



## **TENAX T-BLOCK** RETAINING WALL SYSTEM FOR GEOGRID REINFORCED BLOCK WALLS

# T-BLOCK SYSTEM: THE SOLUTION FOR REINFORCED WALLS

**T**he reinforced soil technique is a construction method that is thousands of years old and has in the past used different types of soil reinforcing materials. Today's geosynthetics, in particular the use of geogrids and the structures designed to use them, are the subject of well researched mathematical solutions. Several types of construction systems utilise the concepts of soil reinforcement. Amongst them, are soil reinforced block wall systems that make use of concrete blocks at the face and incorporate geogrids as reinforcing elements. These systems have proven to be extremely viable from technical, aesthetic and economic standpoints.

The T-Block Retaining Wall System is unique and can be considered as a state of the art system, developed from the joint cooperation between two of the most experienced and qualified companies in the market: **TENAX** and **Geoblock**. The cooperation between the two companies has allowed the development of a unique system that delivers the maximum possible benefits and advantages when combining the use of geogrid reinforcement with concrete block components. The T-Block Retaining Wall System offers the best block, the best geogrid and the best connection system, fully supported by a comprehensive professional design approach.

*Photo 1: Ireland - The T-Block System optimises the cost and space availability within site boundary constraints.*

*Photo 2: Seoul, Korea - This wall shows the flexibility of the T-Block system that maximises the use of a small busy urban area. The strikingly curved, multi-layered wall geometry provides the local residents with ample parking facilities and aesthetically pleasing recreational areas.*

**The T-Block unit design** (by Geoblock) utilised by the system has been successful and proven since 1990 in a variety of wall applications from bridge abutments wing walls, railway platform extensions, water facing walls and many other applications, all further demonstrating its versatility.

**The integrated mono-oriented geogrid** (by TENAX) is manufactured in a continuous process with cross directional bars homogeneously connected to the high tensile longitudinal strands to form a monolithic structure.

Finally, a 100% mechanical connection technology delivered by the simple TENAX patented **T-Clip connector**, attaches securely to the TENAX geogrid and is locked into place between the blocks.





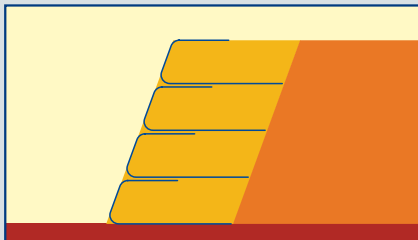
# T-BLOCK SYSTEM: THE BENEFITS

The T-Block Retaining Wall System offers many advantages to clients, specifiers and contractors when compared with traditional methods such as reinforced concrete in retaining wall applications:



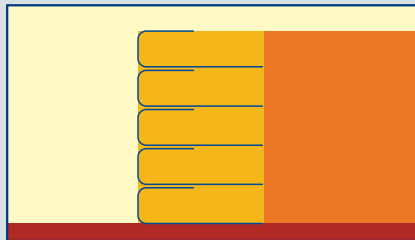
- ▶ Proven and recognised reinforced soil technique with numerous worldwide successful projects;
- ▶ Possibility of using site-won backfill, therefore providing further savings;
- ▶ Fast and easy to construct;
- ▶ Area behind wall can be trafficked straight away;
- ▶ Structures designed for 120 years life;
- ▶ No practical height limitations;
- ▶ Simple construction method that requires no specialist skills;
- ▶ Large cost savings over traditional reinforced concrete solutions;
- ▶ Can be designed for all surcharge loading applications;
- ▶ Variety of facing types to suit client requirements;
- ▶ Better resistance to dynamic effects arising from seismic activity.

## WALL SELECTION GUIDE



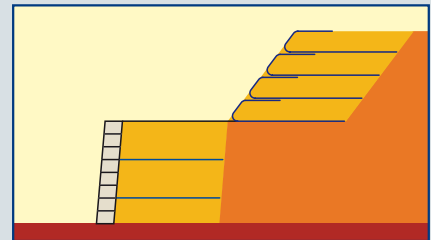
### Wrap-around vegetated slopes (from 45° to 70°)

- ▶ Low environmental impact
- ▶ Fast installation
- ▶ Possibility to modify the slope's geometry



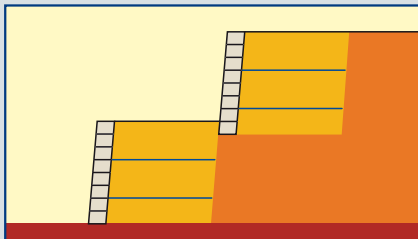
### Wrap-around vegetated slopes (from 70° to 90°)

