TERRAFORCE®

The original, reversible, hollow core retaining block

the *living* retaining wall system

STANDARD

L11 - L12-

- L15 - L16

L13 - L18 - L22

ROCK FACE

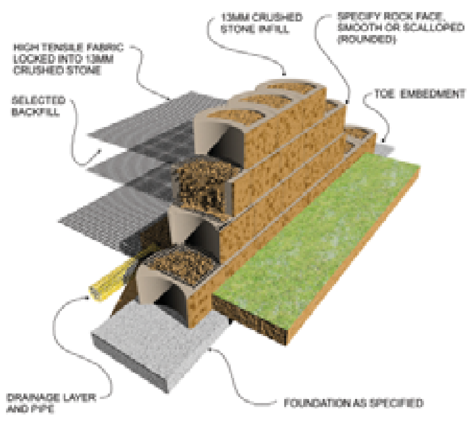
L11 - L12 -

- L15 - L16

L13 - L18 - L22

Design and Installation Manual

For Geosynthetic Reinforced Soil Applications
and for Gravity Retaining Walls



COMPOSITE RETAINING WALL
(EARTH REINFORCED WITH GEOGRID)

www.terraforce.com

INDEX

TERRAFORCE HAS BEEN SERVING THE CONSTRUCTION INDUSTRY FOR OVER 25 YEARS IN PROVIDING SUSTAINABLE AND ENVIROMENTALLY FRIENDLY EARTH RETAINING SOLUTIONS. OUR VERSATILE REVERSIBLE CONCRETE RETAINING BLOCKS HAVE BEEN IN PRODUCTION SINCE 1984 AND ARE NOW AVAILABLE ON 5 CONTINENTS.

ROADSIDE RETAINING

LANDSCAPING WITH SPLIT FACE BLOCK

REINFORCED RETAINING BELOW AND ABOVE ROAD

ROUND FACE MASS GRAVITY WALLS

COMPOSITE TERRACES AND WALLS

ROUND OR SPLIT FACE

TERRAFORCE®
The original, reversible, hollow core retaining block

COVER PHOTOS:
1. Composite terraces in split finish (Rock Face) incorporating stairs and feature planting on terraces.
2. Terraforce blocks supporting a major road in round face finish.

The generic designs which are described in this manual, and the design charts which are presented are suitable for construction of retaining walls within a specified height range, and presume good ground conditions.

The Terraforce system is suitable for retaining wall construction in a wide range of subsurface conditions which are beyond the scope of this manual. Walls with varying heights, which include geometric complications, and which involve difficult ground conditions can be successfully constructed using Terraforce blocks. However, the design of retaining walls for such systems should only be prepared by suitably qualified design professionals.

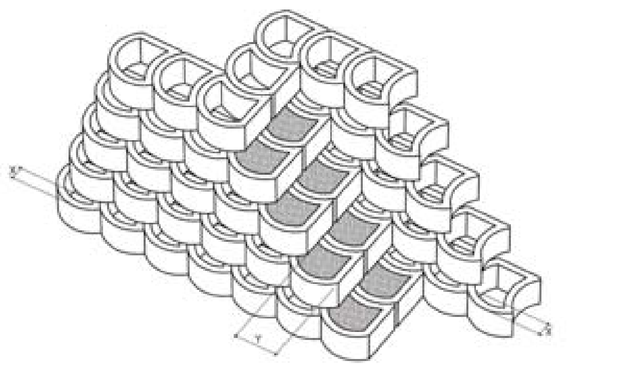
Your Terraforce supplier would be pleased to recommend an experienced, well-qualified professional engineer to assist you in these matters.

Terraforce walls higher than 1.2 m (4 ft) should be constructed with the assistance of, or under the supervision of experienced, qualified personnel. Your Terraforce supplier can also assist you in selection of contractors, or put you in contact with experienced site personnel to train and direct others in construction techniques.

The popularity of modular masonry units to provide the fascia of soil-reinforced segmental retaining wall systems has been growing progressively in the recent past, primarily due to their adaptability, attractiveness, ease of construction by manual means, durability and their economical cost.

In common with other fascia systems, Terraforce units are durable, are capable of inclusion in retaining systems which have been constructed to heights of up to 20m (60ft), are suitable for construction in areas which are remote from the supply of conventional construction materials such as concrete, have a long service life, and provide an economical alternative to conventional construction. In addition to these proven advantages of modular masonry fascia units, Terraforce provides several unique advantages which offer an even wider range of use and enhanced flexibility in layout design. By virtue of their unique, horizontal interlocking design, the Terraforce units can be laid in a variety of profiles ranging from straight lines to circles, concave or convex curves to serpentine walls. From vertical face walls to walls with varying degree of setback, from fully integrated stairs to free standing walls, all are created never having to cut or split a unit.

Sharp or wide, convex or concave curves are formed by simply turning each unit within the half-moon interlock. Design options are limitless with Terraforce because the unique shape allows straight or stagger bond, and wall angles from vertical to a 30° slope.

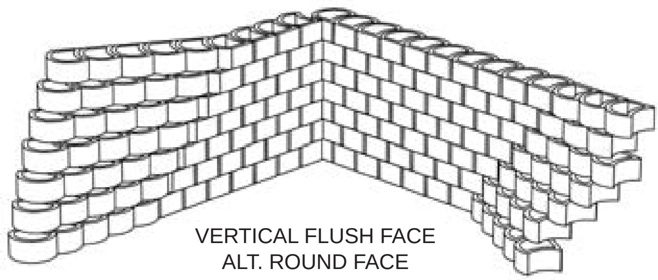


Use this detail to create stairs down a Terraforce wall.

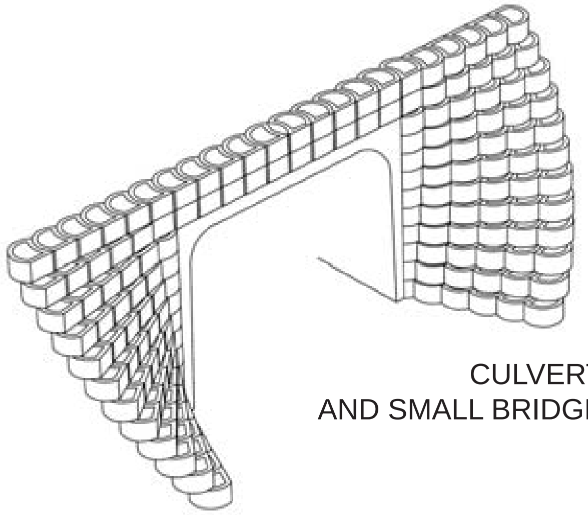
Several colors and two architectural textures offer unlimited design options.

A unique feature of a full or partially planted wall can be attained by filling these hollow units with topsoil. Various plants, flowers and ground covers can be used to create a "Living Wall" as part of an overall Landscape design.

In designing gravity structures, shear keys can be employed with Terraforce units to enable the fascia to be constructed at various angles of inclination as well as to develop vertical interlock between successive courses of masonry units. This results in economical construction for the given height of the wall. The flexibility of Terraforce allows variations in inclination from vertical to a shallow angle. Refer to the following illustrations.

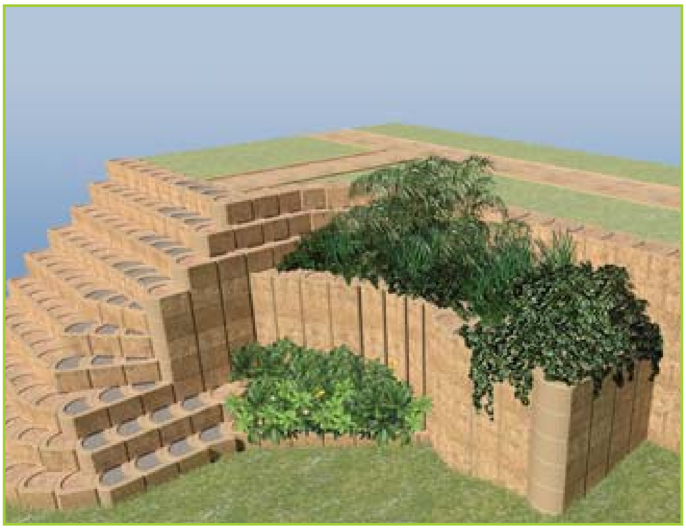


INTERNAL VERTICAL CORNER



CULVERTS
AND SMALL BRIDGES

TERRAFORCE®
The original, reversible, hollow core retaining block



PRODUCT DESCRIPTION

A. Technical Specification

BLOCK TYPE / UNITS PER SQ.M OF WALL			L13/13	L18/18	L11/11	L22/22	L15/15	L12/12	L16/16
LENGTH	B(W)	mm	425	350	350	300	295	300	260
COVER	A	mm	340	280	400	230	335	290	300
HEIGHT	h	mm	225	200	225	200	200	210	200
WALL THICKNESS		mm	50	45	45	40	45	45 - 50	45
AVE. MASS OF BLOCK		kg	32	20	30	16	23	24	20
INFILL VOLUME		m^3	0.018	0.011	0.016	0.006	0.0083	0.011	0.005
AVE. MASS OF CONCRETE kg per m^2 of wall (SINGLE SKIN)			410	360	320	350	330	290	440
AVE. MASS CONSTRUCTED kg per m^2 of wall (SINGLE SKIN) INFILL = SOIL 1500kg/ m^3			760	660	580	550	510	490	500
AVE. MASS CONSTRUCTED kg per m^2 of wall (SINGLE SKIN) INFILL = GRAVEL 1900kg/ m^3			854	736	654	600	558	540	592
AVE. MASS CONSTRUCTED kg per m^2 of wall (SINGLE SKIN) INFILL = CONCRETE 2200kg/ m^3			925	775	707	640	594	580	616
AVE. MASS CONSTRUCTED kg per m^2 of wall (DOUBLE SKIN)			CHOOSE INFILL AND DOUBLE UP ON ABOVE FIGURE						
MIN. CRUSHING STRENGTH OF BLOCK UNDER IN SITU LOADING/MPa			11	11	11	11	11	11	11
21 DAY CUBE STRENGTH OF CONCRETE (UNCURED)			25 MPa min						
MIN. FRICTIONAL RESISTANCE BETWEEN BLOCKS WITHOUT KEYS: Cf			0.54	0.54	0.54	0.54	0.54	0.54	0.54

B. Quality Control

Terraforce blocks are available worldwide from a number of selected, pre-approved manufacturers. Each licensed manufacturer is required to apply strict control on all aspects of production including:

- Physical properties and dimensions which may vary according to manufacturer;
- The quality of the materials used in manufacture;
- The maintenance of dimensional standards for product integrity, and;
- A comprehensive testing program on completed masonry units to confirm that they meet or exceed the product strength requirements.

These matters are addressed in a strict quality assurance protocol which has been put in place to satisfy the user that the product they use will assuredly meet the demanding strength and dimensional control requirements of the system. Quality Control test results are available upon request from your Terraforce supplier.

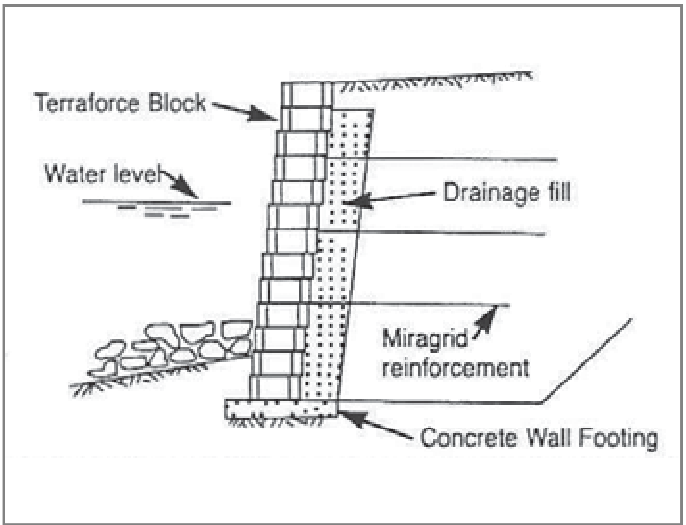
C. Non-Standard Requirements

Modifications can easily be made to the concrete mix design to suit specific applications, e.g. where a wall is to be constructed in an aggressive environment. Your Terraforce supplier will be able to assist you in meeting any special needs imposed by your own particular situation. Custom coloring is available from most manufacturers, given sufficient quantities.

As well as use in construction of earth retaining walls, the Terraforce masonry units can be used to construct aesthetically pleasing noise barriers and physical separation walls due to their ability to sustain vegetation. Likewise, they provide an excellent enclosing wall for raised flower beds as well as other landscaping features. Free-standing vertical walls, intergrated stair systems, concave, convex or serpentine walls are achieved easily using this uniquely shaped block, without ever cutting or splitting a unit. This single shaped system offers the most flexibility available in segmental retaining wall systems.

Terraforce segmental retaining wall units can also be used as a fascia in side liners to water bodies such as channelized streams, artificial lakes and ponds, etc. In this case the Terraforce units must be filled with concrete or well graded gravel, the wall foundation should consist of reinforced concrete, and the foundation must be protected from scour by placing a protective blanket of rip rap at the toe of the wall.

The Terraforce segmental retaining wall system uses gravity to resist the sliding action of the soil which is retained. The weight of soil-filled units creates sufficient mass that under normal soil conditions the Terraforce wall can attain heights of 3m and over at varying angles and soil conditions. Separate design tables (see Appendix 'C') and a comprehensive Terraforce manual is available to deal with these



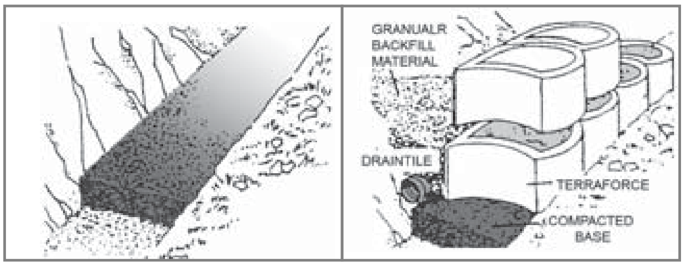
conditions. This manual has been compiled for greater wall heights or steeper wall angles necessitating earth reinforcing techniques. Using a qualified engineer is recommended for these situations. A variety of uses of Terraforce units is illustrated below.

BEACH STABILISATION AND ACCESS

HIGHWAY STABILISATION

The design for such installations should be prepared by an experienced professional engineer who will provide a design which will prevent a build-up of hydrostatic pressures, filtration compatibility between fills, and infill soil reinforcement, on a site-specific basis.

As noted in the introduction, the constructed Terraforce segmental retaining wall creates a flexible gravity structure capable of withstanding repeated freeze-thaw and moderate differential movement. Where the native soil has good bearing characteristics and does not consist of frost susceptible soils (e.g. silt or topsoil) or, in situations where the native soil consists of compact sand or gravel, or stiff clay soils, shallow-bury foundations are appropriate. Where the shallow-bury option is adopted, a compacted crushed stone (granular) mattress or pad may be constructed to provide the foundation element of the wall. See the following illustration.



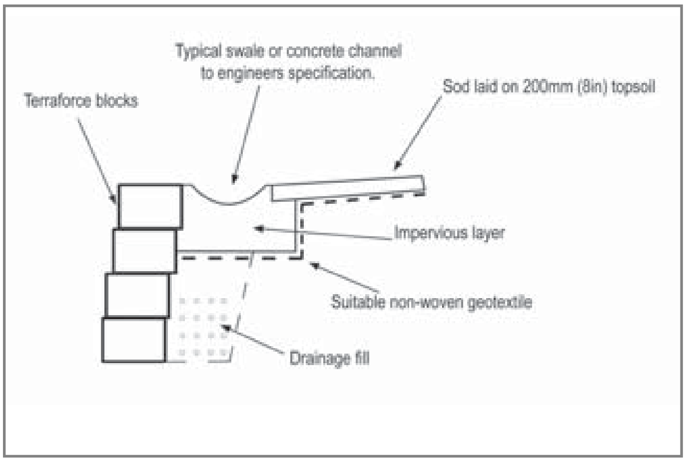
Foundation installation is critical to the stability, appearance and service life of a Terraforce segmental retaining wall. Thus, care must be taken to remove all unstable soils from under the footing and replace with a well compacted minimum 600 mm wide granular pad with a minimum thickness of 150 mm. The finished grade (i.e. elevation) of the granular pad must be deep enough to allow the base course of Terraforce units to be partially buried. Normally 30mm of the base units buried per 300mm of wall height.

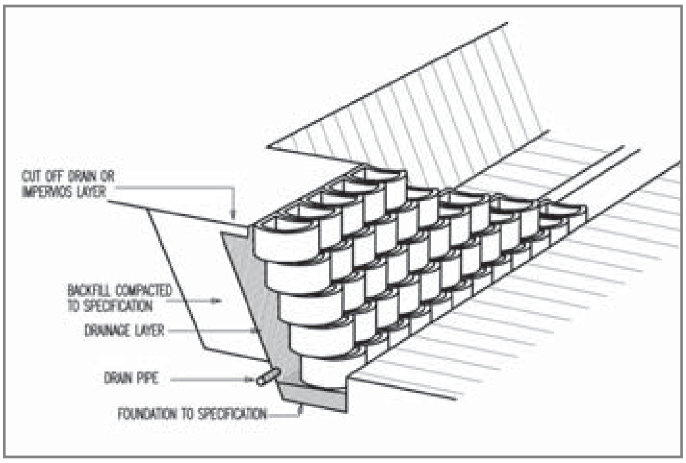
Where the soils consist of loose sand or gravel, firm to stiff silty clay, or if the native soils are frost-susceptible you should seek assistance from your Terraforce supplier. In such situations a professional design would be recommended, and in many situations this will consist of a granular mattress foundation which may incorporate a cellular confinement system.

Rigid (concrete) foundation systems must always be fully protected from contact with freezing temperatures, and thus a full frost cover to the foundation is required. This option is commonly used in some countries and to a certain extent would reduce the flexible nature of the modular retaining wall.

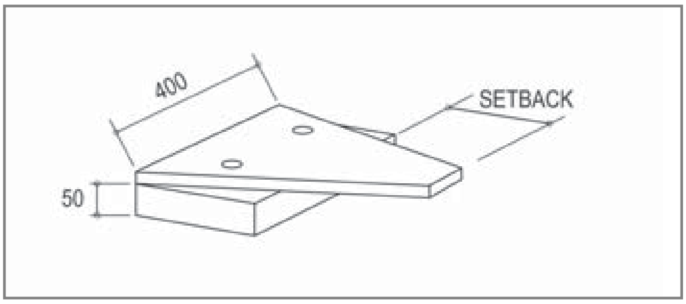
4.2.Drainage

The design of Terraforce retaining wall systems presumes that there will be no build-up of hydrostatic pressures on the rear face of the retaining wall fascia, i.e. the retained soil will be drained. This requirement is generally achieved by placing a prism (chimney) of free draining materials on the retained side of the wall to collect water which may enter the system, and channel this to a collector drain. The collector generally disposes of the water through a series of outlets at the base of the wall or at the end of the wall. A typical system is illustrated below. If your site is in a wet condition, or is subject to high groundwater table, you should consult a qualified design professional.





In order to construct the wall to a constant gradient, each course must be set back from the underlying course by a constant width. This is known as "the setback" and is established in the field by construction of a simple gauge, as is shown below.

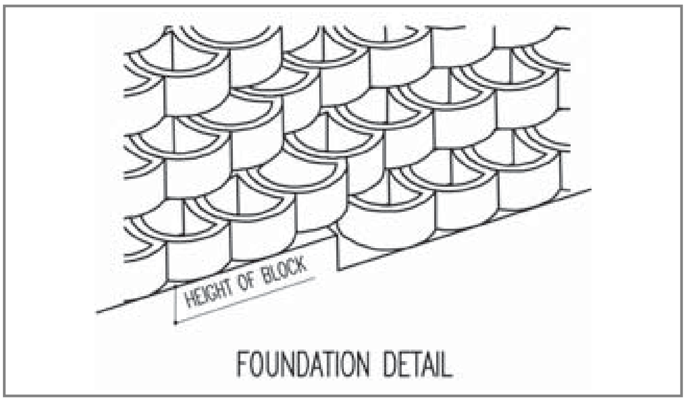


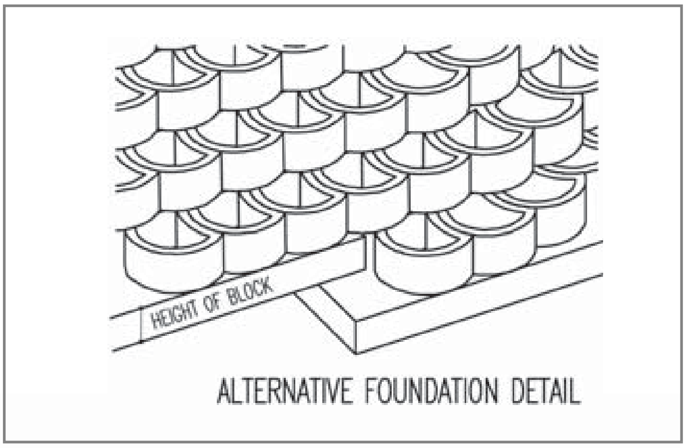
4.4 Shear Keys

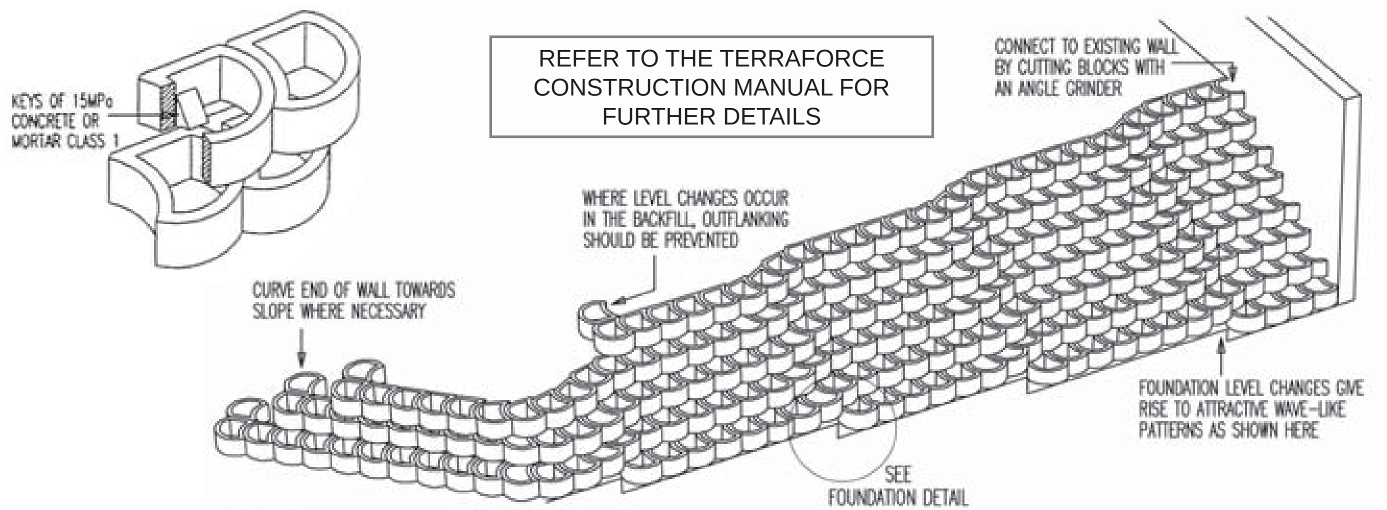
Insitu of 15 MPa, concrete or mortar may be placed where specified. See illustration below. Concrete brick can be used as a shear key and will provide a consistent fascia setback.

