PisaLite®

OneStone™

Installation Guide

ABBOTSFORD CONCRETE PRODUCTS

RisiStone®
retaining wall systems

Risi Stone Retaining Wall Systems
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Risi Stone Inc. has attempted to ensure that all information contained in this guide is correct. However, there is the possibility that this guide may contain errors. Review all designs with your local sales representative prior to construction. Final determination of the suitability of any information or material is the sole responsibility of the user. Please check our website www.risistone.com, for the most up-to-date versions of the specification. All dimensions are nominal.

Contents

Overview of a Successful Project

The following procedure is recommended for the construction of segmental retaining walls over 1.0m (3.0') in height, or as required by local building codes.

Clear Plan

- Aboveground Site Assessment: existing grades, structures, utilities, property lines, visible water features, etc., established.
- Contact all utility companies to confirm location of underground utilities that may not be visible in aboveground assessment.
- Proposed site modifications defined by designer (landscape architect, engineer, architect) based on owner's requirements and site limitations. Includes proposed grades, retaining wall geometry, slopes, proposed use of land (parking areas, water detention, landscape), relocation of existing structures/utilities, new structures/utilities, location of trees, etc.
- Project drawings generated and submitted to appropriate agencies for approval.
- Investigate local building codes and apply for all permits required.

Assessment of Subsurface Conditions

- Geotechnical Investigation conducted to evaluate subsurface conditions of site, including soil types, characteristic properties, in-situ state, groundwater conditions, overall slope stability, bearing capacity.
- Recommended design parameters, construction/excavation techniques, effects of proposed and existing structures, ground improvements, erosion protection, drainage considerations, anticipated settlement, etc., should be identified.

Site-Specific Retaining Wall Design

- Information provided in plan and geotechnical investigation provided to the wall design engineer.
- The design may be provided by Risi Stone Systems through the Design Assistance Program (contact local manufacturer for details), or a third-party engineer qualified in this field. The design must synthesize all available information and include cross-section and/or elevation-view drawings, specifications, calculations, quantities, and related construction details.

Pre-construction meeting

- We recommend that all involved parties (designers, owner's representative, general contractor, installer, inspecting engineer, supplier, etc.) attend a pre-construction meeting to define schedule and clearly state responsibilities.
- Parties not directly involved with the design and construction of the wall, but who may do future work that could influence the wall (e.g. paving, installing fences) should attend the meeting to understand the limitations of the wall and address precautions.
- Experience has shown that this simple step prevents a multitude of potential problems!

Qualified Professional Engineer Hired for Inspection/General Review

Inspection and General Review of the proposed SRW must be conducted by a qualified third-party engineer. Inspection is more than soil and compaction testing, but includes all aspects of the installation. The scope of the GRE's responsibilities include, but are not limited to:

- Inspection of all materials used in construction (SRW units, backfill, drainage material, reinforcement, other structures);
- Verification that the design is compatible with the site in all respects;
- Identification of discrepancies between the plan and/or SRW design and actual site conditions, and subsequent notification of designer;
- Continuous evaluation of site conditions, surface water and groundwater, compaction testing, foundation bearing capacity, excavation procedures, construction practices for safety and compliance with design;
- Ensuring wall is constructed according to design; and provide a letter to the owner that the wall has been constructed in general conformance with the design.

Proper Installation

- Adherence to design, specifications, details, guides, and good construction practice is necessary.
- Conducted under supervision of the GRE.

Final Grading

- Final grading should be conducted as soon as possible following construction to divert water away from the wall and create the optimum condition for great performance.

Safety Notes

- Ensure all workers are well-versed in the proper use of all equipment and vehicles
- Prior to each use, inspect all machinery to ensure that it is in good condition
- Do not exceed the recommended load/speed/capacity specified by the equipment manufacturer
- Ensure overall maintenance of all machinery is kept up
- Follow all occupational health & safety guidelines set forth by your local government

Following the Design

Understanding the Design

Depending on the stage in the design process, there are generally three potential types of design:

Typical Design – Not for Construction

Non-site–specific design(s) selected from Risi Stone Systems' library of pre-engineered cross-section drawings (all available at risistone.com). Selected based on preliminary information regarding proposed maximum wall height, use of structure, grading, etc. Suitable for preliminary cost estimates, feasibility studies, and conceptual approvals. **Not for Construction.**

Preliminary Design – Not for Construction

A site-specific design produced for preliminary purposes when some component of the required design information is not yet available. Includes all elements needed to construct the wall, but is not considered ready for construction as it remains contingent on verification of some site-specific detail(s). Includes site-specific cross-section drawings, elevation views, specifications, quantity calculations, details, statement of limitations, etc. **Not sealed by the designer.**

Final Design

All necessary information has been established and the design has been deemed ready for construction. This type of design is sealed by the designer.

Components of the Design

The design should clearly provide all information necessary to construct the proposed SRW structure. The basic components are as follows:

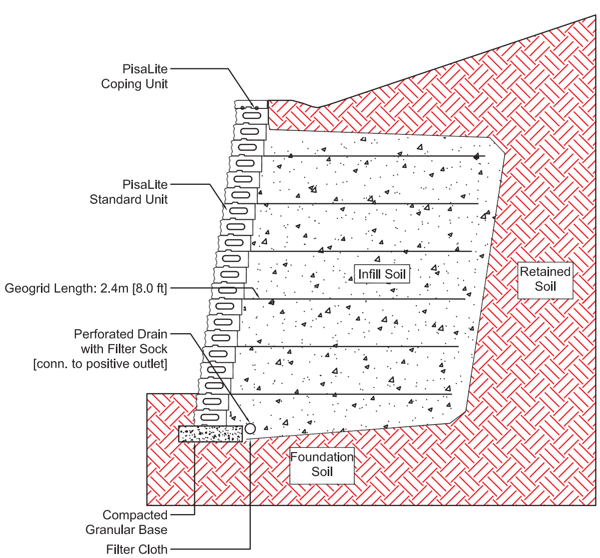
Design Notes / Limitations

The design should include information regarding the design standard used, limitations of design, status of design (preliminary or final), design assumptions, purpose of the wall, and potential construction issues.

