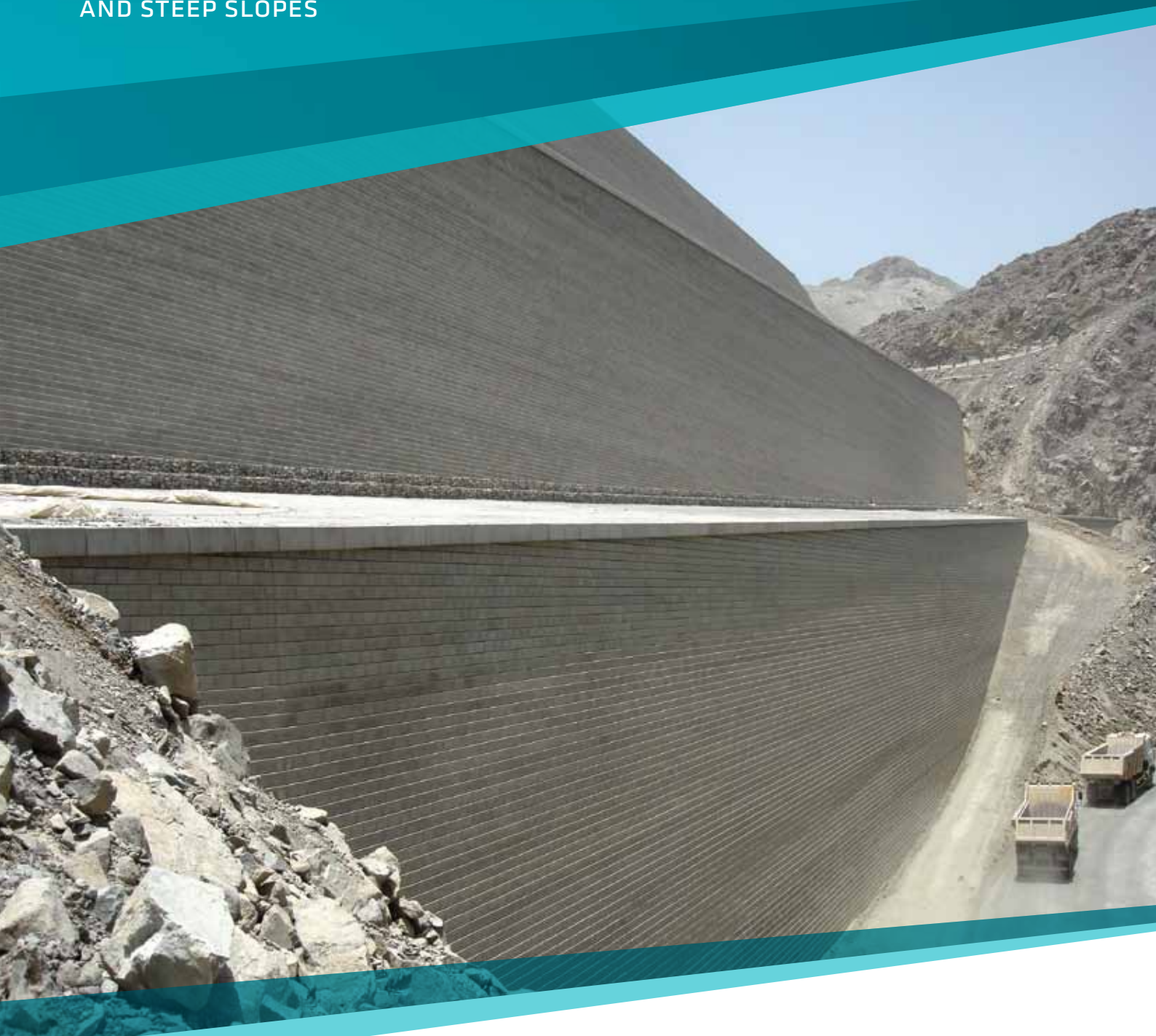
WALLS AND SLOPES

TENSARTECH™ EARTH RETAINING SYSTEMS

BRIDGE ABUTMENTS, RETAINING WALLS AND STEEP SLOPES



Tensar®

Tensar® offers a broad variety of cost effective and attractive alternatives for all types of construction projects requiring retaining walls or slopes.

Tensar Technology – Proven Practical Solutions and the Know-How to Get them Built

Based on the characteristic properties of Tensar® geogrids, Tensar Technology is widely adopted for ground stabilisation and soil reinforcement problems, delivering real savings in cost and time. We can help you apply Tensar Technology to improve the bottom line on your project.

