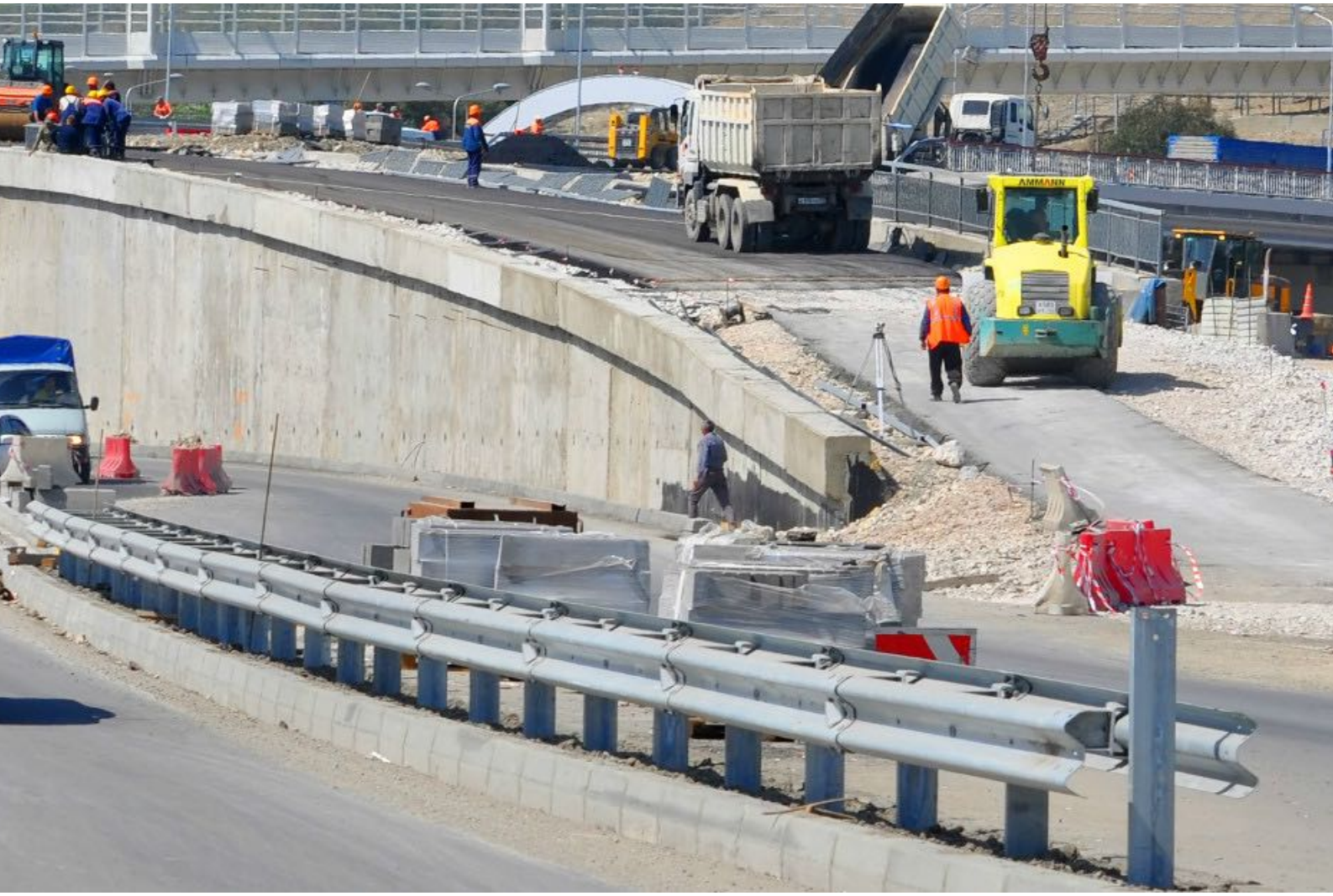
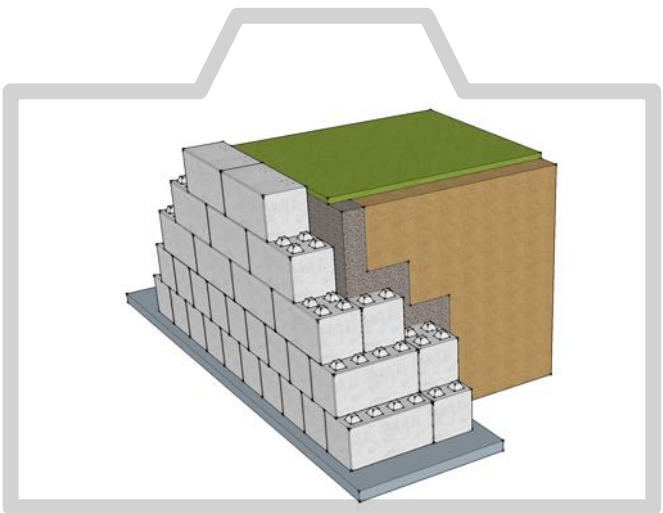
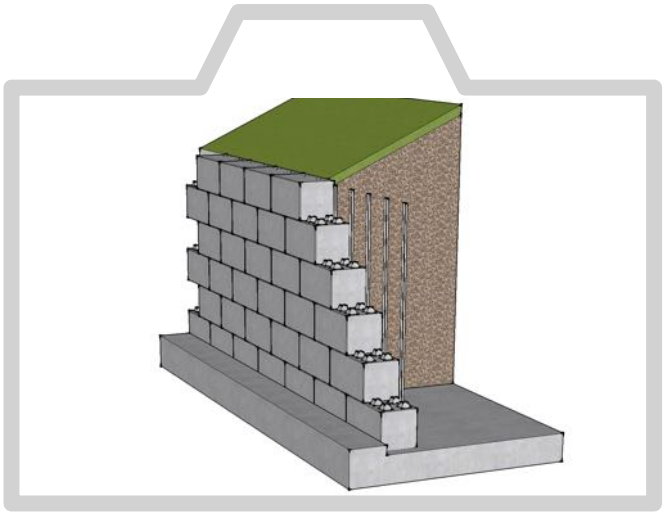
Retaining Wall Solutions



Retaining Wall Design Guide



Gravity Retaining Walls



Reinforced Earth Walls

Basic Design Principles

This is a simple explanation of the principles of retaining wall design.

The diagrams below show the core functions and the design criteria for a retaining wall. The following failure criteria are encountered while designing a retaining wall.