- ▶ Low environmental impact
- ▶ Fast installation
- ▶ Possibility to modify the slope's geometry and its natural angle of repose



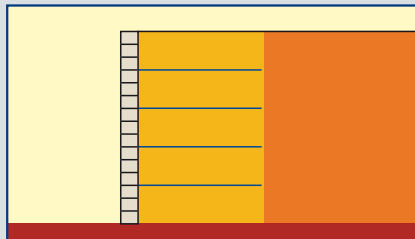
### Walls and vegetated slopes (from 45° to 90°)

- ▶ Possibility to create any combination of wall and slope profiles to satisfy both the design concept and the environmental needs
- ▶ High durability



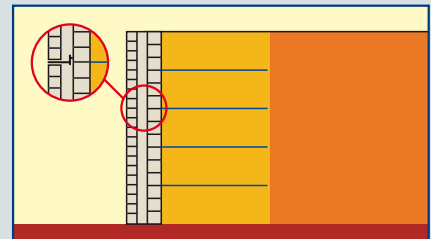
### Terraced walls (from 82° to 90°)

- ▶ Ideal for residential developments
- ▶ Cost savings versus other method
- ▶ High durability



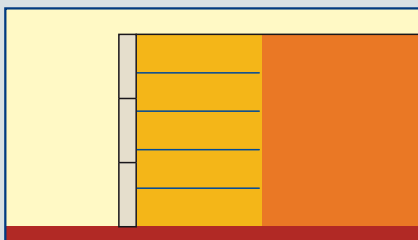
### Modular concrete blocks (from 82° to 90°)

- ▶ High factor of safety
- ▶ Suitable to minimize land take
- ▶ Possibility to include wall patterns through coloured concrete or pigmented blocks



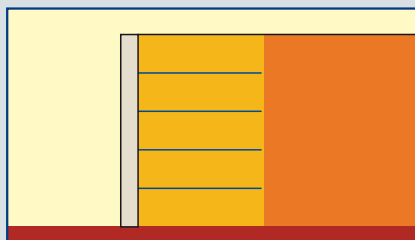
### Modular concrete blocks with custom dad facing (90°)

- ▶ Possibility to create any combination of wall and slope profiles to satisfy both the design concept and the environmental needs
- ▶ High durability



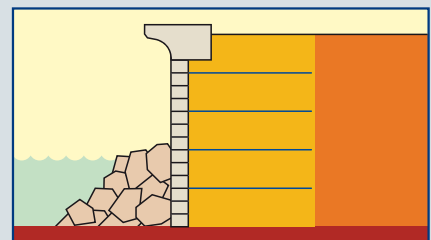
### Incremental concrete panels (90°)

- ▶ Possibility to use panels factory produced or cast on site
- ▶ Fast installation



### Full height concrete panels (90°)

- ▶ Geogrids precast into panels at design levels to speed up installation even further
- ▶ Panels allow for the inclusion of detailed architectural/decorative designs on the face of the structure without interruption



### Marine units (from 82° to 90°)

- ▶ The T-Block system is well suited for extreme conditions associated in marine environments
- ▶ Specially made marine units require no face support during installation

# THE COMPONENTS OF T-BLOCK SYSTEM

The T-Block Retaining Wall System features a modular precast concrete block facing unit, a polymeric T-Clip connector and layers of **TENAX TT SAMP** geogrid reinforcement material.

## THE REINFORCING ELEMENTS: TENAX TT SAMP MONO-ORIENTED GEOGRIDS

The **TENAX TT SAMP** mono-oriented geogrids are two-dimensional polymer structures manufactured from HDPE (High Density Polyethylene) by a process of extrusion and mono-directional drawing. The geogrids are certified for the reinforcement of the soil mass behind the wall by major international organisation. Soil and aggregate interlock within the geogrid openings, which confine the soil, limit its relative displacements and increase the soil's shear stress resistance. The soil/ geogrid structure integrates the fill soil's high compressive strength with the geogrid's tensile strength, thus creating a material having greater rigidity and stability and improving the structure's resistance to static and dynamic loads.