Cross-Section Drawing(s)

The cross-section drawing is usually provided to illustrate the general arrangement of the wall, soil zones, assumed parameters, structural elements, water levels, etc. A cross-section drawing is normally provided for the maximum height section through the wall and/or the most critical section. Additional cross-sections may be provided to indicate variable conditions or wall orientation (terraces/location of structures) throughout.

TYPICAL SECTION - NOT FOR CONSTRUCTION



Design Specific Geometric Information

Retaining Wall System	PisaLite w/ Geogrid	Geogrid Type and Manufacturer	See Notes
Maximum Height mm (in)	3120 (122)	Minimum Geogrid LTDS kN/m (lb/ft)	See Notes
Maximum Slope Above Wall	1V:3H	Maximum Slope Below Wall	None
Max. Surcharge Above Wall kPa (lb/sq.ft)	None	Depth of Embedment mm (in)	310 (12)
Batter of Wall	7.12 °	Compacted Base Dimension mm (in)	610 x 153 (24 x 6)

Design Specific Soil Information

	Soil Region				
	Infill	Retained	Foundation	Base	Drainage
Description (by USCS)	GW Well graded, free draining Granular	CL Inorganic Clays Low Plasticity	CL Inorganic Clays Low Plasticity	GW Well graded, free draining Granular	see infill
Effective Internal Friction Angle	35°	28°	28°	39°	NR
Moist Unit Weight kN/cu.m (lb/cu.ft)	22 (140)	20 (127)	20 (127)	22 (140)	NR
Effective Cohesion kPa (lb/sq.ft)	NR	NR	NR	NR	NR
Soil Notes	Placed in 150mm (6") lifts and compacted to 95 % SPD.	Undisturbed dense soil or well compacted Eng. fill.	Allowable bearing cap.must exceed 150kPa (3125 psf).	Crushed Gravel (free draining) compacted to 98 % SPD.	Gravel infill must be well graded, angular, free drain w/max. 8 % fines

NR - Not Required

Notes:
1. This design meets or exceeds the minimum factors of safety required by Risi Stone Systems based on the design parameters listed above. The analysis was performed as outlined in the National Concrete Masonry Association Design Manual for Segmental Retaining Walls, Second Edition. This is a typical, non site-specific Design.
2. No analysis of global stability, total or differential settlement, or seismic effects has been performed.
3. This design is only provided to illustrate the general arrangement of the SRW structure for preliminary costing and feasibility purposes only. This drawing is not for construction. A qualified Engineer must be retained to provide the Final Design prior to construction.
4. Structures such as handrails, guardrails, fences, terraces, and site conditions such as water applications, drainage and soil conditions, additional live and dead loads, etc., have significant effects on the wall design and have not been taken into account in this typical section. When accounted for in the Final Design, other conditions and elements may result in additional design measures (geogrid, drainage, etc) and cost.
5. For geogrid reinforced structures, a minimum Long Term Allowable Design Strength of 14 kN/m was assumed. Contact your manufacturer or Risi Stone Systems for a list of approved geogrid reinforcements.

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PisaLite®
Retaining Wall
Geogrid Section
3120mm (10.23ft)
Site: 3H:1V Slope - Clays
Infill: Granular

PL1RBSAI312

Elevation-View Drawing(s)

The elevation view or "face" view of the wall depicts the wall as a whole, essentially laying the wall out flat on the page. This drawing details the overall geometry of the proposed wall, steps at the top and bottom of wall, required geogrid length and placement (where applicable), location of other structures, etc. This drawing provides the contractor with an exact model upon which to establish grades and construct the wall.

Calculations and Quantity Estimates

Risi Stone Systems conducts analysis using the Vespa.RS design software *(please contact your Abbotsford Concrete representative to obtain your copy, 1-800-663-4091),* a branded version of the popular Vespa MSE Design Software.Risi Stone Systems' design reports feature the Vespa design output. This output is customizable and depending on the application, may include the design calculations, all design parameters, quantity calculations, etc. The quantity calculations exactly represent the wall layout provided in the elevation view and Calculated Panel Geometry section of the Vespa.RS output. The contractor is responsible for verifying the quantities provided by checking the most recent grading information, and/or site grading, against the elevation view provided.