Concrete keys can substantially increase the shear resistance of walls and provide a positive vertical interlock at most wall inclinations. When walls are steeper than 75º it may be difficult to install the keys and a 13 - 16mm gravel infill should be specified to take over the vertical interlock function where required. Horizontal interlock is achived through the ball and socket effect of the uniqely shaped Terraforce units. The end result is a mortarless dry stack system with positive interlock in all directions, unlike other systems that offer only vertical interlock.

In order to collect and dispose of stormwater run-off, a swale or concete channel should be constructed in the backslope immediately above the crest of the retaining wall. This swale should be directed to dispose of stormwater to the local system. Often this will involve constructing the wall with a high point and providing a gradient along the crest of the wall. A typical detail of a drainage swale is given on page 10.





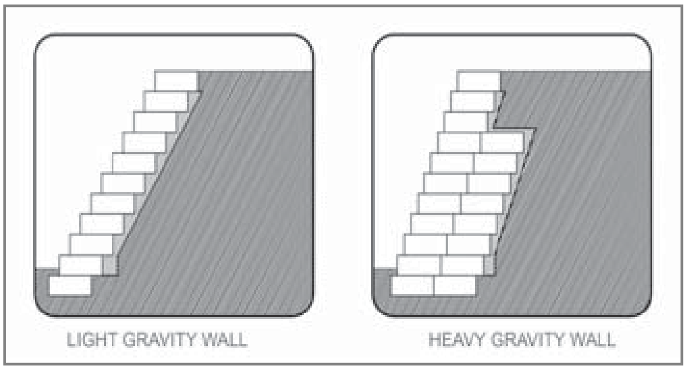


5.0 GENERAL

In retaining systems which are more than 1.2 m high, the Terraforce unit can be used as part of either a gravity system or as the fascia of a geosynthetic reinforced segmental retaining wall structure or as a fascia for a cement stabilized backfill.

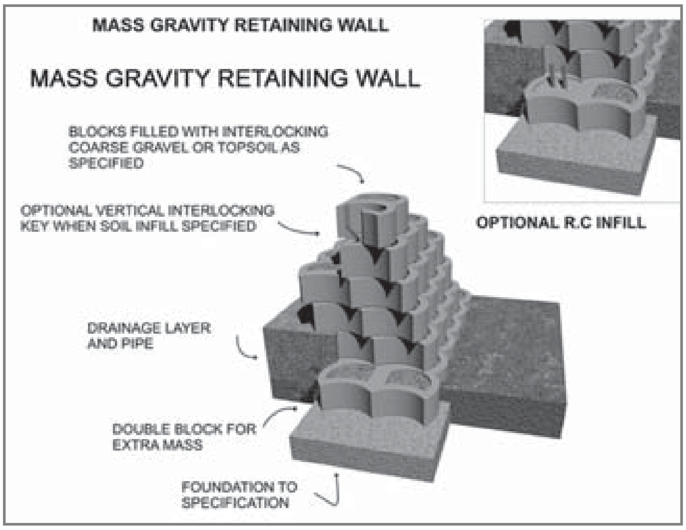
5.1 Gravity Retaining Walls

Gravity retaining walls rely on their self-weight to resit lateral earth pressure, and such walls have been in use for centuries. Many different construction materials have been used in gravity walls. Most similar to the use of Terraforce in this situation is the (centuries old) traditional use of unreinforced bricks or dressed stone as the construction medium. In a gravity system the Terraforce masonry units can be stacked several courses deep to provide support to the forces imposed by the retained soil; the weight and geometry of the stacked units prevent the constructed wall from sliding on its base or at an intermediate height, toppling over, or rotating out of position.



Unlike a reinforced concrete retaining wall, which is usually designed to resist bending moments, a gravity wall resists the thrust imposed on it by the backfill by virtue of its own weight only. A certain amount of movement of the wall is required to mobilise the vital resisting forces. Under normal circumstances it is assumed that the material retained is free draining and that water pressure is prevented from building up behind the embankment.

Due to the inherent flexibility of the wall, it is not usually possible to compact the backfill fully at construction stage. Consequently, some degree of settlement over time is inevitable and this should be borne in mind when proposing rigid structures close to the top of the wall. This is why it is sometimes important to stabilise the backfilled material with cement to ensure little or no settlement.



As with any retaining wall, adequate drainage of the backfill and equally importantly, adequate surface water removal is absolutely essential to the proper functioning of the wall. The integrity of any retaining wall is very sensitive to the “angle of internal friction” of the retained material. The angle of internal friction in turn is severely compromised by increased moisture content and by sub-standard compaction. Effective compaction in turn is only possible behind blocks with a closed vertical surface structure.

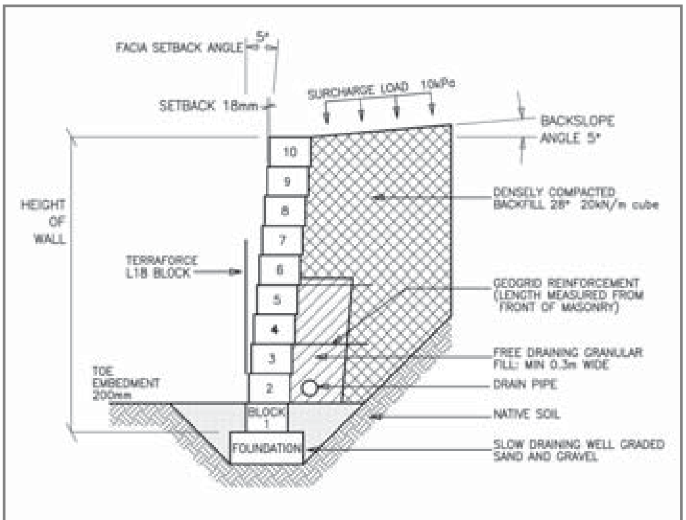
Information relating to the design of single block width gravity retaining walls is given in the publications “Guide to Terraforce L13 retaining walls” and “Basic design charts for Terraforce gravity walls” are attached in appendix “C”. Designs which feature multiple rows of blocks should be prepared on a site specific basis by an experienced professional engineer. Attention is drawn to a Terraforce publication that may assist in the preparation of such site specific designs:

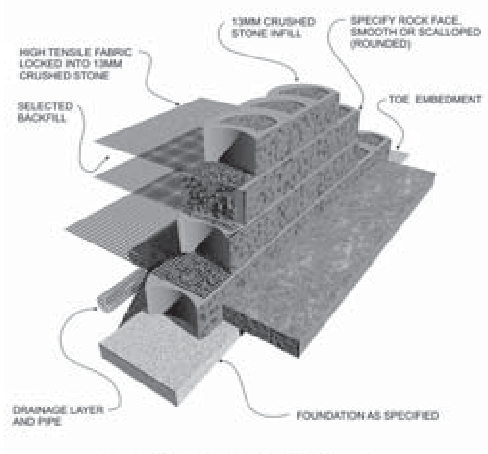
- **Guide to the Design of Terraforce Retaining Walls, Oct. 1992 by W G Technau of Hawkins, Hawkins & Osborn - Rivonia, South Africa.**
- **www.terraforce.com/downloads**

Geosynthetic reinforced soil segmental retaining walls utilize reinforcing sheets of geogrid or suitable woven geotextile which are attached to the fascia and are embedded in a body of engineered fill. The integrated nature of the fascia and the abutting large body of reinforced soil thereby supports the applied earth forces. In this case the ‘gravity’ component of the retaining wall is provided by the reinforced soil mass acting as a monolithic unit. By virtue of their inherent flexibility, such walls are able to accommodate movement and some settlement without suffering distress. This makes the system particularly suitable for construction on (engineered) filled ground or in areas which may be prone to settlement effects. Also, the cost and difficulty of construction of such retaining walls is minimized as the need to provide full frost wall foundations can be waived in many circumstances.

To this end it was necessary to conduct rigorous laboratory testing pertaining to interblock shear resistance, whole block compressive strength and geogrid pullout resistance. **In the pullout tests, the primary mode of failure was rupture of the geogrid outside the blocks and performance was found to be above average, based on experience with a large number of systems tested over many years.**

It was thus shown that the grip obtained by clamping geogrid between blocks filled with coarse gravel is virtually unbeatable. The designer having chosen a geosynthetic of optimal strength can rely on Maxiforce2000 to specify the correct spacing and wall angle.





COMPOSITE RETAINING WALL
(EARTH REINFORCED WITH GEOGRID)

Maxiforce 2000, is a user-friendly design software, capable of calculating conventional gravity as well as composite retaining walls. Utilising various Terraforce elements it is capable of performing the necessary calculations based on varying input values, design parameters and statutory requirements, complete with a printout for submission to local authorities.

Multiple design charts which cover a wide variety of situations are provided on the following pages. The designs have been standardized on the use of Miragrid 2XT (specification) or equivalent, and the Terraforce L18, L15 and L22 block which are 200 mm high. See notes regarding other Terraforce blocks on the following pages.

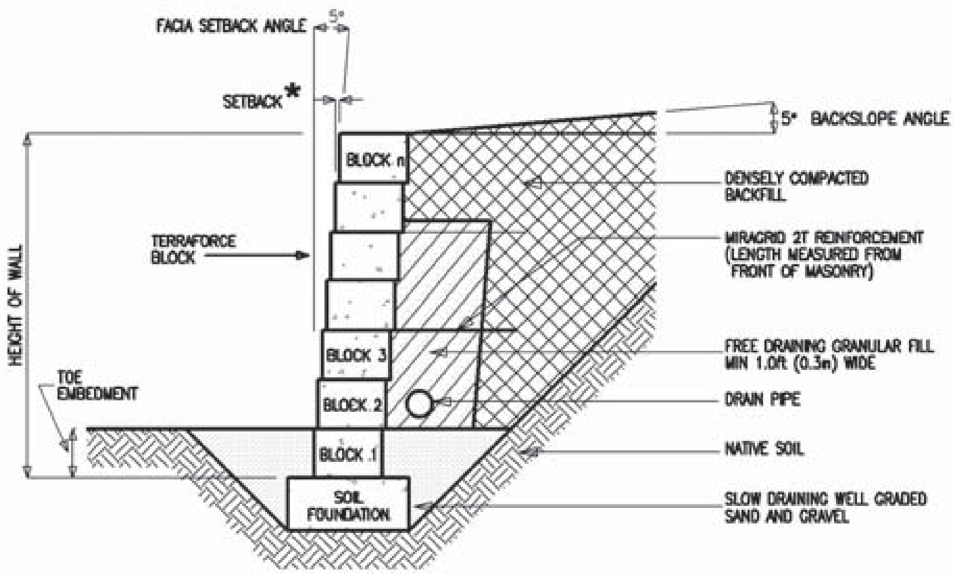
The **Terraforce Table Creator** (available on request) will assist with basic gravity stability checks while the **Maxiforce 2000 design software** (free www.terraforce.com or www.maxiwall.com) will asisst with extended applications.

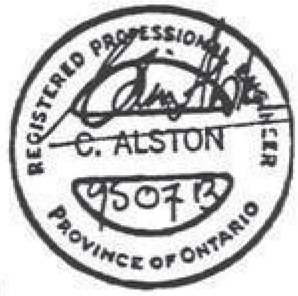
CONDITION 1

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

5° facia setback angle
5° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 1:			
Wall Inclination from Vertical:	5 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	26 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		





Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	3.3	3.1	2.9	2.7	2.6	2.4	2.3	2.2	2	1.9	1.7	1.6	1.8	1.5
Grid Length (ft)	10.8	10.2	9.5	8.9	8.5	7.9	7.5	7.2	6.6	6.2	5.6	5.2	5.9	4.9
No. of Layers of Geogrid	6	6	5	5	4	4	4	3	3	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 6	16	15												
5	12	11	14	13										
4	8	7	10	9	12	11	10							
3	5	4	6	5	8	7	6	9	8					
2	3	2	3	2	4	3	2	5	4	7	6	5		
(Bottom Layer) 1	1	1	1	1	1	1	1	1	1	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

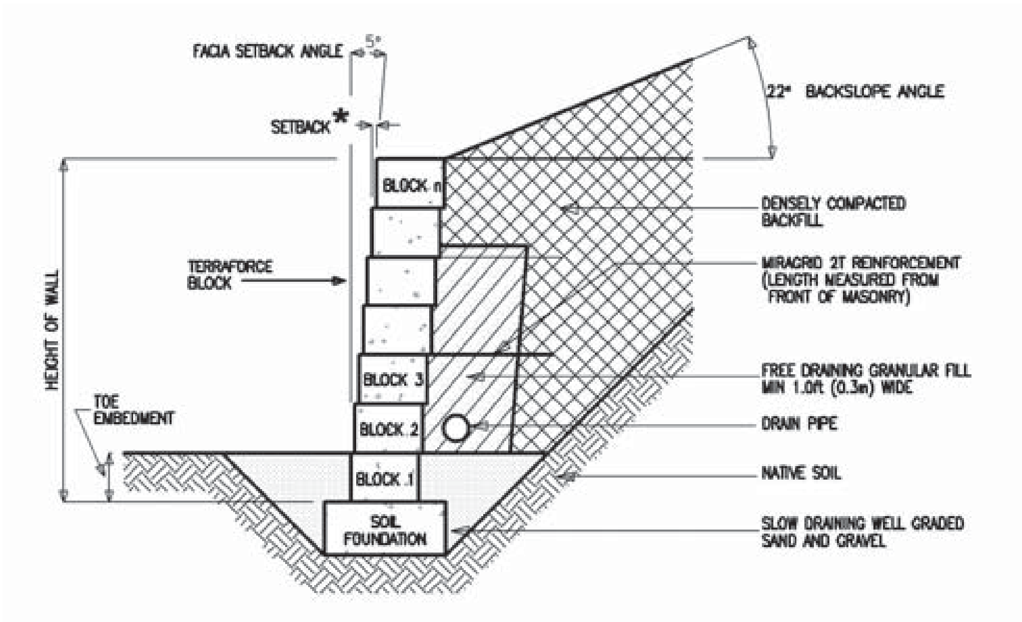
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 2

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

5° facia setback angle
22° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 2:			
Wall Inclination from Vertical:	5 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	26 degrees		
Backslope Angle:	22 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	5.6	5.3	5	4.7	4.4	4.2	3.9	3.6	3.3	3	2.8	2.5	2.2	2
7.2G6.6rid Length (ft)	18.4	17.4	16.4	15.4	14.4	13.8	12.8	11.8	10.8	9.8	9.2	8.2	7.2	6.6
No. of Layers of Geogrid	8	8	7	6	6	5	5	4	4	3	3	2	2	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 8	17	16												
7	13	12	15											
6	9	8	11	14	13									
5	8	7	7	10	9	12	11							
4	5	4	6	6	6	8	7	10	9					
3	4	3	3	5	4	5	4	6	5	8	7			
2	2	2	2	2	2	3	2	2	3	4	3	6	5	
(Bottom Layer) 1	1	1	1	1	1	1	1	1	1	1	1	1	1	4

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

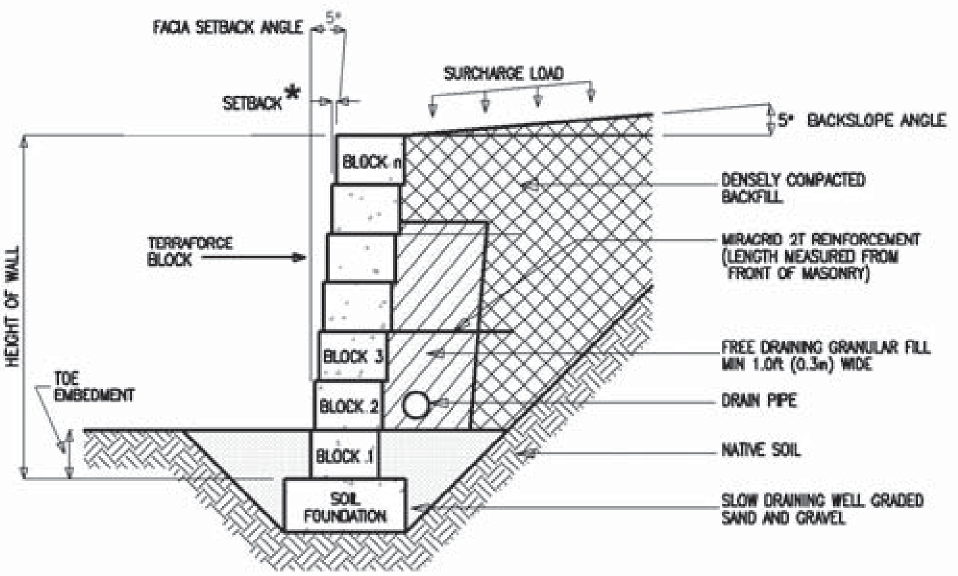
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

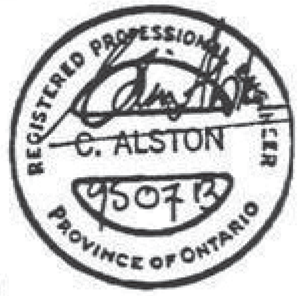
CONDITION 3

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

5° facia setback angle
5° backslope angle
10kPa (210psf) surcharge
sand and gravel backfil

Terraforce Design Chart 3:			
Wall Inclination from Vertical:	5 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	26 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	10KPa 210psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		





Height of Wall (m)		4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)		13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)		3.5	3.4	3.2	3.1	2.9	2.8	2.7	2.5	2.4	2.2	2.1	1.9	1.8	1.7
Grid Length (ft)		11.5	11.2	10.5	10.2	9.5	9.2	8.9	8.2	7.9	7.2	6.9	6.2	5.9	5.6
No. of Layers of Geogrid		8	7	7	6	6	5	5	4	4	4	3	3	3	2
Number of Block Courses above Base (200mm high Blocks)															
Georgid Layer No.	8	19													
	7	15	18	17											
	6	11	14	13	16	15									
	5	8	10	9	12	11	14	13							
	4	6	7	6	8	7	10	9	12	11	10				
	3	3	5	4	5	4	6	5	8	7	6	9	8	7	
	2	2	2	2	3	2	3	2	4	3	2	5	4	3	5
(Bottom Layer)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

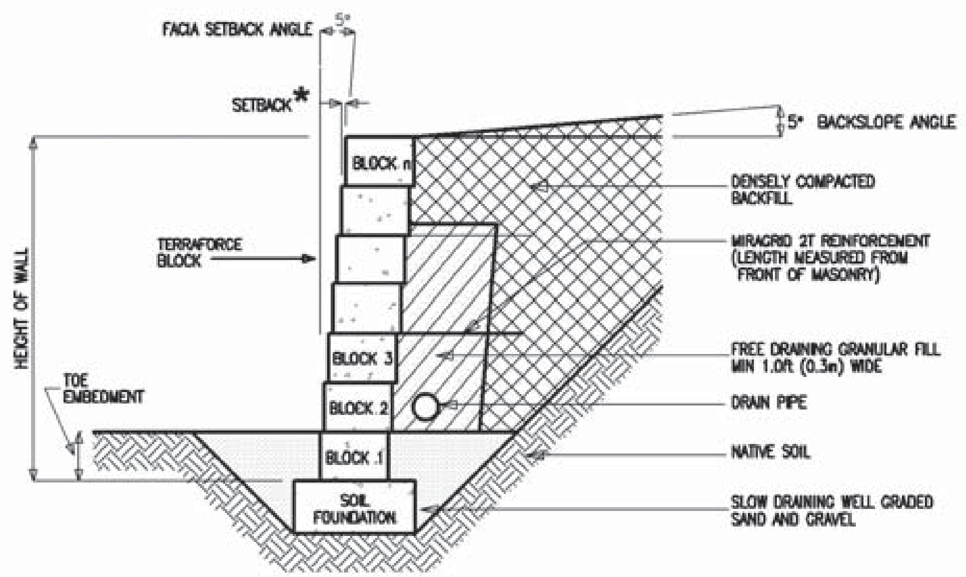
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 4

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

5° facia setback angle
5° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 4:			
Wall Inclination from Vertical:	5 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	31 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)		4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)		13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)		2.8	2.6	2.5	2.4	2.3	2.1	2	1.9	1.7	1.6	1.5	1.3	1.4	1.2
Grid Length (ft)		9.2	8.5	8.2	7.9	7.5	6.9	6.6	6.2	5.6	5.2	4.9	4.3	4.6	3.9
No. of Layers of Geogrid		5	5	5	4	3	3	3	3	2	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)															
Georgid Layer No.	5	16	15	14											
	4	12	11	10	13										
	3	8	7	6	9	12	11	10	9						
	2	4	3	3	5	8	7	6	5	8	7	6	5		
(Bottom Layer)	1	1	1	1	1	4	1	2	1	4	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

