Roads & Highways | Coastal & Flood Defence | Railways

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TERRAM™
Geosynthetics you can trust

TERRAM Geocell

Ultimate Solution for Slope Stabilization

TERRAM™
Geosynthetics you can trust

TERRAM - The Brand

TERRAM branded products have been at the forefront of the geosynthetic industry globally. Continuous innovation has led to manufacture of superior products and made TERRAM synonymous with highest standards of quality and performance.

With over 45 years experience in the geosynthetics market, TERRAM provides value engineered solutions for highways, coastal, waterways, flood defence, railways, landfill, mines, landscapes and other sectors.

TERRAM Products

TERRAM product portfolio includes the original, innovative, trusted and proven Geotextiles, Geocells and Geocomposites.

Since the first TERRAM products were launched, the Company remains committed to the development of innovative and cost-effective geosynthetic solutions.

The Company intends to lead the market in the design and manufacture of geosynthetics and continue to provide ground - breaking solutions- the next generation of TERRAM products.

ROADS & HIGHWAYS

Geosynthetics in highways and related applications

Geosynthetics have been used in civil engineering since the 1970's. One of the earliest applications was in the construction of highways where simple geotextile filters were placed between the sub-base and the subgrade to maintain the integrity of the stone layer.

TERRAM products

The ability of a geotextile filter to allow the passage of water yet still prevent intermixing of stone and soil has meant these filter/separators are being used every day around the globe. At one end of the scale it could be a remote unpaved haul road or, at the other, a major highway connecting international business centres.

The uses and products have expanded over the years as technologists and engineers have innovated and exploited the unique properties of the products that have been developed and refined.

Geosynthetics are now being used to control erosion on cut slopes as a result of road widening schemes, for roadside drainage, as part of SUDS projects for infrastructure access and housing/retail/commercial developments, and in the construction of retaining walls, bridge abutments and steep slopes.

TERRAM 1000 has been the most frequently specified geotextile in the world for over 45 years.

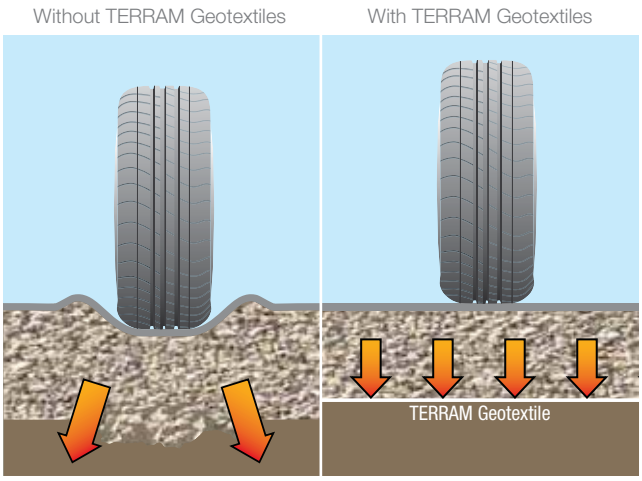
Improving granular layer performance

TERRAM Standard Geotextiles prevent intermixing of sub-base and subgrade layers. This intermixing causes a loss in bearing strength, as the stone layer becomes progressively contaminated, resulting in failure in the form of deformation. This can be remedied if it's an unpaved area/road by filling the ruts but even this can be uneconomical or unacceptable if stone has to be imported over long distances at a later date.

If it's a paved road then the intermixing could manifest itself as deformation at the pavement surface e.g. cracking and/or rutting, by which time the damage at the sub-base/subgrade interface cannot be repaired without re-construction and any repairs are cosmetic rather than structural. It is therefore better to pre-empt the problem by including a suitable geotextile.

Site-damage resistance

The geotextile must first be capable of withstanding the rigours of installation as this is when the textile is most susceptible to damage. If it is not sufficiently robust, and is capable of tearing or being punctured, then the product may be incapable of performing its design function. For example, the filaments of many low-cost, woven textiles can be easily teased apart, even during physical examination. They have little integrity and it is easy to imagine how they will perform when angular stone is placed on them and compacted. A textile filter/separator must have an apparent pore size which remains unaffected by loading. Any openings which are created or widened, or are caused by tearing/puncture, will allow subgrade particles to be pumped through to the sub-base.



Intermixing of the sub-base and subgrade prevents the full load-bearing capacity of the stone layer being mobilised and leads to failure. A suitable geotextile acts as a filter separator throughout the highway's life and acts to preserve the stone layer's integrity.

TERRAM Standard Geotextiles **see page 31**

Improving granular layer performance

Radial load requires isotropic properties

The loading from a wheel at the sub-base/subgrade interface is radial and this means that the geotextile should have isotropic strength to deal with it. It is not sufficient for the textile to have high strength in one or two directions as with woven geotextiles.

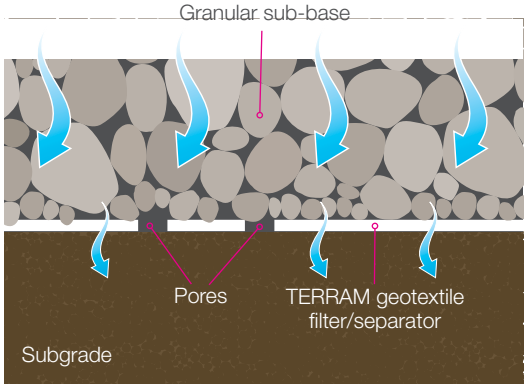
Sustained filtration

The geotextile must provide sustained filtration whilst also separating the two layers i.e. the textile must allow the free passage of ground water yet limit the passage of soil particles. This involves matching the pore size with the sub-grade's smallest particle size. This does not mean that the geotextile should have a pore size smaller than the smallest soil particle. It has been established that a geotextile helps create filtration by virtue of a natural filter that is formed against the surface of the textile.

The ultimate objective is to maintain the integrity of the granular layer and thus gain the maximum life from the structure. This can be achieved by allowing its maximum bearing strength to be mobilised throughout the road's width and depth, and throughout its life.

Typical paved and unpaved applications where geotextiles are used beneath granular layers include:

- Highways
- Car parks
- Hardstandings
- Access and haul roads
- Cycle ways and footpaths



A natural filter is established adjacent to the geotextile's pores.

TERRAM Standard Geotextiles **see page 31**

Drainage

TERRAM Geocomposite Drains are manufactured by bonding a compression resistant net core between two geotextile filters or between a geotextile and a geomembrane. The grade of net dictates the composite's flow capacity.

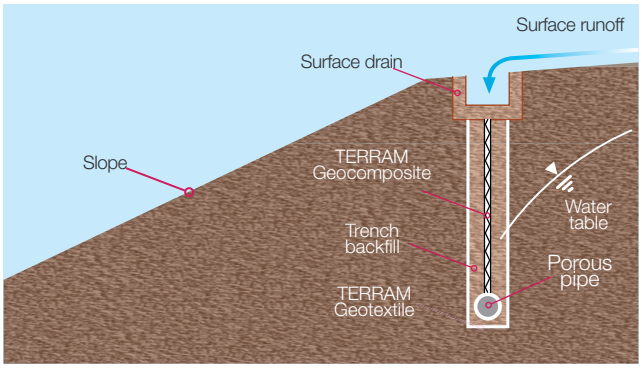
The filter/net/filter composites are used for general area drainage and are easy-to-install, factory-assured replacements for tradition stone installations. The filter/net/membrane composites are used to drain from one side only and provide a barrier to the other – a cut-off drain. Both types can be deployed vertically or horizontally.

TERRAM Geocomposite Drains are preferred to stone as they are less expensive, and much easier to install; particularly against vertical faces such a bridge abutment. They are also lighter and more compact which means lower transportation costs and minimum traffic disruption.

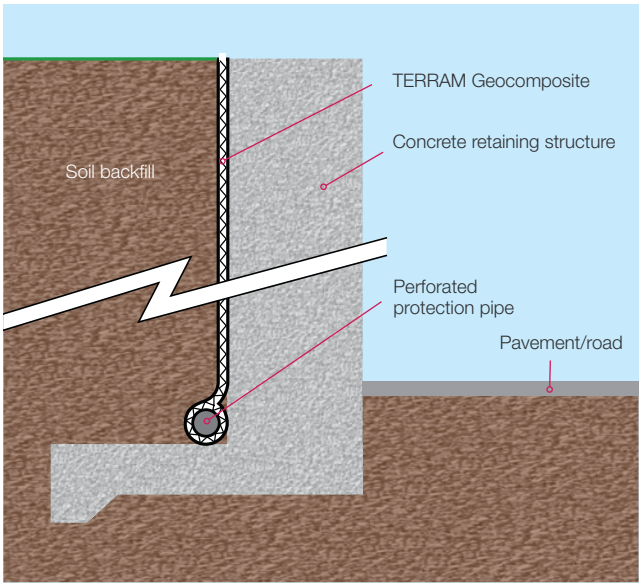
TERRAM Geocomposite Drains have factory-assured properties so there's no issue of stone grading and consistency. As most stone drains rely on a geotextile to prevent the ingress of fines, it's simpler to replace the stone with a drainage core such as a net.