## CONNECTION STRENGTH

The design of the T-Block connection system is the result of seventeen years experience making mechanical connections between HDPE geogrids and segmental concrete blocks. This experience with loose connectors grids and blocks led us to increasing the simplicity by making smaller connectors which clip onto the geogrids thus making two parts into one. This enables the grid with the connectors to be laid on the blocks and secured in position with the next layer of blocks very easily. The mechanical connection is important as it allows the system to be used in seismic areas and optimises the design by allowing the full long term strength of the geogrids to be used in the geotechnical design of

the structure. By using a straight through path for the geogrids the blocks sit level on the geogrids and so eliminate rotation of the wall common with some other systems.



TENAX TT SAMP GEOGRIDS CONNECTION STRENGHT						
Characteristics	u.m.	TT045 SAMP	TT060 SAMP	TT090 SAMP	TT120 SAMP	TT160 SAMP
Connection Strenght	kN/m	40,0	54,0	81,0	110,0	125,0
Long Term Design Strenght	kN/m	21,2	28,3	42,4	56,5	75,4
Tensile Strenght at 2% strain	kN/m	11,0	17,0	26,0	36,0	45,0



## THE T-BLOCK WALL UNITS

The **T-Block units** are high strength pre-cast concrete modular facing units with a compressive strength of 35 kN. Each T-Block unit has a face area of 0,06 m<sup>2</sup> (0,15x0,40 m) and consists of a groove formed in the bottom of the block and a locating rib (or tongue) formed in the top of the unit. This "tongue and groove" connection allows many T-Block units to be securely inter-connected, thereby forming a locked vertical face.

The concrete have a minimum compressive strength of 35kN. Moisture absorption is less than 5%.

Pigments used in the concrete are iron pure oxides or, if green or blue, chrome oxides. Plasticizers and water profer may be used, but sodium accelerants are not suggested.

Aimed at satisfying the most demanding markets worldwide aesthetically and technically, it's possible to deliver a range of existing blocks or custom-design blocks for specific market needs.



1. Split faced block.  
2. Triple split faced block.  
3. Smooth faced block.

4. Dry stone faced triple block.  
5. Trapezoidal flute block.  
6. Resoil block.

## THE T-CLIP CONNECTORS

One of the most critical areas for retaining wall structures is the connection strength between the geogrid reinforcement and the block wall facing units.

The TENAX patented **T-Clip connectors** deliver a 100% effective mechanical connection with the geogrids and the T-Block units to form a totally integrated system.



## THE FILL MATERIAL

Typically constructed using compacted granular backfill, selected site-won or imported material. There is also the opportunity to use carefully selected recycled or stabilized backfills within the reinforced soil mass, thereby dealing with environmental pressures concerning the use of natural resources.

# CONSTRUCTION SEQUENCE

A fully detailed construction sequence is available on request. However, a brief summary is provided below:

## Excavation

- ▶ The subgrade shall be excavated vertically to the plan elevation and horizontally to the designed geogrid lengths.
- ▶ Over excavated and filled areas shall be compacted to a minimum of 95% Standard Proctor Dry Density.
- ▶ Excavated materials that are used for backfilling the reinforcement zone shall be protected from the weather.

## Foundation

- ▶ The wall is built on a simple shallow

concrete levelling strip or compacted stone foundation below the wall face.

- ▶ The reinforced zone and levelling pad foundation soils shall be inspected by an engineer to ensure the proper bearing strength.