TensarTech™ Systems are versatile and meet the environmental and economic demands of any project, as demonstrated on this 22 m high plateau which allowed the re-use of colliery spoil as site-won fill. (Greater Bargoed, South Wales)

Unsurpassed Experience and Reliability

Tensar International (Tensar) is a world leader in geogrid technology and the provision of high performance earth retaining systems, with over 30 years of experience.

Tensar offers a broad variety of cost effective and attractive alternatives for all types of construction projects requiring retaining walls or slopes.

We offer the services of a team of professionals who can assist in developing concepts to support your design or undertake full construction design. We also provide advice and initial training on-site to assist you to effectively install our products and systems in your project.

By combining our knowledge of materials, application technologies and geotechnical design techniques, we are able to offer a TensarTech™ System providing structural integrity and long-term reliability.

PRODUCT SHEET 1
TENSAR RE AND RE500 GEOGRIDS FOR REINFORCED SOIL RETAINING WALL AND BRIDGE ABUTMENT SYSTEMS

PRODUCT SHEET 2
TENSAR TW1 WALL SYSTEM FOR REINFORCED SOIL RETAINING WALLS AND BRIDGE ABUTMENTS

PRODUCT SHEET 1
TENSAR RE AND RE500 GEOGRIDS FOR REINFORCED SOIL EMBANKMENTS

Reinforced Fill Product Certificate No RF 2/2011
for Tensar RE500 Geogrids

Q 05288
ISO 9001:2008

EMS 86463
ISO 14001:2004

Tensar uniaxial geogrids have been given accreditation by a number of independent government and other certifying agencies. No other soil reinforcement material has such a wide range of certification.

TensarTech™ Earth Retaining Systems

Design engineers need to make choices when faced with difficult and variable site terrain where it is necessary to maximise the area suitable for development. Where retaining structures need to be constructed the options available are varied, including reinforced concrete, mass concrete, gabions, crib walls, sheet piling and structural brickwork.

However, increasing numbers of engineers and architects look first to Tensar for a tailored solution from a single source – TensarTech™ Earth Retaining Systems.

Our TensarTech Earth Retaining Systems for Walls and Slopes offer you a range of reinforced soil structures with a choice of faces to suit your design code, budget, environmental constraints and aesthetic requirements. They are designed as 'true systems' using carefully integrated components for superior structural integrity.

ECONOMICAL

- TensarTech Wall Systems can save up to 50% on traditional reinforced concrete structures
- TensarTech Slope Systems can save up to 75% on traditional reinforced concrete structures
- Rapid to construct TensarTech Systems can cut construction times by half
- Use of site-won materials can reduce costly imported fill and outlay on both aggregate and landfill charges
- Often no specialist skills are required for construction

FLEXIBLE AND ATTRACTIVE

- Varying face angles possible from 20° to 90°
- Numerous architectural finishes available to conform with project specific requirements
- Attractive longitudinal curves and terraces easily achievable without special components

RELIABLE

- TensarTech Systems are internationally certified for independently assessed performance
- Thousands of structures successfully completed throughout the world
- TensarTech Systems feature unique high strength connection to the geogrid reinforcement
- TensarTech Systems require little or no maintenance and may be designed for a 120 year design life
- The systems can be designed to accommodate extreme dynamic loading and seismic conditions

ENVIRONMENTALLY SOUND

- Delivers significant reductions in construction carbon emissions compared with traditional concrete structures
- Potential to use site-won fill or reclaimed fill materials
- Site-won material used as reinforced fill can avoid fill importation and off-site tipping whilst reducing the inherent pollution associated with transportation
- Vegetated slopes enhance aesthetic appeal and blend with natural surroundings

TensarTech™ TW1 Wall System used with spectacular effect on these bridge wingwalls.

TensarTech™ Systems – Making the Right Choice for Your Scheme

There are many variable parameters that need to be considered before reaching the decision on which TensarTech System meets your needs. Making the right choice for your scheme may depend on:

- Aesthetics
- Durability (design life)
- Available space for construction (face angle)
- Geotechnical considerations (soil types)
- Budgetary constraints

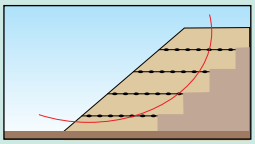
Whatever your project characteristics, contact us as soon as you can as we are likely to have either a TensarTech Wall or TensarTech Slope System that will fit your requirements.

A Guide to Choosing a **Tensar**Tech™ Earth Retaining System for Your Project

At Tensar® we believe that understanding your requirements at the planning stage will help us to deliver the best option for any project. Here is a quick guide to show you how adaptable TensarTech Systems can be.