Typical drainage applications include:

- Alongside roads.
- Within slopes.
- Around culverts, basements, reservoirs and other buried structures.
- At the rear of retaining walls and abutments.
- In the construction of tunnels.



Slopes and embankments. The drainage function is a critical element in the design of soil slopes and in slip repairs.



Retaining Structures. To maintain the stability of a retaining structure it is important to provide an efficient drainage system at the rear of a retaining structure to prevent the build up of pore pressure.

TERRAM Geocomposite Drains **see page 32**

Drainage

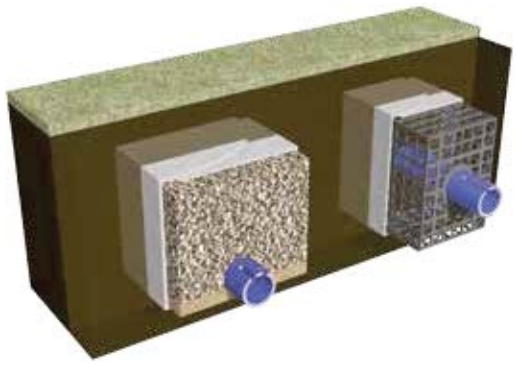
Sustainable Urban Drainage Systems (SUDS)

Paved areas and roof gardens require a light and versatile drainage system capable of a high in-plane flow. TERRAM Geocomposite Drains offer high flow rates, high compressive strength and good resistance to creep. Their use reduces manpower and minimizes the need for heavy materials making them ideal solutions for these applications.

Traditional drainage applications

TERRAM Standard Geotextiles and TERRAM Geocomposite Drains are used in traditional drainage methods including Fin, Lateral, French and SuDS drains.

Standard Geotextiles used in a French Drain application.



Standard Geotextile used in a SuDS box drainage system.

Quick, easy to handle, efficient and cost effective drainage systems are necessary in areas of construction such as basements, culverts, car parks, reservoirs and many other structural and subsurface applications.

Vertical edge drains running parallel to a roadway are necessary to intercept the lateral flow of groundwater. A geocomposite fin drain saves on excavation and is quicker to install than a stone alternative.

TERRAM Geocomposite Drains **see page 32**

Preventing frost heave

Frost heave is perhaps the most common cause of failure for pavements in cold climates.

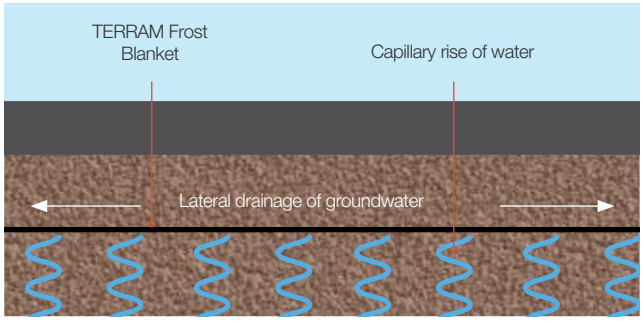
Preventing frost heave beneath highways

Frost-susceptible soils typically have a significant silt/fine sand content which allows the capillary rise of water. This water can turn to ice lenses in winter and further water is drawn up from the water table to balance the capillary forces. This cycle ultimately leads to heave at the surface which causes pavement cracking and uplifting.

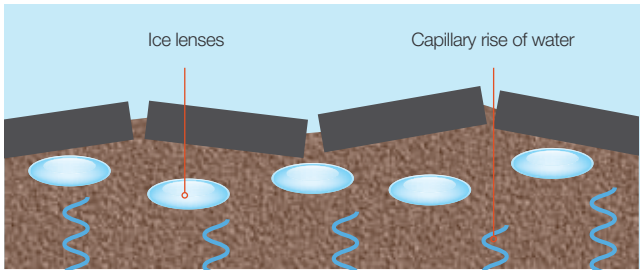
This is further complicated as the upper ice thaws in winter. The volume of water held as ice is many times greater than water held by the soil under saturated conditions. The water cannot drain down through the soil as it is still frozen. The result is a further weakening of the highway as the subgrade's ground-bearing capacity is diminished.

TERRAM Frost Blanket is a net-based geocomposite which provides the capillary break that the soil lacks and thus prevents the upward movement of water. Its installed cost is insignificant when compared with annual maintenance costs associated with such highway pavements.

Independent testing and field trials have confirmed the ability of TERRAM Frost Blanket to prevent the upward passage of water by capillary action.



TERRAM Frost Blanket prevents the capillary rise of groundwater and avoids the potential for damage during the freeze/thaw cycle.



Damage during the freeze/thaw cycle.

- Babtie Engineering Laboratories, Geotextile materials to suppress frost heave in soils. TERRAM 230gm geotextile with hydrophobic enhancement, 07/05/02.
- US Army Corps of Engineers, Laboratory Investigation of the Use of Geotextiles to Mitigate Frost Heave, CRREL Report 90-6, August 1990.

TERRAM Frost Blanket **see page 33**

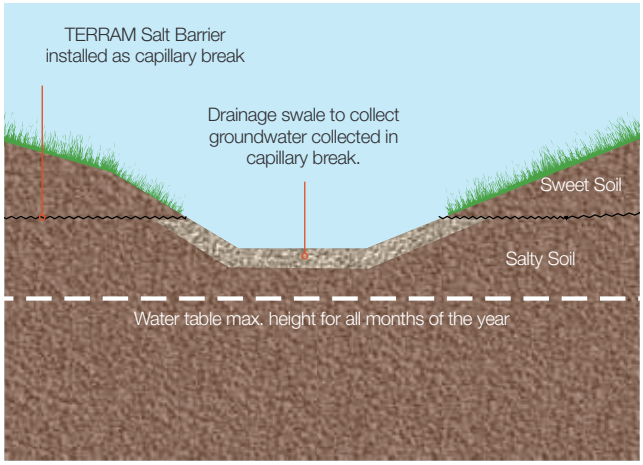
Preventing the capillary rise of salt water

TERRAM Salt Barrier has been specially developed to replace the granular layer and reduce environmental impact.

Preventing the capillary rise of salt water

TERRAM Salt Barrier is similarly effective in preventing the capillary rise of salt water that would otherwise contaminate sweet soil layers capable of sustaining vegetation.

This geocomposite can be used instead of the traditional 300mm thick stone layer which would have been used in the past. A much more environmental-friendly alternative, particular if stone is not locally available.



TERRAM Salt Barrier is designed to prevent the capillary rise of salt water into sweet soils.

TERRAM Salt Barrier **see page 34**

Controlling erosion on the highway slopes

Combat slope erosion and stabilise surfaces using TERRAM GEOCELL.

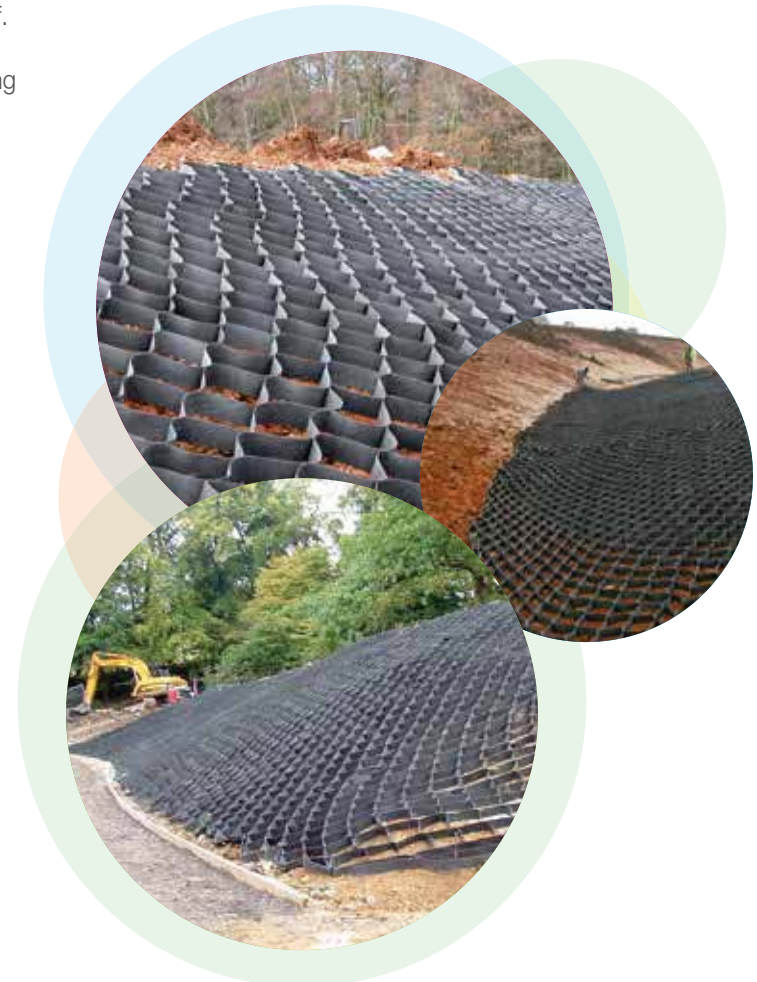
Using TERRAM GEOCELL to control erosion ensures better resistance to the erosive effects of wind and water run-off. As TERRAM GEOCELL is made from permeable geotextile, it allows water to flow freely between cells encouraging drainage and vegetation.