- Overturning
- Bearing capacity
- Sliding
- Slope stability
- Shear

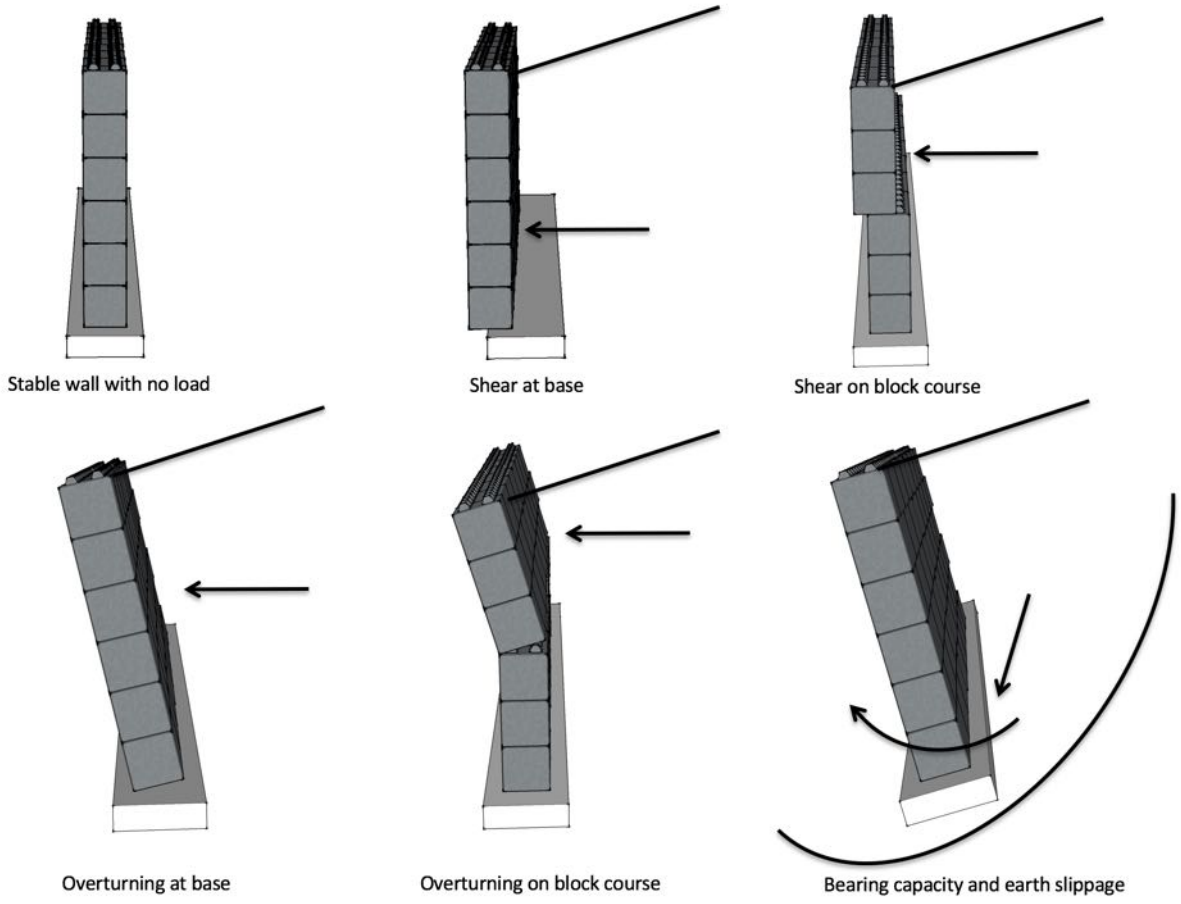
Overturning - The material being retained creates a force (moment) that causes toppling of the wall. The weight of a gravity retaining wall resists this moment.

Bearing capacity - The weight of the wall and earth is supported by the base. The ground bearing capacity needs to be checked to ensure any settlement is within limits.

Sliding - The material being retained creates a horizontal force that can cause the retaining wall to slide. This is resisted by the friction between the wall and earth beneath and the embedment of the wall.

Stability - The earth around the wall requires adequate strength to avoid an overall slip failure.

Shear - The blocks can shear at the base or between courses. We introduce a kicker at the base and interlocking buttons to resist these forces.



Design Tables

There are a number of solutions to overcome the failure modes discussed on the previous page. Our solutions are based on interlocking concrete blocks. We have designs for four types of retaining walls. They are:

- Gravity retaining walls
- Reinforced block retaining walls
- Inclined retaining walls
- Reinforced earth retaining walls

The following pages include details on each type of wall and include a design table. The design tables include a number of varibles.

Glossary of Terms

Height of Wall - The effective height of the retaining wall.

Block Type - Blocks come in either 300mm, 600mm, and 800mm widths. Refer to data sheets further below within this document.

Base Width - The design width of the foundation base.

Base Depth - The design depth of the foundation base.

Rebar Toe - The bar diameter and spacing of the base toe reinforcement.

Rebar Heel - The bar diameter and spacing of the base heel reinforcement.

Pocket Rebar - The vertical bar diameter and number of bars within each pocket.

Wall Incline - The angle of the inclined wall. We can design for various wall inclines that may result in different block requirements.

Surcharge - The vertical load expressed as a uniformly distributed area load at the top of the wall. This is shown as a car park in one of the examples.

Factor of Safety - This is based upon a mobilisation factor of 1.5

Cost Index - This number represents 100m of constructed wall but does not include earth works. The number 80 = £80,000 to build 100 linear meters of wall.

Gravity Retaining Walls

Gravity retaining walls are a basic design and rely on the mass of the wall to retain the earth behind.

A very simple method to design a gravity retaining wall is to use the base width x 2 to calculate the height.

The wall in figure 1 is 800mm wide and 1600mm high. As a rule of thumb this method works and will give a factor of safety in excess of 1.5 in most cases.

As a general rule you can build economical gravity retaining walls from 600mm high to 4m high.

The foundation does not need to be reinforced, however providing a kicker at the front edge will restrain the wall from slippage.

In poor soils the foundation can be constructed deeper and wider to add more resistance. Inclusion of drainage material to the back of the wall together with drainage holes at the bottom of the wall is recommended to relieve hydrostatic pressure.

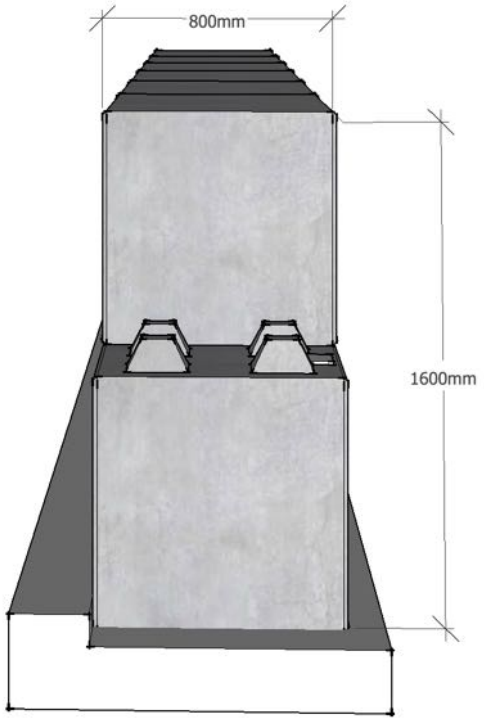


Figure 1

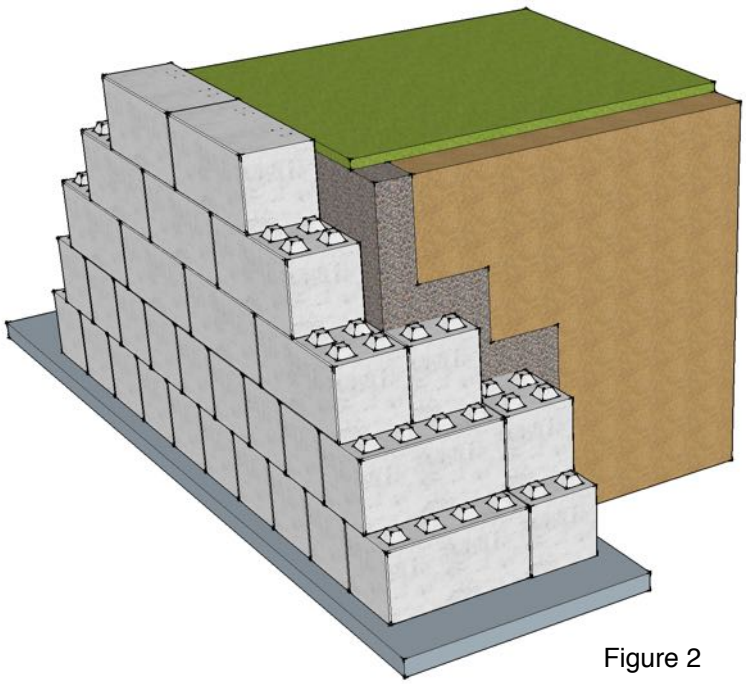


Figure 2

Figure 2 on the left is an example of a 4m high gravity retaining wall using 800mm wide blocks.