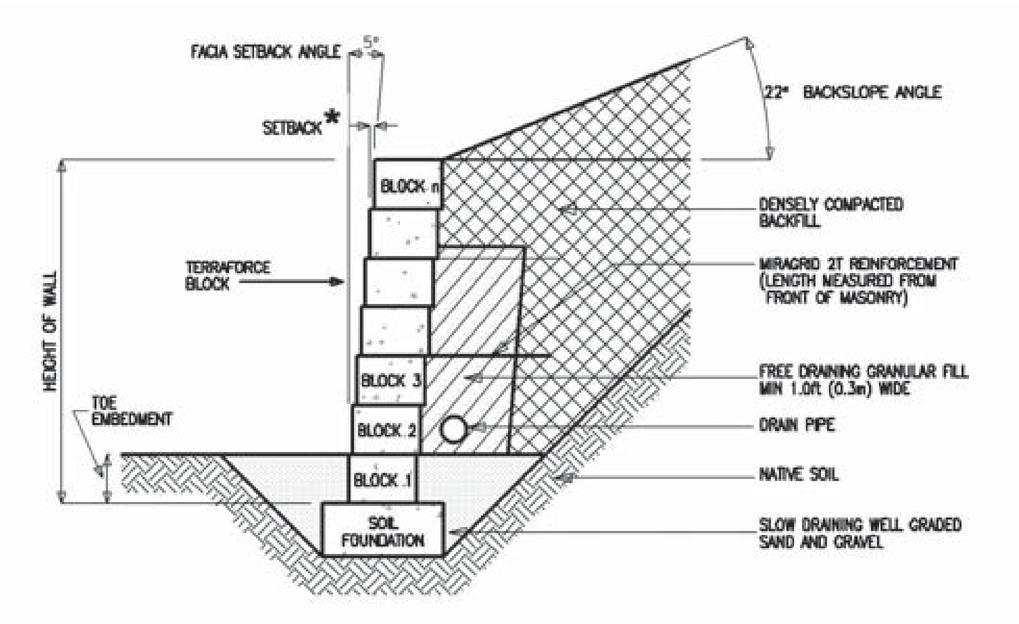
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 5

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

5° facia setback angle
22° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 5:				
Wall Inclination from Vertical:	5 degrees	Setback of Each Block:	* See Setback Chart on page: 34	
Backfill Soil Friction Angle:	31 degrees			
Backslope Angle:	22 degrees	Surcharge on Retained Soil:	0KPa	0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf			
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m	770lbs/ft
Wall Toe Embedment	0.2m 8in			



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	3.4	3.2	3	2.9	2.7	2.5	2.4	2.2	2	1.9	1.7	1.5	1.6	1.3
Grid Length (ft)	11.2	10.5	9.8	9.5	8.9	8.2	7.9	7.2	6.6	6.2	5.6	4.9	5.2	4.3
No. of Layers of Geogrid	7	6	6	5	5	4	4	3	3	3	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 8														
7	16													
6	12	15	14											
5	8	11	10	13	12									
4	6	7	6	9	8	11	10							
3	4	5	4	5	4	7	6	9	8	7				
2	2	2	2	3	2	3	2	5	4	3	6	5		
(Bottom Layer) 1	1	1	1	1	1	1	1	1	1	1	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

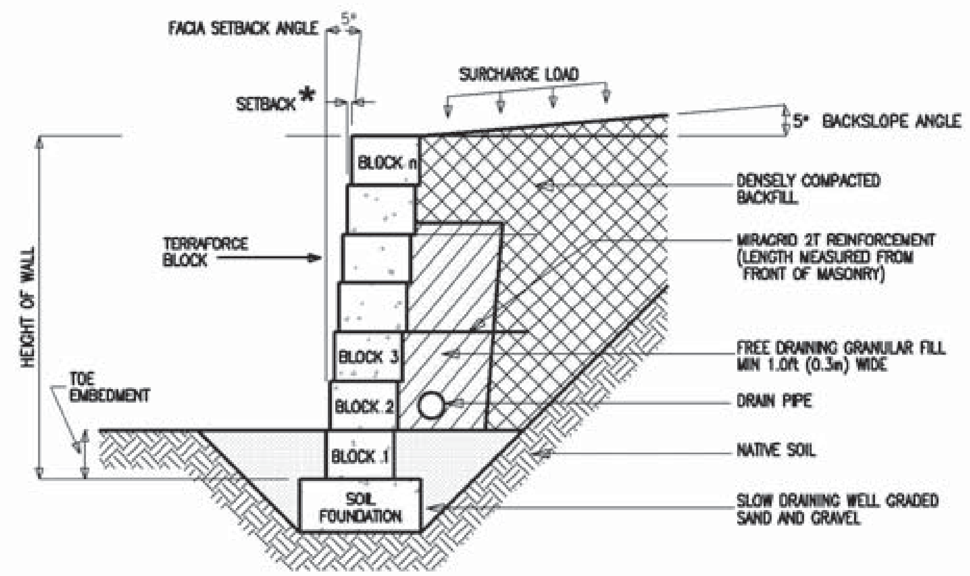
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 6

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

5° facia setback angle
22° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 6:				
Wall Inclination from Vertical:	5 degrees	Setback of Each Block:	* See Setback Chart on page: 34	
Backfill Soil Friction Angle:	31 degrees			
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	10KPa	210psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf			
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m	770lbs/ft
Wall Toe Embedment	0.2m 8in			



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	3	2.9	2.8	2.6	2.5	2.4	2.3	2.1	2	1.9	1.7	1.6	1.5	1.3
Grid Length (ft)	9.8	9.5	9.2	8.5	8.2	7.9	7.5	6.9	6.6	6.2	5.6	5.2	4.9	4.3
No. of Layers of Geogrid	6	6	6	5	5	4	4	4	3	3	3	2	2	2
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 6	18	17	16											
5	14	13	12	15	14									
4	10	9	8	11	10	13	12	11						
3	6	5	4	7	6	9	8	7	10	9	8			
2	4	3	2	3	2	5	4	3	6	5	4	7	6	5
(Bottom Layer) 1	1	1	1	1	1	1	1	1	2	1	1	3	2	1

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

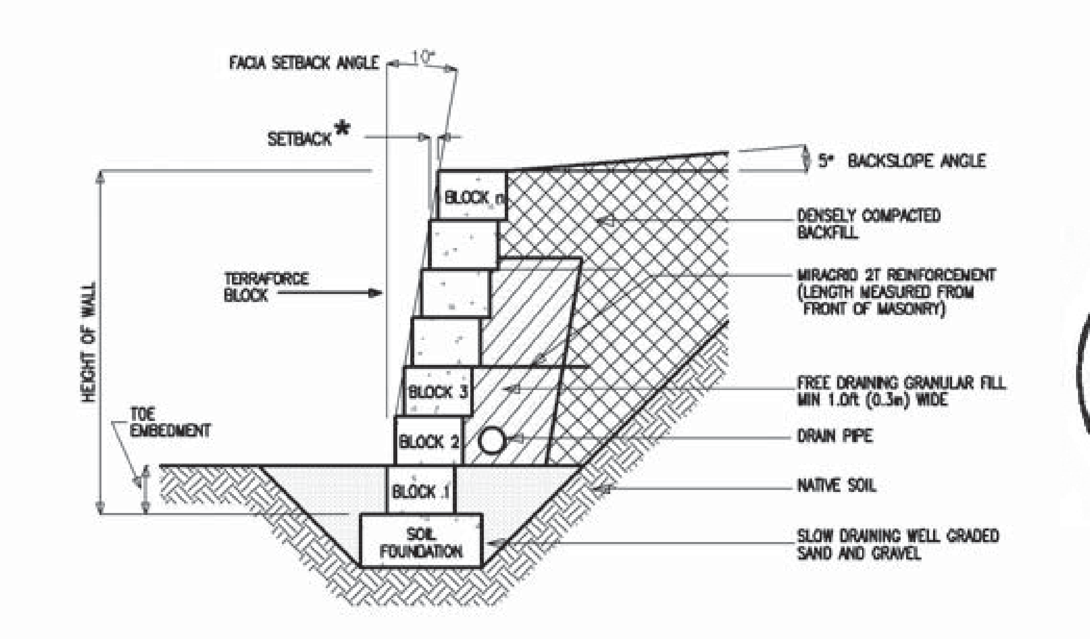
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 7

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

10° facia setback angle
5° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 7:			
Wall Inclination from Vertical:	10 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	26 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	3.1	2.9	2.8	2.6	2.5	2.3	2.2	2.1	2	1.8	1.7	1.5	1.7	1.4
Grid Length (ft)	10.2	9.5	9.2	8.5	8.2	7.5	7.2	6.9	6.6	5.9	5.6	4.9	4.6	4.6
No. of Layers of Geogrid	6	5	5	5	4	4	4	3	3	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 6	16													
5	12	15	14	13	13									
4	8	11	10	9	9	11	10							
3	5	7	6	5	5	7	6	9	8					
2	2	4	3	2	2	3	2	5	4	7	6	5		
(Bottom Layer) 1		1	1	1	1	1	1	1	1	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

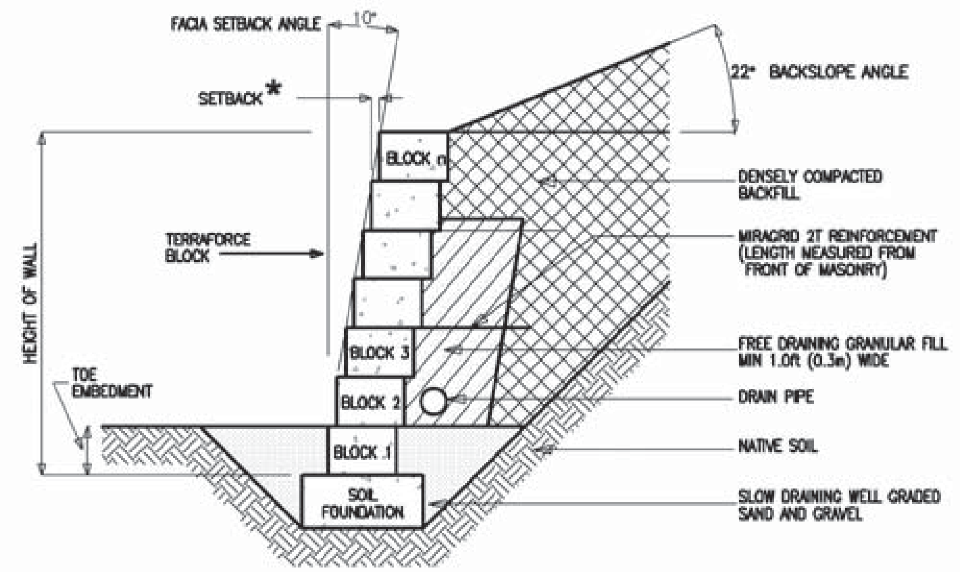
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 8

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

10° facia setback angle
22° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 8:			
Wall Inclination from Vertical:	10 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	26 degrees		
Backslope Angle:	22 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	4.8	4.6	4.3	4.1	3.8	3.6	3.3	3.1	2.9	2.6	2.4	2.1	1.9	1.9
Grid Length (ft)	15.7	15.1	14.1	13.5	12.5	11.8	10.8	10.2	9.5	8.5	7.9	6.9	6.2	6.2
No. of Layers of Geogrid	8	7	7	6	5	5	4	4	3	3	3	2	2	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 8	17													
7	13	16	15											
6	9	12	11	14										
5	7	8	7	10	13	12								
4	5	6	5	6	9	8	11	10						
3	3	4	3	4	5	4	7	6	9	8	7			
2	2	2	2	2	3	2	3	2	5	4	3	6	5	
(Bottom Layer) 1	1	1	1	1	1	1	1	1	1	1	1	2	1	4

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

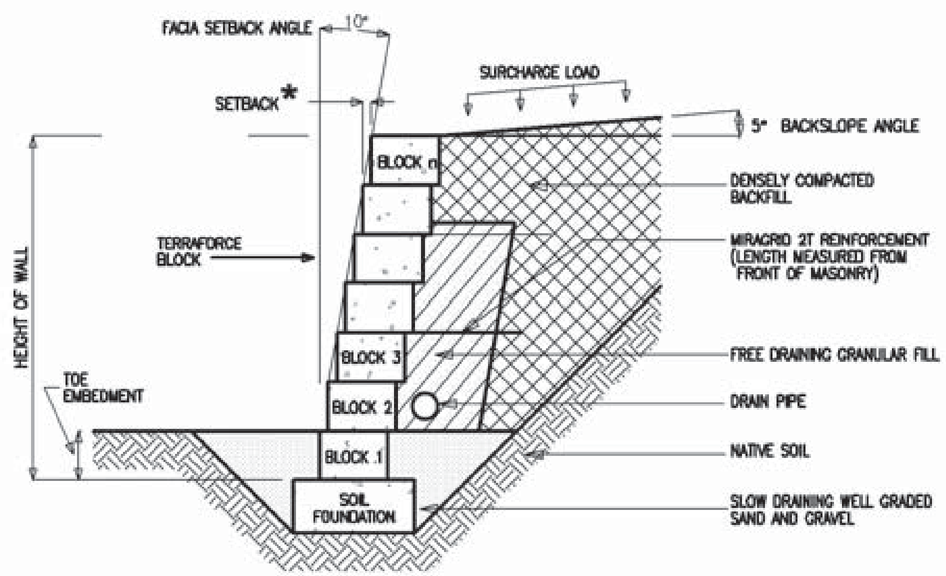
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 9

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

10° facia setback angle
5° backslope angle
10kPa (210psf) surcharge
sand and gravel backfil

Terraforce Design Chart 9:			
Wall Inclination from Vertical:	10 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	26 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	10KPa 21psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	3.3	3.1	3	2.9	2.7	2.6	2.5	2.3	2.2	2	1.9	1.8	1.6	1.5
Grid Length (ft)	10.8	10.2	9.8	9.5	8.9	8.5	8.2	7.5	7.2	6.6	6.2	5.9	5.2	4.9
No. of Layers of Geogrid	7	6	6	5	5	5	4	4	4	3	3	3	2	2
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 7	18													
6	14	17	16											
5	10	13	12	15	14	13								
4	7	9	8	11	10	9	12	11	11					
3	4	6	5	7	6	5	8	7	6	9	9	7		
2	2	3	2	4	3	2	4	3	2	5	4	3	6	5
(Bottom Layer) 1	1	1	1	1	1	1	1	1	1	1	1	1	2	1

Notes:

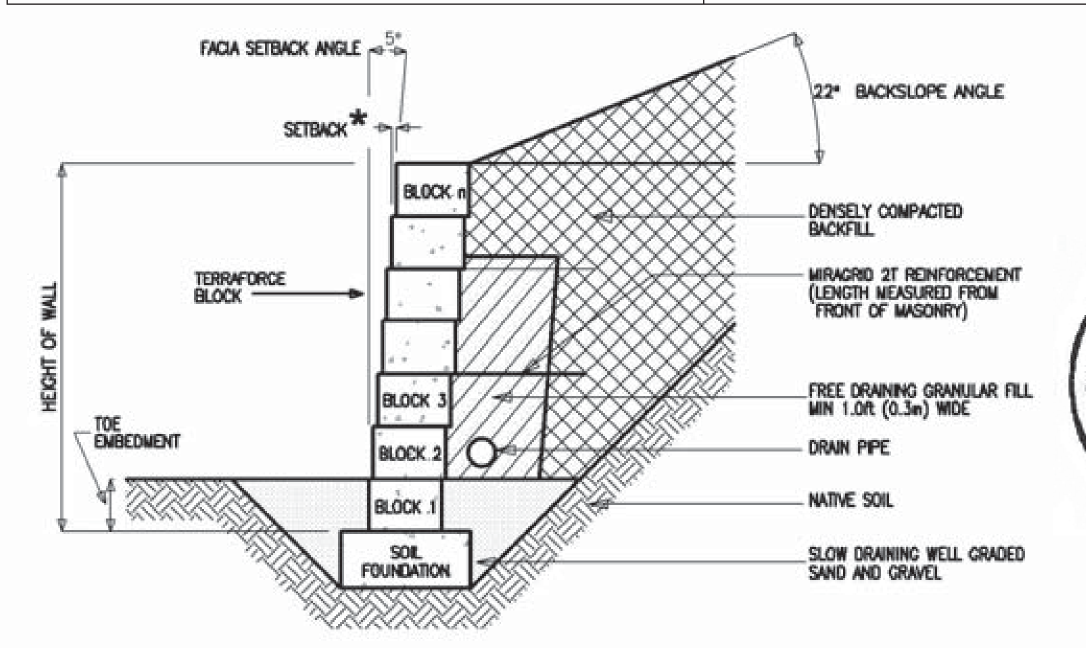
1. Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.
2. This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.
3. Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.
4. Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 10

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

10° facia setback angle
5° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 10:					
Wall Inclination from Vertical:	5 degrees		Setback of Each Block:	* See Setback Chart on page: 34	
Backfill Soil Friction Angle:	31 degrees				
Backslope Angle:	5 degrees		Surcharge on Retained Soil:	0KPa	0psf
Backfill Soil Unit Weight:	20 kN/m ³	127pcf			
Geogrid Reinforcement:	Miragrid 2T or equal		Long Term Design Strength:	11.2kN/m	770lbs/ft
Wall Toe Embedment	0.2m	8in			



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.6	2.5	2.4	2.3	2.2	2	1.9	1.8	1.7	1.5	1.4	1.3	1.4	1.1
Grid Length (ft)	8.5	8.2	7.9	7.5	7.2	6.6	6.2	5.9	5.6	4.9	4.6	4.3	4.6	3.6
No. of Layers of Geogrid	5	5	5	4	4	4	3	3	2	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 5	16	15	14											
4	12	11	10	13	12	11								
3	8	7	6	9	8	7	10	9						
2	4	3	2	5	4	3	6	5	8	7	6	5		
(Bottom Layer) 1	1	1	1	1	1	1	2	1	4	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

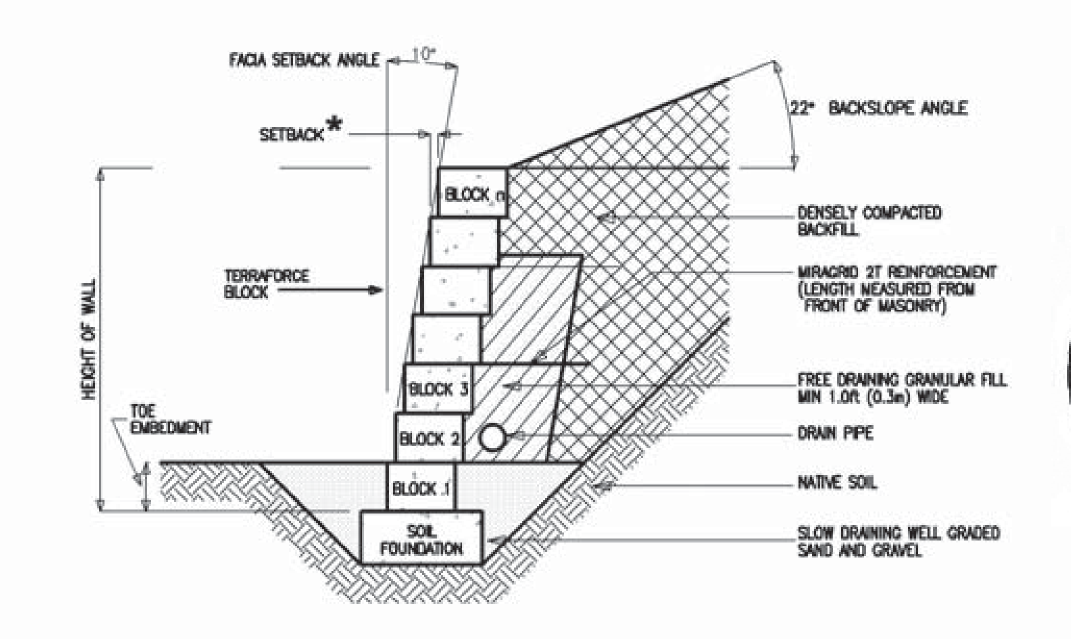
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 11

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

10° facia setback angle
22° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 11:			
Wall Inclination from Vertical:	10 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	31 degrees		
Backslope Angle:	22 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	3.2	3	2.9	2.7	2.6	2.4	2.2	2.1	1.9	1.8	1.6	1.5	1.5	1.2
Grid Length (ft)	10.5	9.8	9.5	8.9	8.5	7.9	7.2	6.9	6.2	5.9	5.2	4.9	4.9	3.9
No. of Layers of Geogrid	6	5	5	5	4	4	4	3	3	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 6	16													
5	12	15	14	13										
4	8	11	10	9	12	11	10							
3	5	7	6	5	8	7	6	9	8					
2	2	4	3	2	4	3	2	5	4	7	6	5		
(Bottom Layer) 1	1	1	1	1	1	1	1	1	1	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

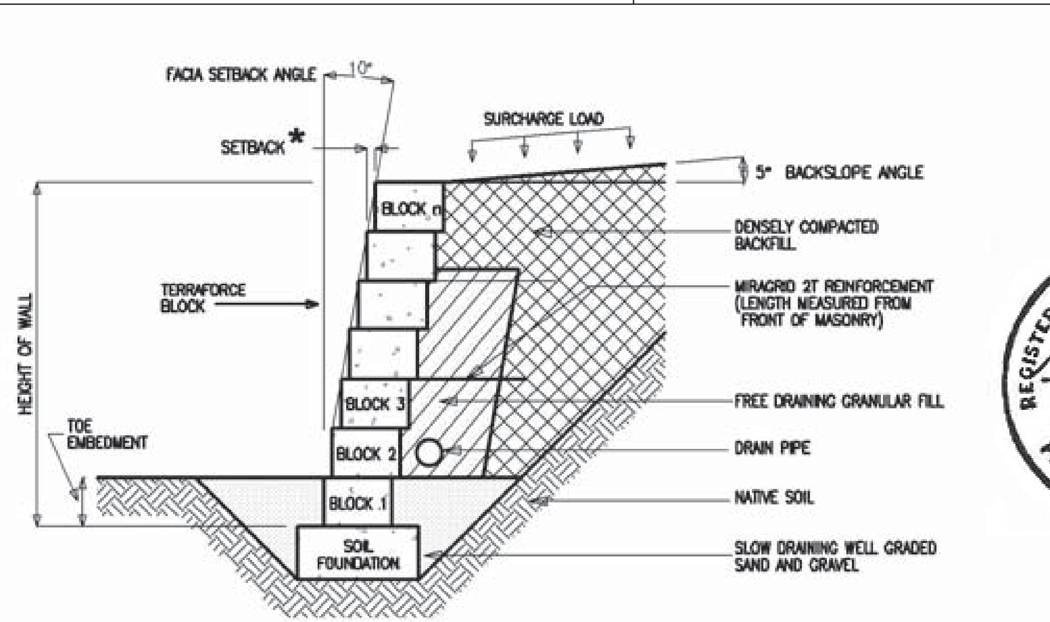
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 12