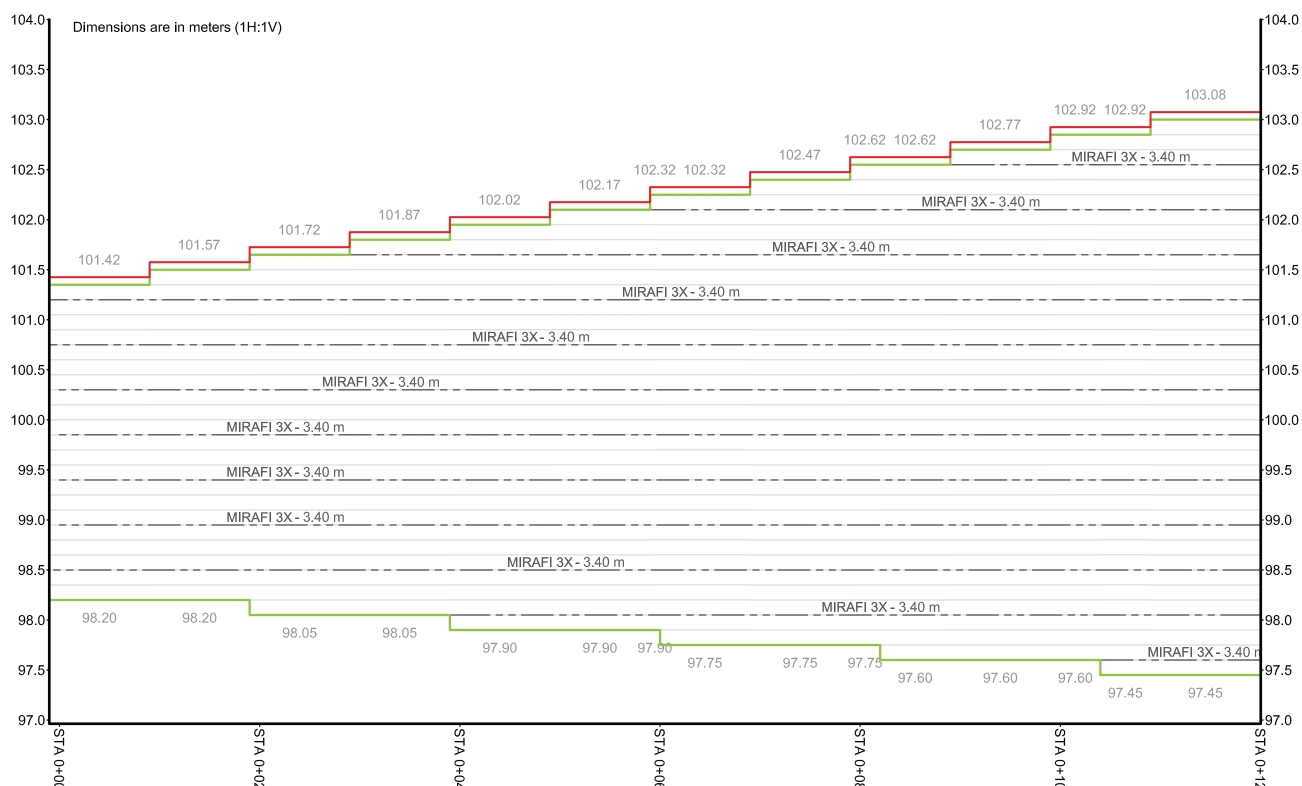
Details

The cross-section and elevation-view drawings are to be used in conjunction with the related detail drawings. These may include handrails, corners, curves, stepping foundation, steps, etc. Adherence to these details is vital for optimum wall performance.

Specifications

The Design should include standard specifications that outline specific requirements of the Design, Construction, Materials, Certification, and Finishing.

Typical Elevation-View Drawing



The PisaLite® Wall System

The PisaLite® system is a modular concrete retaining wall system that is used to stabilize and contain earth embankments, large or small.

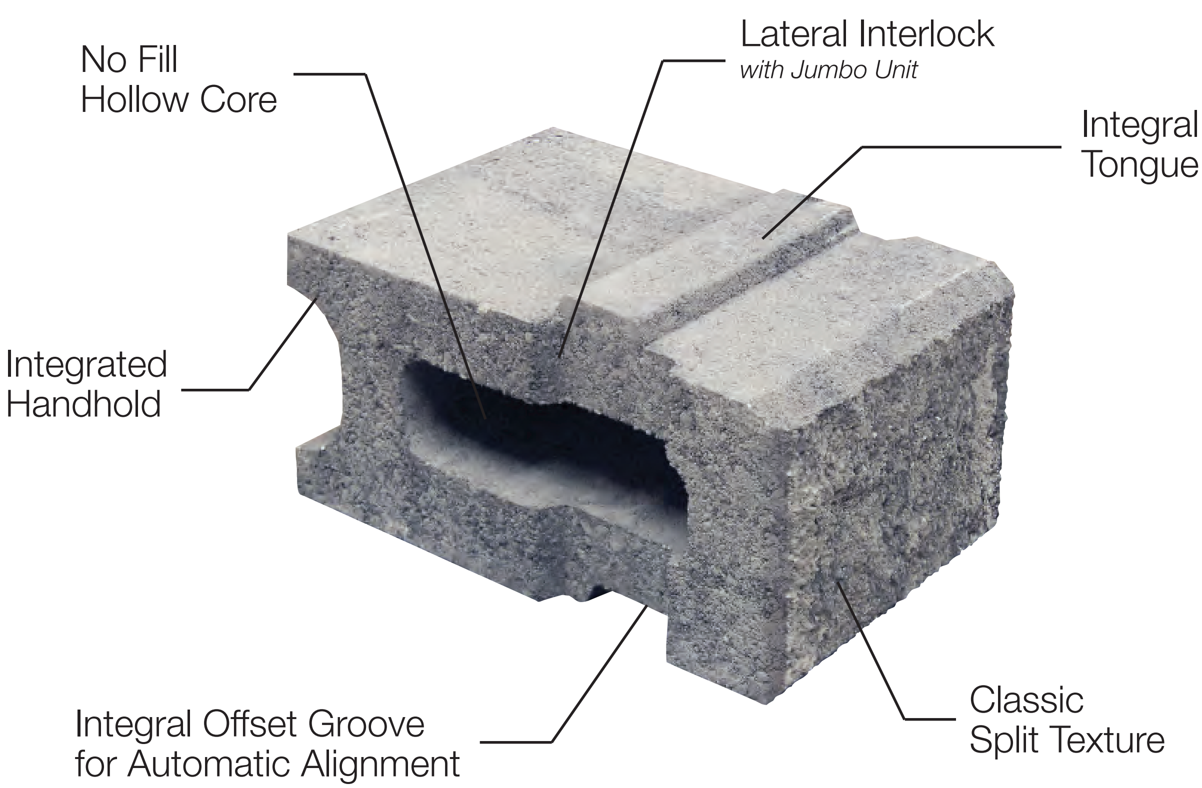
The PisaLite® system is based on the principles and designs of the PisaStone system developed in the 1970's. Since then, hundreds of successful installations were completed. During this period the requirements of designers, installers and owners were further refined and identified.

There are many applications for PisaLite® retaining walls. Most examples can be divided into two configurations: landscape applications and or structural applications.

In landscape applications, the primary purpose of retaining walls is aesthetic in nature. Some examples of PisaLite® landscape uses are planters, driveway edging, steps, tree wells, and smaller garden retaining walls. Most landscape applications call for walls under 1.0m (3') in height, with minimal loads being applied to the wall. Consequently, most landscape walls are built as conventional SRWs.

In structural applications, the primary function of retaining walls is to provide structure and strength to steep slopes or cuts. Some common structural uses for PisaLite® retaining walls are high walls, some in excess of 4.0m (12'); walls required to support parking, roads, or highways; and erosion protection along streams or lakes. In all of these cases, geosynthetic reinforcement is used.