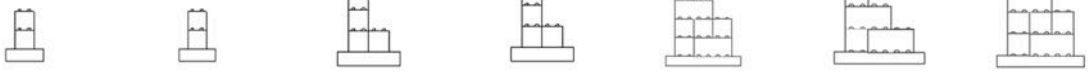
The wall has been designed to the characteristics in the table on the next page.

The blocks interconnect to stop course slippage. The top course can be flat or sloping depending on the customers requirements.

The concrete strength is a minimum 25 $N/mm^{2.}$ .Other mixes are available for more aggressive environments.

Gravity Wall Design Table

Design Table 1

Height	1200	1600	1800	2400	3000	3200	4000
Block Type	600	800	600	800	600	800	800
Base Width	800	1000	1400	1800	2600	2600	2600
Base Depth	100	100	100	100	100	100	100
Surcharge	2.5kn/m²	2.5kn/m²	2.5kn/m²	2.5kn/m²	2.5kn/m²	2.5kn/m²	2.5kn/m²
Factor of Safety	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5
Cost Index	30	41	42	73	77	89	125
Sketch							

The design table above presents Indicative designs based upon a base material with allowable bearing pressure of >200kPa.

The retained material is assumed to be well graded, granular backfill with back of wall drainage or weep holes to relieve hydrostatic pressure.

All indicative information presented in this table is based upon assumed loading and ground conditions and may be subject to change following detailed, site specific design.

Ideal For River Bank Errosion

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Reinforced Block Retaining Walls

The reinforced block wall is the more economical solution for taller walls than gravity walls. The design is based on casting full depth rebar voids through the blocks.

Rebar cast into the foundation is lapped onto rebar located within the vertical voids.

The wall rebar is then placed into the wall and fixed using a cement based grout.

The example wall shown in figure 3 is 5.6m high using 800mm blocks.

The design characteristics are shown on the table on the next page.

The foundation together with the wall acts as a cantilever to retain the material behind the wall.

Placing drainage material to the back of the wall together with drainage holes at the bottom of the wall is recommended to relieve hydrostatic pressure.

The reinforced wall has improved retaining design characteristics which allows for higher surcharge loads to be resisted.

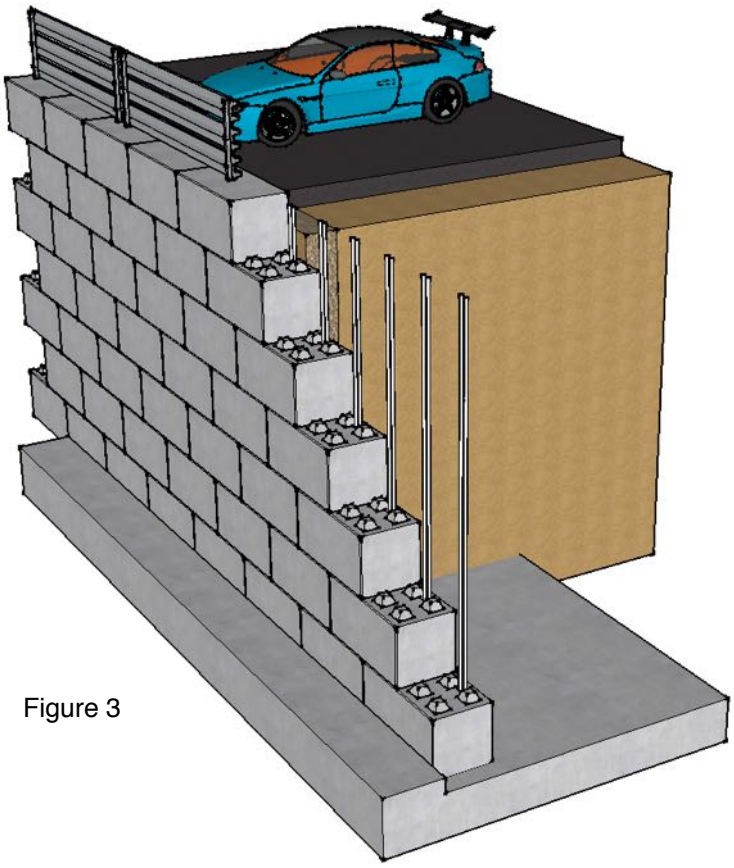


Figure 3

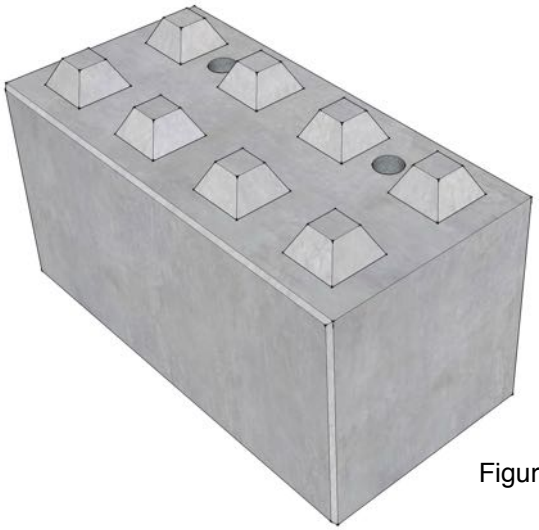


Figure 4

The block in the example in figure 3 is our Stackablock as shown here in figure 4.

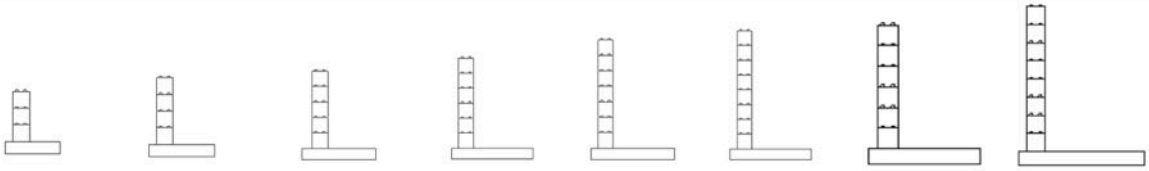
As you can see in the table we use our 600mm Vitablock for smaller walls.

All blocks come with a lifting bolt and a lifting clutch.

The blocks are manufactured to BS 8500 standard with a compressive strength of 25 N/mm^2. We can cast blocks in other design mixes for more aggressive environments.

Reinforced Wall Design Table

Design Table 2

Height	1800	2400	3000	3600	4200	4800	5600	6400
Block Type	600	600	600	600	600	600	800	800
Base Width	1400	1800	2200	2400	2800	3200	4800	5600
Base Depth	200	300	300	400	500	500	600	700
Rebar Toe	A393	A393	A393	B785	B785	B785	B785	H16 @200
Rebar Heel	A393	A393	B785	H16 @200	H16 @200	H20 @200	H20 @200	H25 @200
Pocket Rebar	1 H25	1 H25	1 H25	1 H25	2 H25	2 H25	1 H40	2 H40
Surcharge	10kn/m²	10kn/m²	10kn/m²	10kn/m²	10kn/m²	10kn/m²	10kn/m²	10kn/m²
Factor of Safety	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5
Cost Index	32	49	60	76	102	116	166	218
Sketch								

The design table above presents Indicative designs based upon a base material with allowable bearing pressure of >200kPa.

The retained material is assumed to be well graded, granular backfill with back of wall drainage or weep holes to relieve hydrostatic pressure.

All indicative information presented in this table is based upon assumed loading and ground conditions and may be subject to change following detailed, site specific design.

Ideal For a Failed Retaining Wall

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Inclined Block Retaining Walls

An inclined block retaining wall is the most economical solution as it uses the inclined blocks and gravity to add resistance to the forces trying to push the wall over. The design concept is similar to gabion wall construction but results in a plain concrete face to the wall and is ideal for situations where gabion baskets are likely to corrode within a short time period.

