adbri MASONRY

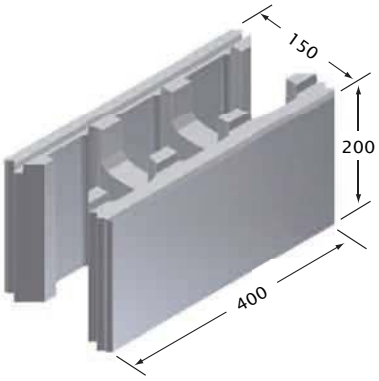
Very Quick.Very Easy
VERSALOC

Versaloc™

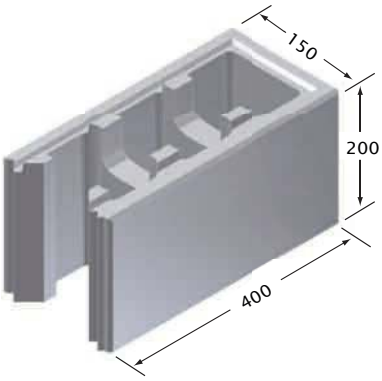
Very Quick, Very Easy

Versaloc™ block series

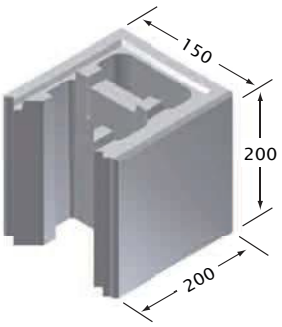
Versaloc™ block 150mm



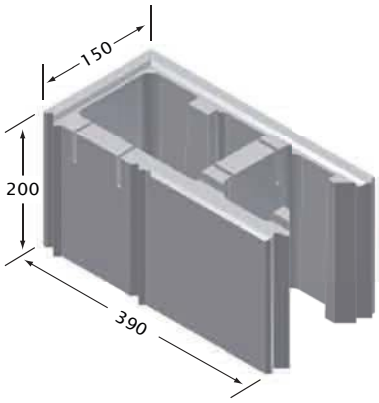
End Block



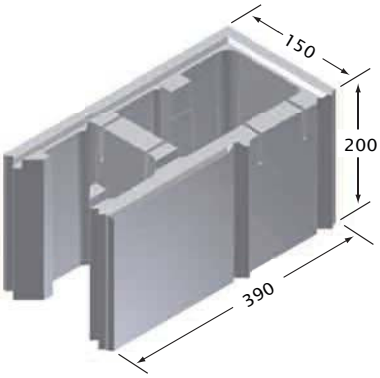
Half Block



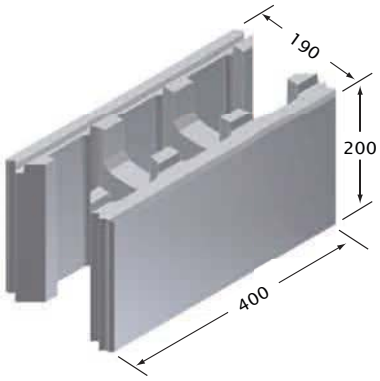
Lefthand Corner



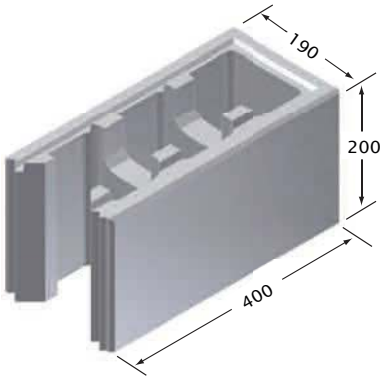
Righthand Corner



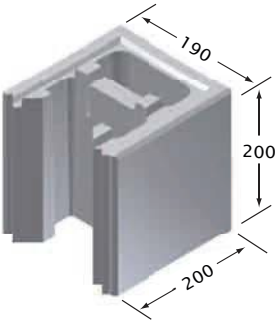
Versaloc™ block 190mm



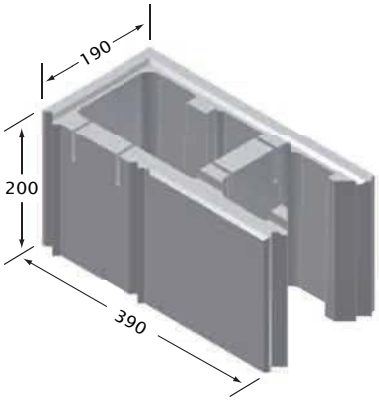
End Block



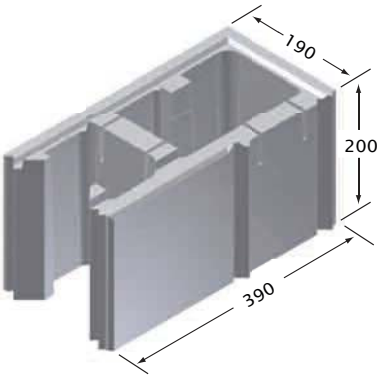
Half Block



Lefthand Corner



Righthand Corner



Preface

Designs shown in the brochure are based on limit state design in accordance with the provisions of AS4678-2002, AS3600-2001 and part of AS3700-2001.

The retaining wall design details provided in this brochure have been prepared by Adbri Masonry specifically for mortarless Adbri Masonry Versaloc™ blocks and are applicable only to retaining walls using Adbri Masonry products for residential or light commercial applications up to 2.6m high with Type 1 and Type 2 bases and 200 series and 150 series blocks.

Basement walls are limited to 2.8m height using 200 series blocks only with well drained soils. Also included is a table showing compressive load capacity of Versaloc™ walls up to 6.0m high with two load cases using 200 series and 150 series blocks.

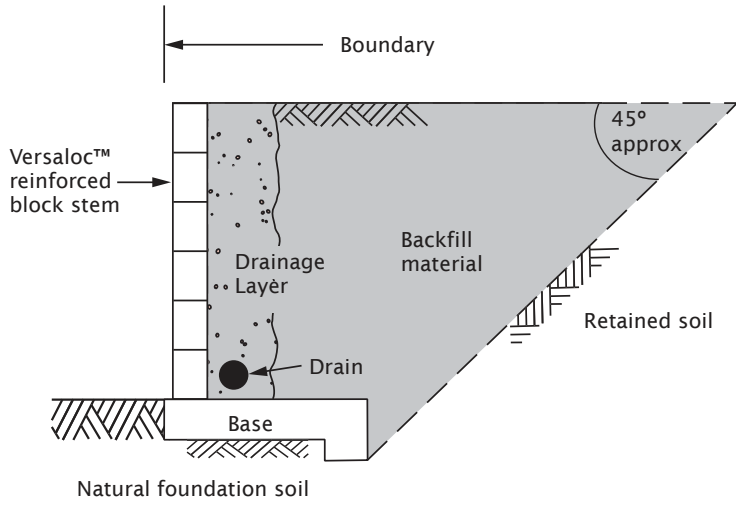
Introduction

Reinforced Adbri Masonry Versaloc™ block retaining walls and basement walls consist of a reinforced concrete base which anchors the wall against overturning and sliding, and a stem of mortarless Versaloc™ blocks. Stems are reinforced with steel bars placed vertically and horizontally, and all cores in the blocks are filled with semi-fluid concrete known as ‘grout’. Vertical reinforcing bars in the cores of reinforced walls are lapped with shorter ‘starter bars’ embedded firmly in the reinforced concrete base. The length of the lap is critically important and must be shown on the drawings.

