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.

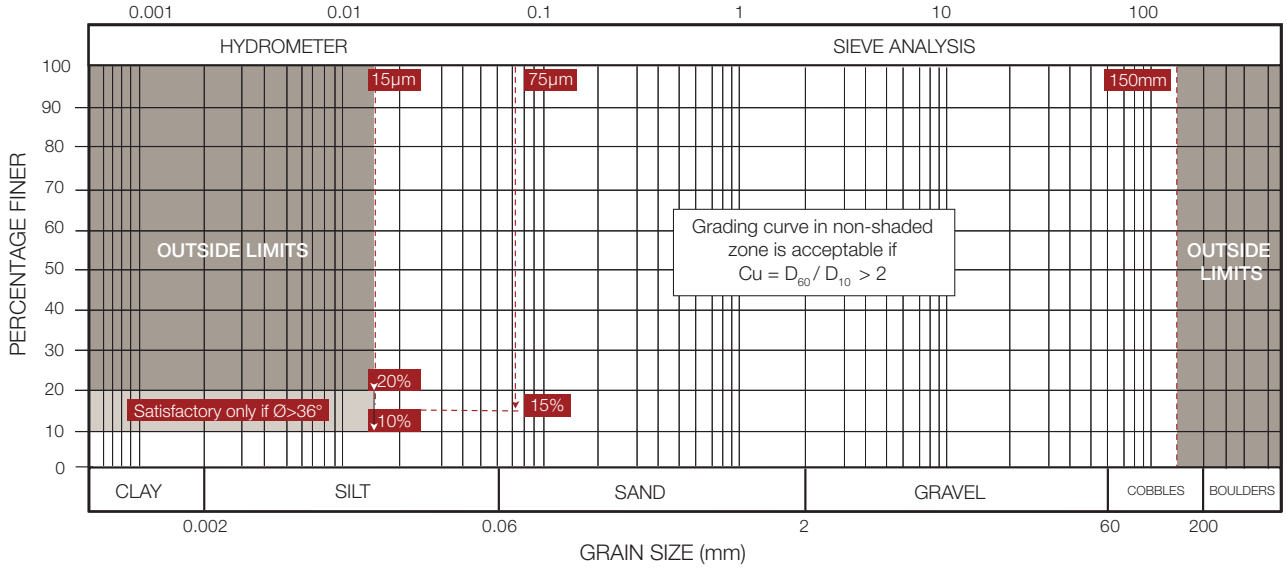
Crew size and production rates

A typical wall erection crew averages three men and a foreman. Construction rates for Reinforced Earth structures 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 50m² of wall area per eight hour shift, providing that backfilling and compaction keep pace with panel and strip placement.



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