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

10° facia setback angle
5° backslope angle
10kPa (210psf) surcharge
sand and gravel backfil

Terraforce Design Chart 12:			
Wall Inclination from Vertical:	10 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	31 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	10KPa 210psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.9	2.8	2.6	2.6	2.4	2.3	2.2	2	1.9	1.8	1.7	1.5	1.4	1.3
Grid Length (ft)	9.5	9.2	8.5	8.2	7.9	7.5	7.2	6.6	6.2	5.9	5.6	4.9	4.6	4.3
No. of Layers of Geogrid	6	6	5	5	5	4	4	4	3	3	3	2	2	2
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 6	18	17												
5	14	13	16	15	14									
4	10	9	12	11	10	13	12	11						
3	6	5	8	7	6	9	8	7	10	9	8			
2	3	2	4	3	2	5	4	3	6	5	4	7	6	5
(Bottom Layer) 1	1	1	1	1	1	1	1	1	1	1	1	3	2	1

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

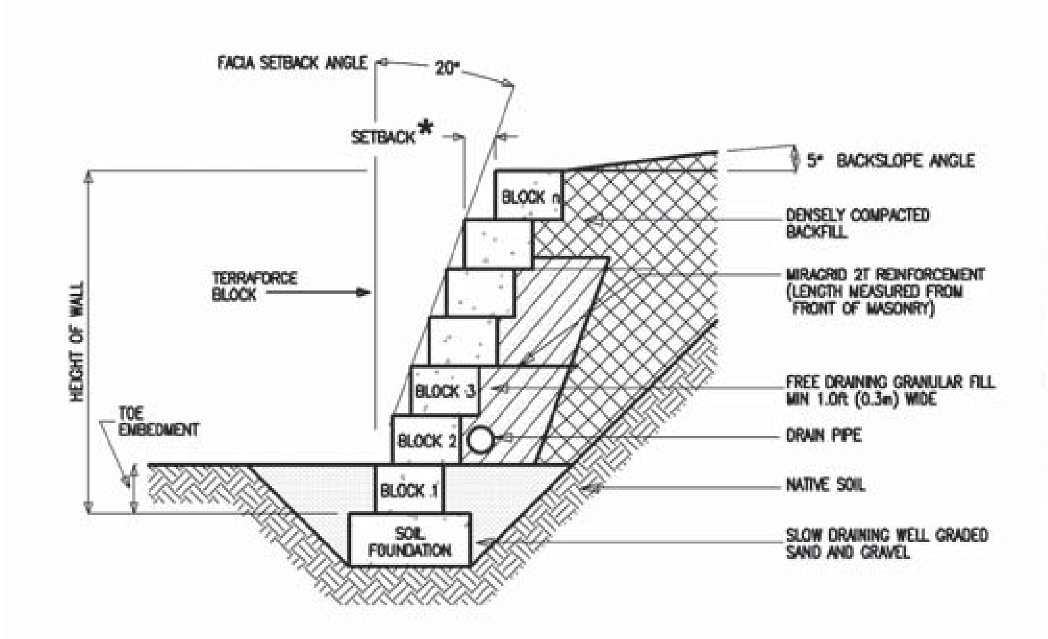
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 13

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

20° facia setback angle
5° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 13:				
Wall Inclination from Vertical:	20 degrees	Setback of Each Block:	* See Setback Chart on page: 34	
Backfill Soil Friction Angle:	26 degrees			
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	0KPa	0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf			
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m	770lbs/ft
Wall Toe Embedment	0.2m 8in			



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.8	2.7	2.5	2.4	2.2	2.1	2	1.9	1.8	1.7	1.5	1.4	1.5	1.3
Grid Length (ft)	9.2	8.9	8.2	7.9	7.2	6.9	6.6	6.2	5.9	5.6	4.9	4.6	4.9	4.3
No. of Layers of Geogrid	5	5	5	4	4	4	3	3	3	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgrid Layer No. 5	16	15	14											
4	12	11	10	13	12	11								
3	8	7	6	9	8	7	10	9	8					
2	4	3	2	5	4	3	6	5	4	7	6	5		
(Bottom Layer) 1	1	1	1	1	1	1	2	1	1	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

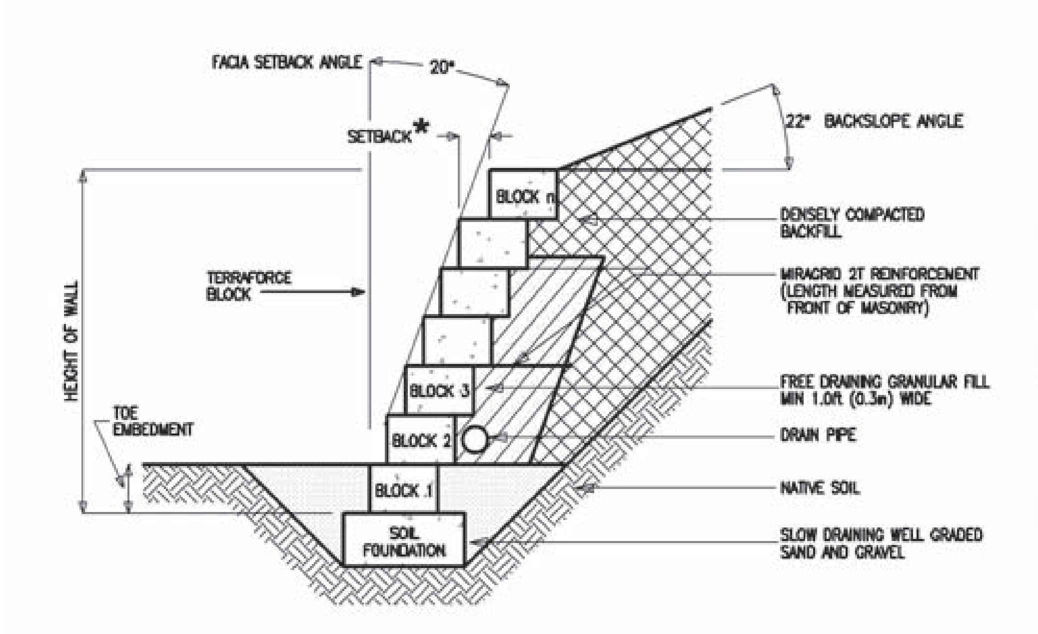
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 14

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

20° facia setback angle
22° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 14:					
Wall Inclination from Vertical:	20 degrees	Setback of Each Block:	* See Setback Chart on page: 34		
Backfill Soil Friction Angle:	26 degrees				
Backslope Angle:	22 degrees	Surcharge on Retained Soil:		0KPa	0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf				
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:		11.2kN/m	770lbs/ft
Wall Toe Embedment	0.2m 8in				



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	3.7	3.5	3.3	3.1	3	2.8	2.6	2.4	2.2	2	1.9	1.7	1.8	1.5
Grid Length (ft)	12.1	11.5	10.8	10.2	9.8	9.2	8.5	7.9	7.2	6.6	6.2	5.6	5.9	4.9
No. of Layers of Geogrid	7	6	6	5	5	4	4	3	3	3	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 7	16													
6	12	15	14											
5	8	11	10	13	12									
4	6	7	6	9	8	11	10							
3	3	5	4	5	4	7	6	9	8	7				
2	2	2	2	3	2	3	2	5	4	3	6	5		
(Bottom Layer) 1	1	1	1	1	1	1	1	1	1	1	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

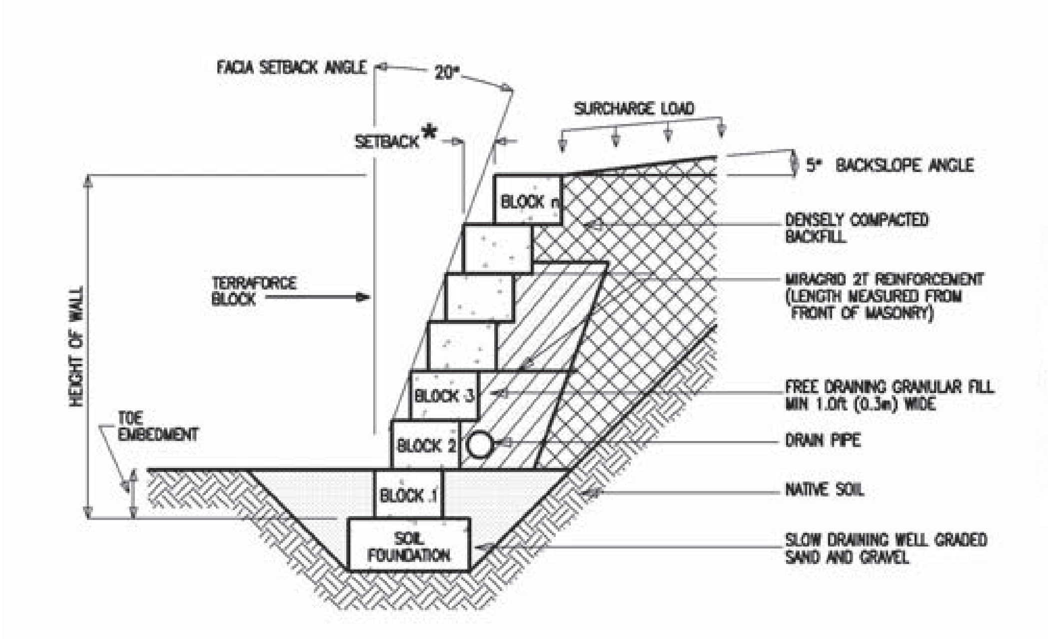
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 15

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

20° facia setback angle
5° backslope angle
10kPa (210psf) surcharge
sand and gravel backfil

Terraforce Design Chart 15:			
Wall Inclination from Vertical:	20 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	26 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	10KPa 210psf
Backfill Soil Unit Weight:	20 kN/m ^{3} 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	3	2.9	2.8	2.6	2.5	2.4	2.2	2.1	2	1.9	1.7	1.6	1.5	1.4
Grid Length (ft)	9.8	9.5	9.2	8.5	8.2	7.9	7.2	6.9	6.6	6.2	5.6	5.2	4.9	4.6
No. of Layers of Geogrid	6	6	5	5	5	4	4	4	3	3	3	2	2	2
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 6	18	17												
5	14	13	16	15	14									
4	10	9	12	11	10	13	12	11						
3	6	5	8	7	6	9	8	7	10	9	8			
2	3	2	4	3	2	5	4	3	6	5	4	7	6	5
(Bottom Layer) 1	1	1	1	1	1	1	1	1	2	1	1	3	2	1

Notes:

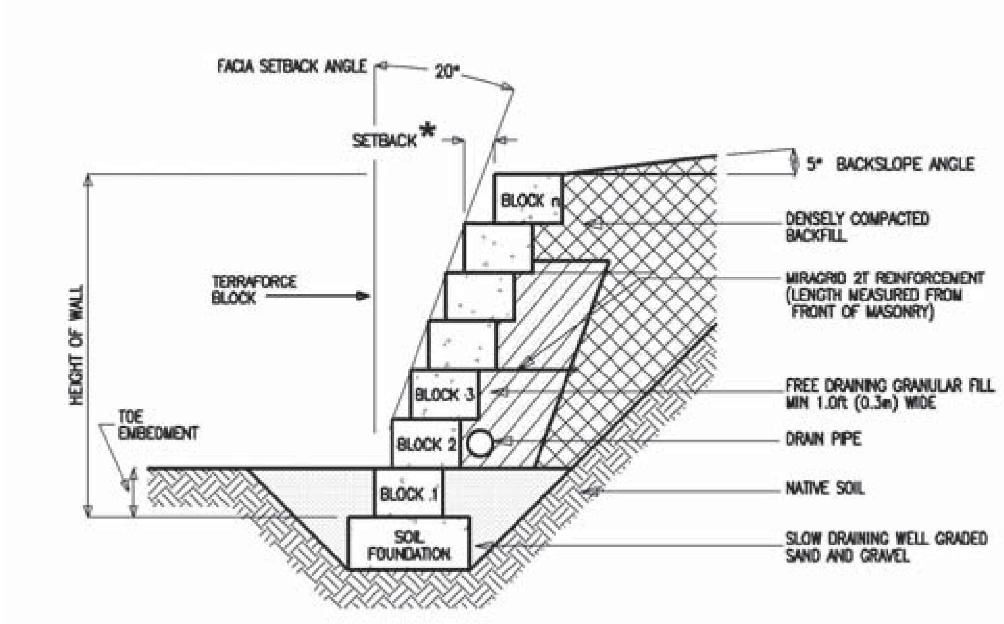
1. Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.
2. This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.
3. Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.
4. Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 16

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

20° facia setback angle
5° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 16:			
Wall Inclination from Vertical:	20 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	31 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.4	2.3	2.2	2.1	2	1.9	1.8	1.7	1.6	1.4	1.3	1.2	1.2	1
Grid Length (ft)	7.9	7.5	7.2	6.9	6.6	6.2	5.9	5.6	5.2	4.6	4.3	3.9	3.9	3.3
No. of Layers of Geogrid	5	5	4	4	4	3	3	3	2	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 5	16	15												
4	12	11	14	13	12									
3	8	7	10	9	8	11	10	9						
2	4	3	6	5	4	6	6	5	8	7	6	5		
(Bottom Layer) 1	2	2	2	1	1	3	2	1	4	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

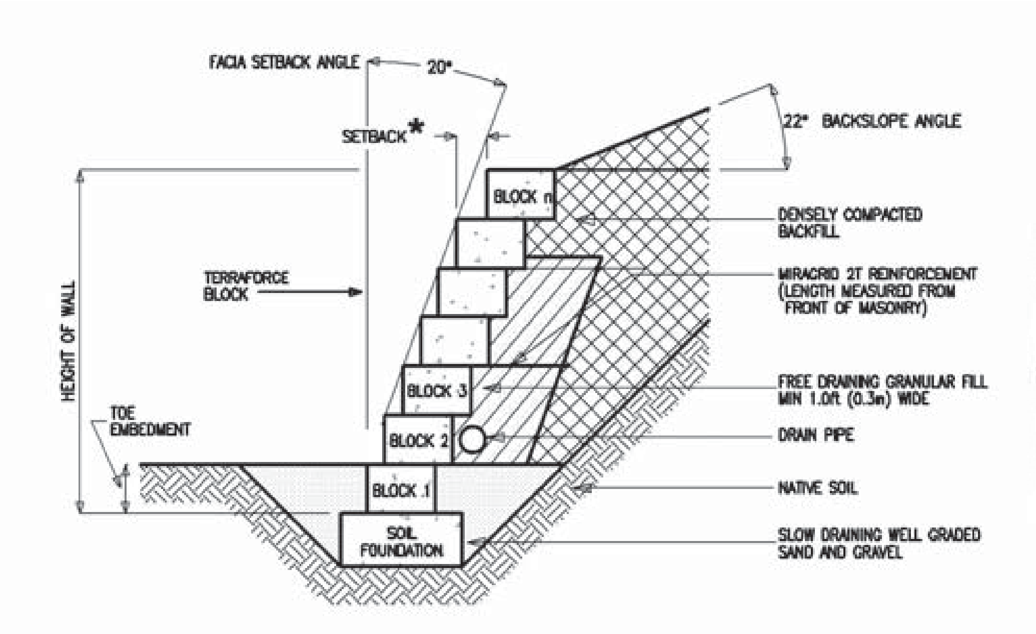
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 17

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

20° facia setback angle
22° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 17:			
Wall Inclination from Vertical:	20 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	31 degrees		
Backslope Angle:	22 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.8	2.7	2.6	2.4	2.3	2.2	2	1.9	1.8	1.6	1.5	1.4	1.3	1.1
Grid Length (ft)	9.2	8.9	8.5	7.9	7.5	7.2	6.6	6.2	5.9	5.2	4.9	4.6	4.3	3.6
No. of Layers of Geogrid	5	5	5	4	4	4	3	3	2	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 5	16	15	14											
4	12	11	10	13	12	11								
3	8	7	6	9	8	7	10	9						
2	4	3	2	5	4	3	6	5	8	7	6	5		
(Bottom Layer) 1	1	1	1	1	1	1	2	1	4	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

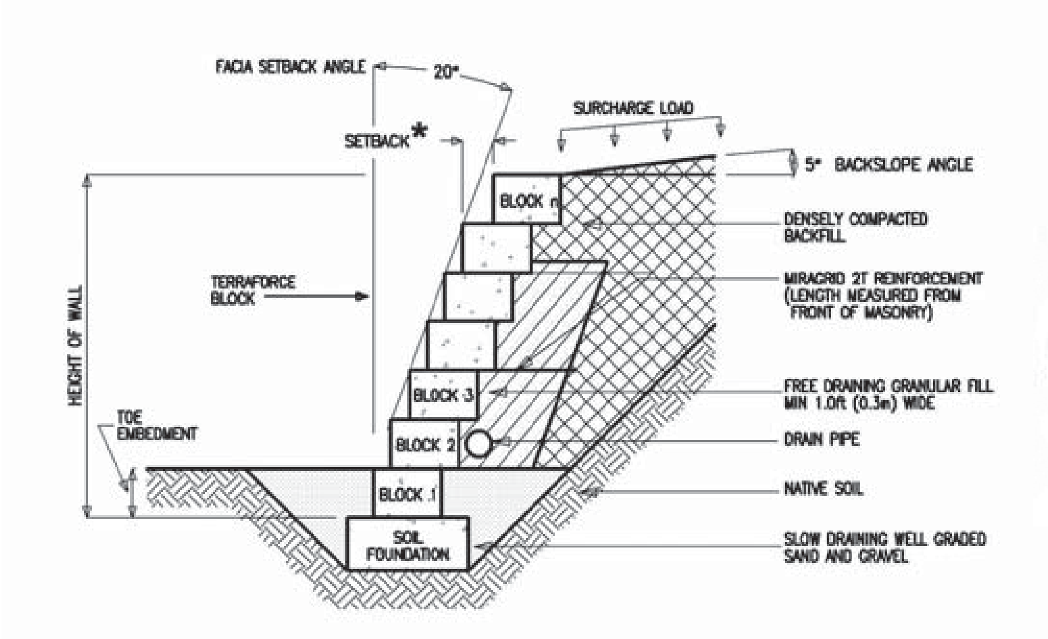
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 18

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

20° facia setback angle
5° backslope angle
10kPa (210psf) surcharge
sand and gravel backfil

Terraforce Design Chart 18:			
Wall Inclination from Vertical:	20 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	31 degrees		
Backslope Angle:	22 degrees	Surcharge on Retained Soil:	10KPa 210psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.4	2.3	2.2	2.1	2	1.9	1.8	1.7	1.6	1.4	1.3	1.2	1.2	1
Grid Length (ft)	7.9	7.5	7.2	6.9	6.6	6.2	5.9	5.6	5.2	4.6	4.3	3.9	3.9	3.3
No. of Layers of Geogrid	5	5	4	4	4	3	3	3	2	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 5	16	15												
4	12	11	14	13	12									
3	8	7	10	9	8	11	10	9						
2	4	3	6	5	4	7	6	5	8	7	6	5		
(Bottom Layer) 1	1	1	2	1	1	3	2	1	4	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

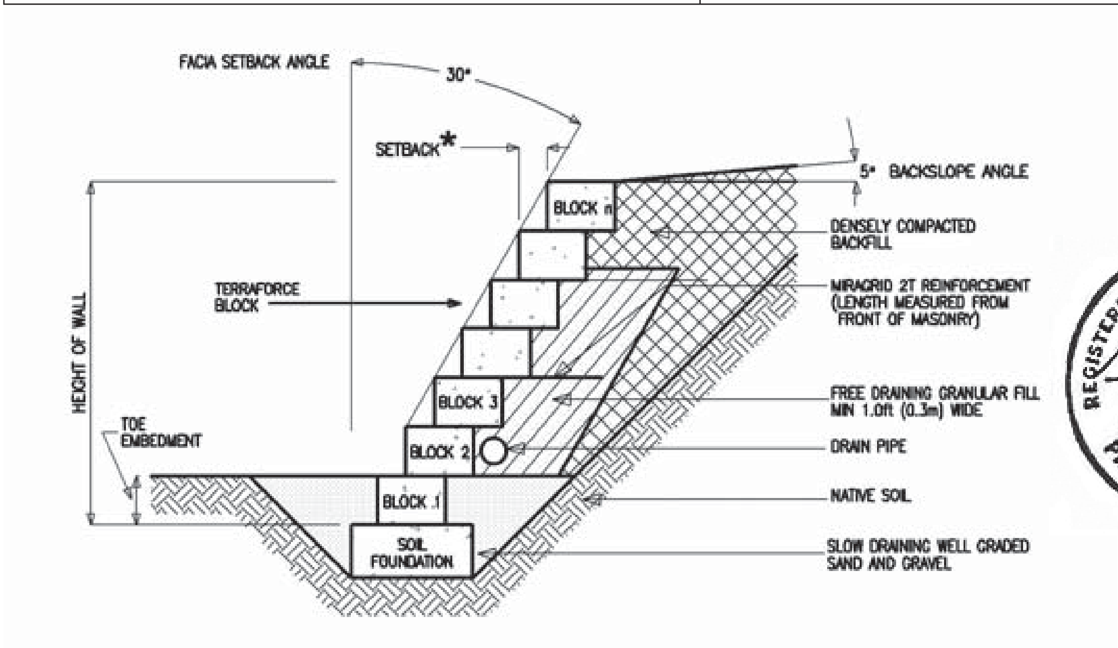
.

