



# Keystone®

High Performance Segmental  
Retaining Wall Systems

**masonry.**  
style and  
function

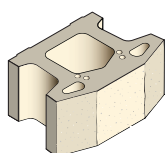


# High Performance Retaining Wall Systems

## Keystone

Engineered perfection.

The Keystone retaining wall system is robust and strong, available in standard and flushface finishes ideal for both straight and curved walls. The patented interlocking pin connecting system is best suited for engineered walls up to 15m in height.

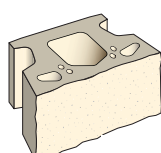


### Standard Unit

Size(mm): 455L x 315W x 200H

Weight (each): 38kg

Face area: 11 units per m<sup>2</sup>

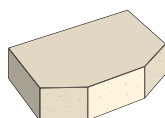


### Flushface Unit

Size(mm): 455L x 315W x 200H

Weight (each): 41kg

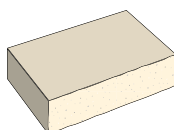
Face area: 11 units per m<sup>2</sup>



### Cap Unit

Size(mm): 455L x 310W x 100H

Weight (each): 20kg



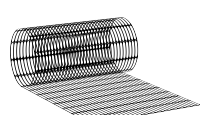
### Flushface Straight Sided Cap

Size(mm): 455L x 310W x 100H

Weight (each): 20kg



Pins



Keygrid Geogrid

### Benefits:

- Durable
- Allows for design creativity and flexibility
- Ease and speed of construction
- Cost effective
- Versatile
- Clean neat finish
- Strong strength to weight ratio
- Construction methodology
- Blends into environmental landscape
- RMS approved walling system

### Applications:

- Low height gravity walls
- Geogrid soil reinforced up to 15m height
- Stream and drainage channels
- Wing walls
- Embankment stabilisation
- Terraced walls
- Geogrid – reinforced soil retaining structures

### Construction/Design:

- Vertically with curves as tight as 1m radius (standard unit only)
- Set-back
- Straight or curved walls
- 90 degree corners
- Stairs

### Blocks:

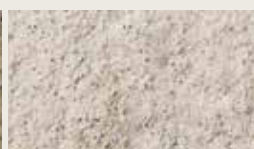
- Standard unit
- Flushface unit



Charcoal



Almond



Natural

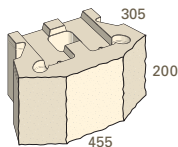
### Keysteel® Specification table

Pins	2 pins per full unit (high strength pultruded fibreglass)
Lifting Bars	Keystone® units should be lifted by two people using the Keystone® lifting bars.
Geogrid	As per design requirements

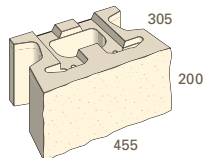


# Keysteel

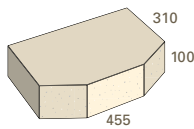
Custom Engineered Retaining Wall Systems



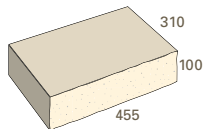
Standard Unit



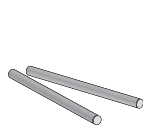
Flushface Unit



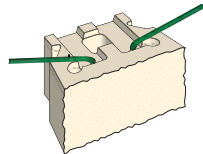
Standard Straight Sided Cap



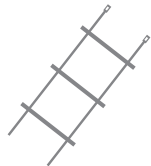
Flushface Straight Sided Cap



Steel Pins (hot-dip galvanised)



Lifting Bars



Steel Ladders (hot-dip galvanised)

## Benefits

- Superior strength
- Durable
- Hot-dipped galvanised steel ladder soil reinforcement
- Erosion prevention
- RMS approved walling system

## Applications:

- Wall heights up to 25m height
- Critical surcharge loads are present
- Steel – ladder reinforced-soil retaining structures
- Bridge abutments
- Stream or drainage channels
- Tunnel access walls
- Wing walls
- Embankment stabilisation
- Terraced walls
- Seawall applications (made to order)
- Soil-anchor and rock-anchor walls