TensarTech Slope Systems – vegetated faces

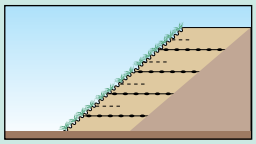
TENSARTECH SLIPREPAIR



20° to 70°

- Regularly re-uses failed soils
- Typically no face support needed
- Economical and environmentally friendly

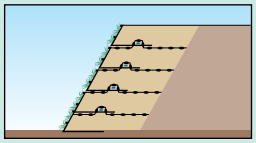
TENSARTECH NATURALGREEN



20° to 45°

- No face support needed
- No limit on construction plant weight working near face
- Uses conventional earthwork techniques

TENSARTECH GREENSLOPE

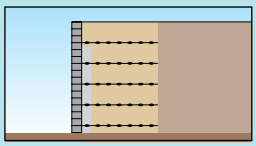


60° to 70°

- The face can be detailed for vegetation
- No external propping required
- Excellent durability with 120 year design life possible

TensarTech Wall Systems – non-vegetated faces

TENSARTECH TW

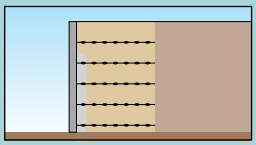


82° to 90°

- Wide choice of textures, colours and face angles
- Easily accommodates optional brick or masonry façade
- Can fit small radius curves
- Dry laid blocks, no mechanical lifting needed

TensarTech Panel

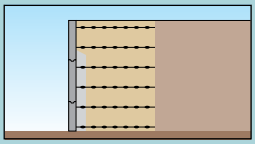
FULL HEIGHT



90°

- No horizontal construction joints
- Panel structures allow rapid face erection with use of crane
- Tight control over vertical alignment
- External finishes easily cast-in during production

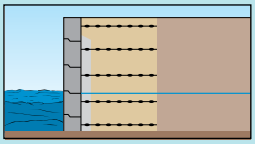
INCREMENTAL



90°

- Panels can be factory produced or cast on-site
- No need for external propping
- Rapid erection of face
- External finish to panels easily cast-in

TENSARTECH MARINE

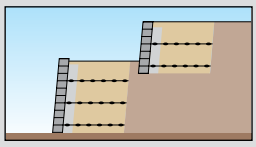


90°

- Concrete facing units can be factory produced or cast on-site
- Designed to resist wave attack
- May accommodate tidal construction

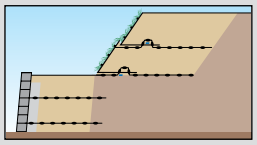
TensarTech Systems – combination structures

TERRACED WALL



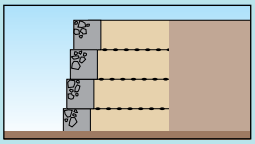
- Terraces allow attractive planting
- Aesthetically pleasing yet durable
- Simple to detail and construct
- Excellent durability with 120 year design life possible

WALL AND SLOPE



- Combines beauty with durability
- Positions concrete adjacent to traffic for durability
- Positions vegetated slope above for aesthetic appeal

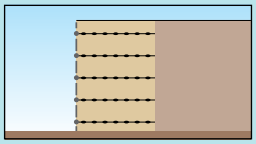
TENSARTECH ROCKWALL



80° to 90°

- Galfan coated or galvanised steel mesh and stone finish
- Permeable and flexible face
- Minimises use of expensive gabion fill
- May use site-won or reclaimed fill behind face

TENSARTECH TR2



70° to 90°

- Low cost and functional for temporary works
- Minimal external propping
- May be used for permanent thrust relief behind existing structures

TensarTech™ Systems – from Concept to Construction with Confidence

Tensar's Professional Support Team are happy to provide guidance and impartial advice on all projects requiring retaining structures. Whether the project is in the first stages of planning or solutions are needed as part of the ongoing construction process, Tensar can help you realise the project's full potential and see it through to completion.

Early consultation with experienced civil engineers will provide invaluable information on budget costing and feasibility which can lead to big savings in time and money. We can also provide you with alternative designs to existing schemes to help you get the most out of your projects.

A simplified version of our powerful in-house design software is now available to designers and specifiers, together with user training with qualified engineers at one of our design workshops.

The earlier you include Tensar, the more we will be able to assist you in successfully completing your project.

TENSAR OFFERS A RANGE OF DESIGN SERVICE OPTIONS IN 3 CORE STREAMS

1 **SUPPLY ONLY**

2 **APPLICATION SUGGESTION & SUPPLY**
Conceptual drawing and advice

3 **DESIGN & SUPPLY**
Certified detailed design and construction drawings with Professional Indemnity (PI) insurance cover

TensarTech™ TW Systems for Proven Construction of Walls and Bridge Abutments

With savings of up to 50% on the cost of conventional reinforced concrete structures, TensarTech™ Wall Systems offer proven solutions worldwide for the construction of retaining walls and bridge abutments.