For example, in the cost index within the design table it can be noted that a 4m inclined block wall is 100 compared to 125 for a similar gravity block retaining wall. The reinforced wall is a similar cost but when earth works are then considered, the inclined wall will be more economical.

Building an Inclined Block Retaining Wall

To construct the wall a tapered foundation at the inclined angle is cast.

The foundation requires a single layer of reinforcement as indicated in the design table.

Single courses of blocks are laid and the retained material is then placed to support the block and compacted.

We can provide full installation method and risk assessments on request.

The kicker stops the block from slipping during compaction.

The interlocking buttons then stop slip as the wall is constructed and compacted at each cource.

The top layer of blocks can be supplied with a flat or sloping top as required.

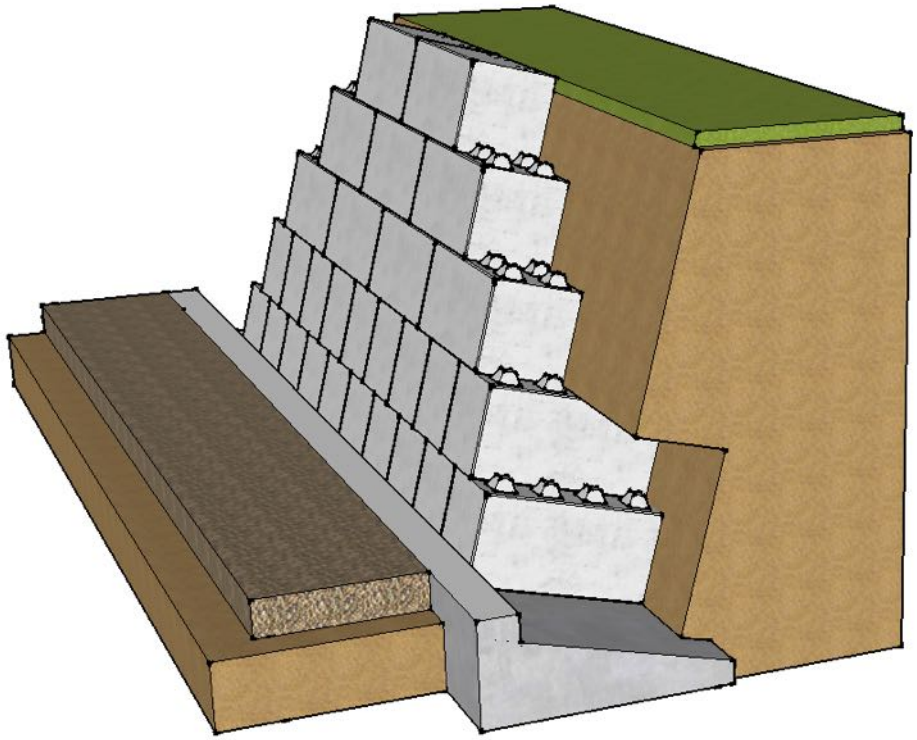
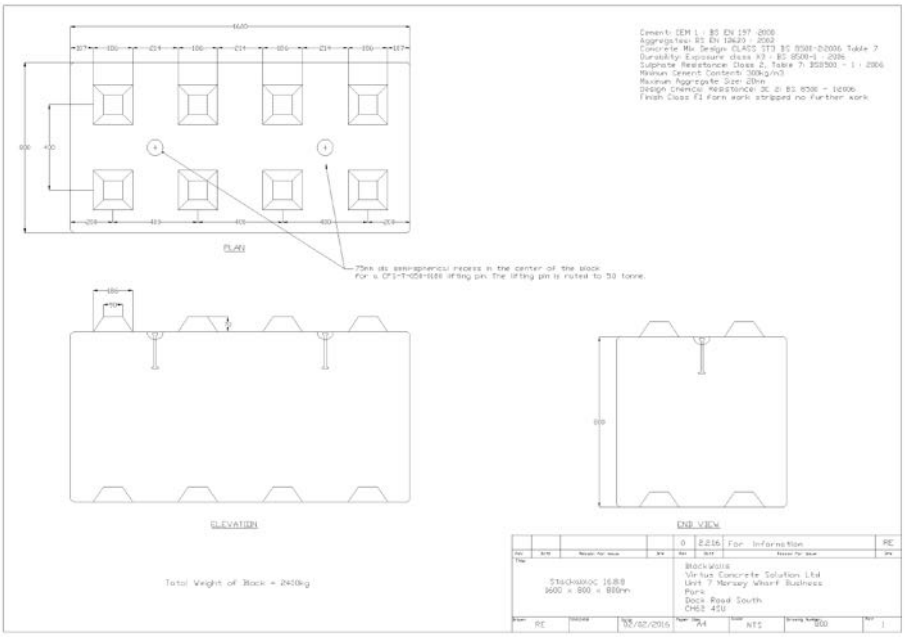


Figure 5

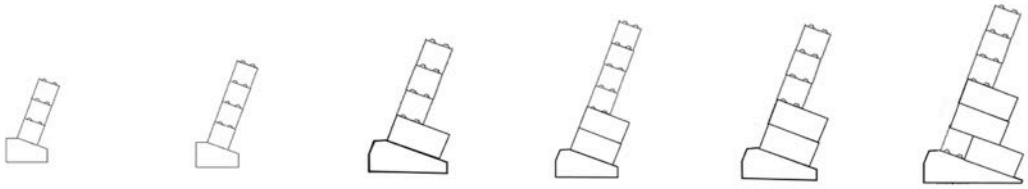


Technical drawing of all our blocks are available from the website.

Figure 6

Design Table

Design Table 3

Height	1800	2400	3200	3600	4000	4800
Block Type	600	600	800	600	800	800
Base Width	1000	1000	2000	1800	2000	2800
Base Depth	100-275	100-275	100-350	100-400	100-450	100-600
Base Rebar	A393	A393	A393	A393	A393	A393
Wall Incline	10^0	10^0	10^0	10^0	10^0	10^0
Surcharge	5kn/m²	5kn/m²	5kn/m²	5kn/m²	5kn/m²	5kn/m²
Factor of Safety	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5
Cost Index	28	35	74	78	100	146
Sketch						

The design table above presents Indicative designs based upon a base material with allowable bearing pressure of >200kPa.

The retained material is assumed to be well graded, granular backfill with back of wall drainage or weep holes to relieve hydrostatic pressure.

All indicative information presented in this table is based upon assumed loading and ground conditions and may be subject to change following detailed, site specific design.

Ideal For Earth Works

Reinforced Earth Walls

Retaining walls higher than 4.2m become more expensive using the gravity retaining wall solution. Our next solution is a reinforced earth wall.

In figure 1 below, the block of earth directly behind the wall is the reinforced earth wall. This is constructed by laying earth fill in layers with a geo mat between each layer. The reinforced earth wall then becomes the structural element that will retain the earth behind it.

The Virtabloc acts as the facing to the wall and protects it from the elements and erosion.

A kicker is created at the toe of the foundation to give greater resistance to slip.

This is a very economical solution for high walls.