CONDITION 19

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

30° facia setback angle
5° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 19:			
Wall Inclination from Vertical:	30 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	26 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ^{3} 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.5	2.4	2.3	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.1
Grid Length (ft)	8.2	7.9	7.5	7.2	6.9	6.6	5.9	5.6	5.2	4.9	4.6	4.3	4.3	3.6
No. of Layers of Geogrid	5	5	4	4	3	3	3	3	2	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 5	16	15												
4	12	11	14	13										
3	8	7	10	9	12	11	10	9						
2	4	3	6	5	8	7	6	5	8	7	6	5		
(Bottom Layer) 1	1	1	2	1	4	3	2	1	4	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

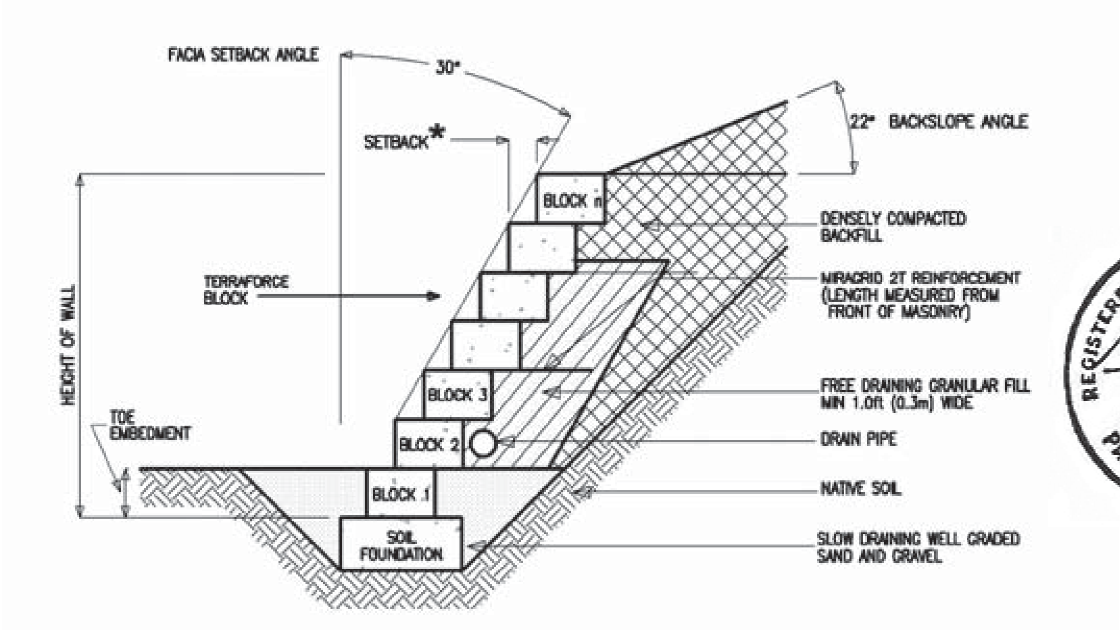
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 20

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

30° facia setback angle
22° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 20:			
Wall Inclination from Vertical:	30 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	26 degrees		
Backslope Angle:	22 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2 33	4.6
Grid Length (m)	3.3	3.2	3	2.8	2.7	2.5	2.3	2.2	2	1.8	1.7	1.5	1.6	1.3
Grid Length (ft)	10.8	10.5	9.8	9.2	8.9	8.2	7.5	7.2	6.6	5.9	5.5	4.9	5.2	4.3
No. of Layers of Geogrid	5	5	5	4	4	4	3	3	2	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 5	16	15	14											
4	12	11	10	13	12	11								
3	8	7	6	9	8	7	10	9						
2	4	3	2	5	4	3	6	5	8	7	6	5		
(Bottom Layer) 1	1	1	1	1	1	1	2	1	4	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

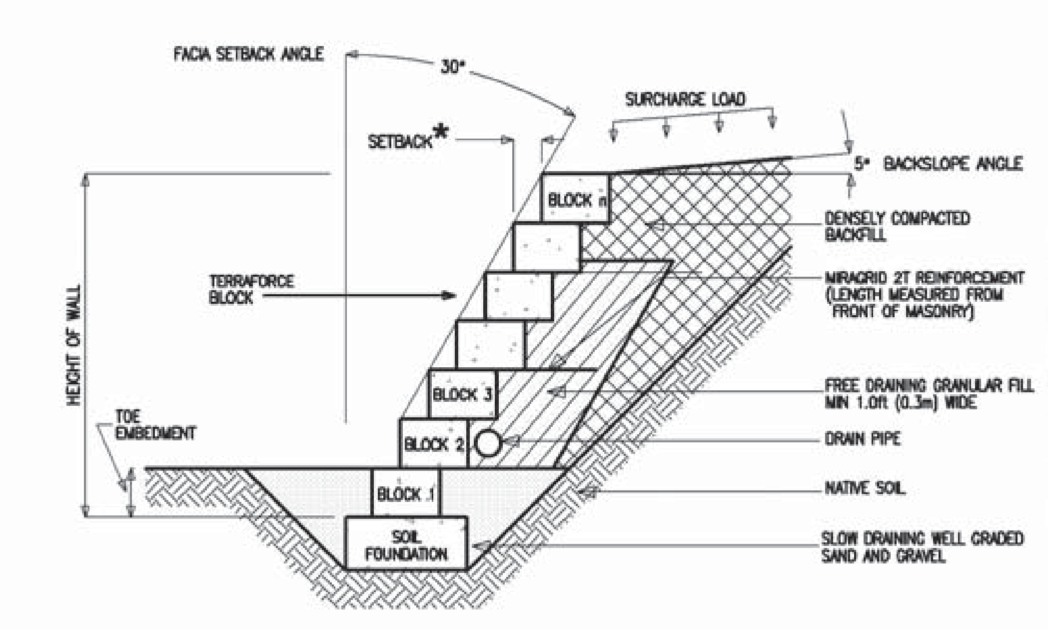
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 21

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

30° facia setback angle
5° backslope angle
10kPa (210psf) surcharge
sand and gravel backfil

Terraforce Design Chart 21:			
Wall Inclination from Vertical:	30 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	26 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	10KPa 210psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.7	2.5	2.4	2.3	2.2	2.1	2	1.8	1.7	1.6	1.5	1.4	1.3	1.3
Grid Length (ft)	8.9	8.2	7.9	7.5	7.2	6.9	6.6	5.9	5.6	5.2	4.9	4.6	4.3	4.3
No. of Layers of Geogrid	5	5	5	4	4	4	3	3	3	2	2	2	2	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 5	17	16	15											
4	13	12	11	14	13	12								
3	9	8	7	10	9	8	11	10	9					
2	5	4	3	6	5	4	7	6	5	8	7	6	5	
(Bottom Layer) 1	1	1	1	2	1	1	3	2	1	4	3	2	1	4

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

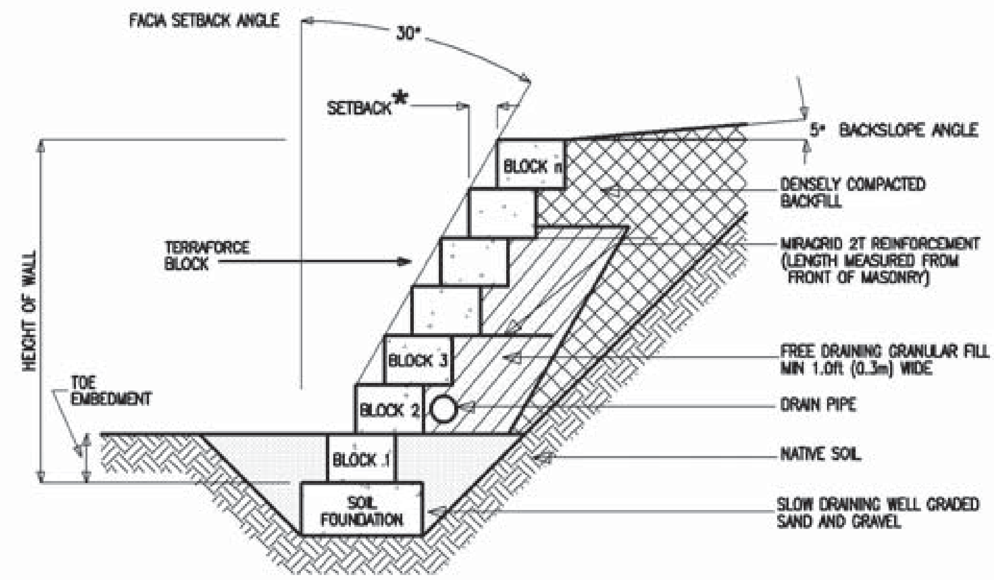
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 22

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

30° facia setback angle
5° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 22:			
Wall Inclination from Vertical:	30 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	31 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	0KPa 0psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.2	2.1	2	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1
Grid Length (ft)	7.2	6.9	6.6	6.2	5.9	5.6	5.2	4.9	4.6	4.3	3.9	3.9	3.6	3.3
No. of Layers of Geogrid	5	4	4	4	3	3	3	3	2	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 5	16													
4	12	15	15	13										
3	8	11	11	9	12	11	10	9						
2	4	7	7	5	8	7	6	5	8	7	6	5		
(Bottom Layer) 1	2	3	2	1	4	3	2	1	4	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

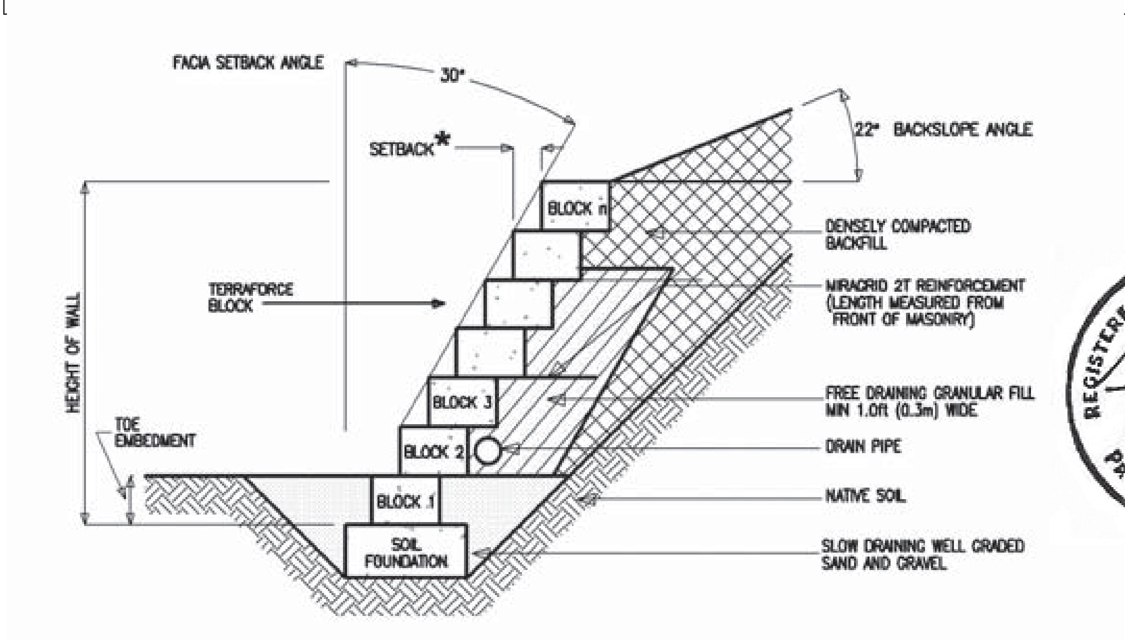
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

CONDITION 23

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

30° facia setback angle
22° backslope angle
nil surcharge
sand and gravel backfil

Terraforce Design Chart 23:					
Wall Inclination from Vertical:	30 degrees	Setback of Each Block:	* See Setback Chart on page: 34		
Backfill Soil Friction Angle:	31 degrees				
Backslope Angle:	22 degrees	Surcharge on Retained Soil:	0KPa	0psf	
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf				
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m	770lbs/ft	
Wall Toe Embedment	0.2m 8in				



Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.5	2.4	2.3	2.1	2	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.1	1
Grid Length (ft)	8.2	7.9	7.5	6.9	6.6	6.2	5.9	5.6	5.2	4.9	4.6	4.3	3.6	3.3
No. of Layers of Geogrid	5	4	4	3	3	3	3	2	2	2	2	1	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 5	16													
4	12	15	14	13										
3	8	11	10	9	12	11	10	9						
2	4	7	6	5	8	7	6	5	8	7	6	5		
(Bottom Layer) 1	1	3	2	1	4	3	2	1	4	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix "A" which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

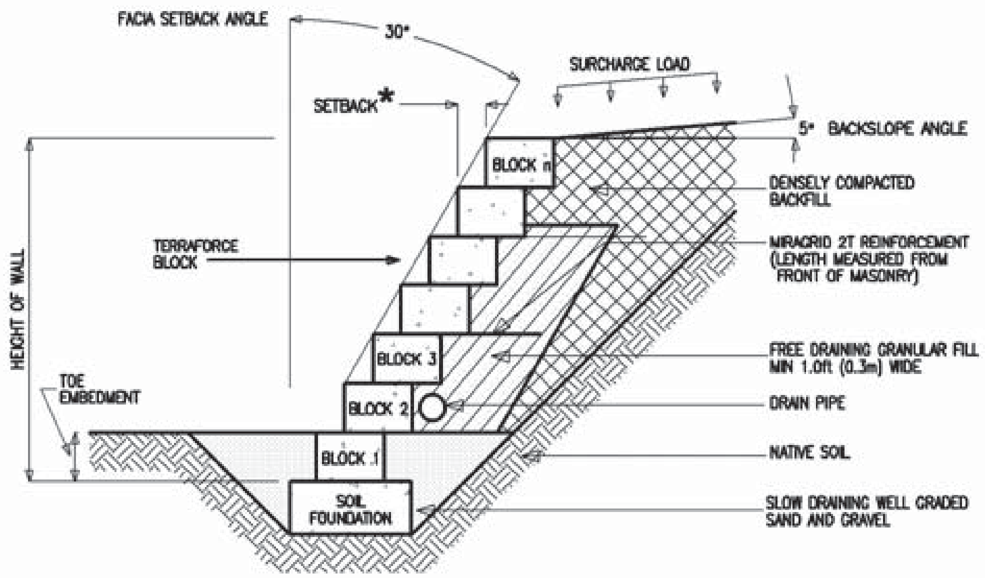
4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

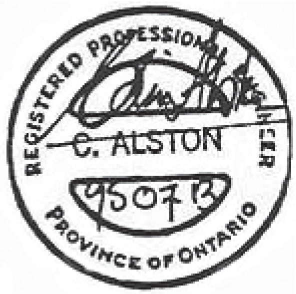
CONDITION 24

The design tables are based on the Terraforce L.18/L.22 or L15 with a block height of 200 mm. Where the Terraforce L.11 or L.13 with a block height of 225 mm are used, or the Terraforce L12 with a block height of 210mm, the lengths of the geosynthetic layers must be increased proportionately, that is by 12.5%, or 5% respectively.

30° facia setback angle
5° backslope angle
10kPa (210psf) surcharge
sand and gravel backfil

Terraforce Design Chart 24:			
Wall Inclination from Vertical:	30 degrees	Setback of Each Block:	* See Setback Chart on page: 34
Backfill Soil Friction Angle:	31 degrees		
Backslope Angle:	5 degrees	Surcharge on Retained Soil:	10KPa 210psf
Backfill Soil Unit Weight:	20 kN/m ³ 127pcf		
Geogrid Reinforcement:	Miragrid 2T or equal	Long Term Design Strength:	11.2kN/m 770lbs/ft
Wall Toe Embedment	0.2m 8in		





Height of Wall (m)	4	3.8	3.6	3.4	3.2	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4
Height of Wall (ft)	13.1	12.5	11.8	11.2	10.5	9.8	9.2	8.5	7.9	7.2	6.6	5.9	5.2	4.6
Grid Length (m)	2.3	2.2	2.1	2	1.9	1.8	1.7	1.6	1.5	1.5	1.4	1.3	1.2	1.1
Grid Length (ft)	7.5	7.2	6.9	6.6	6.2	5.9	5.6	5.2	4.9	4.9	4.6	4.3	3.9	3.6
No. of Layers of Geogrid	4	4	4	4	3	3	3	3	2	2	2	2	1	1
Number of Block Courses above Base (200mm high Blocks)														
Georgid Layer No. 4	16	15	14	13										
3	12	11	10	9	12	11	10	9						
2	8	7	6	5	8	7	6	5	8	7	6	5		
(Bottom Layer) 1	4	3	2	1	4	3	2	1	4	3	2	1	4	3

Notes:

1 Detailed notes regarding the use of this design chart are given in Appendix “A” which should be thoroughly studied prior to construction.

2 This design applies to situations where the native soil consists of competent clay-silt-sand soil which has a safe bearing capacity of not less than 3000 p.s.f. (150 kPa) in regard to supporting foundations and can be densely compacted as a backfill material.

3 Geogrid reinforcement must be fully embedded between courses of Terraforce masonry units, and must be tensioned as the wall backfill is placed.

4 Wall foundation to comprise densely compacted well graded sand and crushed gravel material.

Use of Design Charts

This manual provides a total of 24 design charts which relate to the following situations :

1. INCLINATION OF TERRAFORCE WALL TO VERTICAL

- 5° charts 1 through 6
- 10° charts 7 through 12
- 20° charts 13 through 18
- 30° charts 19 through 24

2. USE OF DIFFERENT WALL BACKFILL MATERIALS

- Soil friction angle of 26° refers to soil consisting of densely compacted silty clay, silt or silty sand.
- Soil friction angle of 31° refers to soil consisting of densely compacted sand or gravelly sand.
- Backfill materials should be placed in thin lifts 150 to 200 mm and thoroughly and uniformly compacted to a dense state of compaction (not less than 95% of the material's standard Proctor maximum dry density).
- The drainage fill will consist of well-graded sand and gravel, or clear crushed stone placed adjacent to the wall fascia, with each lift. The width of the drainage fill is to be at least 0.3 m.

3. GEOGRID REINFORCEMENT

For various heights of wall ranging from 1.4 to 4.0 m the charts provide :

- The number of layers of geogrid (grid) reinforcement required;
- The vertical height increments at which the grid sheets are laid, described by the course below;
- The length of grid, measured inwards from the face of the wall.

The designs have been standardized on the use of Miragrid 2T or equivalent i.e. Restrain 50 etc. For details: www.terraforce.com/downloads.

This material is a high quality, multi-strand polyester geogrid which is particularly suitable for use in wall construction as it can be rolled out along the length of the wall rather than being cut transversely. When laid in this manner the main (strongest) direction of this Miragrid reinforcement is perpendicular to the face of the wall. Miragrid rolls can be cut into the exact widths required by the design. Alternatively Miragrid 5T or equivalent can be used. In this case the Miragrid 5T is rolled perpendicular to the face of the wall and cut to the required length.

When the grids are laid to reinforce the Terraforce wall fascia, the level of the compacted backfill is raised to the design geogrid installation level and is installed first at the fascia. The next course of Terraforce blocks is laid above the geogrid and infilled, the geogrid is extended over its designed width and tensioned, and the tension is held by placing backfill material (for the next lift) on the edge remote from the wall. The next lift of backfill is then laid and densely compacted.

4. BACKSLOPE

Charts are provided for the following conditions

- Backslope above crest of wall 5°to horizontal (1V:11H slope);
- Backslope above crest of wall 22°to horizontal (1V:2.5H slope);
- Backslope above crest of wall at 5° to horizontal and able to sustain a surcharge load (imposed pressure) of 10 kPa, this is adequate to allow for parking passenger cars.

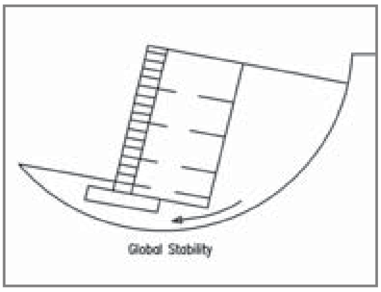
5. FOUNDATION CONDITIONS

It is assumed that the soil which supports the wall foundation consists of competent material capable of supporting a load of 150 kPa. Soils such as stiff clay soils, and compact to dense silty sand are examples of competent materials. In the event that weaker soils are found, or that the foundation soil is a frost susceptible material (e.g. silt), you should contact your Terraforce distributor who will refer you to an experienced design professional.

6. GLOBAL STABILITY

Potential global failure mechanisms are not addressed directly in this design manual but should be considered in the design of reinforced soil walls. This is the same as would be in the case in any retaining wall design whether reinforced soil or conventional. Global instability may be associated with potential failure, surfaces passing through the backfill soil and into the foundation soils beyond the limits of the reinforced soil zone. Therefore, it is prudent to perform this global analysis prior to undertaking detailed wall calculations.

Calculation of the factor of safety against global failure modes should be undertaken by a competent geotechnical engineer familiar with the subsurface conditions at the site.

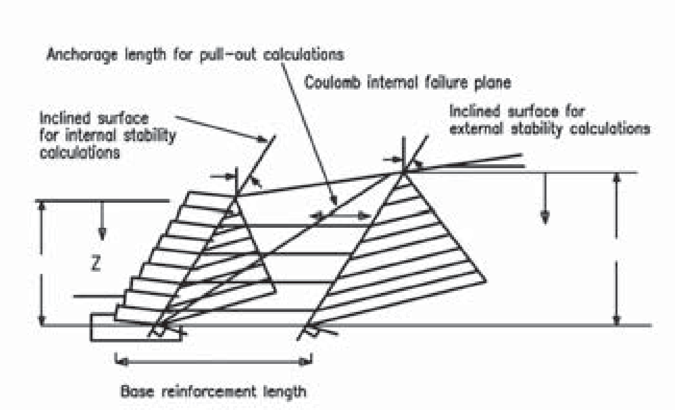


APPENDIX 'A'

In most cases these analyses can be carried out using conventional limit equilibrium slope stability methods of analysis as given in standard geotechnical engineering textbooks.

External failure mechanisms consider the stability of an equivalent gravity structure comprising the facing units, geosynthetic reinforcement, and reinforced soil fill. Internal stability calculations are restricted to potential failure mechanisms within the reinforced soil zone. Local stability calculations are focused on the stability of the dry-stacked column that forms the facing and the connections with the reinforcement layers. Design of the maximum unreinforced wall height at the top of the structure is carried out using the stability analysis and factors of safety recommended for conventional (gravity) segmental retaining walls.

Not illustrated in this figure is the requirement that global stability of the structure be satisfied as is the case for all retaining wall systems. Conventional slope stability methods of analysis that have been modified to include the stabilizing influence of horizontal layers of geosynthetic reinforcement can be used for this purpose.



The principal components of a geosynthetic reinforced soil segmental retaining wall and the earth pressures which act on that wall are illustrated in the previous figure.