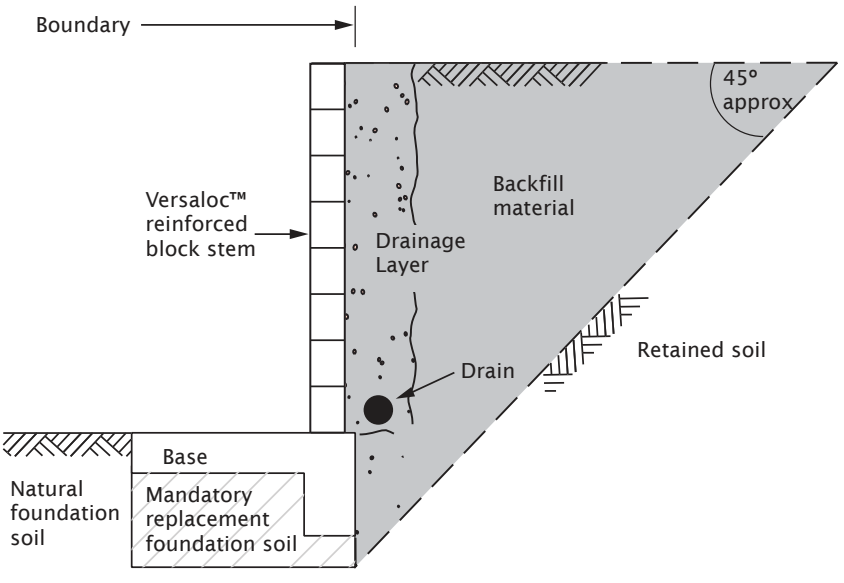
1.0 Versaloc™ Retaining Walls

1.1 Designs for reinforced retaining walls type 1 and type 2

Designs consist of:
200 series block retaining walls up to 2.6m high for level backslope and 2.2m high for 1:4 backslope
150 series block retaining walls up to 1.6m high for level backslope and 1.4m high for 1:4 backslope



Wall Type 1



Wall Type 2

Diagrams not to scale

1.2 Design details

1.13.1 Design details for walls up to 2600mm high with level backfill slope with Type 1 base

1.14.1 Design details for walls up to 2200mm high with 1:4 backfill slope with Type 1 base

1.15.1 Design details for walls up to 2600mm high with level backfill slope with Type 2 base

1.16.1 Design details for walls up to 2200mm high with 1:4 backfill slope with Type 2 base

1.3 Material specifications

Versaloc™ Block	150mm f'uc = 20.0 MPa
	190mm f'uc = 20.0 MPa
Concrete base	f'c = 25 MPa
Reinforcement	Grade 500 N
Grout	Refer section 1.11.5 - Grout Specifications

1.4 Soil classification of backfill material, retained soil and foundation soil

1.4.1 Wall Type 1

For simplicity wall type 1 design details in this brochure for backfill material, retained soil and foundation soil are based on a common soil with the following typical properties; coarse grained with low permeability due to admixture of particles of silt size, residual soil with stones, fine silty sand and granular materials with conspicuous clay content with an internal friction angle of 28°. Note: often retained soil is used as backfill material if suitable.

1.4.2 Wall Type 2

The backfill material and retained soil design details for wall type 2 are also based on the common soil noted above; **however this soil is not suitable for wall type 2 foundation material**, as it results in unacceptably long bases and/or deep keys. **Therefore it is mandatory that this insitu foundation soil is removed and replaced with higher quality material such as compacted road base (or equivalent).** Note: often retained soil is used as backfill material if suitable.

Backfill Material and Retained Soil	Wall Type 1	Wall Type 2
Characteristic internal angle of friction ϕ	28	28
Design uncertainty factor for friction Φ u ϕ	0.85	0.85
Design internal angle of friction (degrees) ϕ*	23.9	23.9
Design external angle of friction (degrees) δ*	15.9	15.9
Characteristic cohesion (kPa) assume c	0	0
Soil density (kN/m3) γ	19	19
Foundation Soil	Wall Type 1	Wall Type 2
Characteristic internal angle of friction ϕ	28	35 see note 1
Design uncertainty factor for friction Φ u ϕ	0.85	0.9
Design internal angle of friction (degrees) ϕ*	23.9	32.2
Design external angle of friction (degrees) δ*	15.9	32.2 see note 2
Characteristic cohesion (kPa) c	4	3
Design uncertainty factor for cohesion Φ uc	0.7	0.75
Design cohesion for sliding (kPa) c*	0	2.25
Design cohesion for bearing (kPa) c*	2.8	2.25
Soil density (kN/m3) γ	19	18.6

Notes:

1) It is mandatory for type 2 walls that the natural foundation soil is to be **removed** and **replaced** with compacted road base material (or equivalent) to a compacted minimum depth of 200mm below the base (or base plus key if included). Density to achieve 98% Standard Relative Dry Density (RDD).
2) It is assumed the design external friction angle is equivalent the design internal friction angle due to the roughness of the insitu concrete base on the foundation material.
3) Seek professional engineering advice if natural soil on the site varies from above, as different base dimensions may be required.

1.5 Backfill Material and Retained Soil

Retaining wall designs in this brochure have been calculated for backfill material and retained soil of soil classification as shown in section 1.4.

Note: The following poor quality soils are not allowed for in the designs:

- very soft clay of high plasticity
- very silty clays
- very loose variable clayey fill
- very loose sandy silts
- with characteristic internal angle of friction below 28 degrees.

If these soils are considered for use or aggressive groundwater exists an experienced professional engineer should be consulted and separate designs be obtained.

1.6 Foundation Soil

1.6.1 Wall Type 1

The design details have been based on a foundation soil as described in section 1.4 and which must be excavated to sufficient depth to expose undisturbed material which is firm and dry.

1.6.2 Wall Type 2

It is **mandatory for type 2** walls that the natural foundation soil is to be **removed** and **replaced** with compacted road base material (or equivalent) to a compacted minimum depth of 200mm below the base (or base plus key if included).

Note 1: Should a designer wish to analyse a retaining wall with better quality retained soil than the soil nominated in section 1.4, base dimensions different from the tabulated values could be appropriate and it is recommended professional engineering advice is sought.

Note 2: If any of the following foundation conditions exist: softness, poor drainage, filled ground, organic matter, variable conditions, heavily cracked rock, aggressive soils, then experienced professional engineering advice should be obtained.

1.7 Drainage System

It is essential that steps be taken to prevent the soil behind the wall from becoming saturated. These steps should include:

- Sealing the soil surface - this can be done by covering it with a compacted layer of material with low permeability (eg clay). The surface should be sloped towards an open drain.
- A drainage system within the soil - this should preferably be achieved by placing gravel to a width of approximately 300mm immediately behind the wall with a continuous 100mm diameter slotted pvc agricultural pipe with a geo fabric sock located at the base of the wall. The outlets from the pipe must be beyond the ends of the wall unless the pipe is connected to a proper storm water drainage system.

  For higher walls, or in cases where excessive ground water exists, it may be necessary to provide another agricultural pipe drain at mid height of the wall. If it is not possible to discharge the drains beyond the end of the wall, weep-holes may be provided (see items for block laying following). In this case, a collecting system (eg spoon drains) must discharge the water into a drainage system to prevent saturation of the ground in front of the wall.

1.8 Water penetration

If considered necessary to reduce the passage of water through the wall, for aesthetic or other reasons such a aggressive ground water, the earth face of the wall should be treated using appropriate sealing techniques (see notes on tanking).

1.9 Tanking

Where the retaining wall is required to be waterproof, various proprietary tanking methods are available. One such method is a three coat liquid rubber compound incorporating a special reinforcing fabric for high stressed areas.

Another method is a heavy duty, pliable, waterproof sheet membrane fixed to the wall back surface. Surface coatings or sheet membranes must always be used in accordance with the manufacturer's specifications.

1.10 Backfill compaction and drainage system

Backfill material should not placed behind the wall until at least ten days after grouting.

- Backfill material should be placed and compacted in layers not more than 200 mm deep. The degree and method of compaction depends on the proposed use of the retaining wall. If unsure, obtain professional engineering device.
- The drainage system should be installed progressively as the backfill soil rises.
- The drainage system behind the wall should be connected to the main drainage system for the site.
- It is advisable to seal off the top surface of the backfill material with a semi impermeable layer of soil or earth (eg clay). Compact and grade the material to a gutter to provide surface drainage.

1.11 How to build the Versaloc™ wall

1.11.1 Preliminary

- Excavate to a satisfactory foundation.
- Arrange for supply of materials to the specifications given previously.

1.11.2 Base and starter bars

- Form the base to the required dimensions and levels as shown in details.
- Place the base reinforcement as shown in the diagrams. Fix the starter bars for the vertical reinforcement (Y-bars) at the correct cover specified in the drawings from the back face of the wall (i.e 50mm) and in the correct positions relative to the block cores to be reinforced. Place horizontal bars in the center on the cross webs.
- Place the base concrete, preferably using ready-mixed concrete, and compact thoroughly by rodding, spading or vibrating. Wood float finish any surface to be exposed permanently. Take care not to dislodge reinforcement.

Note: First reinforcement bar is placed at 60mm from the end (to avoid cross web).

1.11.3 Block laying

- Block laying procedure follows that of the normal practice but without the need to mortar the blocks together.

Note: The first layer of blocks should be mortared to the concrete base in the normal way to provide line and level for the remaining block courses.

- The blocks are laid with the shallow recessed cross webs at the top (refer diagram 1.12.1). During construction, it is important to keep debris off the bed joint plane; otherwise the wall may begin to develop vertical curvature. In addition, as a unit is positioned, some small particles of concrete may be rubbed off the units and fall on the bed joint surface. Usually the force of placing the block will crush these particles. Otherwise, rubbing the block back and forth along the joint will wear down the material. If a joint is visibly open, the unit should be removed and the debris removed.

Note: Small plastic wedges can be used under blocks to achieve vertical alignment.