Typical Applications

- Cut or Fill Embankments
- Dams or Spillways
- Revetments
- Abutment Protection
- Geomembrane Protection
- Soil-nailing Cover
- Landfill Lining

TERRAM GEOCELL is supplied as flat packed panels which are opened to form the honeycomb-like structure. These are positioned and pinned to the ground using fixing pins and filled with a suitable, permeable infill.

TERRAM GEOCELL can be used on slopes up to 1:1 and is flexible enough to be formed around trees and other obstacles. Seeded topsoil is the most suitable fill for less-exposed slopes with small shrubs, offering improved protection, whilst a granular material offers the highest protection.



TERRAM Geocell erosion control **see page 35**

Load platforms and tree root protection

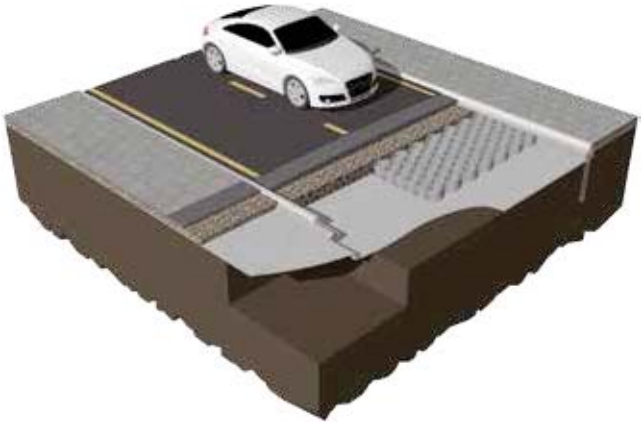
TERRAM Geocell load platforms, once filled with a free-draining granular material, act as a mattress that spreads traffic loads laterally to reduce vertical deflections. The fill is confined within the individual cells by hoop stress.

Load platforms

TERRAM Geocells are also used to construct semi-rigid platforms over poor soils and over areas where there's a no dig-restriction.

Tree Root Protection

Where an access road, woodland path or driveway is required in tree sensitive areas, TERRAM Geocells should be used. A no-dig construction using geocells protects the roots distributing downward forces laterally allowing the tree roots to remain undisturbed (see Arboricultural Advisory and Information Services APN12: Driveways close to trees).



TERRAM Geocell load-platform.

TERRAM Geocell load-platform.

TERRAM Geocell tree-root-protection.

TERRAM Geocell tree root **see page 37**

Retaining walls

photo Sol Solution

Need an earth retention structure? TERRAM GEOCELL can stabilise and retain wall structures.

TERRAM GEOCELL provides a cost-effective alternative to conventional earth retention structures as it eliminates the potential for cracking, spalling, splintering and corrosion commonly seen in concrete, steel and timber systems.

Typical Applications

- Steepened Embankments
- Dams and Flood Defence Bunds
- Retention Bunds
- Green Walls
- Culvert Head Walls
- Sound Barriers

TERRAM GEOCELL is supplied as flat packed panels which are opened to form the honeycomb-like structure. These are positioned and installed in horizontal layers to form a gravity or composite wall.

Composite Wall

TERRAM GEOCELL is installed in layers creating a totally confined facing wall that is directly connected to the backfill using a traditional earth reinforcement system. Typical reinforcement techniques such as geogrids, soil nails, rock bolts and helical anchors are commonly used. When combined with TERRAM GEOCELL they create a mechanically stabilised earth structure.

Gravity Wall

TERRAM GEOCELL is installed in layers creating horizontal terracing on the fascia wall, capable of resisting internal loads and pressures to maintain structural integrity. In some circumstances TERRAM GEOCELL can be utilised to create a vegetated cover for the fascia.

WHY TERRAM GEOCELL?

- Lightweight and easy to handle, reducing installation costs.
- The flexible TERRAM geotextile material allows TERRAM GEOCELL to effectively adapt to any variations in the terrain.
- TERRAM GEOCELLS are easily cut to size without damage, therefore reducing cost.


photo Sol Solution

TERRAM Retaining wall **see page 36**

Coastal, Waterways & Flood Defence

Geosynthetics in coastal, waterway & flood applications

The use of geosynthetics in the construction of marine embankments and erosion control structures within waterways is now widely accepted as a cost effective replacement for traditional materials.

The use of geosynthetics within these applications has expanded over the years as technologists and engineers have innovated and exploited the unique properties of the products that have been developed. Geotextile filters can be deployed below marine breakwaters as an alternative to a traditional underlay, providing material savings and a reduction in overall construction costs. Specialist geocomposite cell structures can be used to provide effective erosion control and for the construction of rapid deployment flood defence systems.

Typical Coastal and Waterway Applications

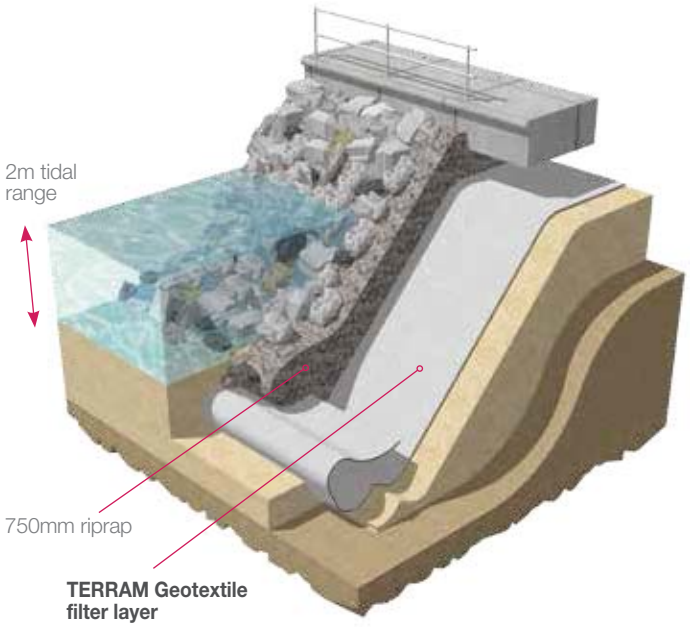
- Foreshores
- Dams and flood bunds
- River and canal banks
- Lagoon, lake and reservoir shores
- Culverts and outfalls
- Ports, breakwaters, artificial islands and causeway

TERRAM has been the trusted name in Geosynthetic Innovation for over 45 years

Geotextiles as filters in marine breakwaters

Traditionally, revetment underlayers have comprised multiple filter layers of stone: grading down from largest stone at the surface. The stone sizes and the number of layers were dictated by the particle size distribution of the underlying soil.

Modern construction techniques utilise a single carefully-selected geotextile layer, to provide the necessary hydraulic and mechanical properties and to prevent leaching of the underlying soil. This geotextile is faster and easier to install than stone layers, and its factory-controlled properties means that it will perform more consistently. In the same way as the stone size and grading were important for the traditional solution, the careful selection and specification of the correct geotextile is vital. The textile must be robust enough to withstand installation and service-life loads. It must have a suitable pore size and permeability, and be capable of providing sustained filtration. It must possess extensibility to adapt to point loads in order to avoid puncture and tearing. Not all geotextiles can provide this unique combination of performance properties. The role of geotextiles in the provision of stability of hydraulic defence structures is vital and often undervalued. This is possibly due to their low unit cost in comparison with the overlying armour-stone. However, their incorrect selection and specification could risk the stability of the entire structure. When correctly specified and installed, geotextiles can provide significant benefits including savings in construction and whole life costs and increase in design life.



Typical detail of a river revetment with a geotextile beneath rock armour, stone-filled mattresses or pre-cast blocks.

TERRAM Standard Geotextiles **see page 31**

Geotextiles as filters in marine breakwaters

Key Advantages:

- Geotextiles can replace graded stone underlays, providing savings in materials, material transportation and placement costs.
- Geotextiles minimise the amount of lost material into soft subsoil at the toe.
- Geotextiles mitigate differential settlement.

The key attributes that require consideration when selecting and specifying a geotextile to be used in revetment type structures are:

Survivability

The geotextile must be robust enough during installation and in service so puncture resistance is very important.

Mechanical performance

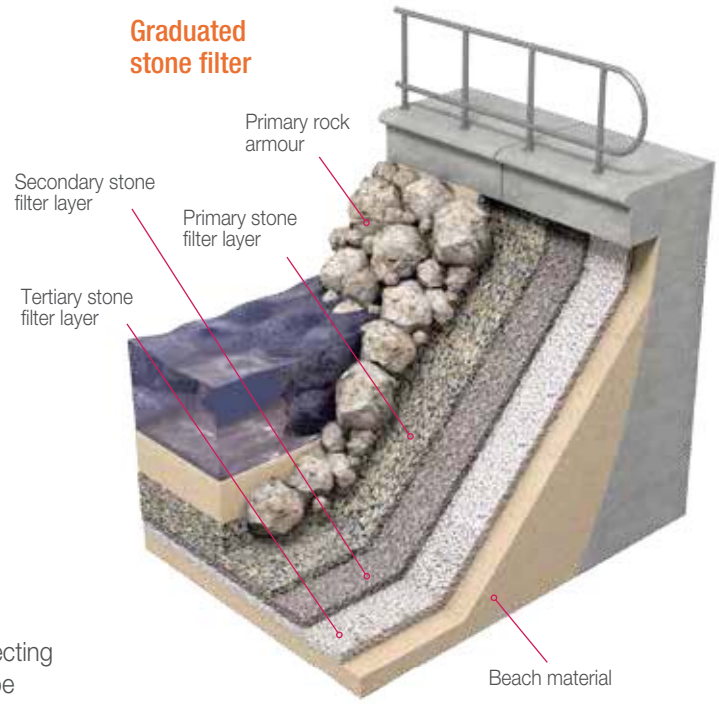
The geotextile must have sufficient extensibility to wrap around point loads and avoid puncture and resist compression.