For a detailed review of design methodology, the reader is referred to the following publications

- Guide to the Design of Terraforce L 13 Retaining Walls, Hawkins, Hawkins and Osborn, 1992 available at www.terraforce.com.
- Guide to the Design of Terraforce L18 Retaining Walls, Steffen, Robertson and Kirsten, 1994.
- Bathurst, RJ., Geosynthetics for Reinforcement Applications in Retaining Walls, Proc. 44th Can. Geotech. Conf. 1991.
- Bathurst, RJ., Simac M.R and Berg, RR, Review of NCMA Segmental Retaining Wall Design Manual for Geosynthetic Reinforced Structures, Transportation Research Record No. 1414, 1993.
- Mitchell, J.K. and Villet, W.C.B. (Eds), Reinforce ment Earth Slopes and Embankments, National Cooperative Highway Research Program Report No. 290, 1987.
- NCMA Design Manual for Segmental Retaining Walls, First Edition, 1993.

The engineering calculations and design drawings for geosynthetic reinforced walls were prepared jointly by Dr. Richard J. Bathurst of Royal Military College, Kingston, Ontario and Colin Alston of Alston Associates Inc., Markham Ontario.

The basic design charts for Terraforce gravity Walls in Appendix "C" were prepared by Johan Joubert of Foundation and Slope Stability Engineering (PTY) LTD Pretoria, South Africa.

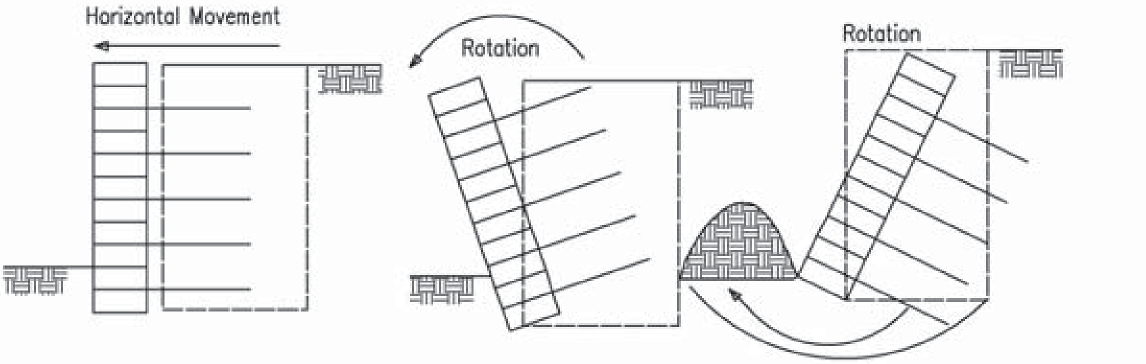
CAUTIONARY NOTE!

Insufficient professional design and supervision input occasionally result in these shortfalls:

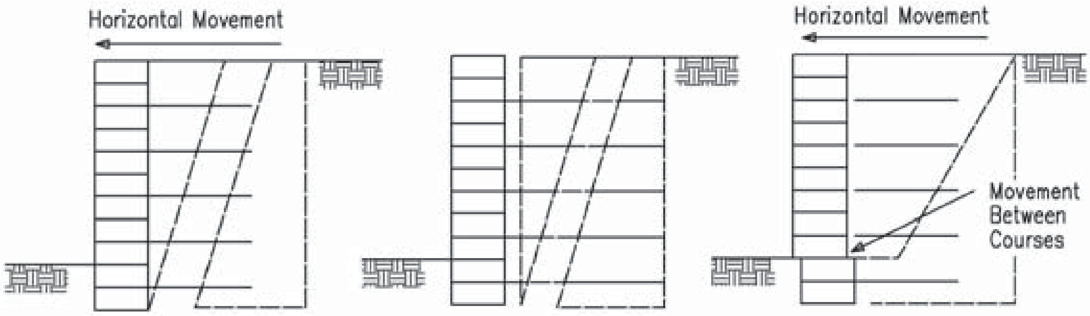
- **Saturated backfill** - lack of drainage above and behind the wall
- **Insufficient constructed mass** - no or negligible design input
- **Limited bearing capacity** - poor or saturated founding conditions
- **Design angle and height exceeded** - lack of supervision
- **Settlement** - substandard backfill or inadequate compaction
- **Face connection failure** - poor connection between block and reinforcing fabrics
- **Undermining** - excavation close to the wall foundation
- **Excessive loading** - not accounted for in original design

APPENDIX ‘B’
Design Methods for Geosynthetic Reinforced Soil Retaining Walls

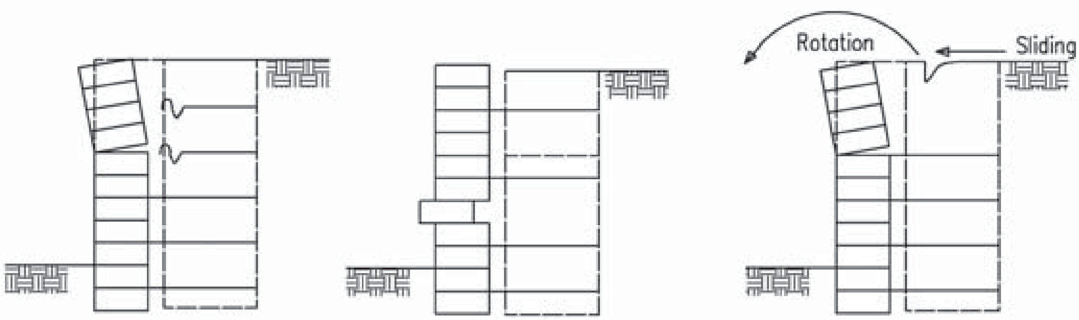
The design of the soil reinforced retaining wall systems
takes into account the potential failure mechanisms illustrated below.



Base Sliding | Overturning | Bearing Capacity & Settlement Excessive Settlement



Pullout | Tensile Overstress | Internal Sliding



Facing Connection | Bulging (Shear Transfer Failure) | Maximum Unreinforced Height

Basic design table for mass gravity retaining walls.

BLOCK L13

- UNIQUE HORIZONTAL INTERLOCK
- WITH OPTIONAL VERTICAL INTERLOCK
- HOLLOW CORE REVERSIBLE UNITS
- FULLY PLANTABLE

Block Name:	L13			
Block Height:	225	mm	8.9	"
Dimension B:	425	mm	16.7	" from front to back
Mass per block:	32	kg	70.5	lb
No. blocks /m2:	13			

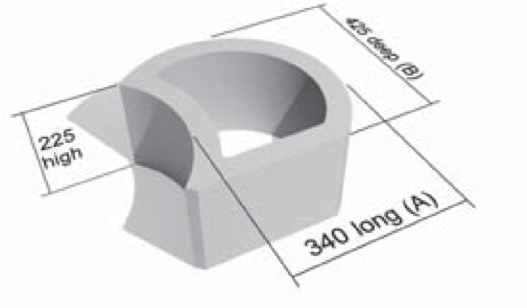
L13

B = 425 mm Mass = 416 kg/m2

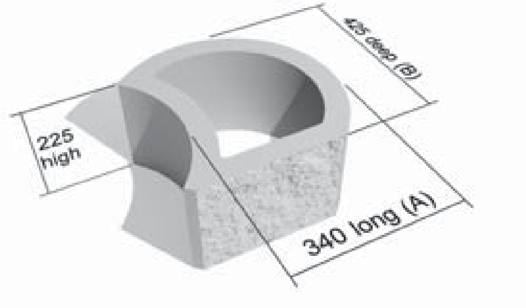
RETAINED SOIL	BACKSLOPE ABOVE CREST OF RETAINING WALL (degrees)	WALL INCLINATION FROM HORIZONTAL							
		60°	65°	70°	75°	80°	85°	90°	inclination
		130	105	82	60	40	20	0	mm setback
		5.1	4.1	3.2	2.4	1.6	0.8	0	inch setback
		MAXIMUM ALLOWABLE UNREINFORCED WALL HEIGHT							
FIRM CLAY & COMPACT SILT P>26°	0°	18.1	14.5	11.3	8.7	6.6	5.0	4.0	blocks
		4.1	3.3	2.5	2.0	1.5	1.1	0.9	metres
		13.4	10.7	8.3	6.4	4.9	3.7	3.0	feet
	10°	14.5	11.7	9.2	7.1	5.5	4.2	3.4	blocks
		3.3	2.6	2.1	1.6	1.2	0.9	0.8	metres
		10.7	8.6	6.8	5.2	4.1	3.1	2.5	feet
	22°	12.0	8.9	6.4	4.5	3.1	2.3	2.1	blocks
		2.7	2.0	1.4	1.0	0.7	0.5	0.5	metres
		8.9	6.6	4.7	3.3	2.3	1.7	1.6	feet
SILTY SAND & SAND P>32°	0°	28.0	21.6	16.3	12.1	9.0	6.9	5.9	blocks
		6.3	4.9	3.7	2.7	2.0	1.6	1.3	metres
		20.7	15.9	12.0	8.9	6.6	5.1	4.4	feet
	10°	24.8	18.8	13.9	10.1	7.3	5.6	4.9	blocks
		5.6	4.2	3.1	2.3	1.6	1.3	1.1	metres
		18.3	13.9	10.3	7.5	5.4	4.1	3.6	feet
	22°	19.2	14.6	10.7	7.7	5.5	4.1	3.6	blocks
		4.3	3.3	2.4	1.7	1.2	0.9	0.8	metres
		14.2	10.8	7.9	5.7	4.1	3.0	2.7	feet

Maximum wall heights (in block height, metres, feet) for a single skin, mass gravity, block retaining wall system - without additional interlocking keys, reinforcements or backfill stabilizing.

1. Wall height measured from top of foundation / levelling pad
2. Top of foundation / levelling pad a minimum of 150mm / 0.5 ft below ground level
3. No allowance made for surcharge above wall
4. Angle of internal friction used in calculations: P(firm clay)>26°,P(silty sand)>32°.
5. Compaction effort at optimum moisture content to ensure maximum density achievable
6. Provided that groundwater conditions are controlled, a wide variety of soil types can be used for infill soil
7. Subsoil drainage is essential to intercept groundwater. Build-up of hydrostatic pressure and seepage forces minimised
8. Surface water run-off should be directed away from the wall
9. Factor of safety for shear and overturning = 1.5



L13 STANDARD



L13 ROCKFACE
CHECK WITH LOCAL SUPPLIER FOR AVAILABILITY

Basic design table for mass gravity retaining walls.

BLOCK L18

- UNIQUE HORIZONTAL INTERLOCK
- WITH OPTIONAL VERTICAL INTERLOCK
- HOLLOW CORE REVERSIBLE UNITS
- FULLY PLANTABLE

Block Name:	L18				
Block Height:	200	mm	7.9	"	
Dimension B:	350	mm	13.8	"	from front to back
Mass per block:	20	kg	44.1	lb	
No. blocks /m2:	18				

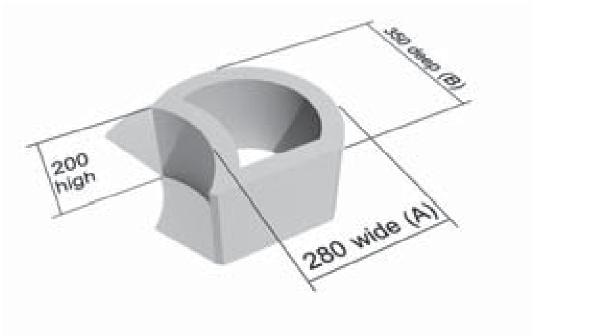
L18

B = 350 mm   Mass = 360 kg/m2

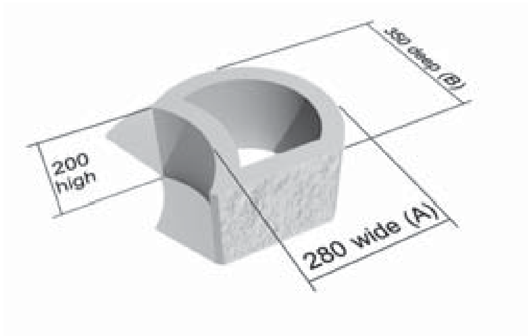
RETAINED SOIL	BACKSLOPE ABOVE CREST OF RETAINING WALL (degrees)	60°	65°	70°	75°	80°	85°	90°	inclination
					WALL INCLINATION FROM HORIZONTAL				
		115	93	73	54	35	17	0	mm setback
		4.5	3.7	2.9	2.1	1.4	0.7	0	inch setback
					MAXIMUM ALLOWABLE UNREINFORCED WALL HEIGHT				
FIRM CLAY & COMPACT SILT P>26°	0°	17.0	13.6	10.6	8.2	6.2	4.7	3.8	blocks
		3.4	2.7	2.1	1.6	1.2	0.9	0.8	metres
		11.2	9.0	7.0	5.4	4.1	3.1	2.5	feet
	10°	13.6	11.0	8.7	6.7	5.2	4.0	3.2	blocks
		2.7	2.2	1.7	1.3	1.0	0.8	0.6	metres
		8.9	7.2	5.7	4.4	3.4	2.6	2.1	feet
	22°	11.3	8.4	6.0	4.2	2.9	2.2	2.0	blocks
		2.3	1.7	1.2	0.8	0.6	0.4	0.4	metres
		7.4	5.5	3.9	2.8	1.9	1.4	1.3	feet
SILTY SAND & SAND P>32°	0°	26.3	20.3	15.3	11.4	8.5	6.5	5.6	blocks
		5.3	4.1	3.1	2.3	1.7	1.3	1.1	metres
		17.3	13.3	10.0	7.5	5.6	4.3	3.7	feet
	10°	23.3	17.7	13.1	9.5	6.9	5.3	4.6	blocks
		4.7	3.5	2.6	1.9	1.4	1.1	0.9	metres
		15.3	11.6	8.6	6.2	4.5	3.5	3.0	feet
	22°	18.1	13.7	10.1	7.2	5.2	3.9	3.4	blocks
		3.6	2.7	2.0	1.4	1.0	0.8	0.7	metres
		11.9	9.0	6.6	4.7	3.4	2.6	2.2	feet

Maximum wall heights (in block height, metres, feet) for a single skin, mass gravity, block retaining wall system - without additional interlocking keys, reinforcements or backfill stabilizing.

1. Wall height measured from top of foundation / levelling pad
2. Top of foundation / levelling pad a minimum of 150mm / 0.5 ft below ground level
3. No allowance made for surcharge above wall
4. Angle of internal friction used in calculations: P(firm clay)>26°,P(silty sand)>32°.
5. Compaction effort at optimum moisture content to ensure maximum density achievable
6. Provided that groundwater conditions are controlled, a wide variety of soil types can be used for infill soil
7. Subsoil drainage is essential to intercept groundwater. Build-up of hydrostatic pressure and seepage forces minimised
8. Surface water run-off should be directed away from the wall
9. Factor of safety for shear and overturning = 1.5



L18 STANDARD



L18 ROCKFACE

APPENDIX 'C'
Basic design table for mass gravity retaining walls.

BLOCK L11

- UNIQUE HORIZONTAL INTERLOCK
- WITH OPTIONAL VERTICAL INTERLOCK
- HOLLOW CORE REVERSIBLE UNITS
- FULLY PLANTABLE

Block Name:	L11			
Block Height:	225	mm	8.9	"
Dimension B:	350	mm	13.8	" from front to back
Mass per block:	29	kg	63.9	lb
No. blocks /m2:	11			

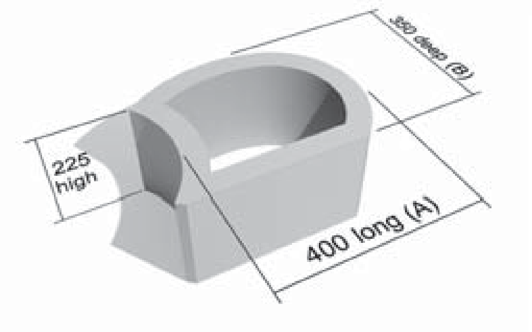
L11

B = 350 mm Mass = 319 kg/m2

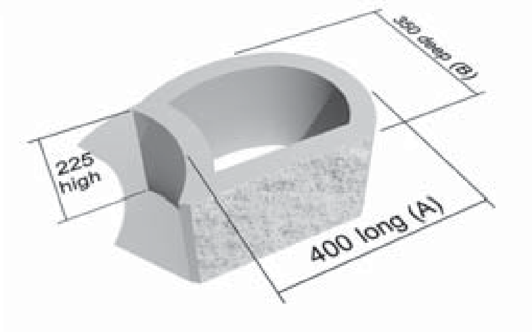
RETAINED SOIL	BACKSLOPE ABOVE CREST OF RETAINING WALL (degrees)	WALL INCLINATION FROM HORIZONTAL							
		60°	65°	70°	75°	80°	85°	90°	inclination
		130	105	82	60	40	20	0	mm setback
		5.1	4.1	3.2	2.4	1.6	0.8	0	inch setback
		MAXIMUM ALLOWABLE UNREINFORCED WALL HEIGHT							
FIRM CLAY & COMPACT SILT P>26°	0°	16.7	13.3	10.4	8.0	6.1	4.6	3.7	blocks
		3.7	3.0	2.3	1.8	1.4	1.0	0.8	metres
		12.3	9.9	7.7	5.9	4.5	3.4	2.7	feet
	10°	13.3	10.8	8.5	6.5	5.1	3.9	3.1	blocks
		3.0	2.4	1.9	1.5	1.1	0.9	0.7	metres
		9.8	8.0	6.3	4.8	3.8	2.9	2.3	feet
	22°	11.0	8.2	5.9	4.1	2.9	2.1	1.9	blocks
		2.5	1.8	1.3	0.9	0.7	0.5	0.4	metres
		8.1	6.1	4.4	3.0	2.1	1.6	1.4	feet
SILTY SAND & SAND P>32°	0°	25.8	19.9	15.0	11.1	8.3	6.4	5.4	blocks
		5.8	4.5	3.4	2.5	1.9	1.4	1.2	metres
		19.0	14.7	11.1	8.2	6.1	4.7	4.0	feet
	10°	22.8	17.3	12.8	9.3	6.7	5.2	4.5	blocks
		5.1	3.9	2.9	2.1	1.5	1.2	1.0	metres
		16.8	12.8	9.4	6.9	4.9	3.8	3.3	feet
	22°	17.7	13.4	9.9	7.1	5.1	3.8	3.3	blocks
		4.0	3.0	2.2	1.6	1.1	0.9	0.7	metres
		13.1	9.9	7.3	5.2	3.8	2.8	2.4	feet

Maximum wall heights (in block height, metres, feet) for a single skin, mass gravity, block retaining wall system - without additional interlocking keys, reinforcements or backfill stabilizing.

1. Wall height measured from top of foundation / levelling pad
2. Top of foundation / levelling pad a minimum of 150mm / 0.5 ft below ground level
3. No allowance made for surcharge above wall
4. Angle of internal friction used in calculations: P(firm clay)>26°,P(silty sand)>32°.
5. Compaction effort at optimum moisture content to ensure maximum density achievable
6. Provided that groundwater conditions are controlled, a wide variety of soil types can be used for infill soil
7. Subsoil drainage is essential to intercept groundwater. Build-up of hydrostatic pressure and seepage forces minimised
8. Surface water run-off should be directed away from the wall
9. Factor of safety for shear and overturning = 1.5



L11 STANDARD



L11 ROCKFACE

APPENDIX 'C'
Basic design table for mass gravity retaining walls.

BLOCK L22

- UNIQUE HORIZONTAL INTERLOCK
- WITH OPTIONAL VERTICAL INTERLOCK
- HOLLOW CORE REVERSIBLE UNITS
- FULLY PLANTABLE

Block Name:	L22			
Block Height:	200	mm	7.9	"
Dimension B:	300	mm	11.8	" from front to back
Mass per block:	16	kg	35.3	lb
No. blocks /m2:	22			

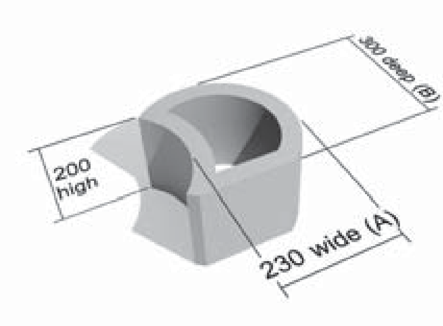
L22

B = 300 mm   Mass = 352 kg/m2

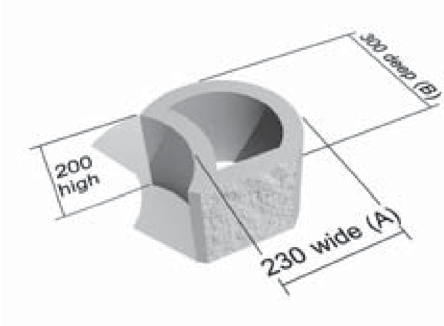
RETAINED SOIL	BACKSLOPE ABOVE CREST OF RETAINING WALL (degrees)	WALL INCLINATION FROM HORIZONTAL							
		60˚	65˚	70˚	75˚	80˚	85˚	90˚	inclination
		115	93	73	54	35	17	0	mm setback
		4.5	3.7	2.9	2.1	1.4	0.7	0	inch setback
		MAXIMUM ALLOWABLE UNREINFORCED WALL HEIGHT							
FIRM CLAY & COMPACT SILT P>26°	0˚	16.5	13.2	10.3	7.9	6.0	4.6	3.6	blocks
		3.3	2.6	2.1	1.6	1.2	0.9	0.7	metres
		10.8	8.7	6.8	5.2	3.9	3.0	2.4	feet
	10˚	13.2	10.7	8.4	6.5	5.0	3.8	3.1	blocks
		2.6	2.1	1.7	1.3	1.0	0.8	0.6	metres
		8.7	7.0	5.5	4.3	3.3	2.5	2.0	feet
	22˚	10.9	8.1	5.8	4.1	2.8	2.1	1.9	blocks
		2.2	1.6	1.2	0.8	0.6	0.4	0.4	metres
		7.2	5.3	3.8	2.7	1.8	1.4	1.2	feet
SILTY SAND & SAND P>32°	0˚	25.5	19.7	14.9	11.0	8.2	6.3	5.4	blocks
		5.1	3.9	3.0	2.2	1.6	1.3	1.1	metres
		16.7	12.9	9.8	7.2	5.4	4.1	3.5	feet
	10˚	22.6	17.1	12.7	9.2	6.7	5.1	4.5	blocks
		4.5	3.4	2.5	1.8	1.3	1.0	0.9	metres
		14.8	11.2	8.3	6.0	4.4	3.3	3.0	feet
	22˚	17.5	13.3	9.8	7.0	5.0	3.7	3.3	blocks
		3.5	2.7	2.0	1.4	1.0	0.7	0.7	metres
		11.5	8.7	6.4	4.6	3.3	2.4	2.2	feet

Maximum wall heights (in block height, metres, feet) for a single skin, mass gravity, block retaining wall system - without additional interlocking keys, reinforcements or backfill stabilizing.