- Provided the construction is started on a level surface, use of a line and carpenters' level should be all that are required to keep the wall aligned vertically and horizontally. In instances where the wall is accidentally laid out of line, this can usually be corrected by using a piece of wood to protect the wall and a heavy hammer to knock the wall back into line.
- At the end of walls, Half Sash blocks may be glued to the block directly below using an appropriate adhesive to increase stability. (eg 2 part epoxy or equivalent)
- Blocks should be laid in running bond with head joints aligned vertically every second course. Exact overlapping by half of a block will ensure that the webs and cells are aligned vertically.
- Weepholes can be provided by passing 50mm diameter upvc pipes holes through the wall at 1200mm centres.
- Reinforcement for wall stems must be positioned accurately, and tied securely before placing concrete or grout. Vertical reinforcing bars (X bars), including starter bars (Y bars), shall be placed to provide 50mm cover to the backface of the wall and bars shall lap 700mm.

1.11.4 Bracing

- During grouting of Versaloc™ walls, it is recommended that suitable bracing be used to support the wall.
- Temporary bracing of partially built Versaloc™ walls is also recommended and especially during windy conditions.

1.11.5 Grouting

Versaloc™ blocks have large cores inside to allow for adequate flow of grout and ensuring complete coverage of reinforcing steel bars. As Versaloc™ requires no mortar above the first course, there are no mortar dags on the steel, allowing adequate flow of the grout and minimal chance of voids in the wall.

The grout must be sufficiently fluid to fill all the voids, bond together adjacent masonry units, bond steel reinforcement into the cores, and to unify the wall into a single structure. It is therefore important that the cores are filled with grout which meets the specifications listed in the following section.

	1m³ of grout will fill approx	Approx No. of blocks per m³ of grout
200 SERIES	10.2m² of wall	130
150 SERIES	13.8m² of wall	175

Grout Filling
Block filling grout is designed to be sufficiently fluid to fill all the voids, bond together adjacent masonry units, bond steel reinforcement into the cores, and to unify the wall into a single structure. It is therefore important that the cores are filled with correctly designed grout, which meets the following specifications:

Grout Specifications
The grout specifications are performance based. Adbri Masonry recommends the grout supplier determine an appropriate mix design to meet the following performance requirements. The performance details are as follows:

01) Flow Characteristics

The grout shall have a minimum spread of 600mm (average diameter), maintained for the period of the pour.

Notes:

- A 'spread' is specified rather than a 'slump' because it is a more appropriate measure of the flow properties for this type of grout. Your concrete supplier should be able to organise the measuring of the spread.
- Do not add extra water to retemper the grout, unless the grout supplier authorises it.

02) Strength Grade
Following testing by CSIRO on behalf of Adbri Masonry "grout cover" to steel requirements used with the Versaloc™ system can be less than required by AS3600 - contact Adbri Masonry for test report details.

For internal applications the minimum strength grade of the grout should be 20MPa.

For external applications in near-coastal zones (between 1km and 50km from coast), the minimum strength grade should be 25MPa.

For external applications less than 1km from the coast, the minimum strength grade should be 32MPa.

For specialist applications or more severe environments an engineer should be consulted.

03) Other
Maximum aggregate size shall be **10mm** (for 190mm block) and **7mm** (for 140mm block). The grout shall be free of contaminating lumps **larger than 15mm** (this may require a screen over the pump hopper).

The grout shall be **smooth, free-flowing and cohesive.**

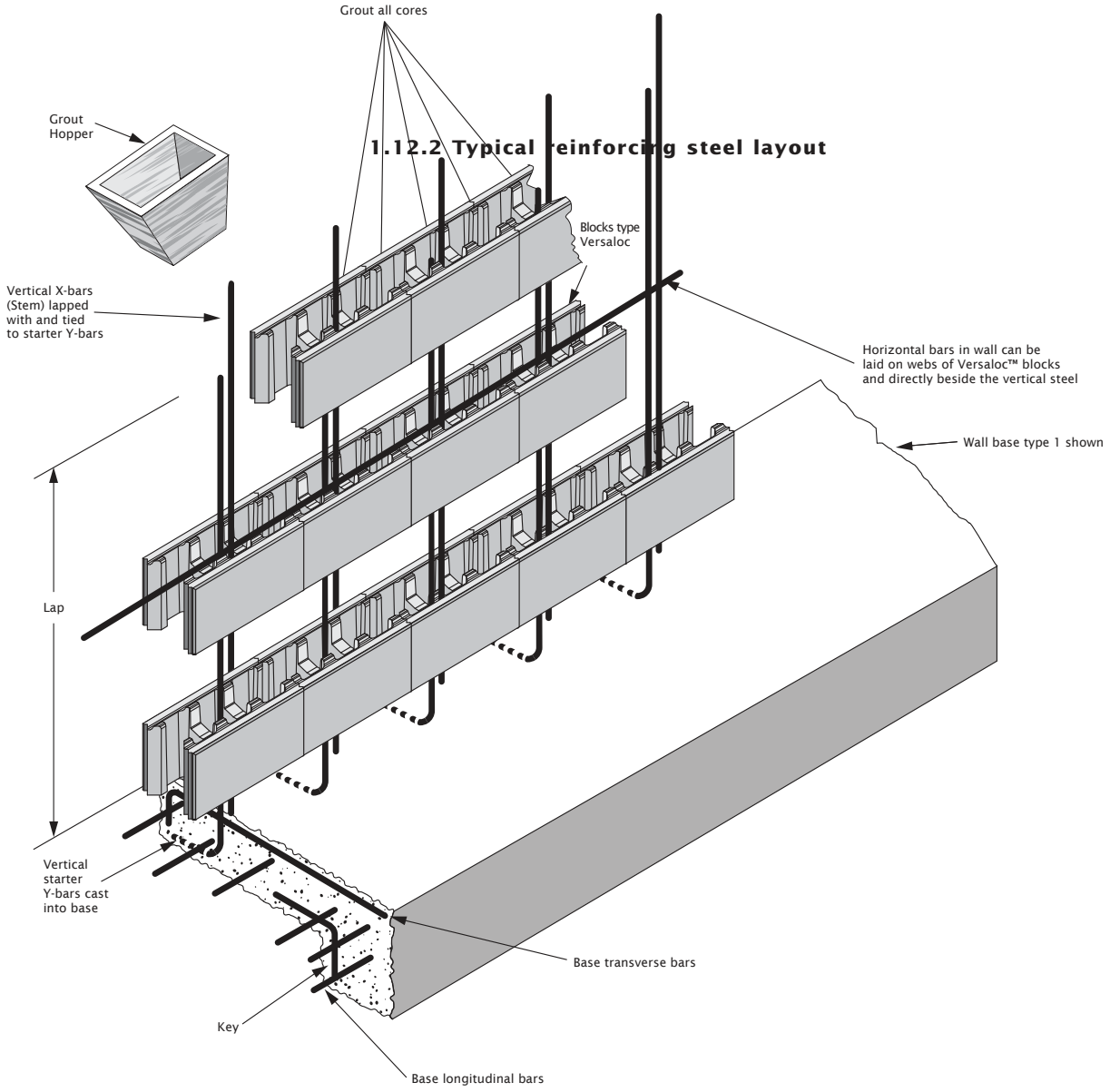
Notes:

- A 'cohesive' mix is one which has no tendency to segregate when pumped down into the Versaloc™ cavity. The concrete supplier should use a high-quality superplasticiser to achieve the flow characteristics required.
- Due to hydrostatic pressure build up by the fluid core-fill grout, a maximum filling height between pours of 1.8m (i.e. 9 courses), is strongly recommended.