The PisaLite® system is supported by Abbotsford Concrete Products and Risi Stone Systems. Abbotsford Concrete Products will make every attempt to answer your general questions and they will gladly provide customers with answers for site-specific applications. The Vespa.RS design software also helps to provide solutions for specific site designs. Unique applications often necessitate the assistance of a professional engineer. Risi Stone Systems can provide these solutions through its Engineering Design Assistance program.



Features & Advantages

The PisaLite® system has a number of features that make the system unique. Each of these features has been developed to give a PisaLite® retaining wall the advantages of increased beauty, simplified installation, and greater strength. These features benefit the owner by lowering the entire cost of the retaining wall, both during installation and well into the future.

Modular Retaining Wall System

Wall is flexible, yet retains its structural characteristics.

- The wall can absorb minor movements due to frost or settlement.
- Requires minimal embedment below grade.

A compacted granular base is all that is required.

- Reduces the cost by not requiring an expensive structural footing.

Core does not require filling and compaction

- Ensures maximum resistance to overturning forces.
- Saves time and money.

Manufactured From 35 MPA (5000 PSI) Concrete

- Provides wall with greater durability.
- Less susceptible to freeze-thaw deterioration.
- Less likely to be broken by handling or in transit.

Tongue and Groove Interlock

Interlocking mechanism moulded into the units so there are no separate pins or clips.

- Increases installation rates.
- Ensures maximum shear connection between units.

Units are dry-stacked.

- Lower costs because no mortar is used in the construction.
- Minimal training is required to achieve excellent installation results.

Units are self-aligning and self-battering.

- Once the first course is laid flat and levelled, there is no need for continual measuring and adjusting.

Creates a continuous interlock throughout the wall face.

- Makes a stronger, more damage-resistant wall.

Chamfered Face

The face of the PisaLite® stone is produced with a chamfer on all four sides.

Size and Weight

Units are well-balanced, easy to handle, and have a moulded finger hold.

- Units can be held by a single person for quicker installation.

Manufacturing method ensures a uniform height for each unit.

- Courses remain at fixed elevations and should not require shimming.

PisaLite® with Geogrid Reinforcement

Ability to construct higher walls.

- Can utilize site soil to infill the geogrids, consequently lowering disposal and extra material charges.
- Can use the same facia throughout a site on lower conventional SRWs and higher geogrid reinforced SRWs.

90° Corner Units

Manufactured to speed construction.

- Offers a finished appearance to the wall.
- Initiates the correct running bond pattern.
- Increases the strength of corners.
- Saves time during installation.

RisiLights

Provide illumination for stairs or landscape accents; blend into the wall during daylight.

RisiSounds

Provide an audio speaker system that blends into the wall.

Complementing Accessories

All the standard features for retaining walls can be supplied by Abbotsford Concrete Products dealer representatives.

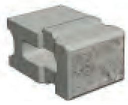
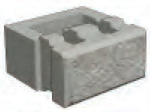
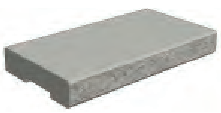
- Saves time during installation.
- Creates a uniform, finished look for the wall.

Technical Support and Engineering Design Assistance

Technical expertise developed over forty years through experience and testing is available to customers.

- Ensures that retaining walls are correctly designed and constructed.
- Advanced software is available to help designers generate stable retaining wall structures.

Block Details

PisaLite® System Units		Width mm / inches	Height mm / inches	Depth mm / inches	Weight Kg / Lbs
	Standard	200 / 7 ⅞"	150 / 5 ⅞"	300 / 11 ⅞"	14.0 / 31
	Tapered	200 / 7 ⅞"	150 / 5 ⅞"	300 / 11 ⅞"	13.2 / 29
	Jumbo *(Functions Horizontally or Vertically)*	200 / 7 ⅞"	150 / 5 ⅞"	300 / 11 ⅞"	20.0 / 44
	Half	100 / 3 ⅞"	150 / 5 ⅞"	300 / 11 ⅞"	6.8 / 15
	Corner	200 / 7 ⅞"	150 / 5 ⅞"	300 / 11 ⅞"	18.2 / 40
	Cap	610 / 24"	80 / 3 ⅛"	330 / 13"	33.1 / 73

True dimensions are in Metric, Imperial dimensions are soft conversions.

Colors

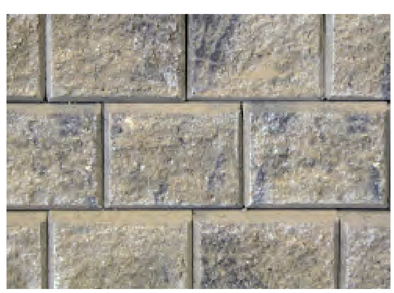
Abbotsford Concrete Products manufactures PisaLite® in six attractive color blends that can be used individually or can be combined with each other to create a unique palette to complement any project.