1. Wall height measured from top of foundation / levelling pad
2. Top of foundation / levelling pad a minimum of 150mm / 0.5 ft below ground level
3. No allowance made for surcharge above wall
4. Angle of internal friction used in calculations: P(firm clay)>26°,P(silty sand)>32°.
5. Compaction effort at optimum moisture content to ensure maximum density achievable
6. Provided that groundwater conditions are controlled, a wide variety of soil types can be used for infill soil
7. Subsoil drainage is essential to intercept groundwater. Build-up of hydrostatic pressure and seepage forces minimised
8. Surface water run-off should be directed away from the wall
9. Factor of safety for shear and overturning = 1.5



L22 STANDARD



L22 ROCKFACE

TERRAFORCE®
The original, reversible, hollow core retaining block

APPENDIX ‘C’
Basic design table for mass gravity retaining walls.

BLOCK L15

- UNIQUE HORIZONTAL INTERLOCK
- WITH OPTIONAL VERTICAL INTERLOCK
- HOLLOW CORE REVERSIBLE UNITS
- FULLY PLANTABLE

Block Name:	L15			
Block Height:	200	mm	7.9	"
Dimension B:	295	mm	11.6	" from front to back
Mass per block:	22	kg	48.5	lb
No. blocks /m2:	15			

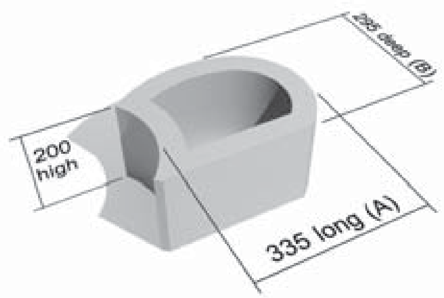
L15

B = 295 mm Mass = 330 kg/m2

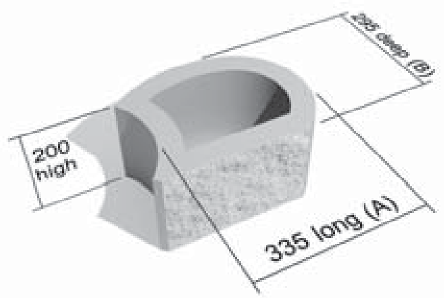
RETAINED SOIL	BACKSLOPE ABOVE CREST OF RETAINING WALL (degrees)	WALL INCLINATION FROM HORIZONTAL							
		60°	65°	70°	75°	80°	85°	90°	inclination
		115	93	73	54	35	17	0	mm setback
		4.5	3.7	2.9	2.1	1.4	0.7	0	inch setback
		MAXIMUM ALLOWABLE UNREINFORCED WALL HEIGHT							
FIRM CLAY & COMPACT SILT P>26°	0°	16.3	13.0	10.1	7.8	5.9	4.5	3.6	blocks
		3.3	2.6	2.0	1.6	1.2	0.9	0.7	metres
		10.7	8.5	6.7	5.1	3.9	2.9	2.4	feet
	10°	13.0	10.5	8.3	6.4	4.9	3.8	3.1	blocks
		2.6	2.1	1.7	1.3	1.0	0.8	0.6	metres
		8.5	6.9	5.4	4.2	3.2	2.5	2.0	feet
	22°	10.8	8.0	5.7	4.0	2.8	2.1	1.9	blocks
		2.2	1.6	1.1	0.8	0.6	0.4	0.4	metres
		7.1	5.2	3.7	2.6	1.8	1.4	1.2	feet
SILTY SAND & SAND P>32°	0°	25.1	19.4	14.6	10.9	8.1	6.2	5.3	blocks
		5.0	3.9	2.9	2.2	1.6	1.2	1.1	metres
		16.5	12.7	9.6	7.2	5.3	4.1	3.5	feet
	10°	22.3	16.9	12.5	9.1	6.6	5.0	4.4	blocks
		4.5	3.4	2.5	1.8	1.3	1.0	0.9	metres
		14.6	11.1	8.2	6.0	4.3	3.3	2.9	feet
	22°	17.2	13.1	9.6	6.9	4.9	3.7	3.2	blocks
		3.4	2.6	1.9	1.4	1.0	0.7	0.6	metres
		11.3	8.6	6.3	4.5	3.2	2.4	2.1	feet

Maximum wall heights (in block height, metres, feet) for a single skin, mass gravity, block retaining wall system - without additional interlocking keys, reinforcements or backfill stabilizing.

1. Wall height measured from top of foundation / levelling pad
2. Top of foundation / levelling pad a minimum of 150mm / 0.5 ft below ground level
3. No allowance made for surcharge above wall
4. Angle of internal friction used in calculations: P(firm clay)>26°,P(silty sand)>32°.
5. Compaction effort at optimum moisture content to ensure maximum density achievable
6. Provided that groundwater conditions are controlled, a wide variety of soil types can be used for infill soil
7. Subsoil drainage is essential to intercept groundwater. Build-up of hydrostatic pressure and seepage forces minimised
8. Surface water run-off should be directed away from the wall
9. Factor of safety for shear and overturning = 1.5



L15 STANDARD



L15 ROCKFACE

APPENDIX 'C'
Basic design table for mass gravity retaining walls.

BLOCK L12

- UNIQUE HORIZONTAL INTERLOCK
- WITH OPTIONAL VERTICAL INTERLOCK
- HOLLOW CORE REVERSIBLE UNITS
- FULLY PLANTABLE

Block Name:	L12			
Block Height:	210	mm	8.3	"
Dimension B:	300	mm	11.8	" from front to back
Mass per block:	24	kg	52.9	lb
No. blocks /m2:	12			

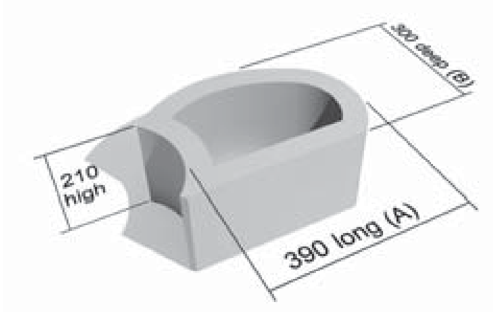
L12

B = 300 mm Mass = 288 kg/m2

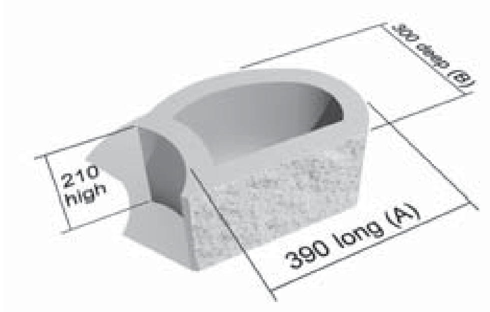
RETAINED SOIL	BACKSLOPE ABOVE CREST OF RETAINING WALL (degrees)	60°	65°	70°	75°	80°	85°	90°	inclination
		WALL INCLINATION FROM HORIZONTAL							
		121	98	76	56	37	18	0	mm setback
		4.8	3.9	3	2.2	1.5	0.7	0	inch setback
		MAXIMUM ALLOWABLE UNREINFORCED WALL HEIGHT							
FIRM CLAY & COMPACT SILT P>26°	0°	15.9	12.7	9.9	7.6	5.8	4.4	3.5	blocks
		3.3	2.7	2.1	1.6	1.2	0.9	0.7	metres
		11.0	8.8	6.8	5.3	4.0	3.0	2.4	feet
	10°	12.7	10.3	8.1	6.2	4.8	3.7	3.0	blocks
		2.7	2.2	1.7	1.3	1.0	0.8	0.6	metres
		8.8	7.1	5.6	4.3	3.3	2.5	2.1	feet
	22°	10.5	7.8	5.6	4.0	2.7	2.0	1.8	blocks
		2.2	1.6	1.2	0.8	0.6	0.4	0.4	metres
		7.2	5.4	3.9	2.8	1.9	1.4	1.2	feet
SILTY SAND & SAND P>32°	0°	24.6	19.0	14.3	10.6	7.9	6.1	5.2	blocks
		5.2	4.0	3.0	2.2	1.7	1.3	1.1	metres
		16.9	13.1	9.9	7.3	5.4	4.2	3.6	feet
	10°	21.8	16.5	12.2	8.9	6.4	4.9	4.3	blocks
		4.6	3.5	2.6	1.9	1.3	1.0	0.9	metres
		15.0	11.4	8.4	6.1	4.4	3.4	3.0	feet
	22°	16.9	12.8	9.4	6.8	4.8	3.6	3.2	blocks
		3.5	2.7	2.0	1.4	1.0	0.8	0.7	metres
		11.6	8.8	6.5	4.7	3.3	2.5	2.2	feet

Maximum wall heights (in block height, metres, feet) for a single skin, mass gravity, block retaining wall system - without additional interlocking keys, reinforcements or backfill stabilizing.

1. Wall height measured from top of foundation / levelling pad
2. Top of foundation / levelling pad a minimum of 150mm / 0.5 ft below ground level
3. No allowance made for surcharge above wall
4. Angle of internal friction used in calculations: P(firm clay)>26°,P(silty sand)>32°.
5. Compaction effort at optimum moisture content to ensure maximum density achievable
6. Provided that groundwater conditions are controlled, a wide variety of soil types can be used for infill soil
7. Subsoil drainage is essential to intercept groundwater. Build-up of hydrostatic pressure and seepage forces minimised
8. Surface water run-off should be directed away from the wall
9. Factor of safety for shear and overturning = 1.5



L12 STANDARD



L12 ROCKFACE

TERRAFORCE®
The original, reversible, hollow core retaining block

Basic design table for mass gravity retaining walls.

BLOCK L16

- UNIQUE HORIZONTAL INTERLOCK
- WITH OPTIONAL VERTICAL INTERLOCK
- HOLLOW CORE REVERSIBLE UNITS
- FULLY PLANTABLE

Block Name:	L16			
Block Height:	200	mm	7.9	"
Dimension B:	260	mm	10.2	" from front to back
Mass per block:	20	kg	44.1	lb
No. blocks /m2:	16.5			

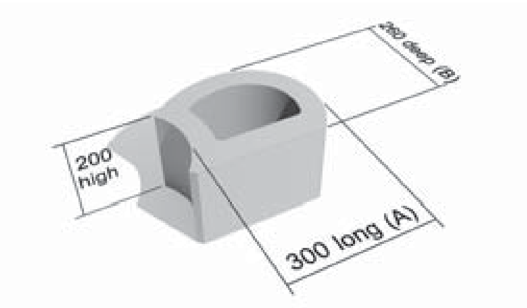
L16

B = 260 mm Mass = 330 kg/m2

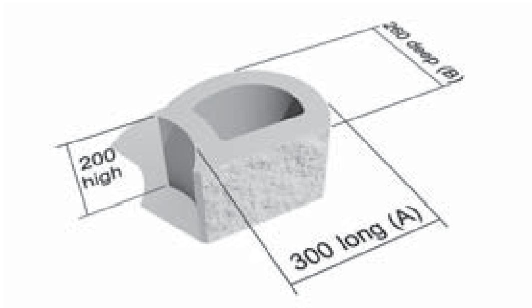
RETAINED SOIL	BACKSLOPE ABOVE CREST OF RETAINING WALL (degrees)	WALL INCLINATION FROM HORIZONTAL							
		60°	65°	70°	75°	80°	85°	90°	inclination
		115	93	73	54	35	17	0	mm setback
		4.5	3.7	2.9	2.1	1.4	0.7	0	inch setback
		MAXIMUM ALLOWABLE UNREINFORCED WALL HEIGHT							
FIRM CLAY & COMPACT SILT P>26°	0°	15.9	12.7	9.9	7.6	5.8	4.4	3.5	blocks
		3.2	2.5	2.0	1.5	1.2	0.9	0.7	metres
		10.4	8.4	6.5	5.0	3.8	2.9	2.3	feet
	10°	12.7	10.3	8.1	6.2	4.8	3.7	3.0	blocks
		2.5	2.1	1.6	1.2	1.0	0.7	0.6	metres
		8.3	6.8	5.3	4.1	3.1	2.4	2.0	feet
	22°	10.5	7.8	5.6	4.0	2.7	2.0	1.8	blocks
		2.1	1.6	1.1	0.8	0.5	0.4	0.4	metres
		6.9	5.1	3.7	2.6	1.8	1.3	1.2	feet
SILTY SAND & SAND P>32°	0°	24.6	19.0	14.3	10.6	7.9	6.1	5.2	blocks
		4.9	3.8	2.9	2.1	1.6	1.2	1.0	metres
		16.1	12.5	9.4	7.0	5.2	4.0	3.4	feet
	10°	21.8	16.5	12.2	8.9	6.4	4.9	4.3	blocks
		4.4	3.3	2.4	1.8	1.3	1.0	0.9	metres
		14.3	10.8	8.0	5.8	4.2	3.2	2.8	feet
	22°	16.9	12.8	9.4	6.8	4.8	3.6	3.2	blocks
		3.4	2.6	1.9	1.4	1.0	0.7	0.6	metres
		11.1	8.4	6.2	4.5	3.1	2.4	2.1	feet

Maximum wall heights (in block height, metres, feet) for a single skin, mass gravity, block retaining wall system - without additional interlocking keys, reinforcements or backfill stabilizing.

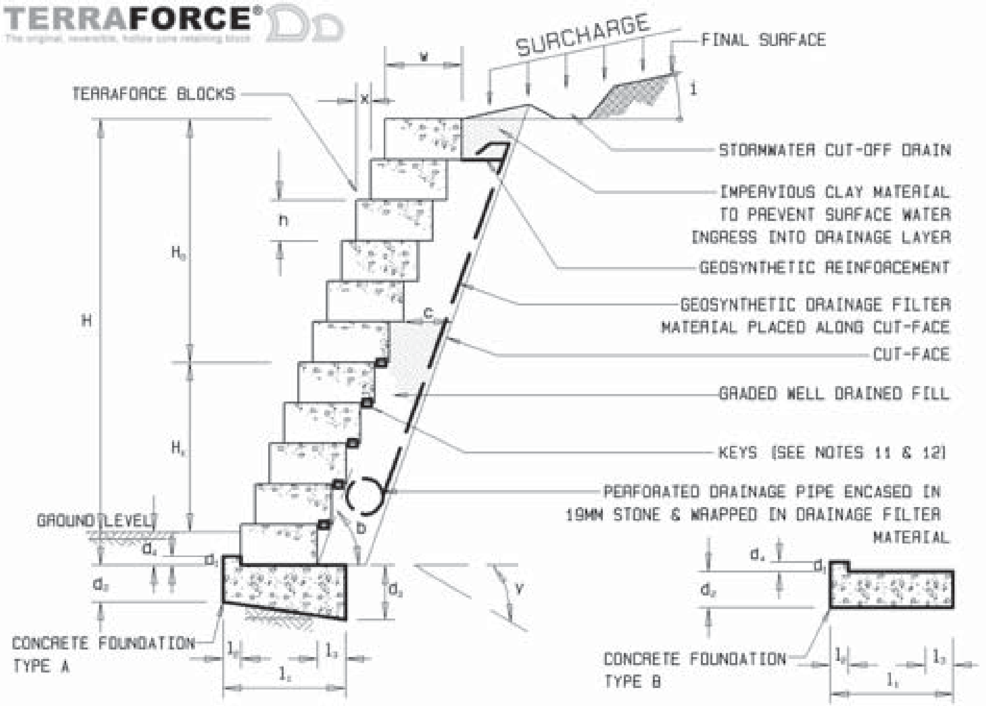
1. Wall height measured from top of foundation / levelling pad
2. Top of foundation / levelling pad a minimum of 150mm / 0.5 ft below ground level
3. No allowance made for surcharge above wall
4. Angle of internal friction used in calculations: P(firm clay)>26°,P(silty sand)>32°.
5. Compaction effort at optimum moisture content to ensure maximum density achievable
6. Provided that groundwater conditions are controlled, a wide variety of soil types can be used for infill soil
7. Subsoil drainage is essential to intercept groundwater. Build-up of hydrostatic pressure and seepage forces minimised
8. Surface water run-off should be directed away from the wall
9. Factor of safety for shear and overturning = 1.5



L16 STANDARD



L16 ROCKFACE



NOTES:

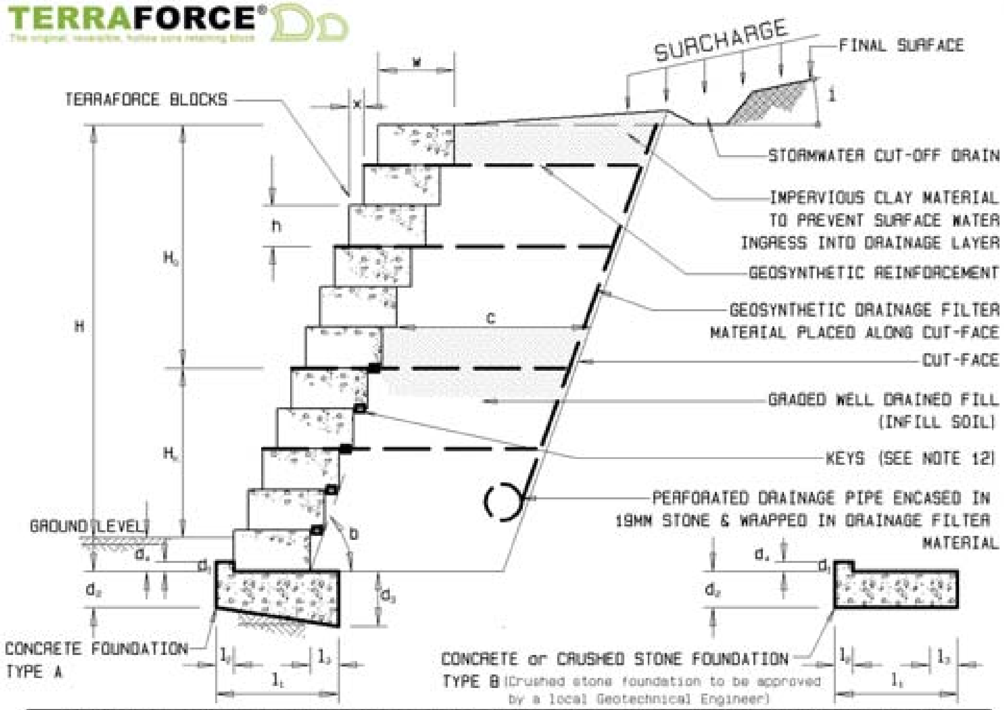
1. Terraforce precast concrete retaining blocks to be used. Type of block to be specified.
2. Terraforce blocks to be placed with off-set as shown and filled with well tamped approved soil or crushed gravel.
3. Infill soil (Backfill / retained) to be granular, well drained and compacted in layers not exceeding 150mm at optimum moisture content.
4. Geosynthetic drainage filter material to be installed along cut-face, draining towards perforated drainage pipe.
5. Geosynthetic reinforcement sheets to be clamped between blocks and be pulled taut prior to placement of backfill material.
6. Stormwater cut-off drain to be constructed behind and along crest of wall, to prevent water to drain onto face of wall.
7. Foundation excavations to be inspected by the Engineer.
8. Existing services in front of proposed wall, running parallel to the proposed foundation, have to be re-excavated and the trench be backfilled with 6% cement stabilised fill compacted to 90% mod AASHTO at optimum moisture content.
9. Excavation of trenches in front of wall not allowed once the retaining wall has been constructed.
10. Maximum superimposed load, surcharge, on retained soil as indicated in the design table.
11. Concrete keys (where required) to be class 1 mortar or 15 MPa concrete or 19mm crushed stone or by tilting back the foundation a few degrees. (Base Angle 'Y')
12. Concrete keys (where required) to be installed as per the Terraforce Design and Construction manuals of 1992 and 2009. (www.terraforce.com)
13. Terraforce retaining wall design software, Maxiforce, may be downloadedfrom www.maxiwall.com or use the basic Terraforce design tables from www.terraforce.com

SUBMISSION SHEET: TERRAFORCE GRAVITY RETAINING WALL DETAILS

FOUNDATION SOIL	VALUE	BLOCKS	VALUE	WALL	VALUE	FOUNDATION	VALUE
INT FRICTION ANGLE		BLOCK TYPE		HEIGHT (H)		CONCRETE (MPa)	
SOIL UNIT WEIGHT (kN/m³)		OFF-SET (x)		TILT ANGLE (b)		l_1 TOTAL WIDTH	
RETAINED SOIL (Native/Insitu soils)		WIDTH (w)		BACK SLOPE (1)		l_2 TOE WIDTH	
INT FRICTION ANGLE		HEIGHT (h)		HEIGHT WITH KEYS (H_k)		l_3 HEEL WIDTH	
SOIL UNIT WEIGHT (kN/m³)		KEYS PER m²		KEYLESS HEIGHT (H_0)		d_1 KICKER HGHT	
INFILL SOIL (Geo reinforced soils)		DRAINAGE LAYER WIDTH (c)		SURCHARGE (kN/m²)		d_2 TOE HEIGHT	
INT FRICTION ANGLE				BASE ANGLE (y)		d_3 HEEL WIDTH	
SOIL UNIT WEIGHT (kN/m³)				CONSTRUCTED MASS (kg/m³)		d_4 FOUNDATION DEPTH	
FILL WIDTH (c)							

TITLE:	**TERRAFORCE RETAINING WALL DESIGN DETAILS**
CLIENT:	
PROJECT:	
DESIGNED BY:	DATE:

SUBMISSION SHEET 2
for composite retaing walls.