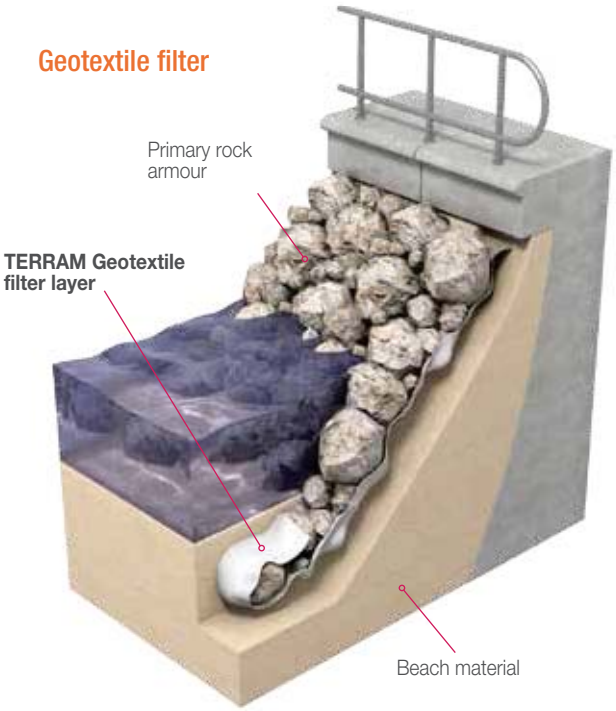
Hydraulic performance

The geotextile must allow water to pass effectively in both directions yet filter fine soil particles.

Durability

Depending on planned exposure times and required design life UV and antioxidant stabilisation will need to be considered.





TERRAM Standard Geotextiles **see page 31**

Temporary flood - alleviation structures

In addition to the more conventional use of geotextiles in coastal and waterways' engineering, Terram manufactures a geocellular system for temporary flood defences.

The TERRAM geocellular system was originally developed for military defences. However, the US Corps of Engineers conducted tests with the system to determine whether it could be used to construct temporary flood defences. Their work concluded that the system significantly outperformed sandbags in terms of installation/removal time, water seepage control and overall endurance. The TERRAM system is fabricated using a geotextile to form a series of interconnected cells which can be laid flat to form a compact unit for shipment. Once on site, the units are quickly unpacked, opened out, positioned, secured to each other and then filled with a locally-won fill or an imported fill such as sand. The units can be placed on top of each other to form taller structures and the resulting walls can be formed with angles and curves. On-site installation can be carried out by unskilled labour and the learning curve is short and shallow.

Installing at a rate of 20 plus units/hour within three hours of starting is typical - the equivalent protection afforded with 22,196 sandbags.

TERRAM Geocell flood protection **see page 39**

RAILWAYS

Geosynthetics in railways and related applications

A geosynthetic provides one or more of four functions when used in track-bed construction:

Separation to maintain the integrity of adjacent soil types i.e. prevent intermixing

Filtration to prevent leaching of soil particles

Drainage to allow the free passage of water

Reinforcement to provide additional strength

The use of geosynthetics to reduce or replace traditional layers is now an accepted part of track-bed construction and renewals around the world. When correctly specified and installed, geotextiles and geogrids are proven to:

- enhance track performance
- significantly extend design life
- reduce the time required to renew a specific length of track (or allow more to be renewed in a fixed time)
- reduce overall material costs

Innovation and the search for value-engineered solutions

Extending track-bed life

Sub-grade erosion pumping over a clay or silty subgrade.

With ballast placed directly over a clay or silty subgrade there is the possibility of a slurry being formed at the ballast/subgrade interface; particularly if there are depressions or pockets at formation level.

Regular traffic causes the ballast to oscillate at the interface which disturbs the clay/silt, and the presence of water in the pockets causes the particles to form a slurry. As the ballast dilates, the slurry moves into the void. The slurry is pumped upwards as the ballast contracts. This rapid, cyclical effect causes the mobile clay/silt particles to be forced progressively up into the ballast.

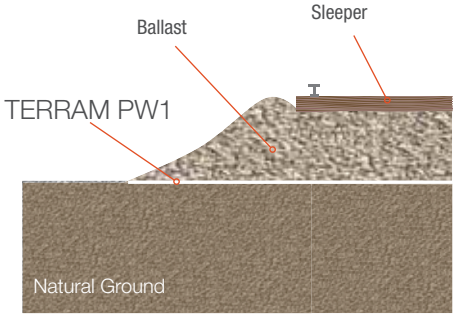
An alternative to using a graded sub-ballast in this situation is described in '[Railtrack's Line Code of Practice' - Track Substructure Treatments 2 and 3 which describes a blanketing sand of specified grading is laid on the sub-grade to act as a fine soil filter/separator to prevent 'pumping'.

Using a filter/separator to replace part of a sand blanket

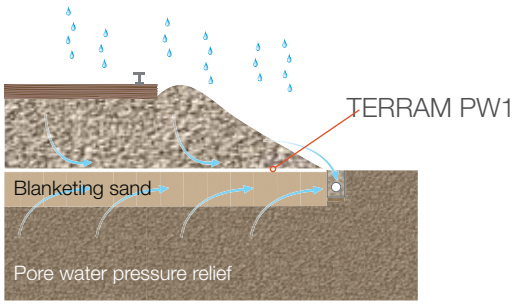
One of the purposes for using a sub-ballast or a sand blanket is to filter any ground-water so that the ballast does not become contaminated with soil particles as a result of sub-grade erosion.

Contamination would cause loss of ballast friction and deformation due to reduced load-bearing capacity in the subgrade. The resulting effect on track alignment would mean a reduction in track speed and, ultimately, track renewal.

A 300mm deep layer of sand was originally introduced in the UK to prevent ballast contamination but it was later found that this could be reduced to 100mm if a geotextile filter/separator was used at the sand/ballast interface – TERRAM PW1. Although this geotextile allows downward movement of water coming via the ballast the relative change in permeability at this interface means this water drains laterally to track-side drains.



Typical track-bed layers



TERRAM PW1 used in conjunction with a sand blanket to prevent sub-grade erosion.

TERRAM PW1 **see page 40**

Extending track-bed life

Sand does not contain the graded-gravel fraction of a sub-ballast and is thus prone to intermixing with the ballast. TERRAM PW1 also acts to prevent this.

Unlike sand, TERRAM PW1 is compact to transport and is rapidly laid ready for placement of the ballast. It has factory-controlled properties which do not rely on the need, unlike sand, for the correct thickness to be laid consistently across and along the track. In addition, excavation and the attendant disposal of fill is reduced when a geosynthetic is used to reduce the sand-blanket depth.

TERRAM PW1's ability to act as a filter over the design life is proven in countless projects around the world over the last twenty five years. Localised excavations along 8 to 10 year-old installations have revealed the TERRAM PW1 to be in good condition and visual inspection provided confidence that it would continue to do its job.

TERRAM PW1 **see page 40**

Ballast over weak sub-grade

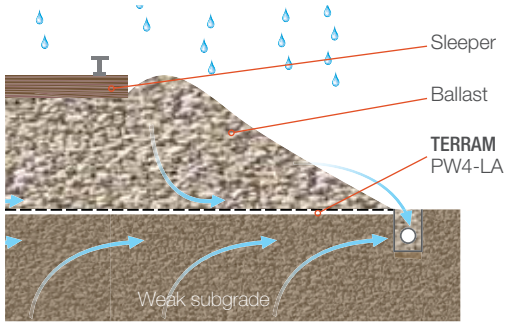
It's accepted that a geogrid stiffens the ballast by providing reinforcement at its base, and that this is highly desirable when track is being constructed over a soft subgrade.

Ballast over weak subgrades

TERRAM PW4-LA is a composite of TERRAM PW1 and a geogrid which speeds up the installation time when both reinforcement and a filter/separator are both required.