Granite

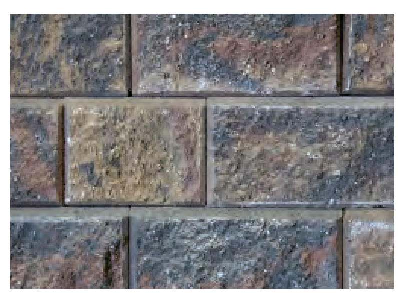
Charcoal

Natural

Moroccan Sunset



Sandalwood



La Jolla

Patterns

Laying Pattern | Integration | Cutting Required

Offset Runner Bond

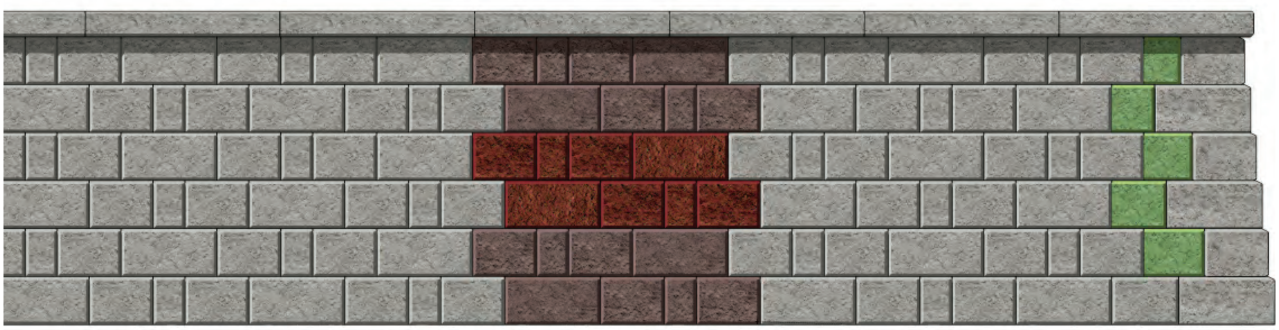
100% Standard

Offset Runner Bond

100% Jumbo

Pattern One

50% Standard | 38% Jumbo | 12% Half



Pattern Two

46% Standard | 46% Jumbo | 8% Half

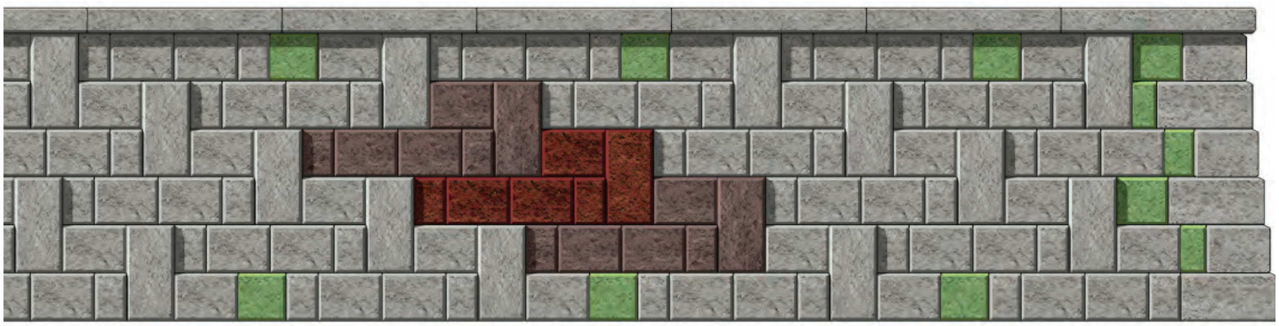
Laying Pattern | Integration | Cutting Required

Pattern Three

54% Standard | 28% Jumbo | 18% Half

Pattern Four

54% Standard | 28% Jumbo | 18% Half

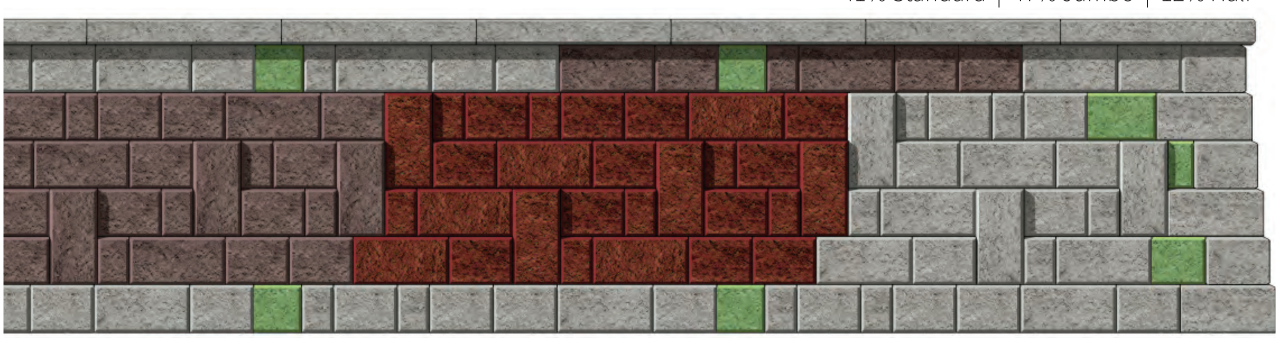


Pattern Five

53% Standard | 40% Jumbo | 7% Half

Pattern Six

41% Standard | 47% Jumbo | 12% Half



PisaLite®

Gravity Wall Installation

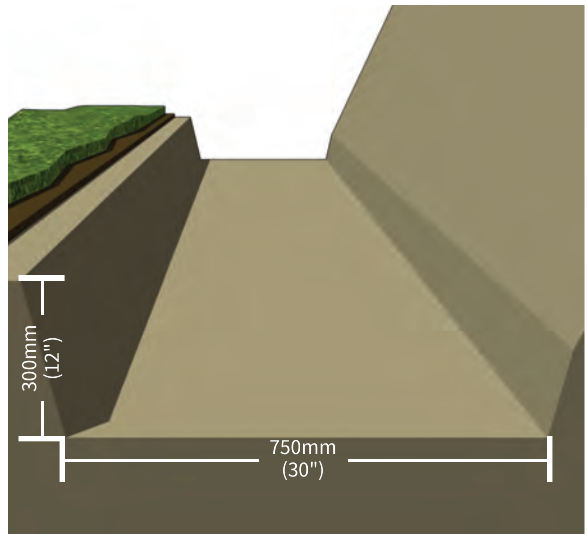
The following are the basic steps involved in constructing a conventional (non-geogrid reinforced) PisaLite® segmental retaining wall. These steps are to be used in conjunction with all relevant details provided. Refer to Overview of a Successful Project before beginning.

Plan

With your final design in hand, begin to establish the wall location and proposed grades. Locate all utilities and contact local utility companies before digging. Mark a line where the front of the wall will be placed, keeping in mind the 19mm (¾") setback per course.