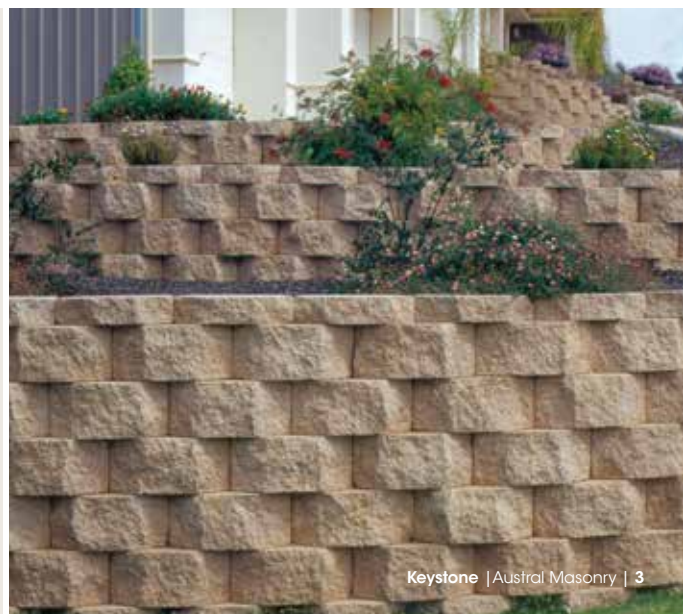
## Construction/Design:

- Vertically with curves as tight as 1m radius (standard unit only)
- Set-back
- Straight or curved walls
- 90 degree corners
- Stairs

## Blocks:

- Standard unit
- Flushface unit

Keysteel® Specification table		
Description	N <sup>o</sup> /m <sup>2</sup>	Nominal Unit Wt (kg)
Standard Unit	11	36
Flushface Unit	11	39
Standard Straight Sided Cap	2.2/lin mtr	25
Flushface Straight Sided Cap	2.2/lin mtr	26
Pins	2 pins per full unit, 2 pins per ladder supplied	
Lifting Bars	Keysteel® units should be lifted by two people using the Keysteel® lifting bars.	
Steel Ladders	As per design requirements	



# Geogrid Soil-Reinforced Wall Construction Guide

For taller, more critical walls, the combination of Keystone units with geogrid soil reinforcement allows walls to be built to heights of 12m and greater, without costly structural footings. When placed between layers of compacted soil, geogrids create a reinforced soil mass, which essentially acts as a larger gravity wall structure.

Geogrids can be used with most existing site-soils and are not affected by water, micro organisms, alkali or acidic soils. Consult with your engineer for design requirements of Keystone walls using geogrid soil reinforcement.

## Notes

Table 1 is prepared as per AS4678 : 2002. Suitability of the information contained in the table must be referred to a qualified professional engineer. These tables are supplied as a guide, and do not form any part of any contact with the user.

Table 1 is based on foundation material with minimum 200kPa bearing capacity.

Where site conditions and loadings vary from those in the table, professional engineering advice should be obtained.

The minimum embedment of wall below ground level is assumed to be  $H/20$  or 100mm, whichever is greater.

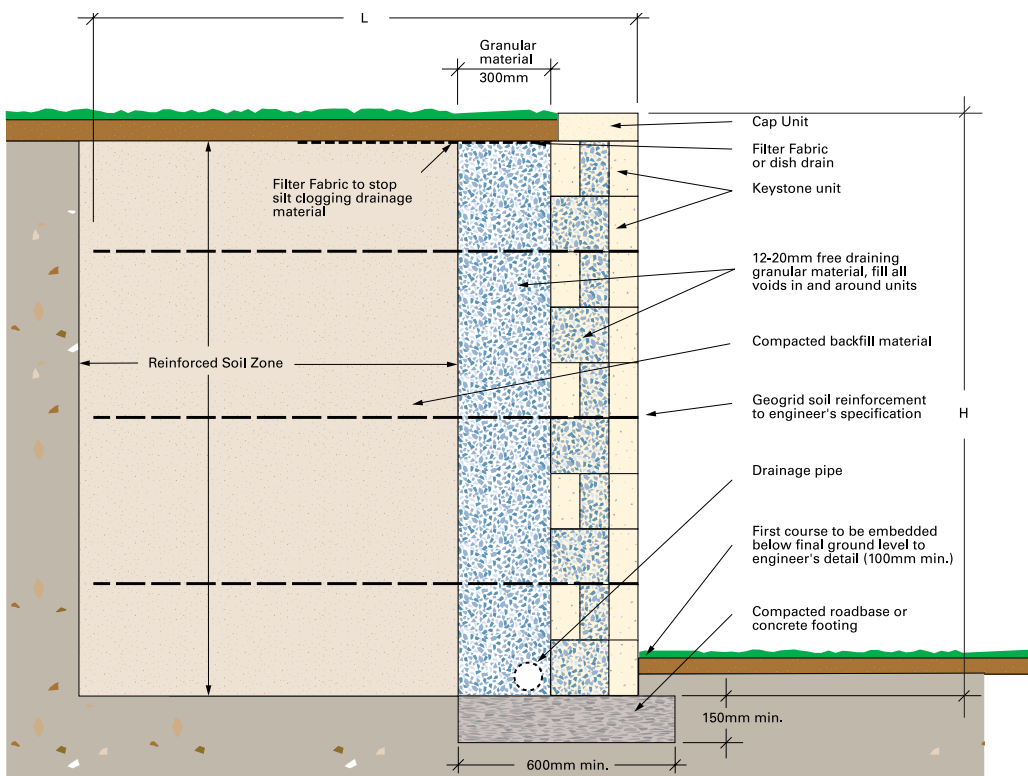
The length of the 15° backfill slope is assumed to be equal to the height of wall, H.