Wall height can be as high as 12m

Figure 7

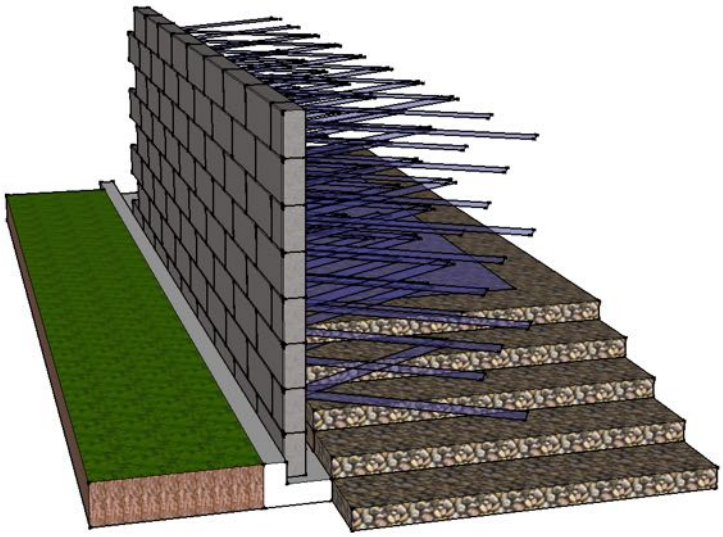
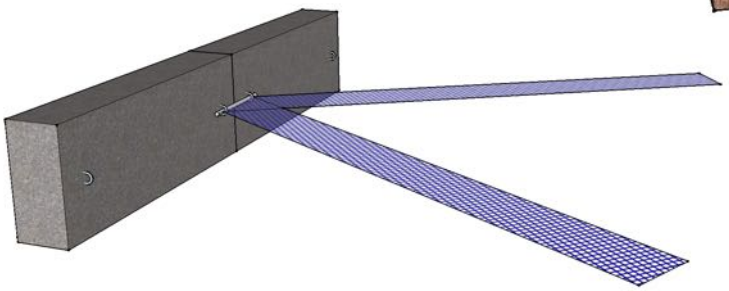


Figure 8



The geo mat is fixed to the Virtabloc using galvanised steel hooks that are cast in.

A galvainsed steel rod is then threaded behind the geo mat and through the hooks restraining the geo mat in place.

Geo Mat

Geo mat is a layer of plastic that has a tensile strength between 50 and 170 Kn/m depending on the grade required for the project.

Geo Mat

We use E'Grid uniaxial geogrid with our Virtabloc to design and build reinforced earth walls. E'Grid is laid and fill material placed on top. This is then consolidated and a second layer placed over it. This process is repeated until the wall is finished.

We build our reinforced earth walls in 300 mm fill layers as this fits in well with the dimensions of our blocks at 600mm.

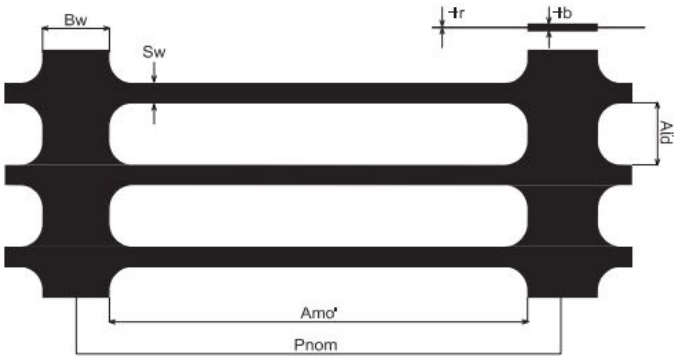
E'Grid reinforcement improves the bearing capacity and safety of the structure making savings on construction cost.

We selected E'Grid as our preferable geo mat due to its strength and competitive pricing for customers.

The design life of E'Grid and our Virtabloc facing is 120 years.

The table below show the various strength of each type of E'Grid. The selection depends on the design of the wall.

Product	Roll size (m)	Tensile strength (kN/m²) note 1	Tensile load (kN/m)		Typical strain at peak load (%)	Ultimate creep limited strength for 120 years (kN/m) notes 2 & 3			Typical dimensions (mm)					
			2% strain	5% strain		10°C	20°C	30°C	Atd	Bw	Sw	Tb	Tr	Pnom
E'GRID 50R	1 x 50	50.0	12.0	23.0	11	24.6	22.2	20.0	16	18	6	2.1	0.6	235
E'GRID 60R	1 x 50	60.0	14.5	28.0	11	29.6	26.7	24.1	16	18	6	2.8	0.7	245
E'GRID 70R	1 x 50	70.0	17.0	33.0	11	34.5	31.1	28.0	16	18	6	2.9	0.8	245
E'GRID 95R	1 x 50	95.7	25.5	49.0	11	47.2	42.5	38.3	16	18	6	4.1	1.1	255
E'GRID 125R	1 x 50	127.2	34.0	66.5	11	62.7	56.5	50.9	16	18	6	5.3	1.4	260
E'GRID 145R	1 x 50	147.0	41.0	81.0	11	72.5	65.3	58.8	16	18	6	5.7	1.6	260
E'GRID 170R	1 x 50	170.0	52.5	103.0	11	83.8	75.5	68	16	18	6	7.4	2.0	260



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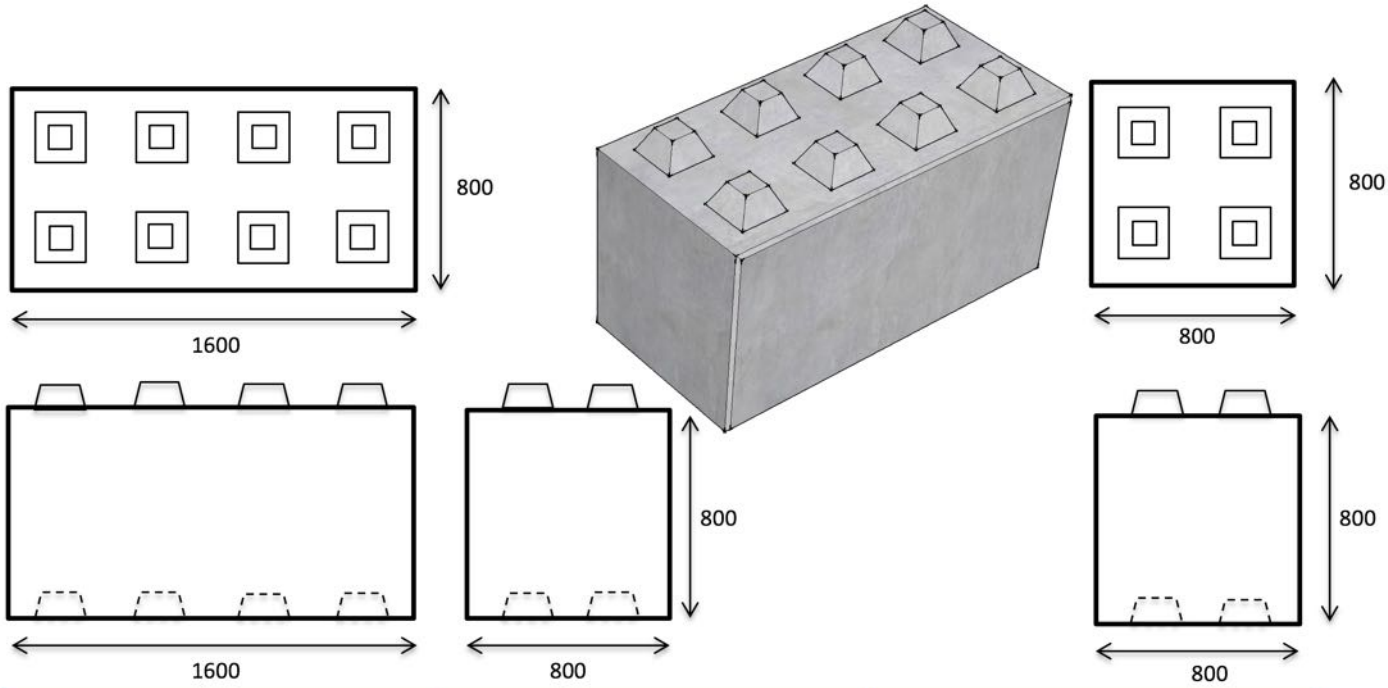
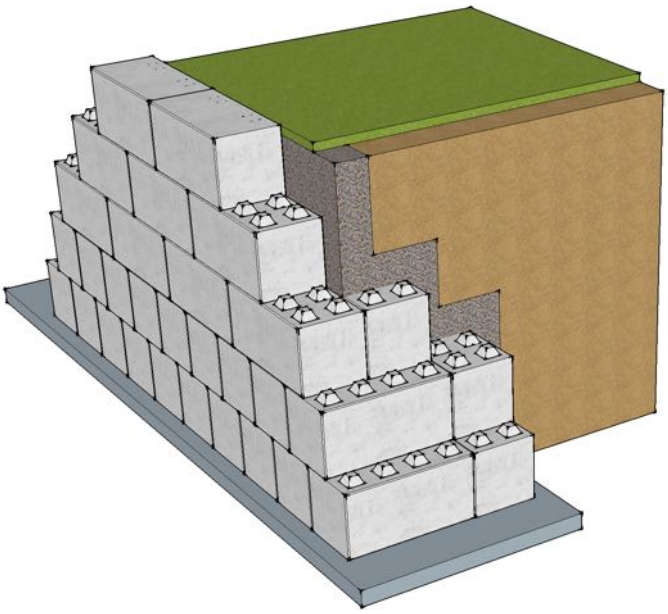
Stackabloc