Each system is based on reinforcing a soil mass with Tensar® uniaxial geogrids allowing rapid and economical construction, reducing conventional construction times, avoiding the need for specialist skills and often enabling the utilisation of site-won fill materials.

The large number of facing options allows the designer to create structures which consistently match the aesthetic and economic demands of the project, whatever the location and application.

An attached façade such as this sandstone finish may be easily achieved using the TensarTech TW Wall System with stainless steel ties.

How Tensar® Can Help Keep Your Project within Budget

Costs are kept to a minimum with Tensar's unique modular block system which can be simply built without cranes or propping.

Facing units and geogrids are simple to install and as with all TensarTech Wall Systems connection to the face is easy yet secure.

You benefit from proven methods and the knowledge that you have saved up to 50% over conventional reinforced concrete structures.

Tensar® Geogrids are Available Which Have Been Independently Assessed and Certified for Use in Structures with a Design Life of Up to 120 Years.

A feature common to all TensarTech™ Wall Systems is the high efficiency of the connection between the geogrid and the chosen facing.

Specifiers can benefit from a wide range of finishes which incorporate intricate detail for maximum effect.

Taking Advantage of Modular Concrete Units

The high efficiency connection between facing unit and Tensar geogrid is a marked feature of the system, creating incredibly strong and durable maintenance free structures.

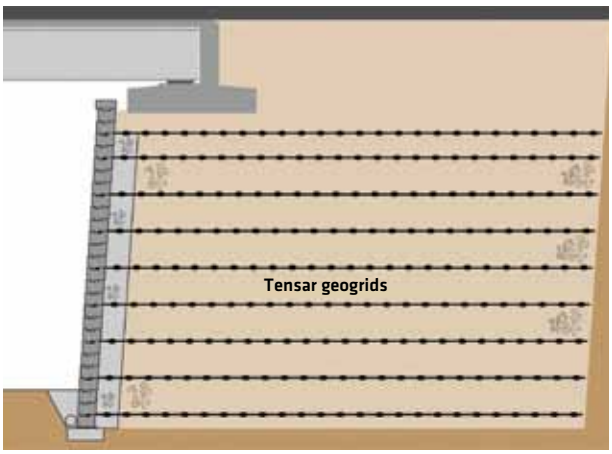
Factory made precast concrete facing blocks have been specially developed to produce an attractive, easily constructed face. They are manufactured from high quality concrete in a range of colours, styles and finishes, some versions also allowing a masonry or brick façade to be simply connected for architectural effect.

More Choice, Right Effect

Thanks to the combination of design expertise and practical experience, built up over more than 30 years, the facings available to specifiers make selection an important part of the creative process.

From motorways to walkways and in the most demanding environments such as docks, slipways and waterways, TensarTech™ Systems meet the challenge.

Systems for Demanding Situations



A typical section through a Tensar load bearing bridge abutment detailed here with a modular block facing.

TensarTech Systems have been independently certified for use as load bearing bridge abutments in highway applications by the British Board of Agrément.

TensarTech™ Earth Retaining Systems – Making the Right Choice for Your Individual Building Projects

Whatever the nature of your project, the versatility and flexibility of TensarTech Systems ensures that there is a reinforced soil structure to suit your project requirements and individual tastes.

TensarTech™ Panel

Full height or incremental panel walls offer an attractive solution. Once propped in position, the Tensar® geogrids are fixed to the rear face by a high efficiency mechanical connection. This high strength connection integrity greatly helps to ensure stability and alignment. By choosing full height panels the designer is able to provide a face clear of horizontal joints whilst maintaining close control over vertical alignment. The designer is able to create a variety of finishes by choosing to use mould liners and treatments for patterned or relief finishes to the structure.

A variety of panels and finishes can be applied with either pre-cast or cast on-site panels.

TensarTech™ Marine

The substantial concrete facing units are well suited to aggressive marine conditions. The geometry of the face units means no propping is required during construction. As with concrete panel faces, starter lengths of grid can be connected or cast into the rear of the units, to ensure that the structure remains secure under the most demanding conditions.

A TensarTech Marine System is well suited to aggressive coastal or tidal conditions such as harbour and river locations.