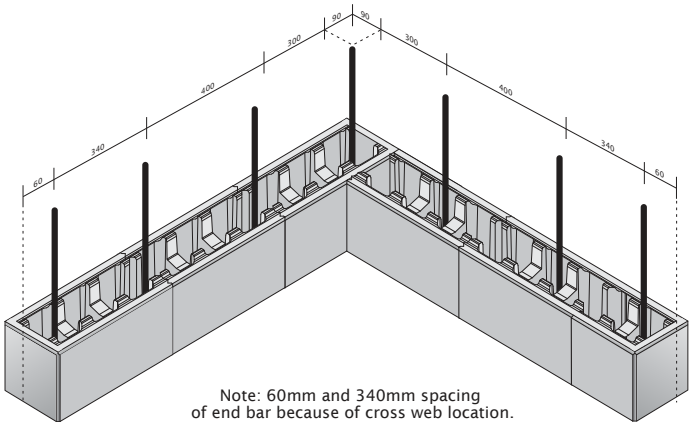
1.12 Exploded view of construction

(for both level backfill slopes and 1 in 4 backfill slopes)

1.12.1 Walls up to 2600mm high using 200 series and 1600mm high using 150 series blocks



1.12.2 Typical reinforcing steel layout

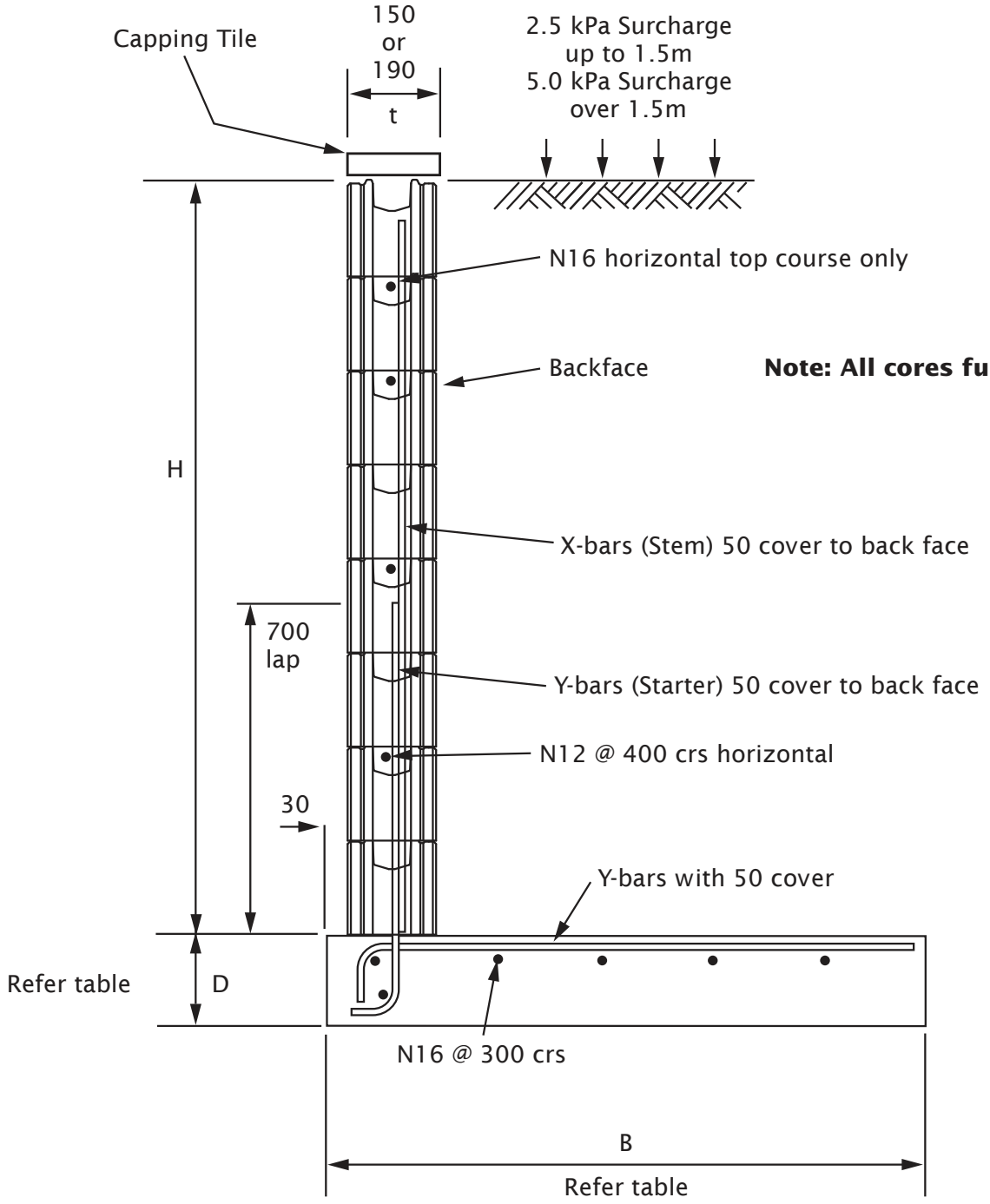


Note: 60mm and 340mm spacing of end bar because of cross web location.

Diagrams not to scale

1.13 Versaloc™ type 1 retaining wall design details for level backfill slope using **200 series** and **150 series** blocks

1.13.1 General layout for walls up to 2600mm high with level backfill slope



Note: All cores fully grouted.

Wall Type 1

Diagrams not to scale

1.13.2 Design details for walls up to 2600mm high with level backfill slope

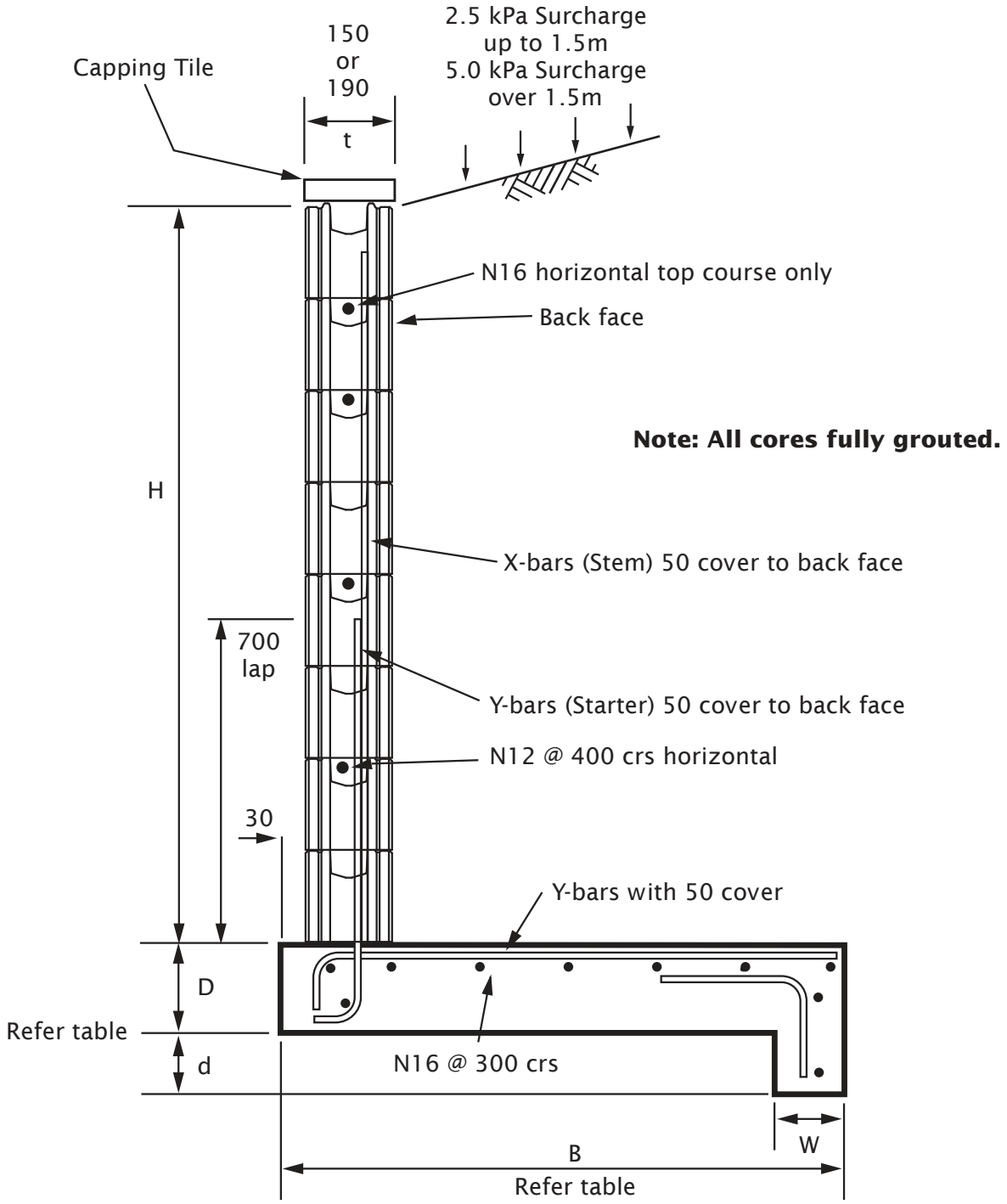
Wall Height H (mm)	Wall Width t (mm)	Base Width B (mm)	Base Depth D (mm)	Key Width W (mm)	Key Depth d (mm)	Backfill Slope	Reinforcement	
							X-bars (Stem)	Y-bars (Starter)
Characteristic internal friction angle of backfill material and retained soil 28° Characteristic cohesion of foundation 4.0kPa Characteristic internal friction angle of foundation 28°								
2600	**190**	1800	350	-	-	level	N16 at 400	N16 at 200
2400	**190**	1700	350	-	-	level	N16 at 400	N16 at 200
2200	**190**	1600	350	-	-	level	N16 at 400	N16 at 200
2000	**190**	1400	350	-	-	level	N16 at 400	N16 at 400
1800	**190**	1300	250	-	-	level	N16 at 400	N16 at 400
1600	**190**	1200	250	-	-	level	N12 at 400	N12 at 400
1400	**190**	900	250	-	-	level	N12 at 400	N12 at 400
1200	**190**	800	200	-	-	level	N12 at 400	N12 at 400
1000	**190**	700	200	-	-	level	N12 at 400	N12 at 400
800	**190**	600	200	-	-	level	N12 at 400	N12 at 400
600	**190**	500	200	-	-	level	N12 at 400	N12 at 400
Characteristic internal friction angle of backfill material and retained soil 28° Characteristic cohesion of foundation 4.0kPa Characteristic internal friction angle of foundation 28°								
1600	**150**	1200	250	-	-	level	N16 at 400	N16 at 400
1400	**150**	900	250	-	-	level	N12 at 400	N12 at 400
1200	**150**	800	200	-	-	level	N12 at 400	N12 at 400
1000	**150**	700	200	-	-	level	N12 at 400	N12 at 400
800	**150**	600	200	-	-	level	N12 at 400	N12 at 400
600	**150**	500	200	-	-	level	N12 at 400	N12 at 400