An extensive, full-scale, independent research programme was carried out by British Rail and this clearly showed that the use of a geogrid beneath ballast over a soft sub-grade:

- Helps to extend maintenance intervals by minimising settlement
- Enables the rate of settlement to approach that of tracks on firm foundations
- Has a stiffening effect and will reduce the elastic deflections
- Can limit the lateral creep of ballast, reducing settlement and, therefore, the rate of deterioration of the vertical track geometry

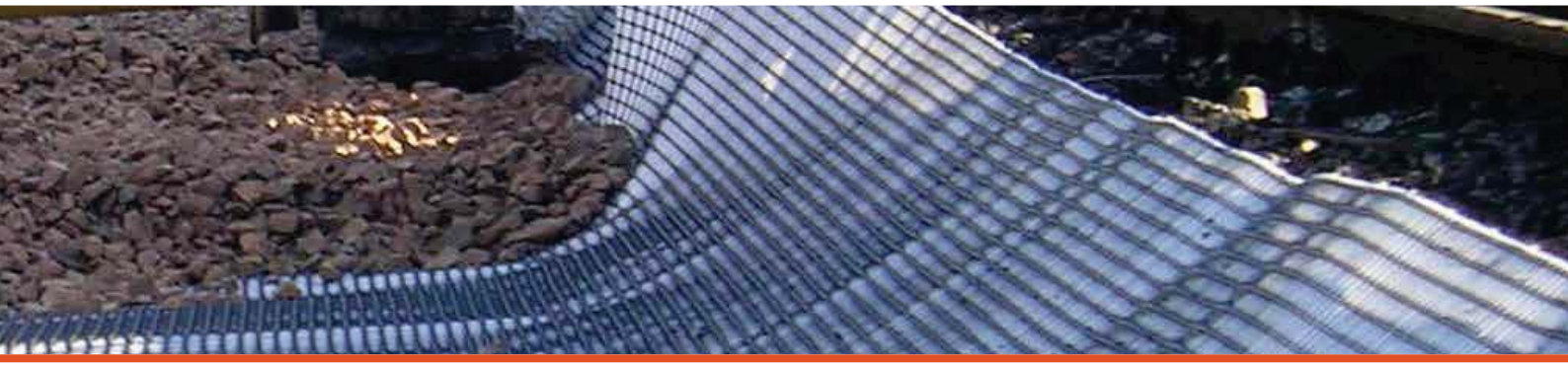


Other benefits of using TERRAM PW4-LA are:

- provides a genuine alternative to increasing ballast depth or chemical stabilisation
- improves ballast performance and makes it more consistent
- allows consistent high speeds to be achieved
- avoids subgrade excavation and replacement with thick layers of imported fill

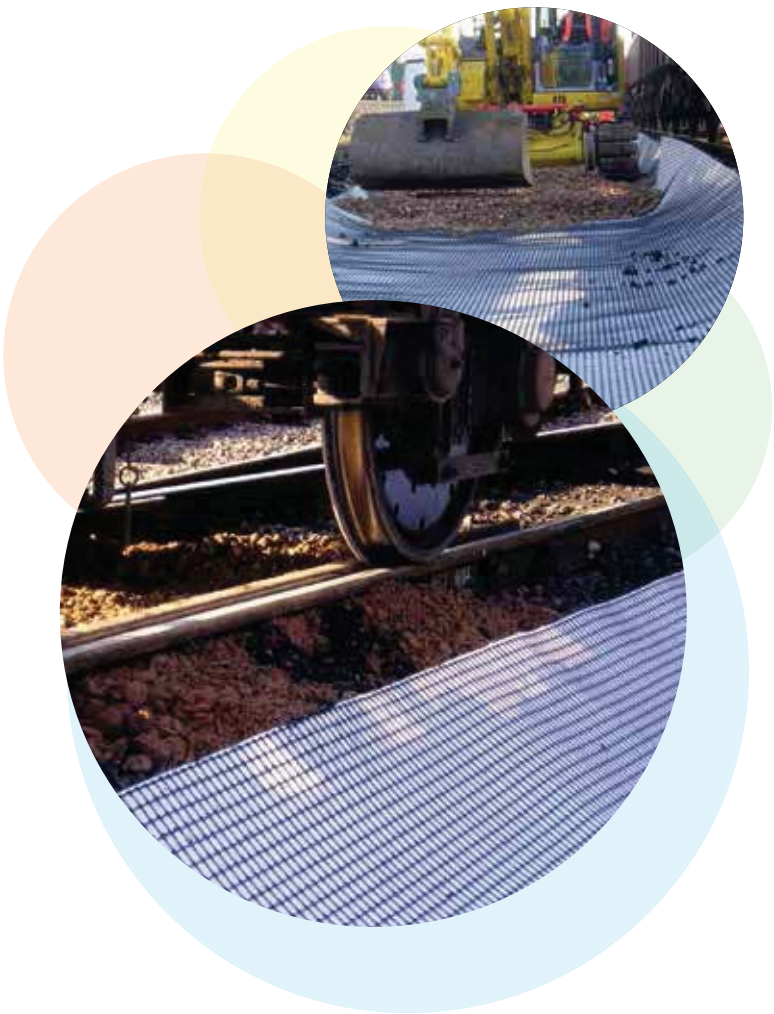
TERRAM PW4-LA **see page 42**

Ballast over weak sub-grade



Low load-bearing capacity can exist with most soil types including organic soils.

Susceptibility of the subgrade to erosion pumping may or may not be an issue. If it is then a suitable grade of a sand blanket plus PW1 should be used in conjunction with the geogrid as required by the subgrade type.



TERRAM PW4-LA **see page 42**

Controlling erosion on railway slopes

TERRAM Geocells are three-dimensional blankets of interconnected cells which are placed on slopes, secured in position using pins, and filled with friable topsoil.

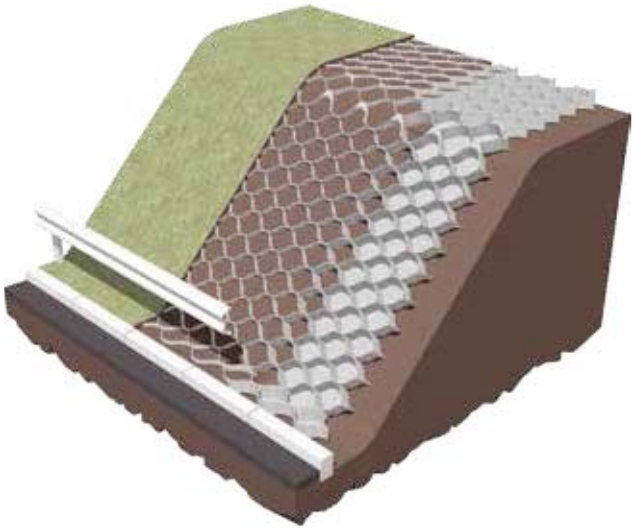
Controlling erosion on railway slopes

Once installed, a TERRAM Geocell provides immediate stability by confining the fill and greatly improves resistance to wind and run-off.

With a topsoil fill, the stability is further enhanced as vegetation becomes established and a geocell can be used to establish vegetation on slopes where establishing cover would otherwise have been a problem. The honeycomb of cells provides protection for the vegetation during the early, sensitive period of germination and growth.

The Geocells are formed from TERRAM Geotextile to confine the fill and the permeable walls allow drainage from cell to cell down the slope. Other geocells achieve this cell-to-cell drainage by perforating the walls but this process can lead to weaknesses. Geocells fabricated from impermeable materials suffer from weiring - water cascading down the slope from cell to cell – and this causes ongoing loss of soil from the cells.

Many variables affect the installation and performance of a slope-protection geocell, including slope angle, slope stability, the infill type, rainfall levels and irrigation (if included). It is important therefore that due consideration is given to all relevant criteria on a project by project basis.



A TERRAM Geocell with its distinctive array of interconnected cells.

TERRAM Geocells are anchored to slopes using U shaped - TERRAM Fixing Pins - these combined with the weight of the soil prevents slippage.

Typical applications include:

- Cuttings and embankments
- Noise-deflection and environmental bunds
- Abutments
- Steepened slopes
- Soil nailing cover
- Drainage ditches

TERRAM Geocell erosion control **see page 35**

PRODUCT PAGES

TERRAM
Standard Geotextiles

TERRAM Standard Geotextiles enhance the performance and design life of granular layers by providing the filtration and separation functions. Typical uses for TERRAM Standard Geotextiles include ground stabilisation (between the sub-base and subgrade) and around drainage materials.

Preventing intermixing of granular materials and soils

TERRAM Standard Geotextiles provide an effective solution to the problem of constructing a stable granular layer over soft foundation soils. When stone is placed directly on a soft subgrade, the imposed load often causes intermixing of two layers. This results in contamination of the stone layer and a resulting loss in bearing strength, surface rutting and deformation at the sub-base/subgrade interface.

Preventing the ingress of fines into drainage media

Whether it's a granular drain or a geosynthetic alternative such as open geocellular units, TERRAM Standard Geotextiles are ideal for preventing the ingress of fines.

Features:

- Engineered to provide high strength and high elongation at break
- Manufactured from high tenacity UV stabilised virgin polypropylene fibres to provide long term durability in all soil types
- Manufactured using a randomly orientated web to provide completely isotropic properties
- Excellent uniformity with high permeability and low pore size for soil filtration

TERRAM filters/separators are used extensively in the construction of:

- Paved and unpaved roads
- Railways
- Car parks and hardstandings
- Cycleways and footpaths
- SuDS installations
- Green roofs

Product Grade	T700	T900	T1000	T1300	T1500	T2000	T3000	T4000	T4500
Roll Width (m)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Roll Length (m)	150	150	100	100	100	100	100	50	50

TERRAM
Geocomposite Drain

TERRAM Geocomposite Drains are manufactured by bonding together textiles, membranes and nets in different combinations to create easier-to-install replacements for conventional granular layers.