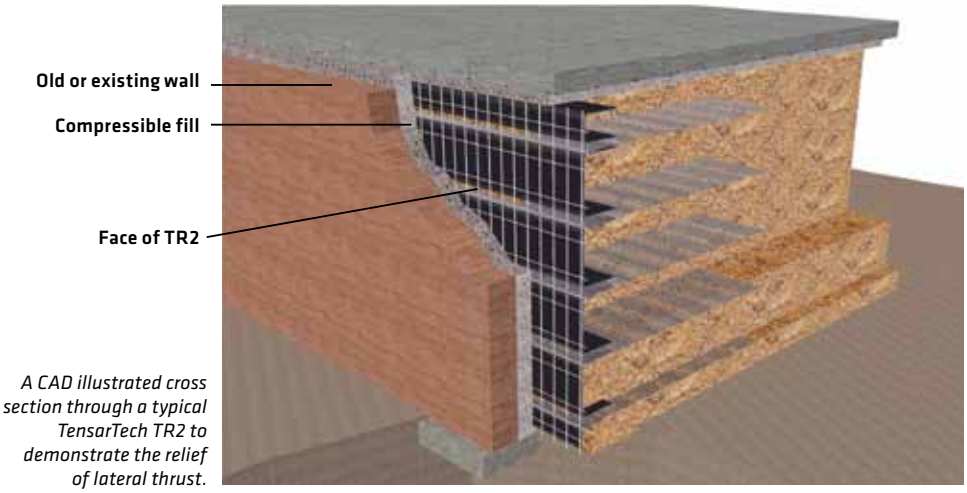
TensarTech™ Systems can offer the appearance of a gabion gravity structure at a fraction of the cost by using reinforced soil.

TensarTech™ RockWall

When the client wants the steel wire and stone appearance of a traditional gabion face why not consider a TensarTech RockWall System? Rather than the traditional mass gabion structure, this reinforced soil approach can provide cost and time savings by using only a single gabion thickness at the face whilst using lower cost fill (often site-won) in the reinforced soil block behind. Using Tensar's high strength connection between the facing unit and the geogrid, rather than merely relying on friction, helps to ensure that the structure remains stable.

TensarTech™ TR2 for Thrust Relief

Where an existing retaining wall is close to failure or would be unable to cope with the required additional loading, constructing a TensarTech TR2 System behind the existing wall can relieve the lateral thrust to provide a cost effective solution to a tricky problem.



A CAD illustrated cross section through a typical TensarTech TR2 to demonstrate the relief of lateral thrust.

TensarTech™ TR2 for Temporary Works Structures

For structures where the design life is short such as in contractors' temporary works or when aesthetics are not the immediate concern, a TensarTech TR2 System is the option to consider. It is economical as well as being quick and easy to erect.

TensarTech Systems are often used to build low cost temporary bridge abutments.

Building in Confidence with the **Tensar**Tech™ GreenSlope System

The TensarTech™ GreenSlope System permits the construction of steeper slopes with the additional benefits of speed, versatility and potential savings on your projects (of up to 75%) over alternative methods.

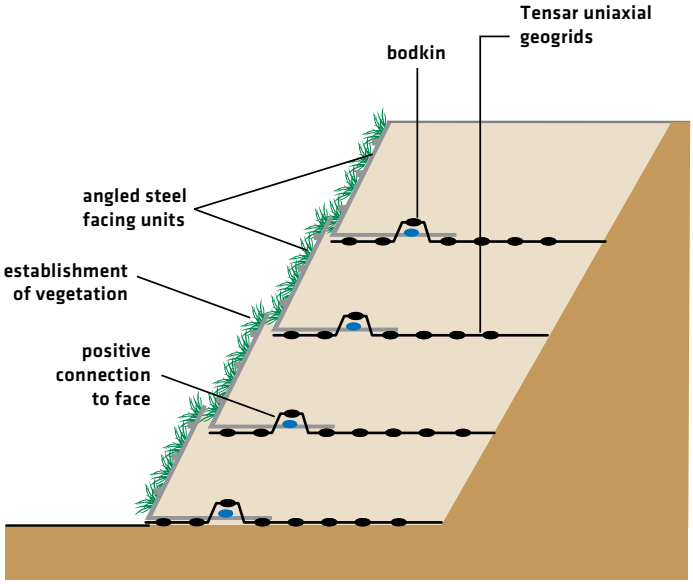
With ever increasing land costs and environmental constraints, Tensar can provide a variety of solutions for vegetated slopes of up to 70° giving you both flexibility on design and finish for your proposed schemes.

The variety of systems we offer can be crucial in gaining early planning approval at the beginning of a scheme and can allow for great aesthetic flexibility in choice of materials than normally offered in traditional earth retaining schemes.