Notes:

1) Cohesion is difficult to predict, is variable, may change over time, and is dependent on the effectiveness of surface sealing, surface drainage and subsurface drainage. These details are based on the assumption that drained and undrained cohesion (as appropriate) is assumed to be zero for active forces and a very conservative value applies for sliding and bearing capacity. Consideration must also be given to shrink/swell action of clay soils.
2) These details have been calculated on the basis of a rough interface between the base and the foundation soil, for which the external angle of friction, δ, equals the internal angle of friction, ϕ. The footing/foundation interface should be constructed such that this assumption is correct. The designer should consider the validity of this assumption.
3) A 2.5kPa surcharge applies for walls up to 1.5m.
4) A 5.0kPa surcharge applies for walls over 1.5m.
5) All wall starter and stem reinforcing bars are located with 50mm cover to the back face of block.
6) All base and key reinforcing bars are to have 50mm clear cover to steel from face of concrete.
7) In accordance with CMAA technical literature and because Versaloc Retaining Walls are fully reinforced and less than 3m high control joints (CJ) may be ommited. If central joints are to be used than 16m maximum spacing is recommended.

1.14 Versaloc™ type 1 retaining wall design details for 1:4 backfill slope using **200 series** and **150 series** blocks

1.14.1 General layout for walls up to 2200mm high with 1:4 backfill slope



Wall Type 1

Diagrams not to scale

1.14.2 Design details for walls up to 2200mm high with 1:4 backfill slope

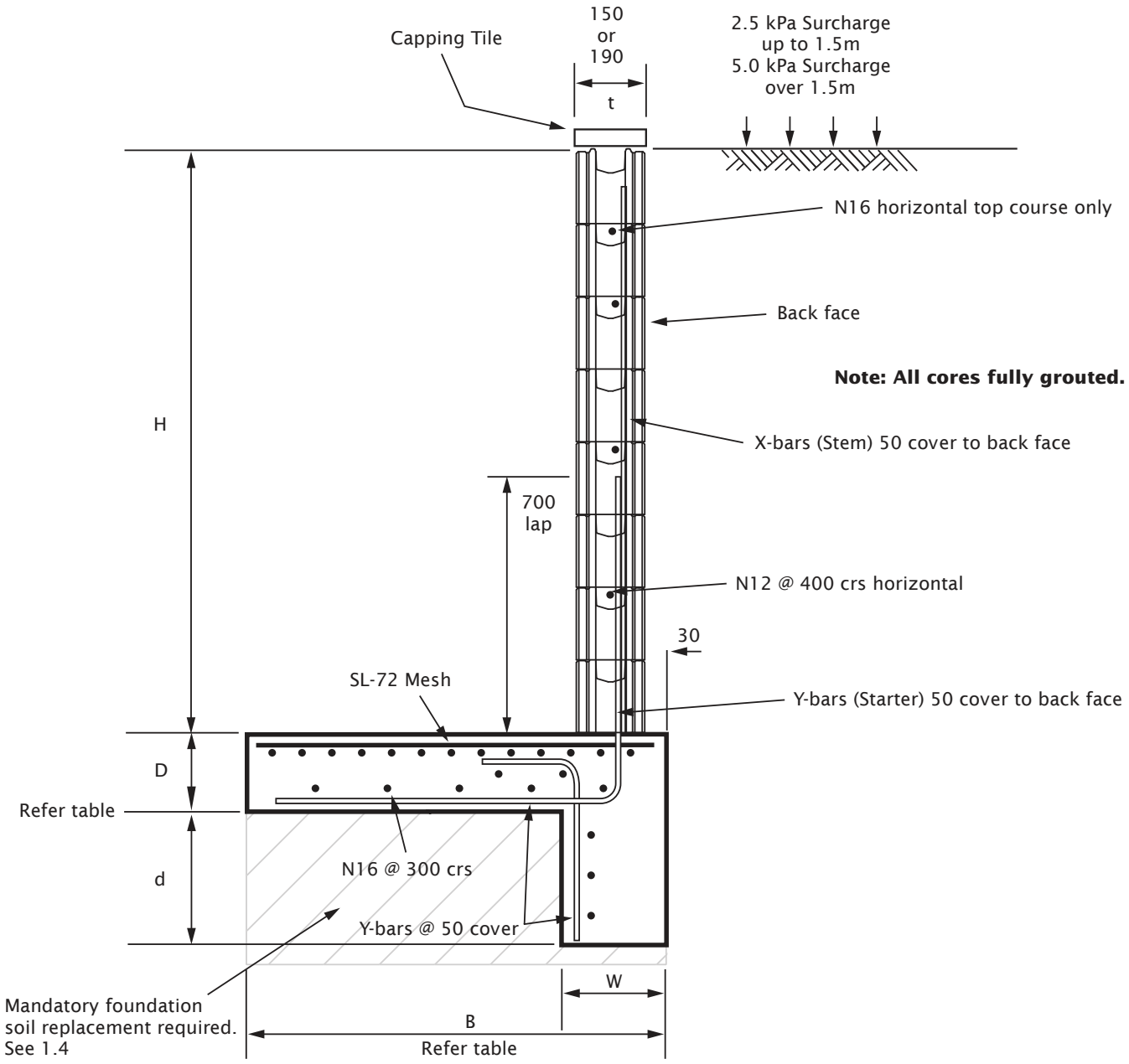
Wall Height H (mm)	Wall Width t (mm)	Base Width B (mm)	Base Depth D (mm)	Key Width W (mm)	Key Depth d (mm)	Backfill Slope	Reinforcement	
							X-bars (Stem)	Y-bars (Starter)
Characteristic internal friction angle of backfill material and retained soil 28° Characteristic cohesion of foundation 4.0kPa Characteristic internal friction angle of foundation 28°								
2200	**190**	2800	350	300	300	1:4	N16 at 400	N16 at 200
2000	**190**	2600	350	300	300	1:4	N16 at 400	N16 at 200
1800	**190**	2400	250	200	200	1:4	N16 at 400	N16 at 400
1600	**190**	2300	250	200	200	1:4	N12 at 400	N12 at 400
1400	**190**	1500	250	-	-	1:4	N12 at 400	N12 at 400
1200	**190**	1300	200	-	-	1:4	N12 at 400	N12 at 400
1000	**190**	1200	200	-	-	1:4	N12 at 400	N12 at 400
800	**190**	1000	200	-	-	1:4	N12 at 400	N12 at 400
600	**190**	800	200	-	-	1:4	N12 at 400	N12 at 400
Characteristic internal friction angle of backfill material and retained soil 28° Characteristic cohesion of foundation 4.0kPa Characteristic internal friction angle of foundation 28°								
1400	**150**	1500	250	-	-	1:4	N12 at 400	N12 at 400
1200	**150**	1300	200	-	-	1:4	N12 at 400	N12 at 400
1000	**150**	1200	200	-	-	1:4	N12 at 400	N12 at 400
800	**150**	1000	200	-	-	1:4	N12 at 400	N12 at 400
600	**150**	800	200	-	-	1:4	N12 at 400	N12 at 400

Notes:

1) Cohesion is difficult to predict, is variable, may change over time, and is dependent on the effectiveness of surface sealing, surface drainage and subsurface drainage. These details are based on the assumption that drained and undrained cohesion (as appropriate) is assumed to be zero for active forces and a very conservative value applies for sliding and bearing capacity. Consideration must also be given to shrink/swell action of clay soils.
2) These details have been calculated on the basis of a rough interface between the base and the foundation soil, for which the external angle of friction, δ, equals the internal angle of friction, ϕ. The footing/foundation interface should be constructed such that this assumption is correct. The designer should consider the validity of this assumption.
3) A 2.5kPa surcharge applies for walls up to 1.5m.
4) A 5.0kPa surcharge applies for walls over 1.5m.
5) All wall starter and stem reinforcing bars are located with 50mm cover to the back face of block.
6) All base and key reinforcing bars are to have 50mm clear cover to steel from face of concrete.
7) In accordance with CMAA technical literature and because Versaloc Retaining Walls are fully reinforced and less than 3m high control joints (CJ) may be ommited. If central joints are to be used than 16m maximum spacing is recommended.