The textile provides the filter function so this allows liquids and gases to pass into the net core but prevents soil particles from washing into and clogging the core. The net collects the liquids and gases which can then be conveyed to collection points. Membranes are used to provide the barrier function and prevent the passage of liquids and the majority of gases.

A composite must:

- be robust to survive installation and service life.
- be stable under load to resist deformation that could ultimately restrict flow.
- have good chemical resistance.

Its filter must:

possess an apparent pore size to suit the soil and prevent the ingress of fines provide sustained performance without blocking TERRAM Geocomposite Drains are proven to satisfy these criteria and stand the test of time. The products have established an impressive track record in building and construction projects across the world for over forty years.

Features:

- Manufactured using TERRAM T1000, a unique geotextile filter developed for its high tensile modulus and ability to prevent soil ingress into the void space of the drainage core
- TERRAM drainage cores are manufactured from HDPE nets which have been engineered to have good flow under high loading

Product Grade	B1	1A1	1B1	1BZ	1C1	1D1	1D1 Light	1E1
Roll Width (m)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Roll Length (m)	50/100	50/100	50/100	50/100	50/100	50/100	50/100	50/100

TERRAM
Frost Blanket

TERRAM Frost Blanket is a purpose-designed, protection geo-composite for mitigating the effects of frost heave.

Installed horizontally, it forms a capillary break to prevent the rise of groundwater into the frost zone thereby reducing the potential for damage as a result of the freeze/thaw cycle (frost heave).

TERRAM Frost Blanket has been installed with great success on a number of significant projects around the world.

For more information visit www.terramgeo.com to download our Frost Blanket guidance document.

Composition
Drainage core with a filter bonded to both sides.

Upper filter
T2000 white high tensile modulas geotextile.

Core
Extruded polyethylene (PE) net.

Lower filter
T2000 brown high tensile modulas geotextile with hydrophobically enhanced fibres.

TERRAM Frost Blanket	
Roll Width (m)	2.0
Roll Length (m)	50/100

TERRAM
Salt Barrier

TERRAM Salt Barrier is a geocomposite developed to prevent damage caused by the capillary rise of saline groundwater into 'sweet' soil zones.

Soft landscaping in areas with saline groundwater has traditionally required a 300mm layer of crushed stone to intercept the groundwater and allow successful cultivation.

TERRAM Salt Barrier has been specially developed to replace this granular layer and reduce the environmental by avoiding the use of a primary resource and the attendant transportation costs.

It has a proven record on a number of high-profile projects in the Middle East where it was extensively used in the Palm Jumeirah Development.

Composition
Drainage core with a filter bonded to both sides.

Upper filter
T2000 white high tensile modulas geotextile.

Core
Extruded polyethylene (PE) net.

Lower filter
T2000 brown high tensile modulas geotextile with hydrophobically enhanced fibres.

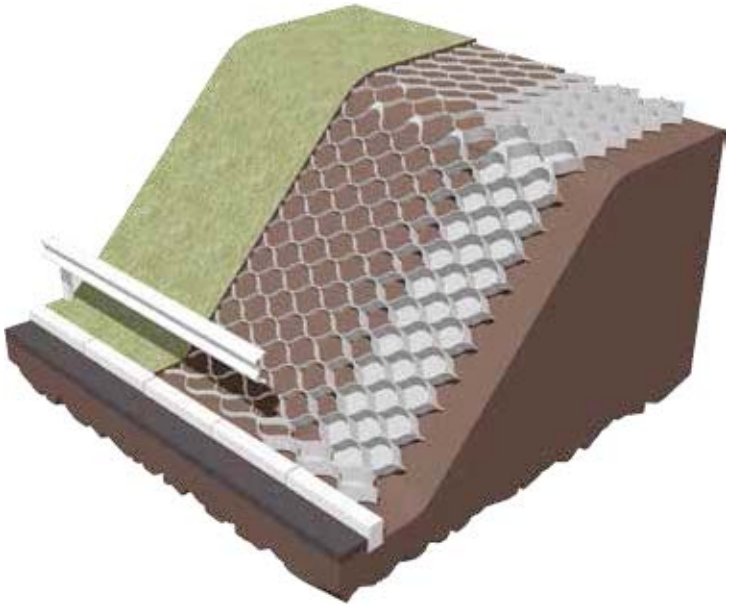
TERRAM Salt Barrier	
Roll Width (m)	2.0
Roll Length (m)	50/100

TERRAM Geocell Erosion Control

Combat slope erosion and stabilise surfaces using TERRAM GEOCELL.

WHY TERRAM GEOCELL?

- Lightweight and easy to handle, reducing installation costs.
- The flexible TERRAM geotextile material allows TERRAM GEOCELL to effectively adapt to any variations in the terrain.
- TERRAM GEOCELLS are easily cut to size without damage, therefore reducing cost.



Fixing Pins

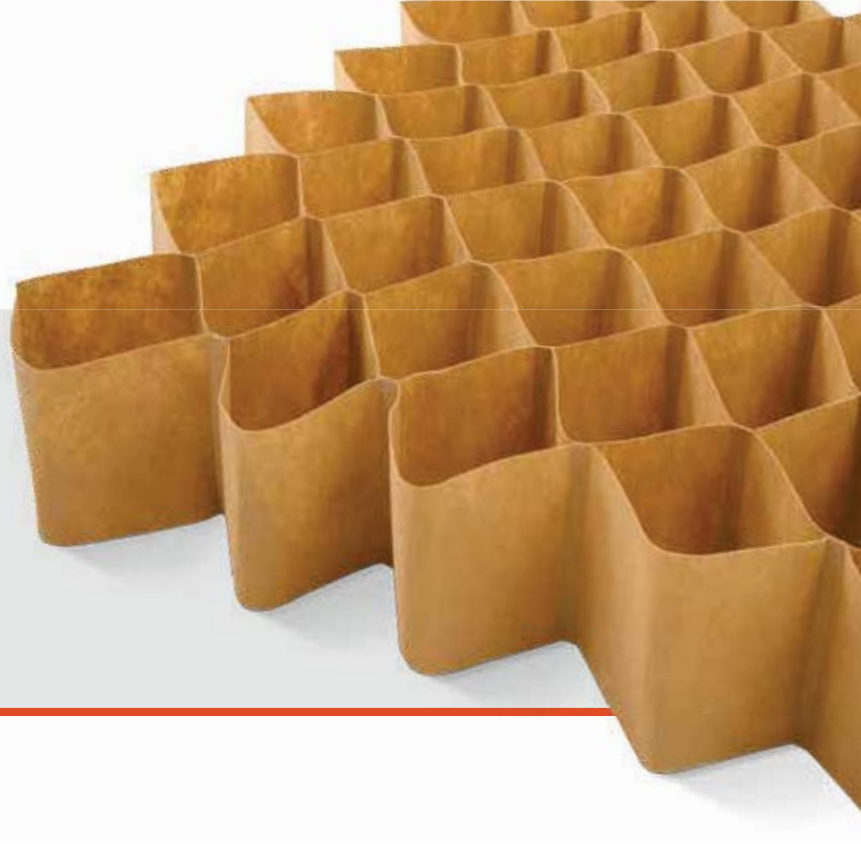
Fixing pins available upon request.

Product Details

PRODUCT	PANEL SIZE (m)	CELL Dia & DEPTH (mm)	PANEL WEIGHT	SLOPE TYPE
GEOCELL 25/10	5 x 7	250 dia x 100	17kg	Large/Medium*
GEOCELL 25/15	5 x 7	250 dia x 150	25kg	Large/Medium*
GEOCELL 35/10	5 x 7	350 dia x 100	11kg	Small*
GEOCELL 35/15	5 x 7	350 dia x 150	17kg	Small*

* These are typical profiles only.

TERRAM
Retaining Walls



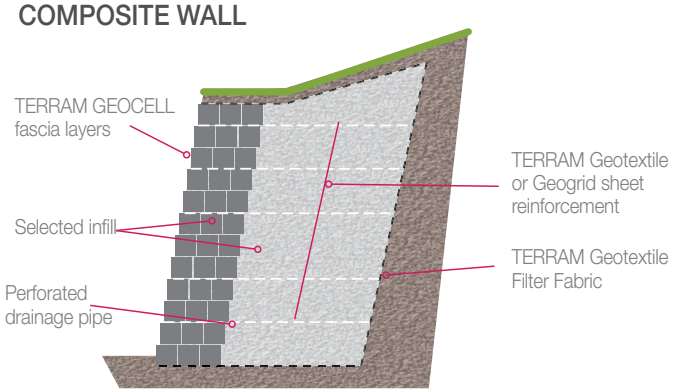
Need an earth retention structure? TERRAM GEOCELL can stabilise and retain wall structures.