Block Type	L x W x H (mm)	Weight (Approx kg)
STACKABLOC 16.8.8	1600 x 800 x 800	2250
STACKABLOC 8.8.8	800 x 800 x 800	1125



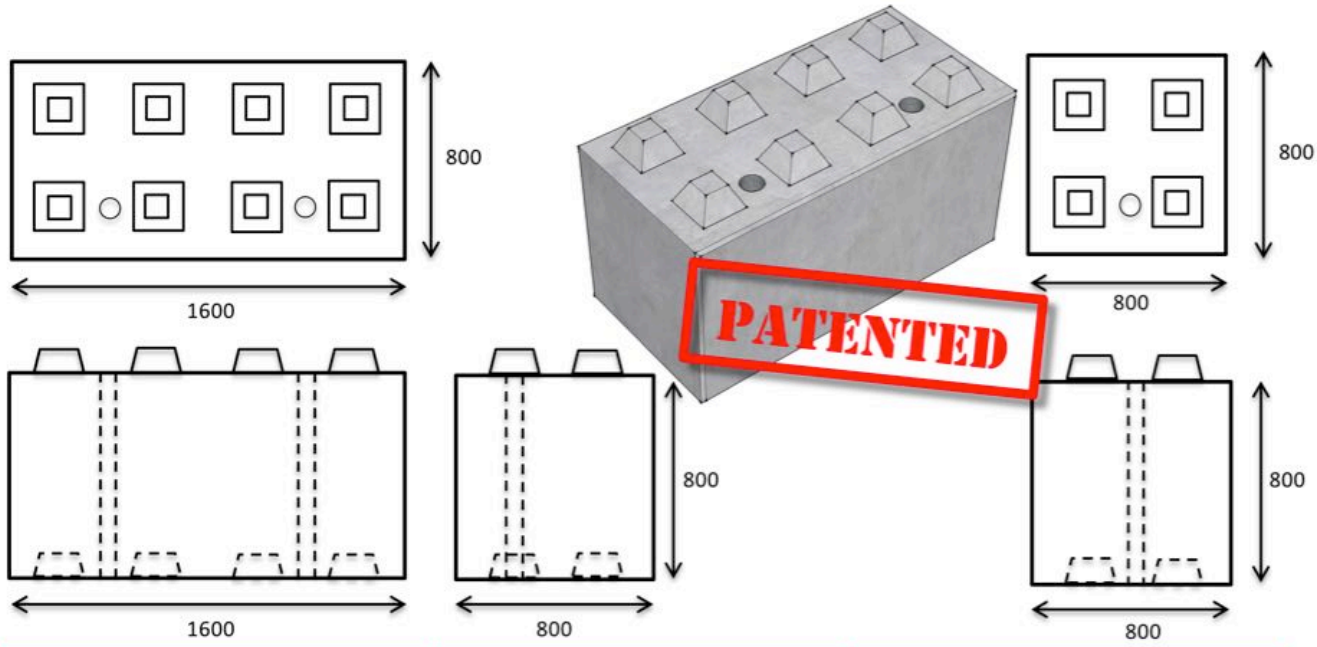
Stackabloc is used to build gravity retaining walls

Stackabloc measure 800mm wide x 800mm high and are 1600mm and 800mm long.They offer greater mass than our Virtabloc version that have a cross section of 600mm x 600mm

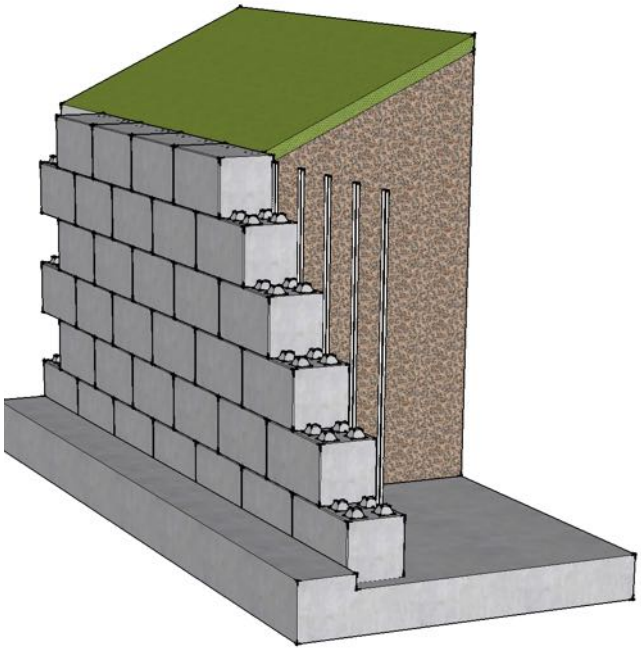
Stackabloc are very versatile and can be used for multiple purposes, such as:

- Buildings
- Bund walls
- Retaining walls
- Safe walking ways
- Security blocks

Stackabloc R



Block Type	L x W x H (mm)	Weight (Approx kg)
STACKABLOC R 16.8.8	1600 x 800 x 800	2250
STACKABLOC R 8.8.8	800 x 800 x 800	1125



Stackabloc R is used to build reinforced block walls

Stackabloc R has the same dimensions as Stackabloc. The only difference is the introduction of two 100mm dia ducts in between the interlocking buttons closer to the rear of the block to give the greatest advantage for the rebar reinforcement.

This allows us to use the blocks in reinforced retaining walls. The height of the wall determines the size of reinforcement and the cantilever foundation. Refer to the design table for more information