- Rapid and economical construction
- Maximise the plateau area on a sloping site
- Designed using BBA certified geogrids
- Tolerant of differential settlement
- Optimise the use of available space
- May allow use of site-won materials (including cohesive or contaminated), or recycled fill materials
- High resistance to earthquake loading
- Low bearing pressure may avoid expensive foundation treatment

The soil structure is effectively contained at the face by durable steel units which are joined using Tensar's highly efficient bodkin connection to the reinforced geogrid soil mass. During installation these are lined with anti-erosion mats, selected for their properties and effectiveness in establishing the vegetative cover whether they are climbing plants, grasses or ground cover.

The TensarTech GreenSlope System offers many advantages over traditional concrete structures and a more attractive solution than gabions or crib walling as well as providing a cost effective solution to your earth retaining projects.



A typical section through the TensarTech GreenSlope System shown with a stepped face to aid irrigation of the vegetation.

By adopting a vegetated face to a retaining structure, significant savings of up to 75% can be achieved over more traditional forms of construction.

The TensarTech™ GreenSlope System can provide practical solutions to challenging project demands.

Construction using standard equipment and materials keeps cost and time to a minimum.

With construction successfully completed, the TensarTech GreenSlope is ready for the vegetation stage.

By selecting vegetation to suit local conditions TensarTech GreenSlope soon begins to establish its green face.

Long-term Solutions and Advice for Difficult Schemes and Projects

With the TensarTech™ GreenSlope System, designers are given alternative solutions to conventional construction methods such as concrete or gabion faces.

The cost effectiveness and versatility of TensarTech GreenSlope, along with expert advice and a design service, ensures that your scheme can be completed without compromise to both finish and stability.

Typically structures such as these are considered to have a 60 year design life. However, designers may rest assured that there are Tensar geogrids available, providing the core stability, which have been independently assessed and certified for use in structures with a design life up to 120 years in the most demanding situations.

TensarTech™ NaturalGreen System rapidly blends into the surroundings of your scheme.

TensarTech™ NaturalGreen Earth Retaining System Makes Light Work of It

The TensarTech NaturalGreen System has proven performance and advantages in the building of slopes of up to 45°.

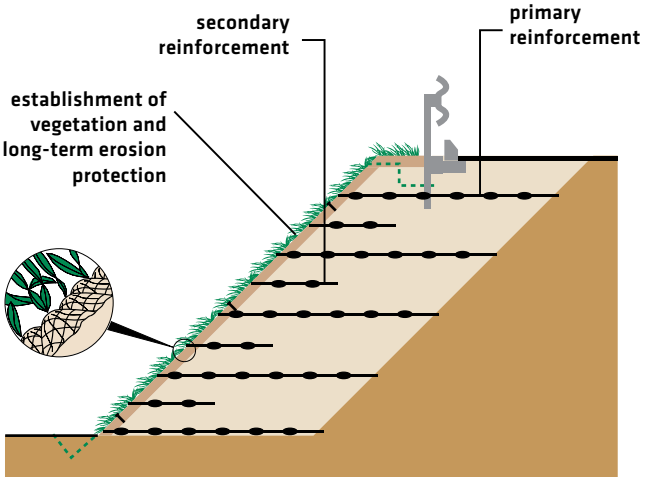
Long-term stability can be simply achieved through the use of horizontal layers of geogrid placed within the soil mass.

The surface matting can ensure that vegetation and root systems are given the optimum amount of support and moisture retention necessary for productive and established growth on the slope surface.

Tensar is keen to give advice throughout the design planning and construction stages giving you the opportunity to optimise design life and cost effectivness.

Further advantages of the system can include shorter construction times, an attractive appearance and all the environmental and sustainability benefits of using site-won or reclaimed fill materials where appropriate.

- Built using conventional embankment construction techniques
- No formal face leads to faster construction
- Heavy plant may work right up to the face
- Easy and accurate face trimming



The presence of the non-biodegradable Tensar Mat in the root system helps to protect the slope from erosion.