1.15 Versaloc™ type 2 retaining wall design details for level backfill slope using **200 series** and **150 series** blocks

1.15.1 General layout for walls up to 2600mm high with level backfill slope



Wall Type 2

Diagrams not to scale

1.15.2 Design details for walls up to 2600mm high with level backfill slope

Wall Height H (mm)	Wall Width t (mm)	Base Width B (mm)	Base Depth D (mm)	Key Width W (mm)	Key Depth d (mm)	Backfill Slope	Reinforcement	
							X-bars (Stem)	Y-bars (Starter)
Characteristic internal friction angle of backfill material and retained soil 28° Characteristic cohesion of foundation 3.0kPa Characteristic internal friction angle of foundation 35° (imported roadbase equivalent)								
2600	**190**	3100	400	400	400	level	N16 at 400	N16 at 200
2400	**190**	3000	400	0	0	level	N16 at 400	N16 at 200
2200	**190**	2700	400	0	0	level	N16 at 400	N16 at 200
2000	**190**	2400	400	0	0	level	N16 at 400	N16 at 400
1800	**190**	2100	350	0	0	level	N16 at 400	N16 at 400
1600	**190**	1800	300	0	0	level	N12 at 400	N12 at 400
1400	**190**	1300	200	0	0	level	N12 at 400	N12 at 400
1200	**190**	1100	200	0	0	level	N12 at 400	N12 at 400
1000	**190**	800	200	0	0	level	N12 at 400	N12 at 400
800	**190**	700	200	0	0	level	N12 at 400	N12 at 400
600	**190**	500	200	0	0	level	N12 at 400	N12 at 400
Characteristic internal friction angle of backfill material and retained soil 28° Characteristic cohesion of foundation 3.0kPa Characteristic internal friction angle of foundation 35° (imported roadbase equivalent)								
1600	**150**	1900	400	0	0	level	N16 at 400	N16 at 400
1400	**150**	1600	200	0	0	level	N12 at 400	N12 at 400
1200	**150**	1200	200	0	0	level	N12 at 400	N12 at 400
1000	**150**	1000	200	0	0	level	N12 at 400	N12 at 400
800	**150**	700	200	0	0	level	N12 at 400	N12 at 400
600	**150**	500	200	0	0	level	N12 at 400	N12 at 400

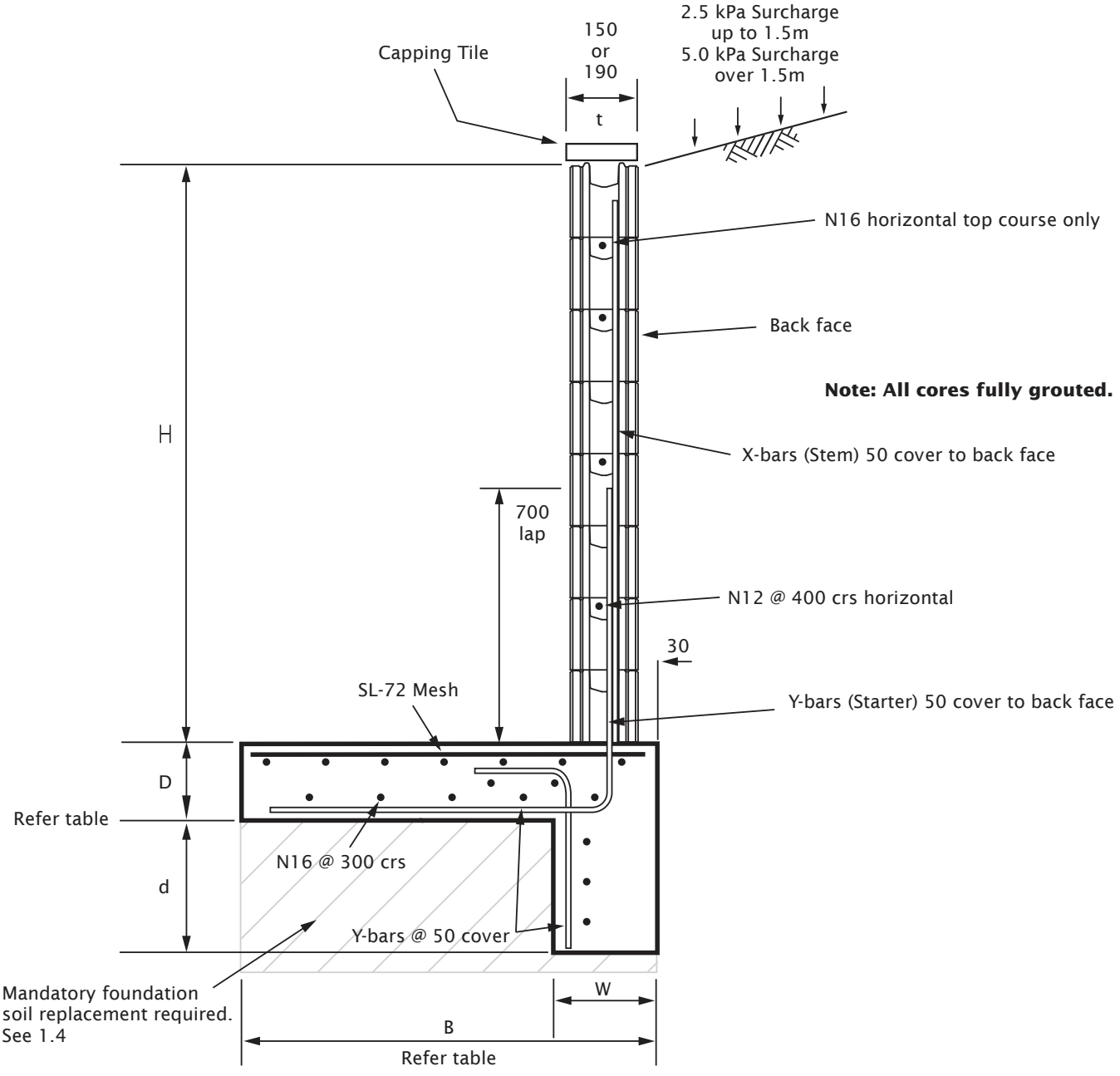
Notes:

1) Cohesion is difficult to predict, is variable, may change over time, and is dependent on the effectiveness of surface sealing, surface drainage and subsurface drainage. These details are based on the assumption that drained and undrained cohesion (as appropriate) is assumed to be zero for active forces and a very conservative value applies for sliding and bearing capacity. Consideration must also be given to shrink/swell action of clay soils.
2) These details have been calculated on the basis of a rough interface between the base and the foundation soil, for which the external angle of friction, δ, equals the internal angle of friction, ϕ. The footing/foundation interface should be constructed such that this assumption is correct. The designer should consider the validity of this assumption.
3) A 2.5kPa surcharge applies for walls up to 1.5m.
4) A 5.0kPa surcharge applies for walls over 1.5m.
5) All wall starter and stem reinforcing bars are located with 50mm cover to the back face of block.
6) All base and key reinforcing bars are to have 50mm clear cover to steel from face of concrete.
7) In accordance with CMAA technical literature and because Versaloc Retaining Walls are fully reinforced and less than 3m high control joints (CJ) may be ommited. If central joints are to be used than 16m maximum spacing is recommended.