Excavate

Excavate a trench down to the foundation grades specified in the design. The front of the trench should be 150mm (6") from the planned face of the wall. The trench should be a minimum of 750mm (30") wide (front to back) and 300mm (12") deep. This depth assumes one unit is buried (unit height of 150mm [6"]) plus the compacted granular base minimum depth of 150mm (6"). As wall height increases, depth of embedment also increases, normally about 10% of the wall height. Greater embedment depths may be required to account for slopes more than 3H:1V in front of the wall, scour protection in water applications, global stability, or as specified in the design. The rear 150mm (6") of the trench is excavated to account for the drainage layer. Excavations should be conducted in accordance with local codes under direction of the General Review Engineer (GRE).

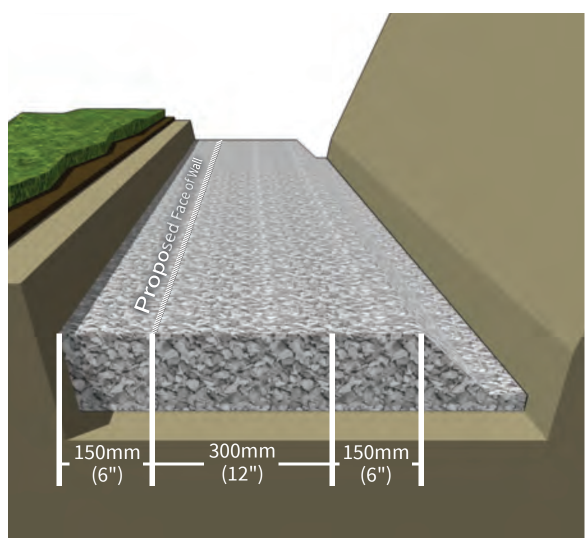


Verify Foundation Subgrade

Once the foundation trench has been excavated to the specified elevations, the native foundation soil must be checked by the GRE. The foundation soil must have the required allowable bearing capacity specified in the design.

Prepare the Compacted Granular Base

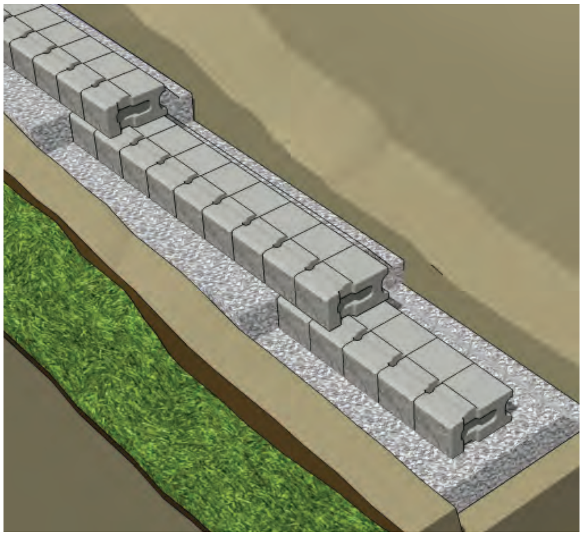
Start the base at the lowest elevation of the wall. The base should be composed of well-graded, free-draining (less than 8% fines), angular granular material (commonly referred to as ¾" minus or road base) and compacted to a minimum of 98% Standard Proctor Density (SPD). The minimum base thickness is 150mm (6") or as required by the GRE to reach competent founding soil. A layer of unreinforced concrete (50mm [2"] thick) may be placed on top of the of the granular material to provide a durable levelling surface for the base course. At the direction of the GRE, geotextile might be required under the granular base. The minimum base dimensions are 600mm (24") wide (front to back) and 150mm (6") deep. The additional 150mm (6") trench width allows for the placement of the drain.



True dimensions are in Metric, Imperial dimensions are soft conversions.

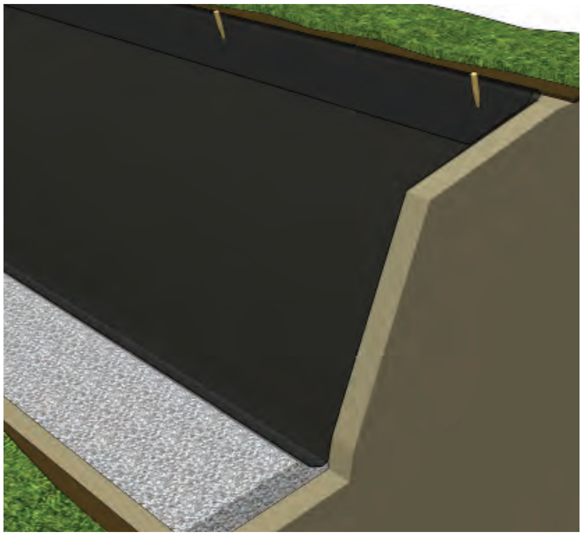
Step the Base

When the grade in front of the wall slopes up or down, the base must be stepped to compensate. Working out the stepped base as the wall steps up in elevation, the foundation steps must be located to ensure the minimum embedment is achieved. The height of each step is 150mm (6") – the height of one course. The 19mm (¾") offset must be accounted for at each step.



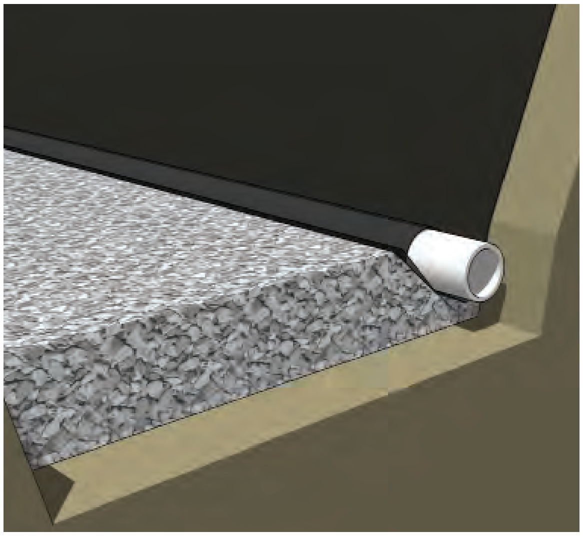
Place Filter Cloth

Lay the approved filter fabric (geotextile) along the bottom of the rear of the trench and extend up the exposed excavation to the proposed wall height. Leave adequate material at the top to fold back towards the wall (completely containing the drainage material). Stake the filter cloth against the slope during construction.