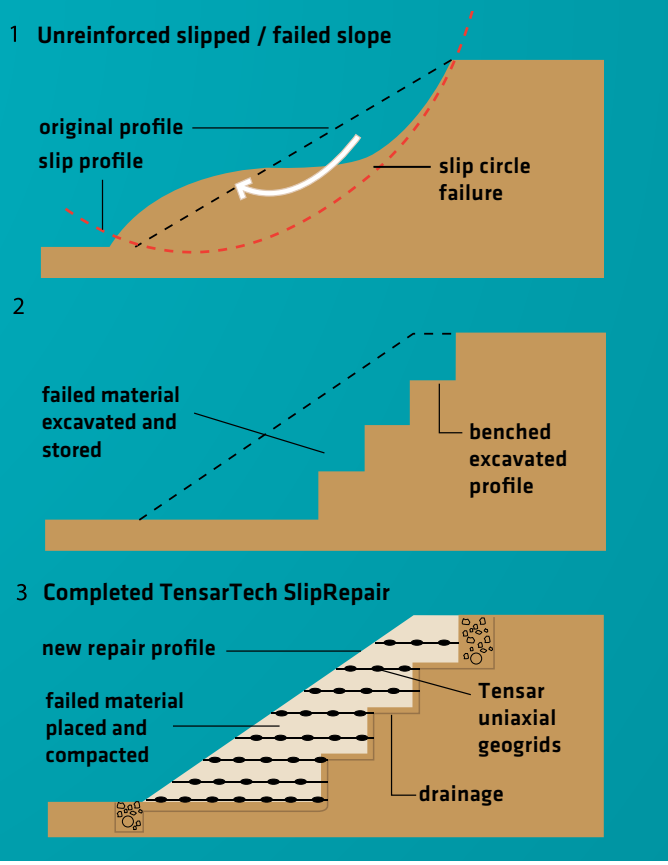
The system allows shorter construction times and reduced traffic disruption.

Avoid Slip Ups when Repairing Soil Embankments and Cuttings

Traditionally slip repair techniques are both time consuming and environmentally damaging, involving the excavation and off-site transportation of failed fill material. Replacing these materials often with imported granular fill results in high carbon emissions and can incur landfill and aggregate taxation and prove more costly due to extended build times. The TensarTech™ SlipRepair System involves excavating soil in the failure zone, replacing it and reinforcing with geogrids. This significantly reduces the need for additional imported fill. The system can provide a cost effective and time saving alternative with reductions in traffic disruption and off-site movements.

- Reduction in off-site tipping
- Reduction in imported fill
- Less transportation costs and pollution
- Minimising traffic disruption and lane closures
- More economic than traditional methods by up to 75%
- Meeting sustainable construction objectives
- Reduction in carbon emissions

A TYPICAL SECTION THROUGH A TENSARTECH™ SLIPREPAIR



The **Tensar**Tech SlipRepair System – Not Just a Pretty Face

TensarTech SlipRepair System minimises off-site disposal of soil and the import of fill.

Appropriate face detailing allows vegetation to quickly establish.

The TensarTech SlipRepair System produces a structure that is not only stable but also naturally attractive.

TensarTech™ Systems – Combination Structures

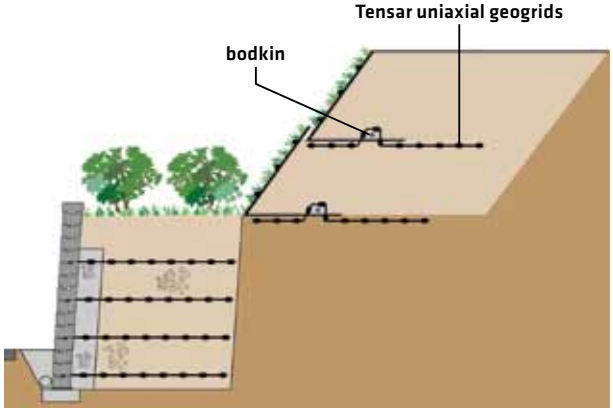
TensarTech™ Earth Retaining Wall and Slope Systems can provide cost effective and attractive solutions to problems in their own right. However, by combining walls with slopes or by terracing, the aesthetic potential for the finished project grows.

Terracing provides space for larger planting such as trees and shrubs.

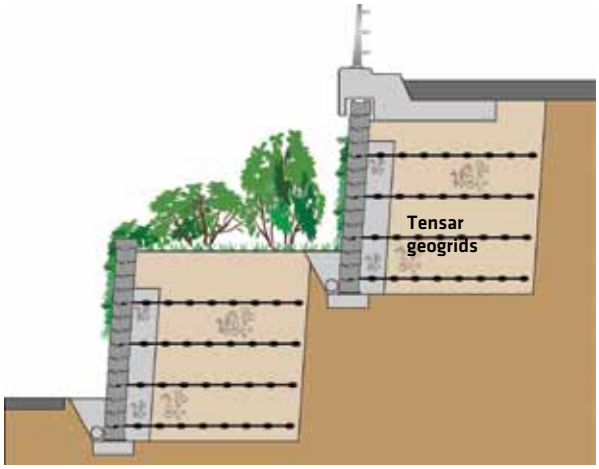
Contrasting the hard durable face of TensarTech Wall Systems with the 'green' vegetated face of TensarTech Slope Systems allows advantage to be taken of both. The resilient face of a concrete-faced wall may be utilised adjacent to the live carriageway where pollutants and salt spray may be present and maintenance needs to be low; whereas two or three metres above this, the softer vegetated face of the slope enables the overall structure to blend sympathetically into suburban or rural surroundings.