Design Considerations

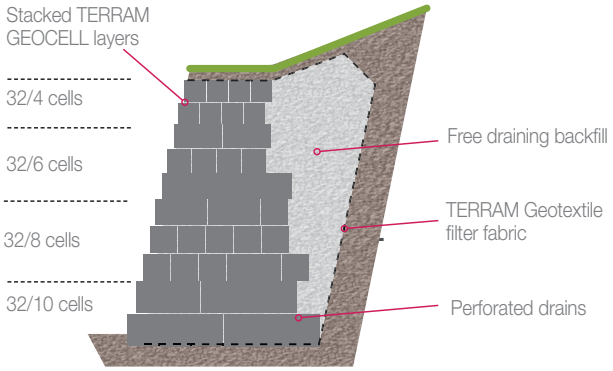
- Wall Height
- Fascia Angle
- Surcharge Load on the top of the wall
- Overturning Stability
- Sliding Stability
- Foundation Bearing Capacity

TERRAM works with specialist partners to provide independently validated solutions in accordance with best practice guidelines.

COMPOSITE WALL



GRAVITY WALL



Fixing Pins
Fixing pins available upon request.

Product Details

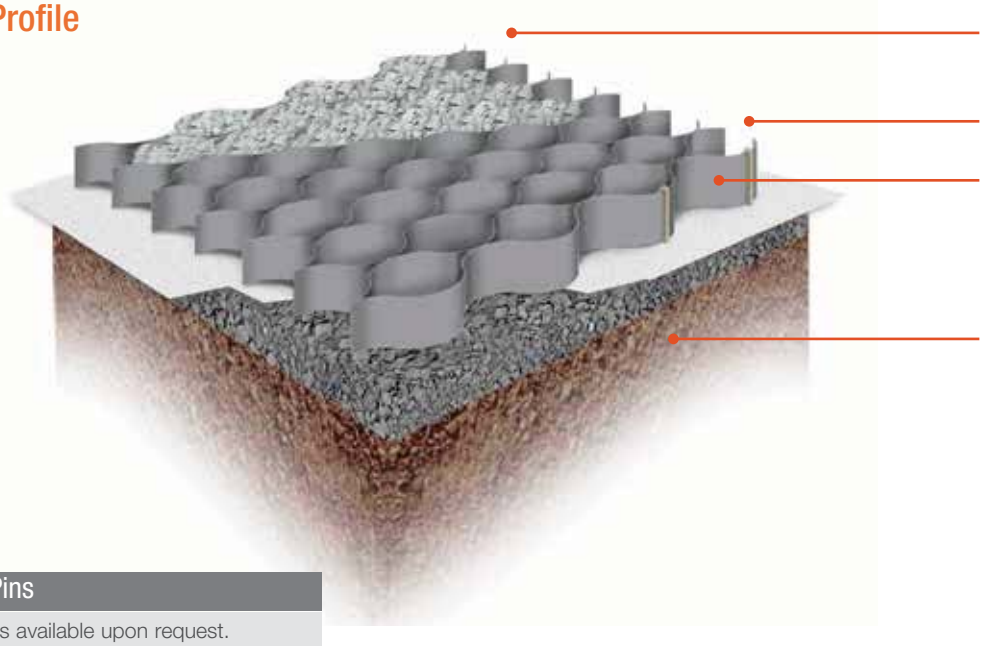
PRODUCT	PANEL SIZE (m)	DEPTH * & CELL Dia (mm)	PANEL WEIGHT
TERRAM Geocell Wall 32/4	10.6 x 1.45	320 x 500 dia	10.43kg
TERRAM Geocell Wall 32/6	10.6 x 2.03	320 x 500 dia	14.26kg
TERRAM Geocell Wall 32/8	10.6 x 2.61	320 x 500 dia	18.09kg
TERRAM Geocell Wall 32/10	10.6 x 3.19	320 x 500 dia	21.92kg

*200 and 250 mm Depth available

TERRAM Geocell Tree Root

Protect tree roots from vehicle traffic, whilst maintaining water and nutrient absorption using TERRAM GEOCELL.

Typical Profile



Fixing Pins

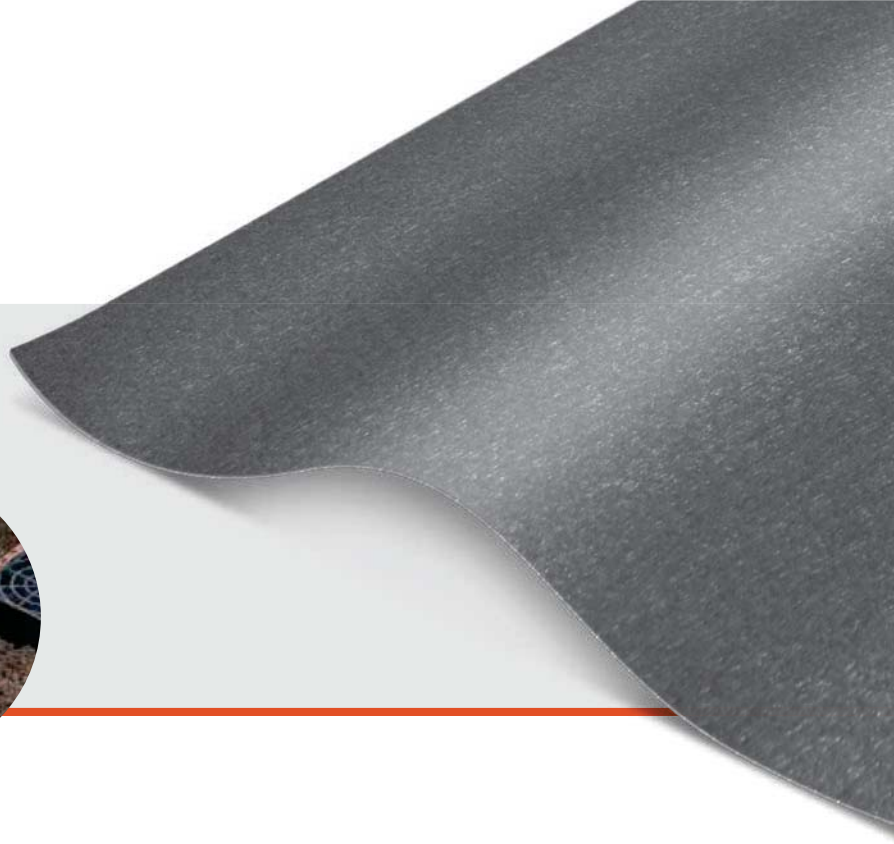
Fixing pins available upon request.

Product Details

PRODUCT	PANEL SIZE (m)	CELL Dia & DEPTH (mm)	PANEL WEIGHT	TYPICAL LOADING
GEOCELL 25/10	5 x 7	250 dia x 100	17kg	Pedestrian cycle*
GEOCELL 25/15	5 x 7	250 dia x 150	25kg	Light vehicles*
GEOCELL 22/20	6 x 3	220 dia x 200	20kg	Optimum for heavier vehicles or more frequent traffic*

* These are typical profiles only.

TERRAM
Rootguard™



Root control barrier to protect buildings, walls, paths, access roads, drainage pipes and underground cables from root damage.

TERRAM ROOTGUARD and TERRAM ROOTGUARD PLUS are used to protect buildings, walls, paths, drainage pipes, cables and lawns from potential damage caused by root development. Tree roots grow very close to the surface and are the cause of considerable damage. Structures with shallow foundations can be undermined. Damaged pipes, or pipes with faulty joints can become blocked by roots. Root growth is also known to cause desiccation of soils to the extent that soil shrinkage can result in parts of the foundation no longer being supported. When this occurs structures may subside and crack, and in these circumstances expensive underpinning may be the only solution. The choice of TERRAM ROOTGUARD product will depend upon the application, specifically whether water needs to pass through the product.

TERRAM ROOTGUARD - permeable solution

In some instances it may be necessary to have a water-permeable solution e.g. surrounding land drains. Although some permeable barriers may not provide the highest level of protection (see TERRAM ROOTGUARD PLUS), they still provide excellent resistance.

TERRAM ROOTGUARD is a geotextile manufactured from polypropylene/polyethylene fibres. It provides excellent resistance to root development; confirmed in numerous trials and commercial projects.
TERRAM ROOTGUARD has high tensile strength, high puncture resistance and is capable of withstanding the differential forces that can develop in clay soils.

TERRAM ROOTGUARD PLUS - impermeable solution

Research has demonstrated that high-density polyethylene (HDPE) can withstand penetration by even the most vigorous of tree roots. TERRAM ROOTGUARD PLUS - a composite of TERRAM ROOTGUARD and an HDPE membrane is the choice when there is no requirement for water to pass through the barrier. This product will provide the greatest degree of protection. Both products are chemically inert to natural soil conditions and resistant to biodegradation.

Terram rootguard product details

PRODUCT	ROLL SIZE (m)	CBR PUNCTURE RESISTANCE	COLOUR	MATERIAL
TERRAM Rootguard	2.25 x 25	3250N	Black	Non-Woven PP/PE
TERRAM Rootguard Plus	2 x 25	2550N	Black	Non-Woven PE/HDPE coated

TERRAM Geocell Flood Protection

TERRAM Geocell for floods provides a cost-effective and fast installation of temporary walls in emergency flood areas. The geotextile cells are filled with local material to build walls faster than conventional sand-bagging.

TERRAM geocells are designed as water containment barriers to help first responders construct flood protection much faster than traditional sandbag methods.

Our flood protection geocells have been tested by the U.S. Army Corps of Engineers and have been proven to significantly outperform sandbags through:

- Faster installation and removal time
- Less water seepage
- Better overall system endurance

Manufactured from permeable geotextile fabric, the geocell panels are lightweight, stackable and can be filled with local sand or soil on site. Being permeable there is no build-up of water, the flow-through of water or moisture helps improves compaction, leading to greater performance.