## Wall construction

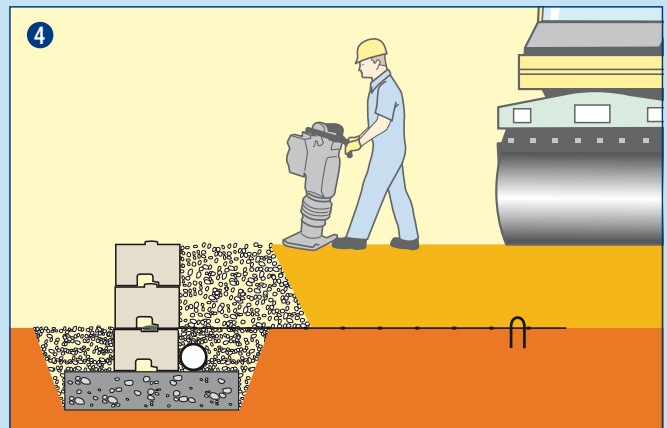
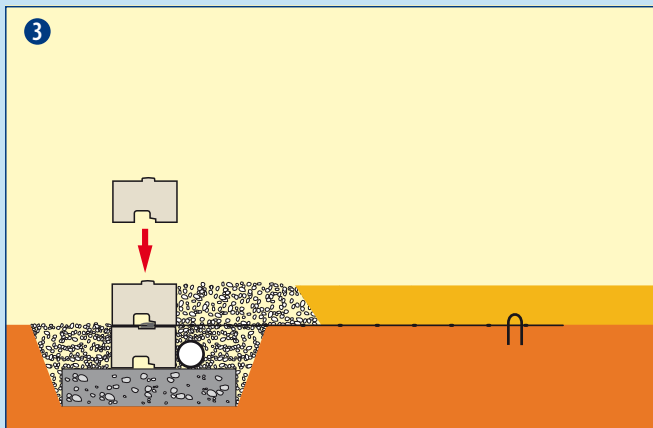
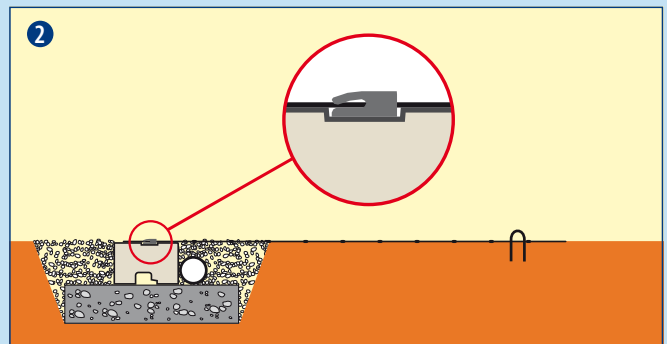
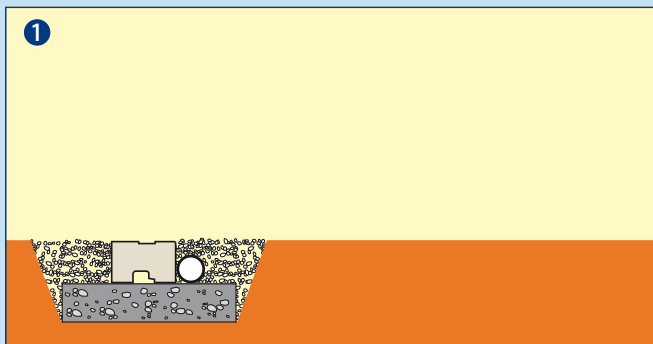
- ▶ The first course of blocks is then laid accurately to line and level on a thin bed of mortar.
- ▶ A perforated drainage pipe is installed at the base and surrounded by a gravel drainage layer.
- ▶ Following courses are laid by placing blocks and sliding the block into position.
- ▶ The first layer of selected fill material is then placed and compacted in

accordance with the specification, ensuring that any heavy rollers are kept away from the wall face.

- ▶ Fill within 2 m of the wall face is compacted with a small roller or vibrating plate.
- ▶ At specific design levels, TENAX geogrid reinforcement is cut to length and positioned with T-Clip connectors inserted to anchor the geogrid between the T-Block units.
- ▶ Construction of the wall continues, placing fill, geogrids and facing blocks, progressively to the top.

## Health & Safety

- ▶ When working at height, a suitable guard rail must be installed to ensure the safety of the work force.



*Photo 1: Available in a wide range of face styles and colours, the T-Block system can be built in a variety of architectural effects and finishes to match or complement the surrounding built environment.*

*Photo 2: Dubai - The walls for this clover leaf interchange were built with blocks designed by Geoblock and produced locally.*