If you add into this the ability of the TensarTech Systems to form sweeping horizontal curves the options for attractive 'out of the ordinary' structures become even greater.

You can combine layouts and face options with the confidence that the structure relies on the proven performance of TensarTech Earth Retaining Systems.



Positioning the wall adjacent to traffic for durability with the vegetated slope located for aesthetic effect.



Terracing wall structures to allow planting of trees and large shrubs.

Our wide range of aesthetic and environmental solutions means we can help you to satisfy local planning and approval issues.

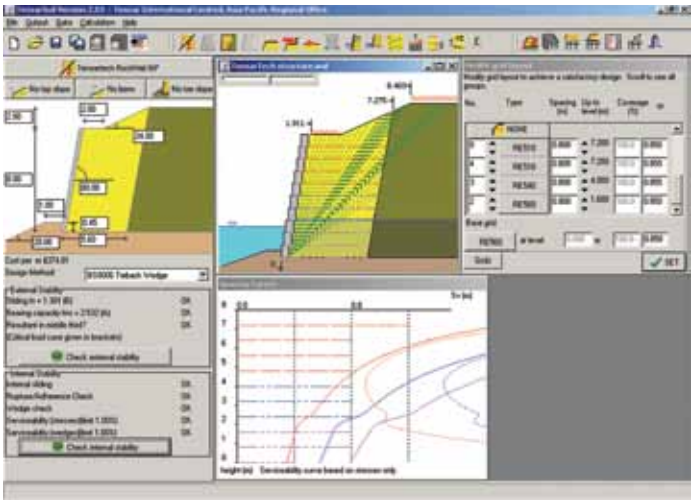
Design and Supply Service

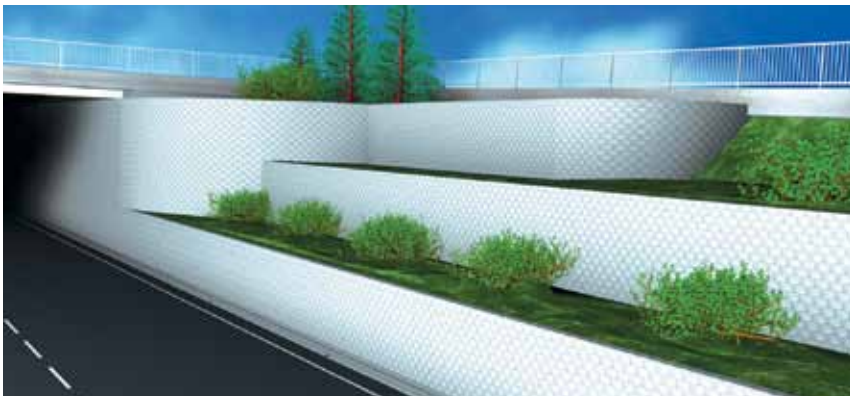
Tensar's experienced civil engineers are available to help take your scheme on to the next stage. Our Design office is on-hand to provide standard Application Suggestions to prove viability and enable planning costings, right through to fully indemnified Design and Supply. We can provide all necessary design certification and working calculations in a form ready for checking, with drawings issued for construction as well as all the crucial specification and installation details.

TensarSoil™ Design Software

Over the last 30 years Tensar has developed some of the most sophisticated reinforced soil design software in the world. This has been used in-house to provide clients with economically efficient, accurate and timely Application Suggestions, assisting in scheme design from feasibility right through to construction.

A version of this TensarSoil™ software is now available to designers and specifiers. You can receive your copy of TensarSoil design software by contacting your local Tensar International representative.





Contact Tensar® International or your local distributor to receive further literature covering Tensar products and applications.

Also available on request are product specifications, installation guides and specification notes.

The complete range of Tensar literature consists of:

- **Tensar Geosynthetics in Civil Engineering**
  A guide to products, systems and services
- **Ground Stabilisation**
  Stabilising unbound layers in roads and trafficked areas
- **TriAx®: A Revolution in Geogrid Technology**
  The properties and performance advantages of Tensar® TriAx® geogrids
- **Asphalt Pavements**
  Reinforcing asphalt layers in roads and trafficked areas
- **TensarTech Earth Retaining Systems**
  Bridge abutments, retaining walls and steep slopes
- **Railways**
  Mechanical stabilisation of track ballast and sub-ballast
- **Foundations Over Piles**
  Constructing over weak ground without settlement
- **Basal Reinforcement**
  Using Basetex high-strength geotextiles
- **TensarTech Geocell Mattress System**
- **Erosion**
  Controlling erosion on soil and rock slopes

Your local distributor is:

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