TERRAM Geocells are engineered to provide:

- Flexible design and contours to adapt to rugged terrain
- Ease of transportation - light weight and compact for remote installation

During the spring floods of 2011, Defencell Flood Walls were employed to defend municipalities along the flood zones from Canada down the Mississippi River to Louisiana

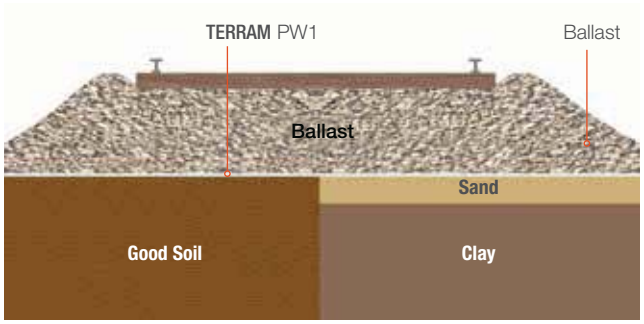
Panel Grade	Height	Width (footprint)	Width (protective)	Length	Weight
T2	0.50m (plus 0.10m skirt)	1.35m	1.10m	4.9m	6.80kg

TERRAM
PW1

TERRAM PW1 trackbed separator is designed to maintain separation between the adjacent sand/ballast layers within the trackbed construction, preventing the upward movement of fine sub-grade particles.

TERRAM PW1 is suitable for where sub-grade soils are good, have sufficient strength and the particles are of even size.

TERRAM Geosynthetics provide solutions for permanent way applications where loss of rail track alignment caused by sub-grade erosion leads to costly maintenance and the complication caused by having to plan and temporarily close the track for its renewal.



Scenario 1
Good soil subgrade

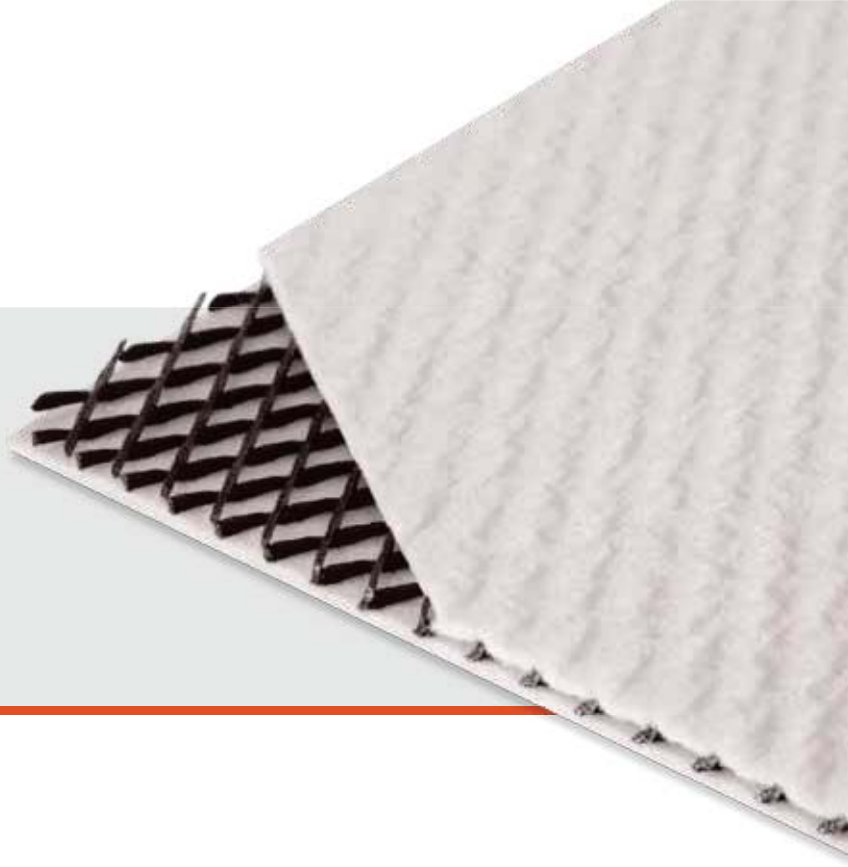
Scenario 2
Clay subgrade and sand blanket

Features:

- Engineered to provide high strength and high elongation at break
- Manufactured from high tenacity UV stabilised virgin polypropylene fibres to provide long term durability in all soil types
- Manufactured using a randomly orientated web to provide completely isotropic properties
- Excellent uniformity with high permeability and low pore size for soil filtration
- Network Rail approved PADS No. 057/100555

Physical Properties	PW1
Roll Width	4m/4.5m
Roll Length	50m/100m

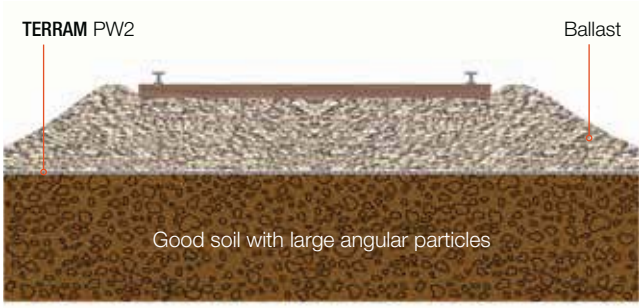
TERRAM
PW2



TERRAM PW2 is a robust trackbed separator designed where the sub-grade soils are good but contain angular stone. This angular stone could damage a standard geotextile, so a robust geotextile that protects the separation geotextile is essential.

TERRAM PW2 is a geocomposite- a robust separator/filter incorporating a stiff net between two textile filter layers

TERRAM Geosynthetics provide solutions for permanent way applications where loss of rail track alignment caused by sub-grade erosion leads to costly maintenance and the complication caused by having to plan and temporarily close the track for its renewal.

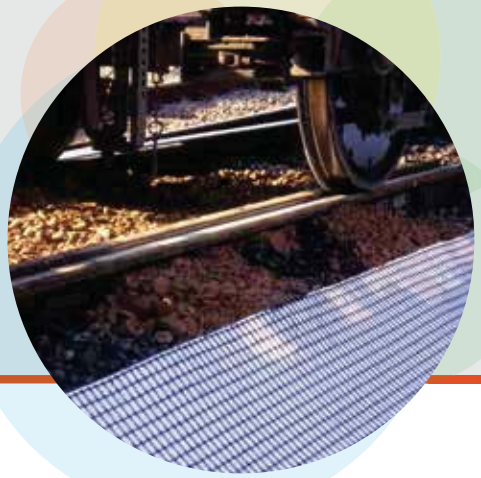


Features:

- Manufactured using HDPE geonet sandwiched between two layers of TERRAM PW1 to provide the necessary robustness when used with large angular soil particles.
- Network Rail approved PADS No. 057/100777

Physical Properties	PW2
Roll Width	2m
Roll Length	25m/50m

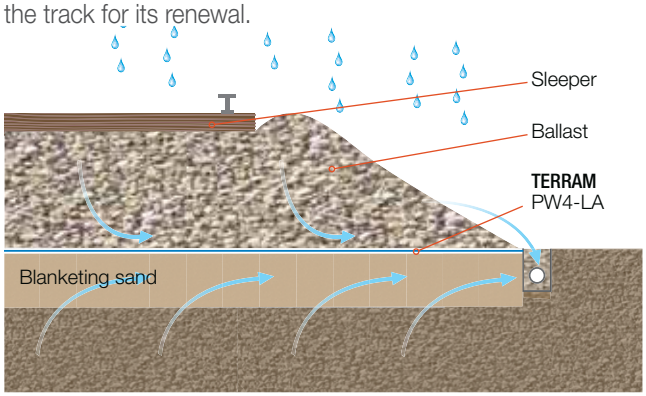
TERRAM
PW4-LA



TERRAM PW4-LA is a reinforced trackbed separator designed where the sub-grade is weak, ie. soft and boggy conditions.

TERRAM PW4-LA is a composite formed from TERRAM PW1 and Tensar SSLA30 geogrid. Tensar SSLA30 improves track life and performance by stiffening ballast laid over weak ground. The advantage of TERRAM PW4-LA is the speed at which a geotextile filter and grid reinforcement can be laid in a single pass with the beneficial effect on construction costs.

TERRAM Geosynthetics provide solutions for permanent way applications where loss of rail track alignment, caused by sub-grade erosion, leads to costly maintenance and the complication caused by having to plan and temporarily close the track for its renewal.



Features:

- The structure and composition of PW4 provides a long term mechanical performance and chemical resistance, even when used in very aggressive conditions.
- Improves the load bearing capacity of soil when placed at the base of ballast, constraining the aggregate by laterally confining it, providing the necessary support.
- Manufactured using large aperture bi-axially orientated geogrid developed specifically for railway applications and use under ballast. PW4-LA provides the ideal dimensional characteristics for the effective interlocking of ballast within the geogrid apertures.
- Network Rail approved PADS No. 057/100779.

Physical Properties	PW4-LA
Roll Width	4m
Roll Length	25m


820

TERRAM™

Geosynthetics you can trust

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