**Table 1 - Maximum Wall Heights for Geogrid Soil-Reinforced Walls**

Surcharge	Wall Height H (m)	Geogrid Layers	Geogrid Height Above Levelling Pad							Geogrid Length L(m)		
			Layers							Soil Type (phi)		
			1	2	3	4	5	6	7	25	30	35
10 Degree or 15 Degree	1.1	2	0.2	0.8	-	-	-	-	-	1.5	1.5	1.5
	1.5	3	0.2	0.8	1.2	-	-	-	-	1.9	1.5	1.5
	1.9	3	0.4	1.0	1.6	-	-	-	-	2.1	1.8	1.6
	2.3	4	0.2	0.8	1.4	2.0	-	-	-	3.4	2.1	1.8
	2.7	5	0.4	0.8	1.2	1.8	2.4	-	-	3.9	2.4	2.1
	3.1	6	0.2	0.6	1.0	1.6	2.2	2.8	-	4.8	2.8	2.4
5kPa Driveway	1.1	2	0.2	0.8	-	-	-	-	-	1.5	1.5	1.5
	1.5	3	0.2	0.6	1.2	-	-	-	-	1.9	1.5	1.5
	1.9	3	0.4	1.0	1.6	-	-	-	-	2.2	1.8	1.6
	2.3	4	0.2	0.8	1.4	2.0	-	-	-	2.5	2.0	1.8
	2.7	5	0.2	0.4	1.2	1.8	2.4	2.4	-	2.8	2.3	2.1
	3.1	6	0.2	0.6	1.0	1.6	2.2	2.2	-	3.2	2.6	2.4

\*Geogrid with  $T_u=55\text{kN/m}$  \*Geogrid lengths for 5kPa driveway are based on the load being applied a minimum of 800mm from the face of the retaining wall.

For full construction steps refer to Austral Masonry Design Guide Manual  
[www.australmasonry.com.au](http://www.australmasonry.com.au)



**Figure 1 - Typical Construction Detail - Keystone® Geogrid Reinforced-Soil Wall**

## No-Fines Concrete Construction Steps

### STEP 1:

#### Excavation/Preparation of Levelling Pad

Excavate a trench 600mm wide and sufficiently deep to allow a levelling base of 150mm +25mm height for each course. Place 25MPa concrete (non-reinforced) to form the footing.

### STEP 2:

#### Installing the First Course

Lay the first course of units side to side over the prepared base, with the 12mm pinholes on top. Maintain the 305mm distance between pinhole centres of adjacent units. In straight walls, units will touch. In concave or convex curves, the units will overlap or require spacing to maintain the 305mm pin distance.

### STEP 3:

#### Installing the Pins

Place two high strength fibreglass connecting pins into each unit. Use the front holes for a vertical wall (corners and curved walls). Use the rear holes for a 1 in 8 setback (i.e. for every course the wall will set back 25mm). **For straight walls only.**

### STEP 4:

#### Additional Courses

Sweep the top of the previous course of units clean of any loose gravel. Place the next course of units so that the kidney holes fit over the pins of the two units below. Pull the unit towards the face of the wall until it locks with the pins on both sides. Repeat Steps 3 and 4.

### STEP 5:

#### No-Fines Concrete Backfill

Backfill the wall with No-Fines Concrete. All voids inside and between the units must also be filled. The vertical height of any pour of No-Fines Concrete is limited to 600mm. Each pour must be allowed to harden prior to pouring the next lift. Alternatively the wall may be propped.

### STEP 6:

#### Installing Capping Units

Lay capping units, backfill and compact to required grade. It is recommended that the capping units be secured using masonry construction adhesive or epoxy cement.





# No-Fines Concrete Wall Construction Guidelines

The No-Fines Concrete backfill system increases the mass of Keystone retaining walls allowing the maximum heights in Table 3 (next page) to be exceeded without using geogrids. This is ideal for boundary walls where the geogrids would otherwise cross into the neighbouring property.