Wall Type 2

1.16 Versaloc™ type 2 retaining wall design details for 1:4 backfill slope using **200 series** and **150 series** blocks

1.16.1 General layout for walls up to 2200mm high with 1:4 backfill slope



Wall Type 2

Diagrams not to scale

1.16.2 Design details for walls up to 2200mm high with 1:4 backfill slope

Wall Height H (mm)	Wall Width t (mm)	Base Width B (mm)	Base Depth D (mm)	Key Width W (mm)	Key Depth d (mm)	Backfill Slope	Reinforcement	
							X-bars (Stem)	Y-bars (Starter)
Characteristic internal friction angle of backfill material and retained soil 28° Characteristic cohesion of foundation 3.0kPa Characteristic internal friction angle of foundation 35° (imported roadbase or equivalent)								
2200	**190**	3200	400	300	300	1:4	N16 at 400	N16 at 200
2000	**190**	2800	400	300	300	1:4	N16 at 400	N16 at 200
1800	**190**	2500	350	300	300	1:4	N16 at 400	N16 at 400
1600	**190**	2400	300	200	200	1:4	N12 at 400	N12 at 400
1400	**190**	1600	300	0	0	1:4	N12 at 400	N12 at 400
1200	**190**	1300	300	0	0	1:4	N12 at 400	N12 at 400
1000	**190**	1100	200	0	0	1:4	N12 at 400	N12 at 400
800	**190**	800	200	0	0	1:4	N12 at 400	N12 at 400
600	**190**	600	200	0	0	1:4	N12 at 400	N12 at 400
Characteristic internal friction angle of backfill material and retained soil 28° Characteristic cohesion of foundation 3.0kPa Characteristic internal friction angle of foundation 35° (imported roadbase or equivalent)								
1400	**150**	1900	200	0	0	1:4	N12 at 400	N12 at 400
1200	**150**	1500	200	0	0	1:4	N12 at 400	N12 at 400
1000	**150**	1200	200	0	0	1:4	N12 at 400	N12 at 400
800	**150**	900	200	0	0	1:4	N12 at 400	N12 at 400
600	**150**	700	200	0	0	1:4	N12 at 400	N12 at 400

Notes:

1) Cohesion is difficult to predict, is variable, may change over time, and is dependent on the effectiveness of surface sealing, surface drainage and subsurface drainage. These details are based on the assumption that drained and undrained cohesion (as appropriate) is assumed to be zero for active forces and a very conservative value applies for sliding and bearing capacity. Consideration must also be given to shrink/swell action of clay soils.
2) These details have been calculated on the basis of a rough interface between the base and the foundation soil, for which the external angle of friction, δ, equals the internal angle of friction, ϕ. The footing/foundation interface should be constructed such that this assumption is correct. The designer should consider the validity of this assumption.
3) A 2.5kPa surcharge applies for walls up to 1.5m.
4) A 5.0kPa surcharge applies for walls over 1.5m.
5) All wall starter and stem reinforcing bars are located with 50mm cover to the back face of block.
6) All base and key reinforcing bars are to have 50mm clear cover to steel from face of concrete.
7) In accordance with CMAA technical literature and because Versaloc Retaining Walls are fully reinforced and less than 3m high control joints (CJ) may be ommited. If central joints are to be used than 16m maximum spacing is recommended.

2.0 Versaloc™ Basement Walls

2.1 General

Note: 150 series Versaloc™ walls are not suitable for basement walls, only 200 series walls should be used.

The foundation slab of a basement can be modified to provide an efficient footing for a retaining wall. In addition, a concrete floor slab will provide a "prop" to the top of the wall, simplifying the wall details compared to a timber wall.

Versaloc™ basement wall design details for a supporting concrete floor are shown in section 2.5 and Versaloc™ basement wall design details for a supporting timber floor are shown in section 2.6.

Designs have been carried out assuming that backfill material and retain soil has a characteristic internal friction angle of 28°.

2.2 Drainage System

As with all retaining walls, it is critical that the backfill is prevented from becoming saturated. Steps to be taken to achieve this include:

- A drainage system within the backfill. This should preferably take the form of a 300mm width of gravel immediately behind the wall with a continuous agricultural pipe located at the base of the wall. The pipe must discharge beyond the ends of the wall or be connected to the stormwater drain.
- Sealing the backfill surface. This can be done by placing a compacted layer of low-permeability material over (eg clay) the backfill and sloping the surface away from the house.

It is also important to prevent hydrostatic pressure under the floor slab. Where there is the possibility of groundwater under the slab, then a subfloor drainage system is advisable.

2.3 Tanking

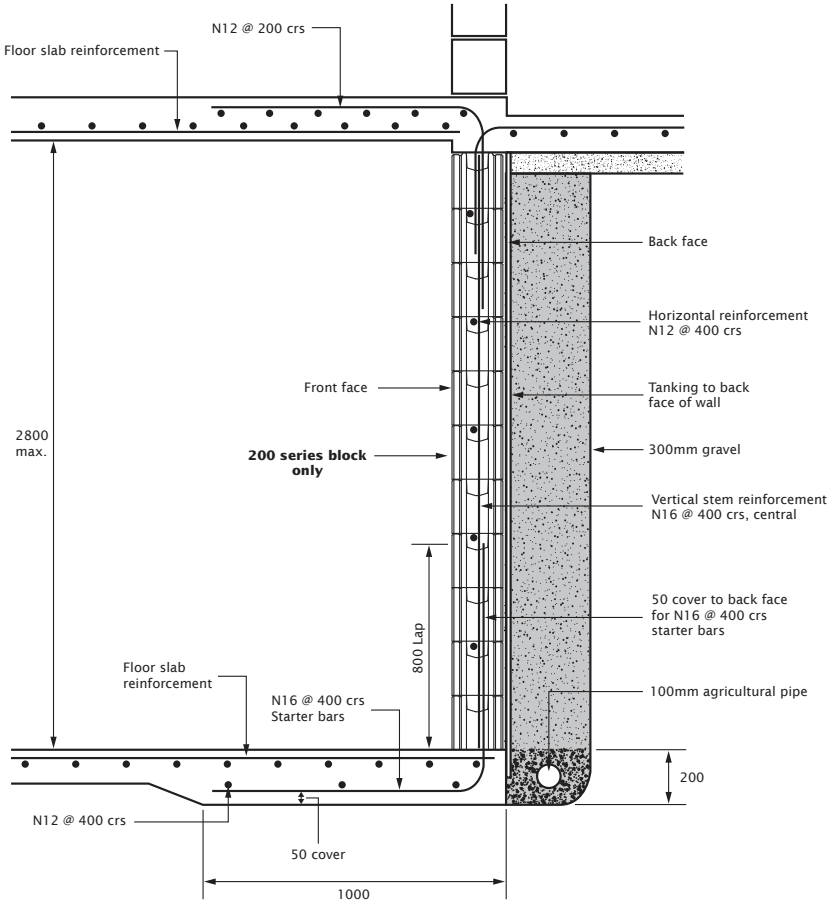
Where it is required that the basement be kept dry, a proper tanking system needs to be installed behind the wall before backfilling. Refer to section 1.9.

An alternative to this is to provide a drain and a false wall in front of the wall (for both concrete and timber supporting floors). The designs for these alternate options in supporting both concrete and timber floors are also shown in section 2.5 (for supporting a concrete floor) and section 2.6 (for supporting a timber floor).

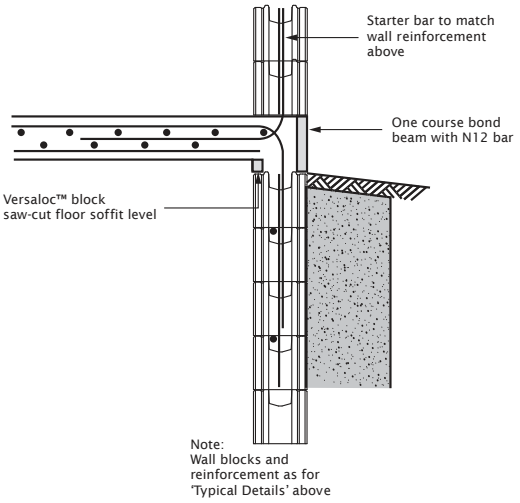
2.4 How to build the Versaloc™ basement wall

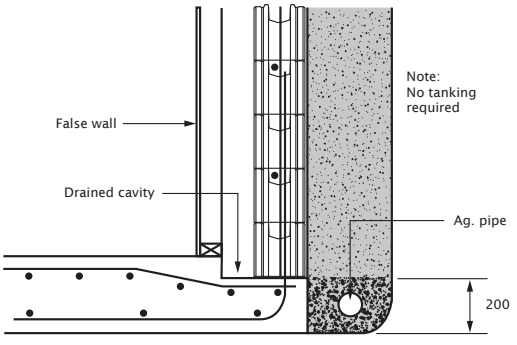
Building a basement wall is essentially the same as building a retaining wall. Please refer to section 1.11 for details on how to build a basement wall.