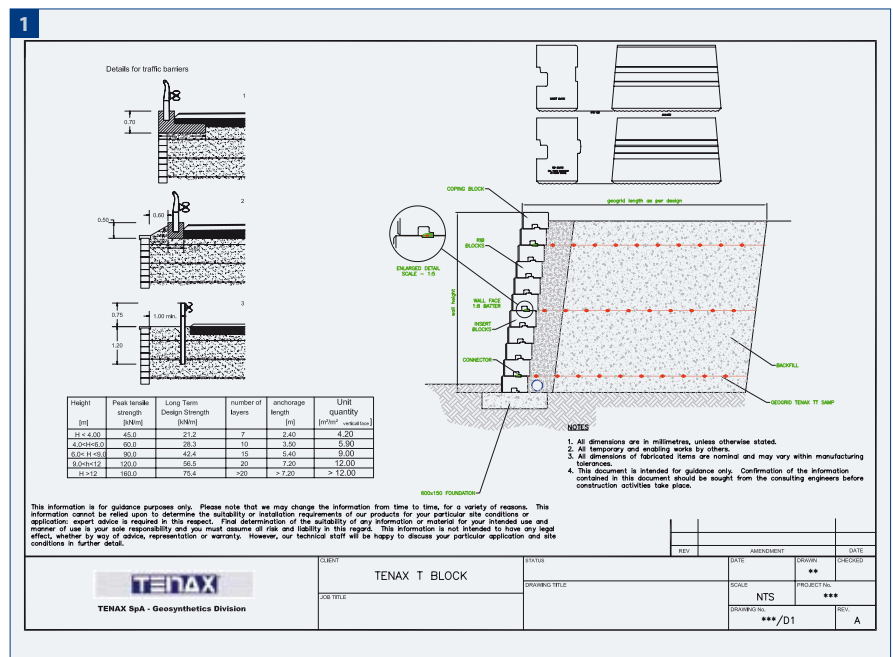
# DESIGN SERVICE

Whether your project is an embankment, a landfill, a highway or a retaining wall, TENAX carries out feasibility studies and application suggestions with the assistance of clients and consultants. TENAX is recognised as a world leader in this field, and the best solution for geotechnical and environmental problems. In order to solve engineering problems, the TENAX Geosynthetics Technical Office (GTO) will assist you in selecting, designing and developing technically appropriate and cost effective solutions. TENAX GTO can assist Engineers in their assessment of the proposed structure ensuring consideration is given to the drainage pathways in and around the structure; any additionally applied external loads and the overall global stability of the structure.

The TENAX Geosynthetics Division provides field and laboratory testing, construction, quality control and engineering analysis. Another important factor to be considered is that TENAX offers local support and services through its worldwide office network.

TENAX has built up a worldwide reputation for its excellence in the following areas:

- ▶ state-of-the-art geotechnical engineering services from field and laboratory testing to engineering analysis and construction procedures;
- ▶ engineers, geologists and environmental experts provide a balanced solution to any environmental project;
- ▶ educational seminars, design workshops and customized "in-house" training;
- ▶ specific software for designing Civil Engineering applications with TENAX geosynthetics.



- ▶ the TENAX design suite of software allows for increased flexibility to adjust design criteria to meet project requirements and specifications. This flexibility allows our Technical Engineers to determine the most cost-effective dimensions, vertical spacing and grade of reinforcement required to produce a safe, economical structure.

*Photo 1: Detailed constructions drawings produced for specific project conditions.*

*Photo 2: Dubai - Materials and design for the landscaping and structures on major road projects.*

*Photo 3: South Korea - Chunsugyo-Saebeari Highway: Geoblock segmental retaining wall System.*



TENAX is an international group which manufactures and supplies a wide range of geosynthetics certified by the major international technical organisations and used in projects of all sizes and complexities throughout the world.

Here are a few examples of uses of geosynthetics:

- ▶ the **stabilisation and consolidation** of collapsing sub-bases and the improvement of their bearing capacity (TENAX LBO SAMP, GT, MS);
- ▶ **horizontal and vertical** drainage via the transport of fluids and gases (TENAX CE, GNT, TENDRAIN, TN, TNT, TDP, NDP);
- ▶ the **reinforcement of embankments** of earth with a grassed surface or a surface of pre-fabricated blocks (TENAX TT SAMP, RIVEL SYSTEM, T-BLOCK SYSTEM);
- ▶ **erosion protection** and the planting of slopes (TENAX TENWEB, MULTIMAT).

Specialised technicians provide prompt, individual assistance from design through to construction, working with you to choose the right solutions for civil engineering and environmental problems.



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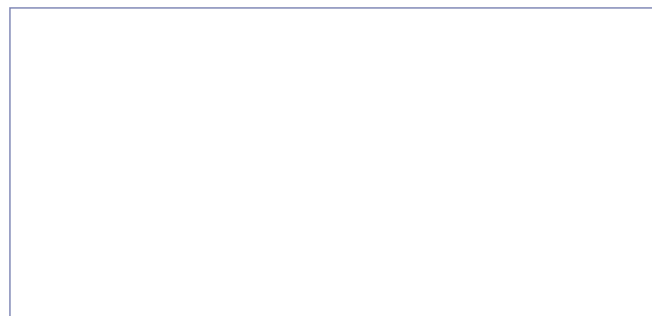


ISTITUTO PER LE TECNOLOGIE DELLA COSTRUZIONE

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I.T.C. is the Italian Body of UEAtc (Union Européenne pour l'Agrément Technique dans la Construction).  
The correspondent British Body is BBA (British Board of Agreement), therefore the I.T.C. Certification for TENAX geogrids shall be considered equivalent to BBA

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