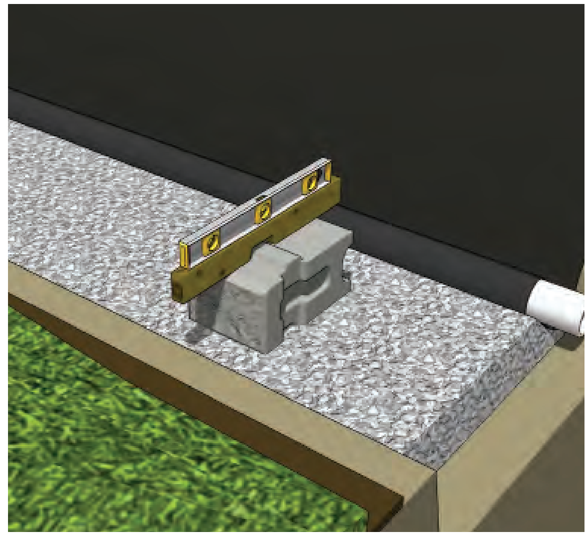
Place the Drain

Various options for drain placement may exist, depending on how the pipe is to be outlet (refer to Drainage). The drain may be outlet through the wall face or connected to a positive outlet (storm drain). The drainage system is extremely important and outlets must be planned prior to construction. In the case of connecting to a positive outlet, the drain should be placed at the lowest possible elevation and sloped at a minimum of 2%. At the rear of the base, allow the granular material to slope down on the sides towards the drain trench. In the 150mm (6") area behind the base, place the approved drain tile (perforated drain with filter sock) on top of the filter cloth and minimal granular coverage.

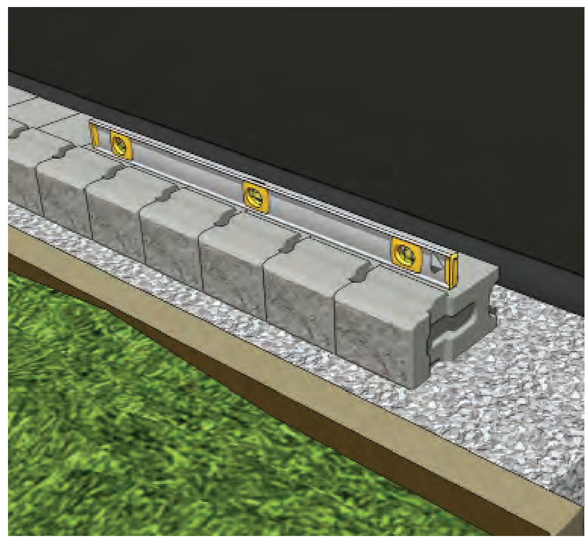


Place the First Course

Position a level string to mark location of the back of the first course (should be 300mm [12"] from the proposed wall face). Place the first course of PisaLite® units side-by-side (touching) on the granular base.



Ensure units are level front to back and left to right. Extra care should be taken at this stage as it is critical for accurate alignment.

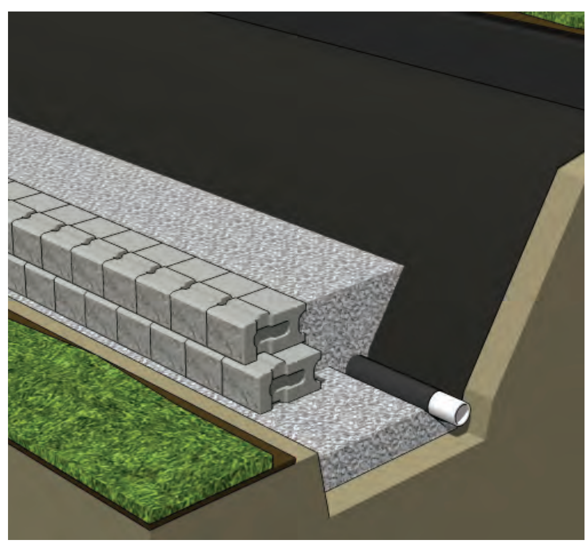


Stack Units

Sweep top of underlying course and stack the next course so that the joints don't align. Continue stacking courses to a maximum of four courses (600mm [24"]) before backfilling.

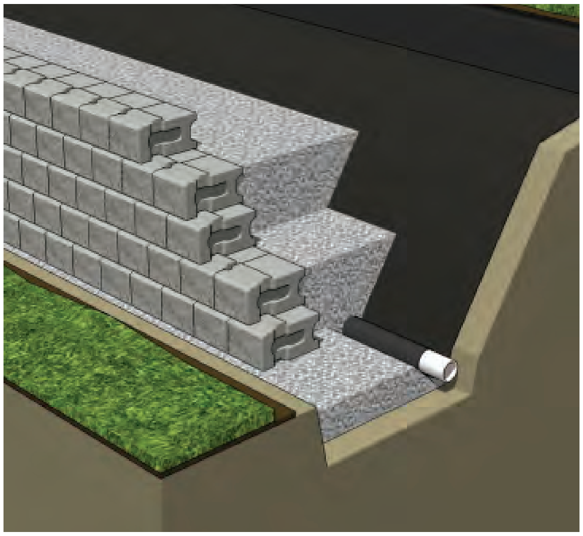
Backfill Drainage Material

A free-draining, 19mm (¾") clear stone drainage material is placed immediately behind the wall facing and compacted with a light manual tamper. The drainage layer must be a minimum of 300mm (12") thick and protected from the native material by the filter cloth.



Continue Stacking And Backfilling

Continue stacking units and backfilling as described above until the desired height is reached, based on the design.



Place Cap Unit

A layer of concrete adhesive must be applied to the top course in order fix the the cap units in place. Place the cap unit firmly on top of the adhesive, ensuring both surfaces are free of debris, and apply pressure to secure. Follow adhesive manufacturer's installation guidelines.