No-Fines Concrete shall consist of cement, water and coarse aggregate. Cement will comply with the definitions for cement per AS3972 : 1991 - 'Portland and Blended Cements'. The quantity of cement is specified as 210kg/m<sup>3</sup> with a total water/cement ratio of between 0.45 and 0.55.

The particle size distribution of the aggregate shall comply with the limitations for the nominal single sized 20mm aggregate specified in AS2758.1. Table 2 is prepared as per AS4678 : 2002, and is based on a 5kPa surcharge loading at the top of the wall. This table is supplied as a guide, and does not form any part of any contract with the user.

- The maximum slope of the backfill behind the wall is to be 5% (1 vertical to 20 horizontal).

## Notes

- 15MPa No-Fines Concrete with a 6:1 ratio (Gravel : Cement).
- The density of this product will vary with the density of the aggregate used. The density range may be from 1800kg/m<sup>3</sup> to 2100kg/m<sup>3</sup>. (Table based on density of 2100kg/m<sup>3</sup>.)
- The void ratio of the mix is expected to be between 20% and 30% and should be free draining.
- This product has no slump and exerts similar pressures on the soil and formwork, as does loosely poured aggregate.
- Global stability considerations should be checked by an engineer especially in poor clay conditions.
- Design assumes a dry excavation (i.e. water table is below bottom of footing level). If ground water appears in the excavation, the wall is to be re-designed by a suitably qualified engineer.

For full construction steps refer to Austral Masonry Design Guide Manual [www.australmasonry.com.au](http://www.australmasonry.com.au)

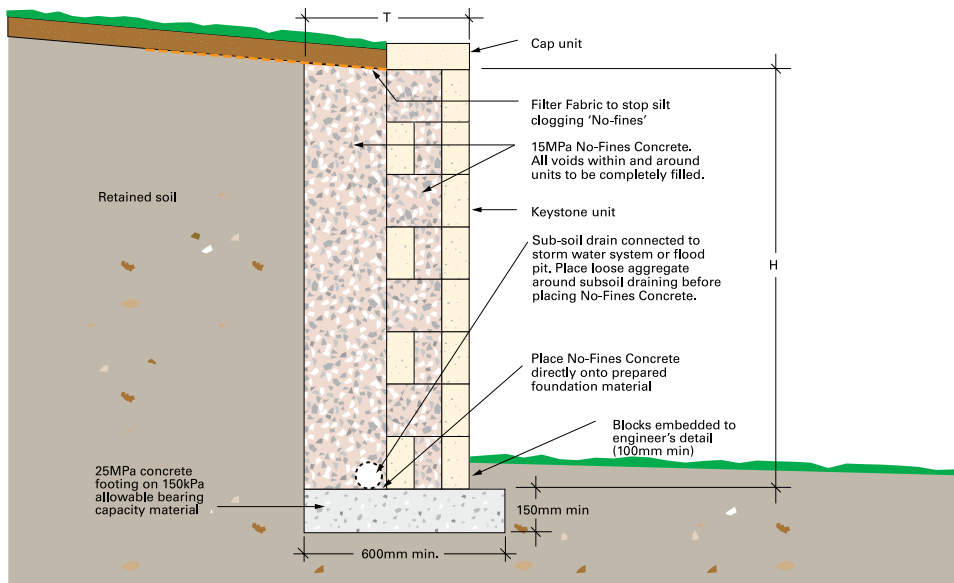


Figure 2 - Typical Construction Detail - Keystone® No-Fines Concrete Mass Gravity Wall

Table 2 - Maximum Wall Heights for No-Fines Concrete Wall Construction

Wall Height 'H' (mm)	Retained Soil CLAY $\phi = 26^\circ$ (POOR) 'T' (mm)	Retained Soil SAND $\phi = 30^\circ$ (AVERAGE) 'T' (mm)	Retained Soil GRAVEL $\phi = 34^\circ$ (GOOD) 'T' (mm)
1000	550	500	450
1400	750	700	650
1800	1050	1000	850
2200	NA	1250	1000
2600	NA	1350	1200

$\phi$  Denotes the internal angle of friction of the retained material

If material below No-Fines Concrete is of poor quality, then the material must be replaced with a 150mm thick layer of crushed sandstone

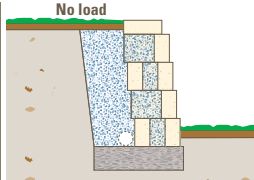
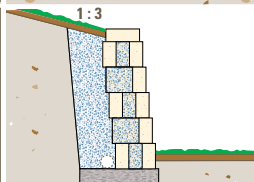
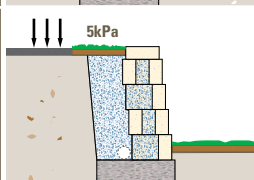
# Gravity Wall Selection

For low, non-critical walls, (i.e. walls covered in the table below) the Keystone Retaining Wall System is effective as a gravity wall structure, utilising their weight and interaction of the units to resist earth pressures.