SUBMISSION SHEET: TERRAFORCE GEOSYNTHETIC REINFORCED RETAINING WALL DETAILS

FOUNDATION SOIL	VALUE	BLOCKS	VALUE	WALL	VALUE	FOUNDATION	VALUE
INT FRICTION ANGLE		BLOCK TYPE		HEIGHT (H)		CONCRETE (MPa)	
SOIL UNIT WEIGHT (kN/m²)		OFF-SET (x)		TILT ANGLE (b)		l_1 TOTAL WIDTH	
RETAINED SOIL (Native/Insitu soils)		WIDTH (w)		BACK SLOPE (i)		l_2 TOE WIDTH	
INT FRICTION ANGLE		HEIGHT (h)		HEIGHT WITH KEYS (H_k)		l_3 HEEL WIDTH	
SOIL UNIT WEIGHT (kN/m²)		KEYS PER m²		KEYLESS HEIGHT (H_0)		d_1 KICKER HGHT	
INFILL SOIL (Geo reinforced soils)		DRAINAGE LAYER WIDTH (c)		SURCHARGE (kN/m²)		d_2 TOE HEIGHT	
INT FRICTION ANGLE				GEOTEXTILE STRENGTH		d_3 HEEL WIDTH	
SOIL UNIT WEIGHT (kN/m²)						d_4 FOUNDATION DEPTH	
REINFORCED FILL WIDTH (c)				GEOTEXTILE NAME			

NOTES:

1. Terraforce precast concrete retaining blocks to be used. Type of block to be specified.
2. Terraforce blocks to be placed with off-set as shown and filled with well tamped approved soil or crushed gravel.
3. Backfill soil (Infill / Retained) to be granular, well drained and compacted in layers not exceeding 150mm at optimum moisture content.
4. Geosynthetic drainage filter material to be installed along cut-face, draining towards perforated drainage pipe.
5. Geosynthetic reinforcement sheets to be clamped between blocks (to be visible at wall face) and be pulled taut prior to placement of backfill material.
6. Geosynthetic reinforcement sheets to be placed and spaced according to Engineer's design (Maxiforce design software)
7. Stormwater cut-off drain to be constructed behind and along crest of wall, to prevent water to drain onto face of wall.
8. Foundation excavations to be inspected by a local Geotechnical Engineer to confirm design and size.
9. Existing services in front of proposed wall, running parallel to the proposed foundation, have to be re-excavated and the trench be backfilled with 6% cement stabilised fill compacted to 90% mod AASHTO at optimum moisture content.
10. Excavation of trenches in front of wall not allowed once the retaining wall has been constructed.
11. Maximum superimposed load, surcharge, on retained soil as indicated in the design table.
12. Concrete keys (where required) to be class 1 mortar or 15 MPa concrete. Alternatively keys may be replaced by filling blocks with 19mm crushed stone.
13. For installation guidelines, refer to the Terraforce Design & Installation Manual of 2009 and to the guide to the Design of Terraforce L13 retaining walls of 1992. (www.terraforce.com)
14. Terraforce retaining wall design software, Maxiforce, may be downloaded from www.maxiwall.com or use the basic Terraforce design tables from the 2009 Terraforce manual or from www.terraforce.com

TITLE: **TERRAFORCE RETAINING WALL DESIGN DETAILS**	
CLIENT:	
PROJECT	
DESIGNED BY:	DATE:

FULL BILL OF QUANTITY
(Example)

Item	Description	Unit	Quantity	Rate	Amount
1	Site establishment	sum	1		
2	Contractual requirements	sum	1		
3	Excavate and trim to lines and grades for foundations.	m^3			
4	Excavate material behind proposed wall face to specified width and spoil/stockpile (delete were not aplicable), to allow for placement of geosynthetic reinforcement and imported fill	m^3			
5	Trimming of batter faces to correct angle and embankment preparation work prior to placement of retaining wall blocks and fill	m^3			
6	Supply and place 20Mpa concrete in foundations as per detail, or	m^3			
7	Supply and place crushed stone / gravel pad in foundations as per detail	m^3			
8	Supply and place steel reinforcement in foundations and walls if specified	ton			
9	Supply and install TERRAFORCE BLOCKS TYPE ________ with a minimum constructed mass of ___________ kg/m² including a minimum 300mm wide coarse drainage layer behind the blocks.	m^2			
10	Granular fill from stockpile: Supply, spread in layers less than 150mm thick, water to optimum moisture content and compact fill to no less than 90% Mod AASHTO	m^3			
11	Granular fill supplied by others to the workface: Supply, spread in layers less than 150mm thick, water to optimum moisture content and compact fill to no less than 90% Mod AASHTO	m^3			
12	Supply, install at specified elevation and orientation geosynthetic reinforcement type __________, as directed by site enginer. Fill shall be placed, spread and compacted in such a manner that eliminates the developement of wrinkles and/or movement of geosynthetic reinforcement.	m^2			
13	Supply, install at specified elevation perforated drainage collection pipe type _________ to maintain gravity flow of water to outside of reinforced soil zone.	m			
14	Wrap drainage collection pipe and 21mm drainage aggregate in drainage material type _________	m			
15	Supply and install drainage filter fabric type _______ along excavated batter as specified	m^2			
16	Supply and lay Findrain / Wickdrain ...mm wide at 45° angles along excavated batter at 2m centres, as per the specifications. Connect to perforated collector pipe. Pipe measured under item 15.	m			
17	Fill retaining blocks with garden soil lightly tamped as the work proceeds	m^3			
18	Professional Engineer's design fees	%			
19	Professional Engineer's supervision fees	sum			

FOR TERRAFORCE RECOMMENDED SPECIFICATIONS, EVALUATION REPORT, DESIGN QUESTIONAIRES, SPARE SUBMISSION SHEETS, BILL OF QUANTITIES AND BRIEF Q & A SECTION, GO TO www.terraforce.com/downloads

Disclaimer

Although every reasonable effort has been made to ensure that the technical information and the design procedures presented in this Guide are correct, neither Terraforce CC and any manufacturer of the product, nor their consultants, who have contributed to the preparation of these guidelines, will be held liable for any loss or damage, either direct or consequential, arising from any failure or collapse of a wall of any description constructed with Terraforce precast concrete blocks.

As with any structure, the design of Terraforce retaining walls should only be undertaken by suitably qualified and experienced designers with due cognisance being taken of the specific geotechnical conditions and vital soil parameters pertaining to the site.

BEFORE...

AND AFTER

HOUSE KANONBERG

DIE KELDERS CAVE

OASIS - SOUND BARRIER

BEFORE...

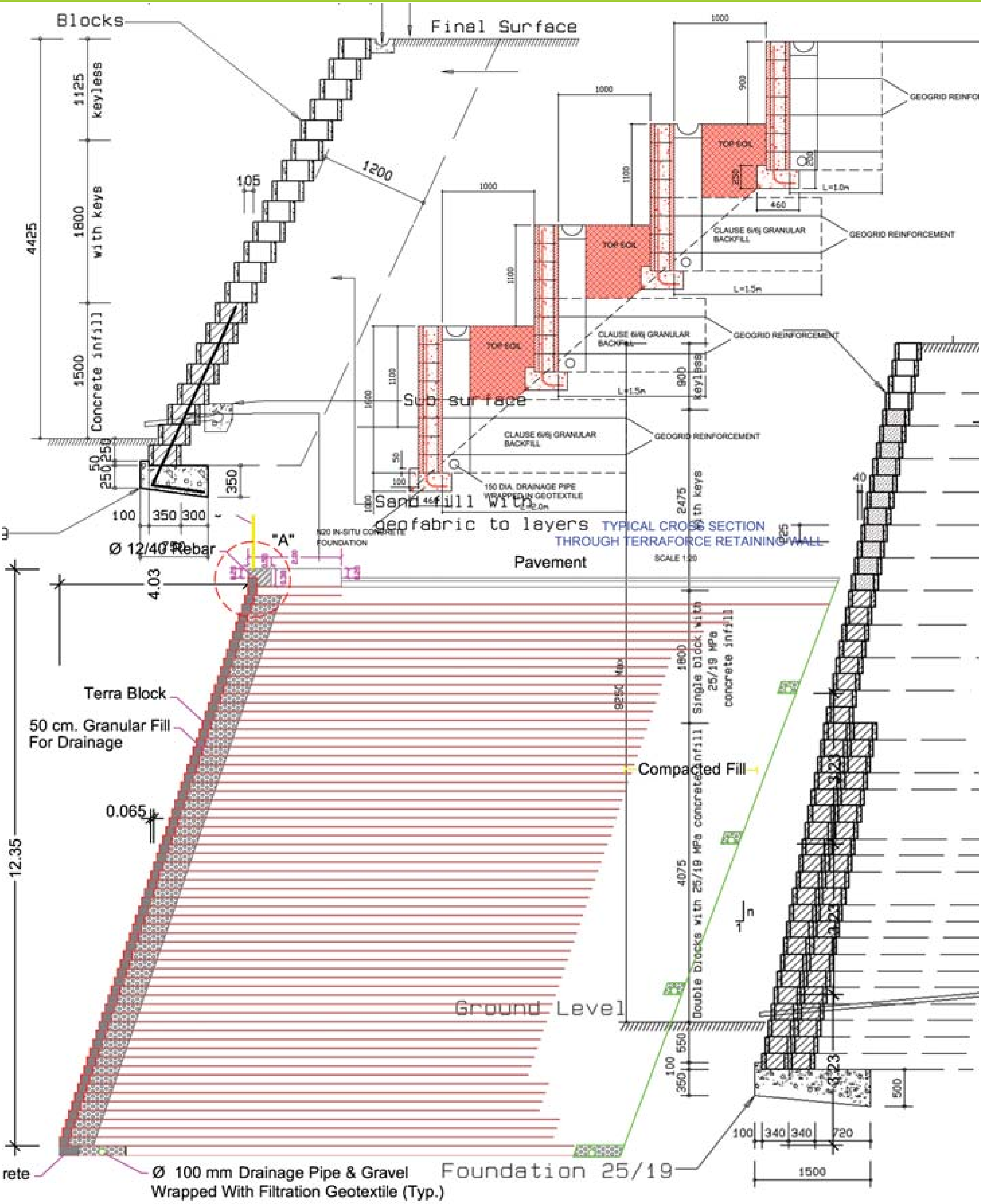
AND AFTER

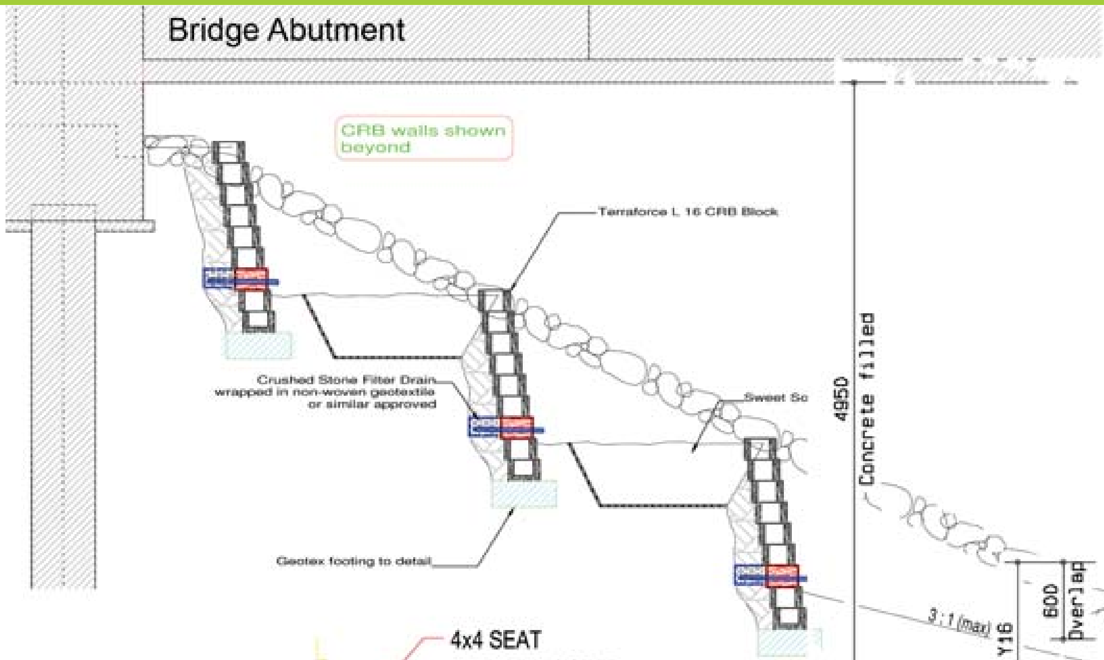
HOUSE KANONBERG

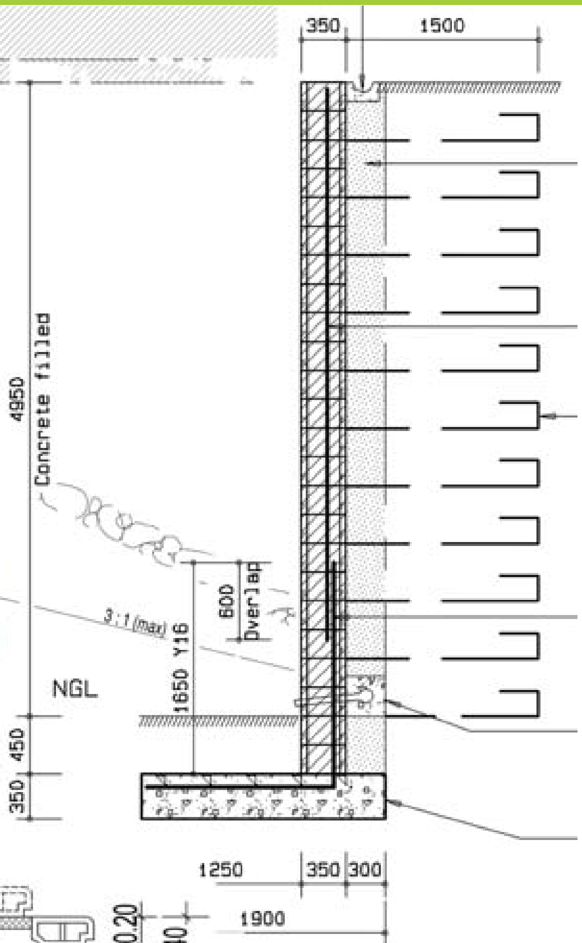
MOUNTAIN RETREAT

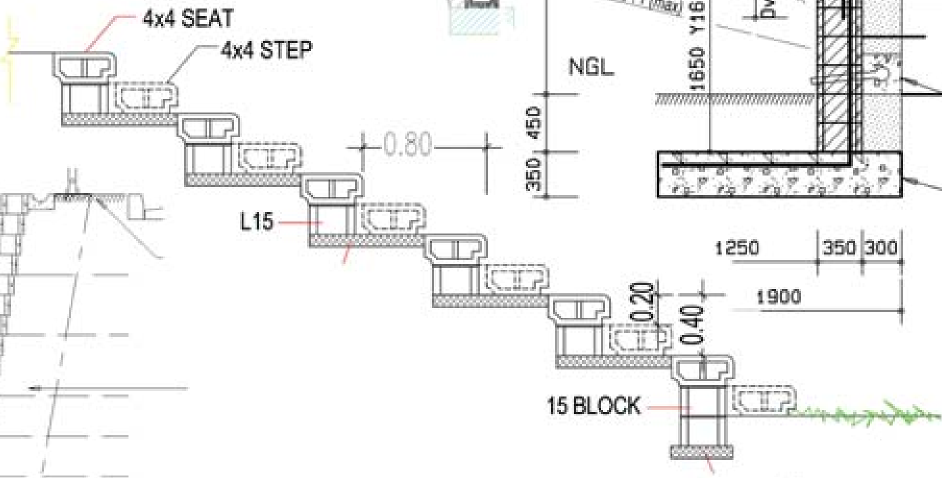
DURBAN LAGUNA BEACH

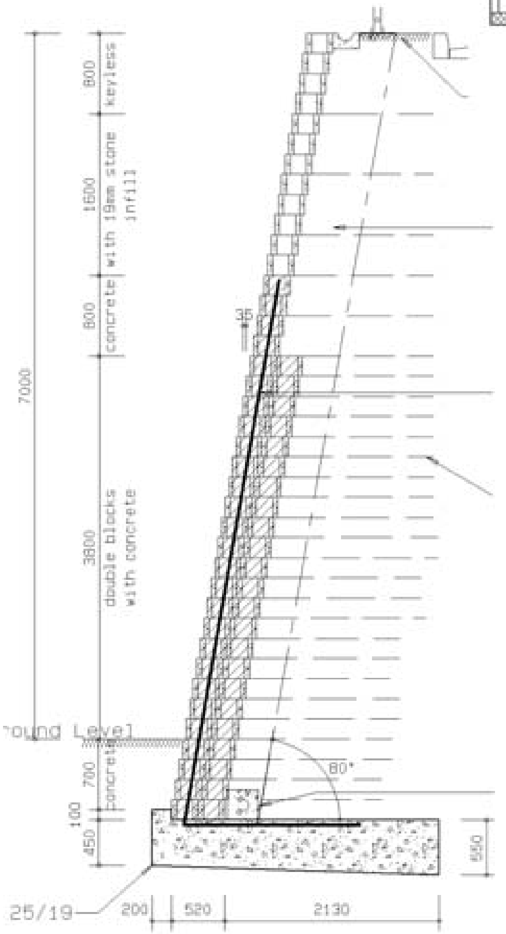
TERRAFORCE®
The original, reversible, hollow core retaining block

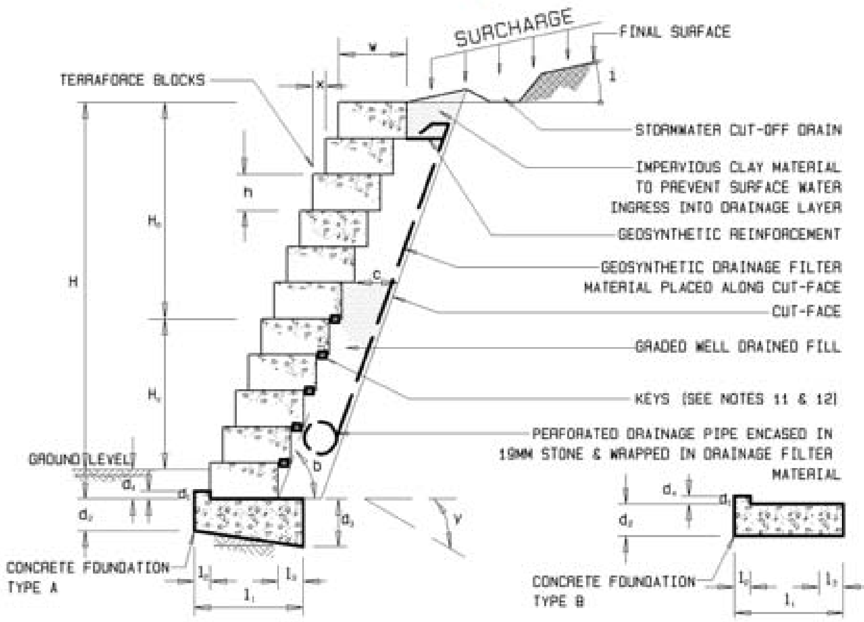

Blocks
Final Surface
1125
keyless
1800
with keys
1500
Concrete infill
4425
105
1200
Sub surface
Sand fill with
geofabric to layers
100
350
300
Ø 12/40 Rebar
"A"
4.03
Pavement
Terra Block
50 cm. Granular Fill
For Drainage
0.065
12.35
Compacted Fill
Ground Level
Ø 100 mm Drainage Pipe & Gravel
Wrapped With Filtration Geotextile (Typ.)
Foundation 25/19
1000
TOP SOIL
CLAUSE 6/6) GRANULAR
BACKFILL
GEOGRID REINFORCEMENT
L=1.5m
L=2.0m
150 DIA. DRAINAGE PIPE
WRAPPED IN GEOTEXTILE
TYPICAL CROSS SECTION
THROUGH TERRAFORCE RETAINING WALL
SCALE 1:20
900
keyless
2475
with keys
1800
Single block with
25/19 MPa
concrete infill
4075
Double blocks with 25/19 MPa concrete infill
550
100
350
340
720
1500
500
40


Bridge Abutment
CRB walls shown beyond
Terraforce L 16 CRB Block
Crushed Stone Filter Drain wrapped in non-woven geotextile or similar approved
Sweet So
Geotex footing to detail


350
1500
4950
Concrete filled
600
Overlap
3:1 (max)
1650 Y16
NGL
450
350
1250
350
300
1900

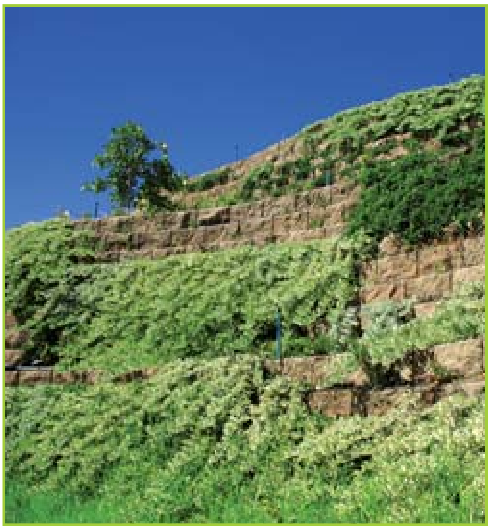

4x4 SEAT
4x4 STEP
0.80
L15
0.20
0.40
15 BLOCK


7000
800
keyless
1600
concrete with 19mm stone infill
800
3800
double blocks with concrete
700
concrete
100
450
35
80°
ound Level
550
25/19
200
520
2130


SURCHARGE
FINAL SURFACE
TERRAFORCE BLOCKS
STORMWATER CUT-OFF DRAIN
IMPERVIOUS CLAY MATERIAL TO PREVENT SURFACE WATER INGRESS INTO DRAINAGE LAYER
GEOSYNTHETIC REINFORCEMENT
GEOSYNTHETIC DRAINAGE FILTER MATERIAL PLACED ALONG CUT-FACE
CUT-FACE
GRADED WELL DRAINED FILL
KEYS (SEE NOTES 11 & 12)
PERFORATED DRAINAGE PIPE ENCASED IN 19MM STONE & WRAPPED IN DRAINAGE FILTER MATERIAL
GROUND LEVEL
CONCRETE FOUNDATION TYPE A
CONCRETE FOUNDATION TYPE B

www.terraforce.com




TERRAFORCE®

The original, reversible, hollow core retaining block