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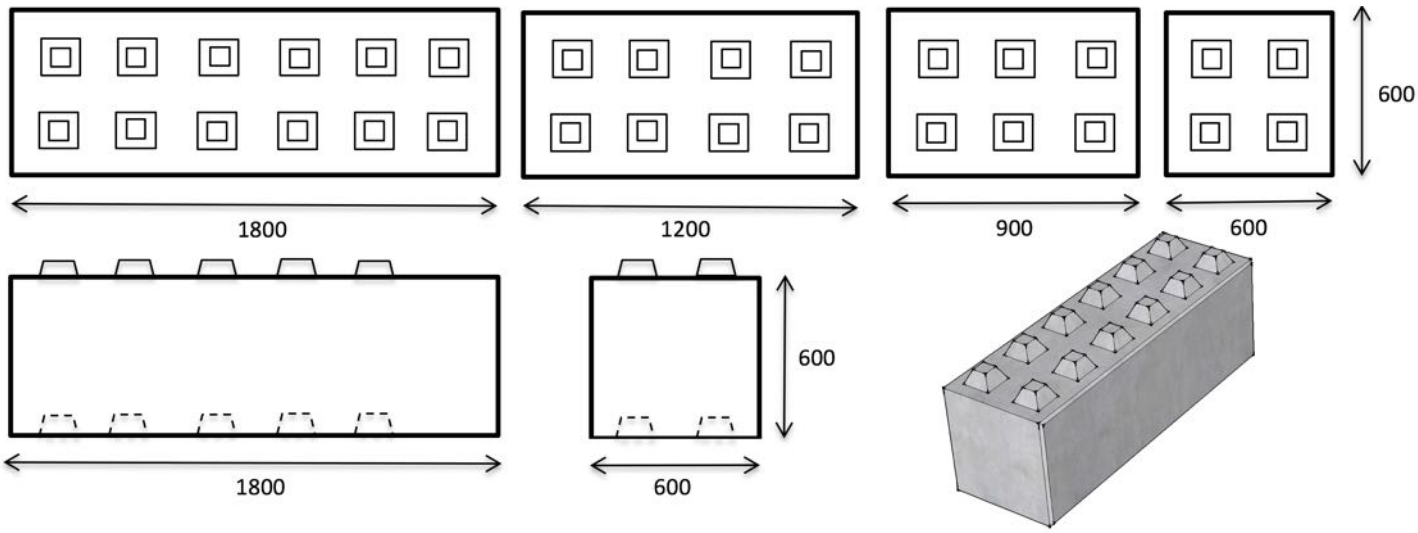
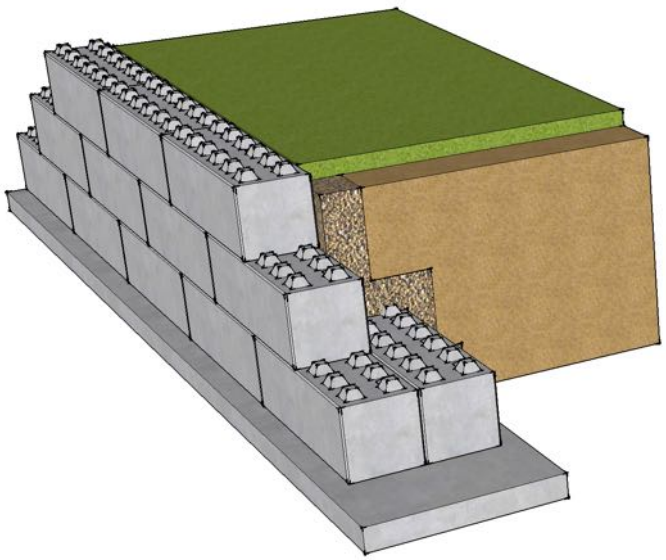
Virtabloc



Block Type	L x W x H (mm)	Weight (Approx kg)
VIRTABLOC 18.6.6	1800 x 600 x 600	1425
VIRTABLOC 12.6.6	1200 x 600 x 600	950
VIRTABLOC 9.6.6	900 x 600 x 600	712
VIRTABLOC 6.6.6	600 x 600 x 600	475

Virtabloc is used to build gravity retaining walls



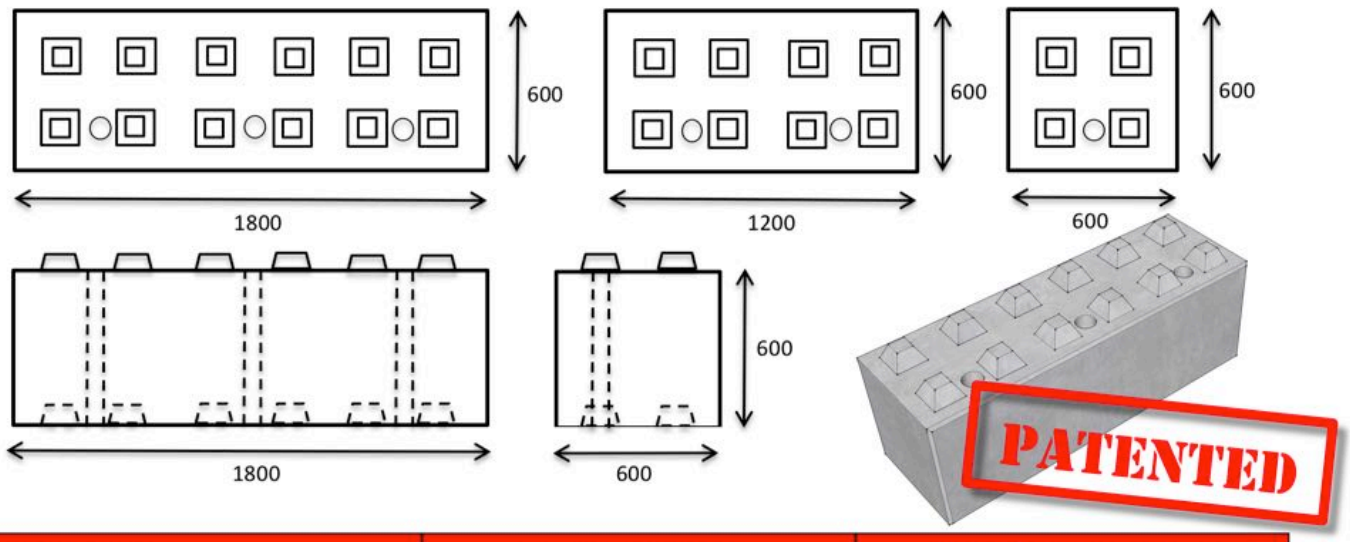
Virtabloc measure 600mm wide x 600mm high and are 1800mm, 1200mm, 900mm and 600mm long. They are used for smaller and slightly more economical gravity retaining walls.

For greater mass we recomend the use of Stackabloc.

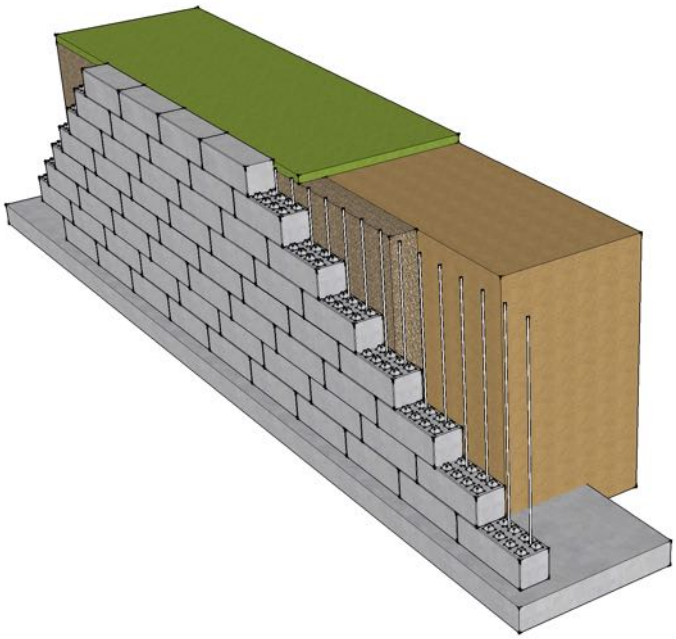
Virtabloc & Stackabloc are very versatile and can be used for many other purposes, such as:

- Buildings
- Bund walls
- Retaining walls
- Safe walking ways
- Security blocks

Virtabloc R



Block Type	L x W x H (mm)	Weight (Approx kg)
VIRTABLOC R 18.6.6	1800 x 600 x 600	1425
VIRTABLOC R 12.6.6	1200 x 600 x 600	950
VIRTABLOC R 6.6.6	600 x 600 x 600	475



Virtabloc R is used to build reinforced block walls

Virtabloc R has the same dimensions as Virtabloc. The only difference is the introduction of two 100mm dia ducts in between the interlocking buttons closer to the rear of the block for the rebar reinforcement.