2.5 Versaloc™ basement wall design details for supporting a concrete floor



Typical Details - Fully-Propped Walls

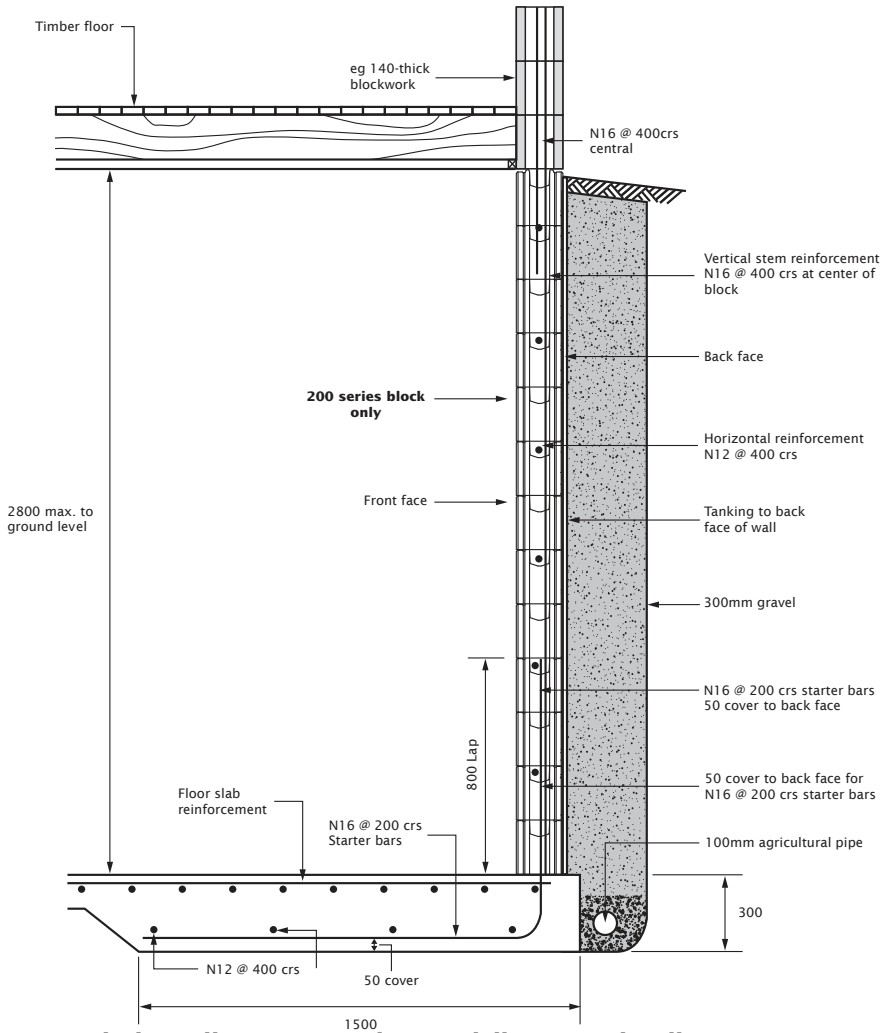




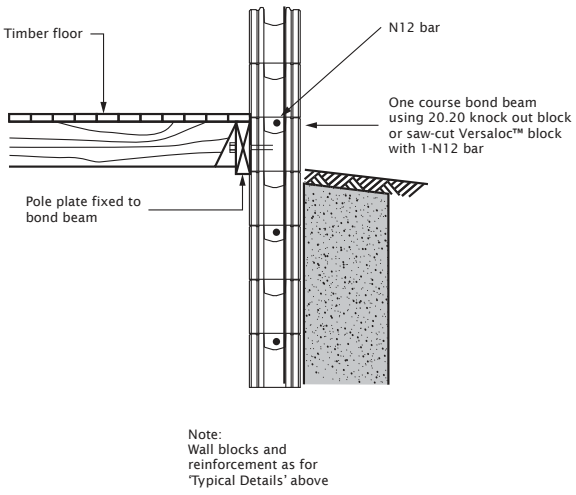
Alternative Details

Diagrams not to scale

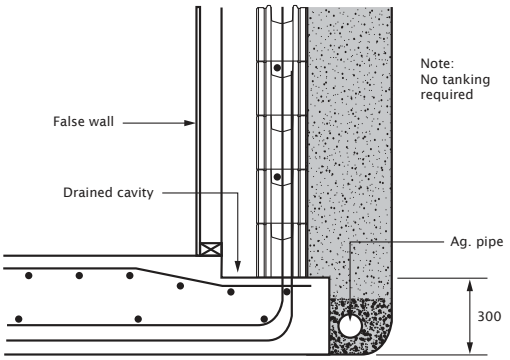
2.6 Versaloc™ basement wall design details for supporting a timber floor



Typical Details - Unpropped or Partially Propped Walls



Note:
Wall blocks and reinforcement as for 'Typical Details' above



Note:
No tanking required

Alternative Details

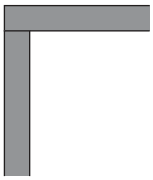
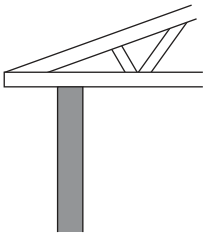
Diagrams not to scale

3.0 Compressive Load Capacity of Adbri Masonry Versaloc™ Mortarless Block Walls

This section has been prepared by Adbri Masonry for use by qualified and experienced structural engineers. The information is based on limit state design and is applicable specifically to Versaloc™ block walls with properties as set out in following table using Simplifield Design Method for Braced Walls Subject to Vertical Forces Only (refer clause 11.4 AS3600).

Versaloc™ wall properties and compressive load capacity

Wall Properties	**200 Series Block**	**150 Series Block**
Block Width tu	190 (mm)	150 (mm)
Block Height hu	200 (mm)	200 (mm)
Block Length lu	398 (mm)	398 (mm)
Net Block Width Less Chamfers tw	180 (mm)	140 (mm)
Chamfer Each Face Shell	5 (mm)	5 (mm)
Block Characteristic Compressive Strength f'uc block	20.0 MPa	20.0 MPa
Wall Grouted Compressive Strength f'mg	11.0 MPa	8.5 MPa
ϕ Strength Reduction Factor AS3600 11.4.4	0.6	0.6
e Load Eccentricity AS3600 11.1.1	30.0 (mm)	23.3 (mm)

Wall Type	**Wall Height Hwe (mm)**	**Height/Thickness Ratio Hwe/tu 190 Block**	**Nu Design Axial Strength 190 Block kN/m**	**Height/Thickness Ratio Hwe/tu 150 Block**	**Nu Design Axial Strength 150 Block kN/m**
Wall Loading Condition Concrete Slab on Wall. Discontinuous concrete floor or roof providing rotational restraint.					
	2400	OK	513	OK	286
	2600	OK	503	OK	276
	2800	OK	493	OK	266
	3000	OK	481	OK	254
	3200	OK	469	OK	242
	3400	OK	456	OK	229
	3600	OK	442	OK	215
	3800	OK	427	OK	201
	4000	OK	412	OK	185
	4200	OK	396	OK	169
	4400	OK	379	OK	152
	4600	OK	361	OK	135
	4800	OK	342	OK	116
	5000	OK	323	OK	97
Other Loads on Wall. Discontinuous concrete floor or roof **not** providing rotational restraint.					
	2400	OK	469	OK	242
	2600	OK	451	OK	225
	2800	OK	432	OK	206
	3000	OK	412	OK	185
	3200	OK	390	OK	164
	3400	OK	367	OK	141
	3600	OK	342	OK	116
	3800	OK	316	OK	90
	4000	OK	289	OK	63
	4200	OK	260	OK	34
	4400	OK	230	N/A	N/A
	4600	OK	198	N/A	N/A
	4800	OK	165	N/A	N/A
	5000	N/A	130	N/A	N/A

Notes:

1) For weather proofing plain face Versaloc™ walling it is recommended coating wall with BOSTIK AQUASHIELD SB40 hydrophobic concrete sealer.
2) For weather proofing aesthetically finished Versaloc™ walling it is recommended application of a single coat of render followed by a single coat of acrylic paint.

Notes:

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Adbri Masonry
Versaloc™
1st Edition Australia

Landscape Solutions: AB.LSED0108

Adbri Masonry is Australia's largest supplier of quality masonry products.

Adbri Masonry manufactures a large range of concrete products such as; bricks, block and architectural coloured block, decorative wall claddings, retaining wall systems, concrete and wetcast pavers as well as an exceptional range of environmental products. These products are used in many large scale civil projects as well as in thousands of backyards throughout Australia.

Adbri Masonry is a wholly owned subsidiary of Adelaide Brighton Ltd, a top 200 ASX listed public company.

Adbri Masonry was formed in July 2008, bringing together two reputable brands, C&M Brick and Hanson Building Products. Both Hanson Masonry and C&M brick boast proud histories and both have been foundation companies whose products have helped to build the face of the Australia we now know. From Hanson pavers in Cairns Airport to C&M Brick's paving in the Homebush Olympic Village, Homebush Bay, many of Australia's iconic projects have utilised the quality products from these two trusted companies.

For further advice call 1300 365 565 now to speak with a product specialist.

Design professionals can request product samples at www.adbrimasonry.com.au or free call 1300 365 565

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