# Retained Soil Descriptions

- Poor Soils** Include fine sands, gravelly clays, sandy clays, silty sands. Angle of internal friction  $\geq 25^\circ$
- Average Soils** Include well graded sands, gravelly sands. Angle of internal friction  $\geq 30^\circ$
- Good Soils** Include gravels, sandy gravels, crushed sandstone. Angle of internal friction  $\geq 35^\circ$

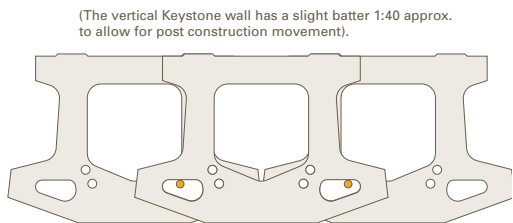
**Table 3:**  
Refer to max. wall heights disclaimer on the back page of this brochure. The gravity wall heights are maximum heights calculated in accordance with CMAA MA-53 Appendix D guidelines and a qualified engineer should confirm the suitability of the product for each intended application.

Table 3 - Maximum Wall Height for Gravel-Fill Walls			
Surcharge Loading	Backfill Type	Wall Height H (mm)	
		Vertical	1 in 8 Setback
 No load	Poor	800	900
	Average	900	1000
	Good	1000	1200
 1:3	Poor	600	900
	Average	700	900
	Good	800	1100
 5kPa	Poor	400	500
	Average	500	600
	Good	600	800

# Gravity Wall Construction Guidelines

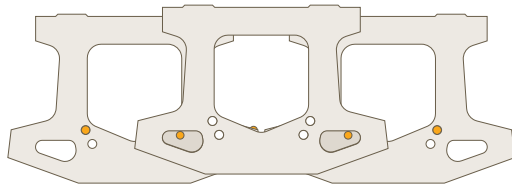
## Setback Options

- Two sets of pin holes are provided in Keystone units.
- For vertical construction, install pins in the front holes.
- For 1 in 8 setback construction, install pins in the back holes.
- Vertical installation must be used when designing walls with curves or corners.



Install pins in front holes for near vertical walls

OR



Install pins in rear holes for 1:8 setback walls

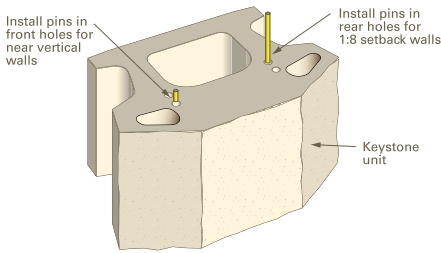


Figure 3 — Installation of Pins

## Important:

Please consult with the regulating council for local design requirements prior to the design and construction of a retaining wall. Councils in general require that retaining walls be designed and certified by a suitably qualified engineer where the wall is over 0.5m in height and/or where there is surcharge loading such as a roadway, house, or other structure near the wall.

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### Trading hours

For trading hours please visit [www.australmasonry.com.au](http://www.australmasonry.com.au)

### Keystone Additional Information

1. Stock colours. Colours other than stock colours are made to order. Contact your nearest Austral Masonry office for your area's stock colours.  
A surcharge applies to orders less than the set minimum quantity.
2. Colour and texture variation. The supply of raw materials can vary over time. In addition, variation can occur between product types and production batches.
3. We reserve the right to change the details in this publication without notice.
4. For a full set of Terms & Conditions of Sale please contact your nearest Austral Masonry sales office.
5. Important Notice. Please consult with your local council for design regulations prior to the construction of your wall. Councils in general require those walls over 0.5m in height and/or where there is loading such as a car or house near the wall be designed and certified by a suitably qualified engineer.
6. Max wall heights disclaimer  
The gravity wall heights are maximum heights calculated in accordance with CMAA MA-53 Appendix D guidelines and a qualified engineer should confirm the suitability of the product for each application. As such, due consideration must be given to but not limited to:
  - Cohesion
  - Dry backfill, no ingress of any water into the soil behind the retaining wall.
  - All retaining walls are designed for zero surcharge unless noted otherwise.

These walls are intended for structure Classification A walls only as defined in AS467B Earth Retaining Structures as being where failure would result in minimal damage and/or loss of access.



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