This allows us to use the blocks in reinforced retaining walls. The height of the wall determines the size of reinforcement and the cantilever foundation. Refer to the design table for more information

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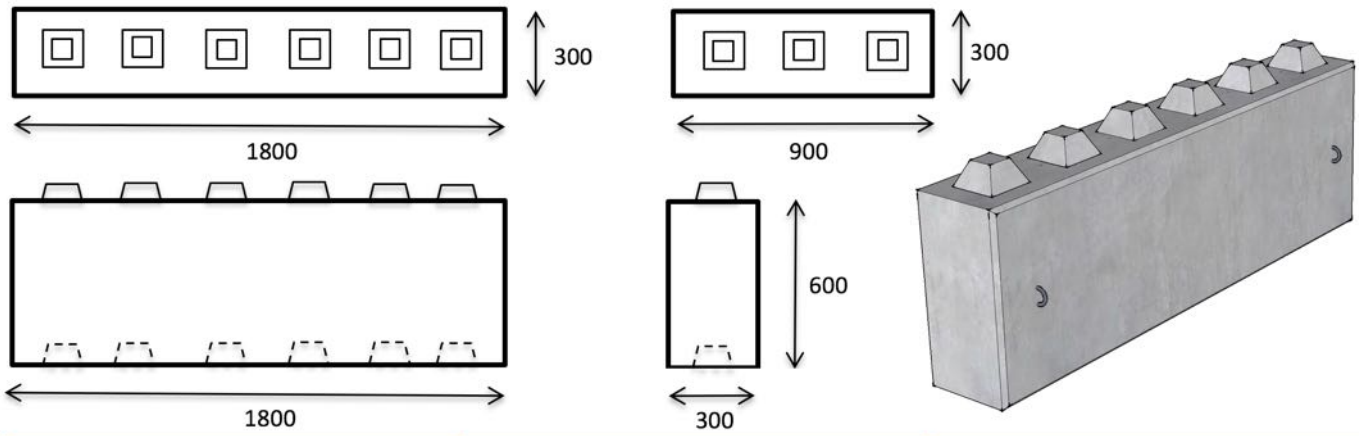
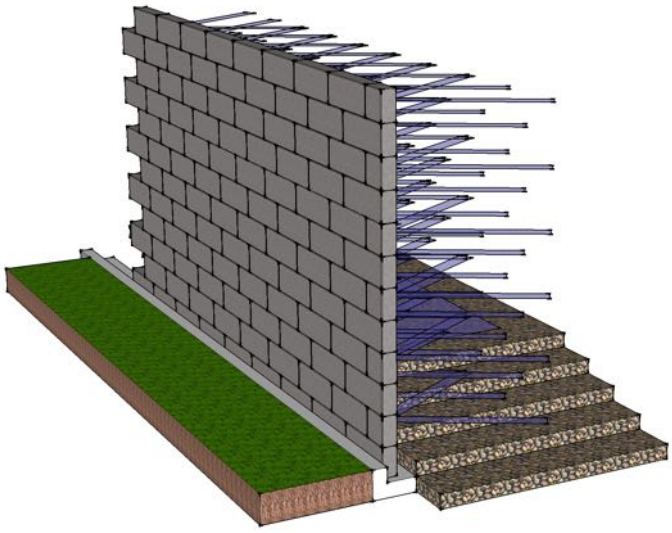
Earth Block



Block Type	L x W x H (mm)	Weight (Approx kg)
EARTHBLOC 18.3.6	1800 x 300 x 600	712
EARTHBLOC 9.3.6	900 x 300 x 600	356



EARTHBLOC is used to build reinforced earth walls

Earthblocs measure 300mm wide x 600mm high and are 1800mm and 900mm long.

A pair of hoops are cast into each block to hold the horizontal ties to the earth wall. These act as the restraint.

The hooks are made from 8mm galvanised round bar.

The geo mat is held in place by threading a 32mm heavy duty polypropylene pipe through the hoops. This restrains the geo mat in place. This construction gives a life time span of over 75 years

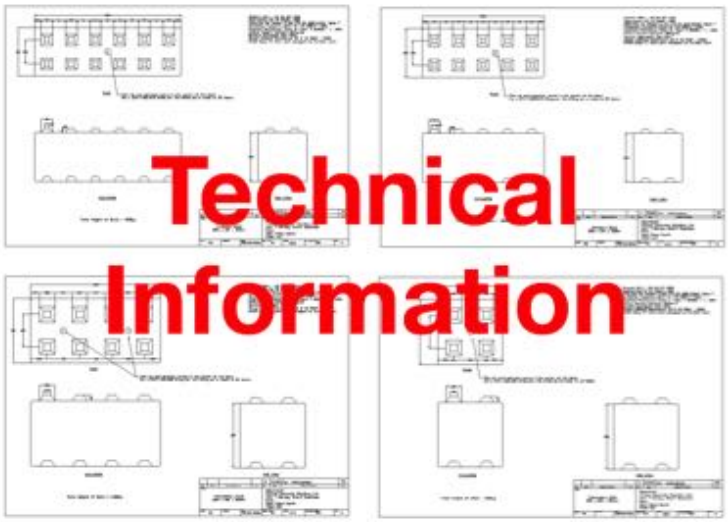
A very simple solution that allows very high retaining walls to be constructed at very competitive prices.

Call today for a comprehensive design and build solution.

Design and Build Consulting

We pride ourselves on a holistic approach to provide clients with solutions for their engineering problems. Our designing service allows clients the freedom to utilise concrete blocks efficiently with great value for money. In this brochure, some examples of our retaining wall design have been displayed. These are indicative and will require additional calculations depending upon the geotechnical conditions.

We encourage clients to supply us with the basic details of the project and come up with swift and feasible designs to suit their needs. On the Retaining Wall Solutions website, the technical section has downloadable PDF and DWG technical drawings of the various concrete blocks supplied by us.



Call today for a comprehensive design and build

Quality

Product quality is assured

We operates to the ISO 9001:2008 quality management system for all our business processes. We adhere to relevant standards and best practice codes for concrete production such as the British Standards. These are detailed below.

Circular economy and Bespoke concrete

We manufacture blocks with a variety of mixes. Our standard mixes are manufactured to BS 8500 – 1:2006 +A1:2012 Part 1 and 2 for concrete grades ranging from C20 - C50.

We provide environment friendly sustainable solutions by producing bespoke concrete with recycled materials as constituents of concrete blocks. We also develop and supply concrete blocks for customers that provide recycled materials complying with Environmental Agency specifications.

We also manufacture concrete with new quarried materials to meet customers specifications and requirments.

Block finishes

Our factory and people are well equipped and trained to provide a variety of surface finishes. In addition to a simple trowel finish, a steel fair face and a shot blast finish to expose the aggregates, we employ a number of stamping

Quality Testing

Strength Testing

In the U.K., the accepted design guidelines by the civil engineering industry are the British Standards.

Our products are tested for strength in compression according to BS EN 12390.

We test concrete on a regular basis to ensure our production of concrete meets the standards we are working to.

This is a crucial aspect to meet our clients needs for concrete blocks of different strengths. These are marked as Concrete Grades which range from C20 – C50, where 20 and 50 stand for compressive strengths of 20 N/mm^2 and 50 N/mm^2.

C20/30 grade is ideally used in non-structural applications such as in waste segregation bays, separation walls, agricultural clients while C40/50 high strength concrete is typically strong enough for bridges, retaining walls and interestingly – shooting ranges.

Particle Testing

Concrete is a cocktail of several building materials such as aggregates, cement and sand. Our concrete blocks are made with constituents that have passed particle test analysis using methods directed by the British Standards, BSEN 123560

We test materials from different sources using sieve analysis and particle distribution analysis to gauge client needs and provide cost effective solutions in the form of quality tested concrete lego blocks.

Call 07792 669576 to order your walls

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