Encapsulate The Drainage Layer and Finish Grading

Fold the excess filter fabric over the top of the drainage layer and extend up the back face of the cap unit. Ideally, place an impervious layer of soil on top of the filter fabric and compact manually, providing for the required grading and/or swales. For other treatments such as pavers, concrete, or asphalt, care must be taken to ensure that heavy compaction/paving equipment remains a minimum of 1.0m (3.25') from the back of the cap unit. Slope the surface above and below the wall to ensure water will flow away from and not accumulate near the wall units.

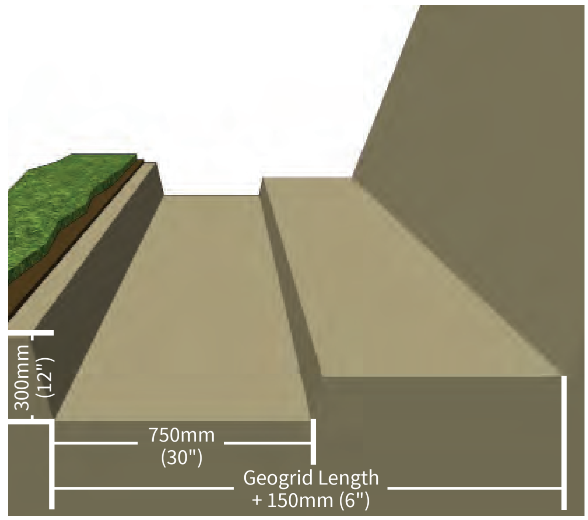
Reinforced Wall Installation

Plan

With your final design in hand, begin to establish the wall location and proposed grades. Locate all utilities and contact local utility companies before digging. Mark a line where the front of the wall will be placed, keeping in mind the 19mm (¾") setback per course.

Excavate reinforced zone

The excavation must be carefully planned and consider several elements. Based on the type of soil being excavated, the GRE must determine the maximum allowable "cut" angle the excavation can sustain. This angle ensures the stability of the excavation during construction. The required geogrid length (as shown in the design) plus 150mm (6") defines the minimum width at the base of the excavation. Measuring from 150mm (6") in front of the wall face, extend a line back the base width determined above. At the rear of the base dimension, an imaginary line should be extended up the slope at the allowable angle. Where this line breaks the slope surface is the beginning of the excavation. Excavation must then begin at the top of the slope and progress downwards at the acceptable angle. Excavation continues until the slope is cleared and a flat area at the base is exposed extending 150mm (6") past the proposed face of the wall.



Excavate Granular Base

Excavate a trench for the granular base. The front of the trench should be 150mm (6") from the planned face of the wall. The trench should be a minimum of 750mm (30") wide (front to back) and 300mm (12") deep. This depth assumes one unit is buried (unit height of 150mm [6 in]) plus the compacted granular base minimum depth of 150mm (6"). As wall height increases, depth of embedment also increases, normally about 10% of the wall height. Greater embedment depths may be required to account for slopes more than 3H:1V in front of the wall, scour protection in water applications, global stability, or as specified in the design. The rear 150mm (6") of the trench is excavated to account for the drain.

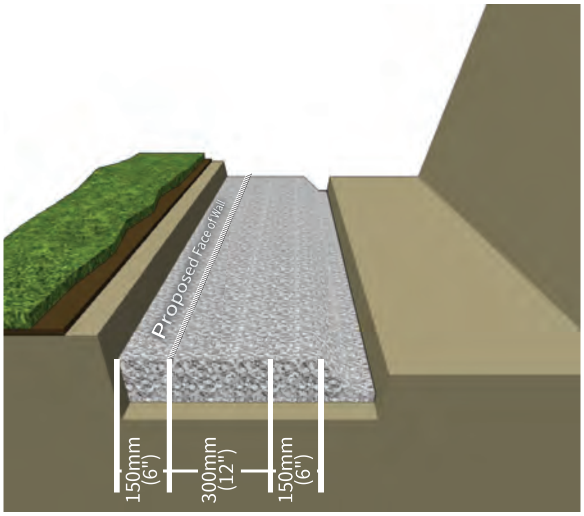
Verify Foundation Subgrade

Once the wall has been excavated, the native foundation soil must be checked by the GRE. The foundation soil in a geogrid-reinforced SRW is considered to be the material underneath both the facing and reinforced zone – that is, the entire wall footprint. This verification should not just be limited to the soil underneath the granular footing. The foundation soil must have the required allowable bearing capacity specified in the design.

True dimensions are in Metric, Imperial dimensions are soft conversions.

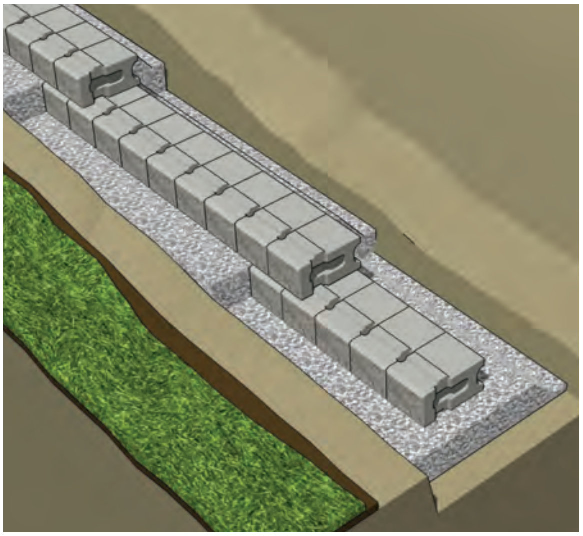
Prepare the Compacted Granular Base

The base should be started at the lowest elevation of the wall. The base should be composed of well-graded, free-draining (less than 8% fines), angular granular material (commonly referred to as ¾" minus or road base) and be compacted to a minimum of 98% SPD. The minimum base thickness is 150mm (6") or as required by the GRE. A layer of unreinforced concrete (50mm [2"] thickness) may be placed on top of the granular material to provide a durable levelling surface for the base course. The minimum base dimensions are 600mm (24") wide (front to back) and 150mm (6") deep. The additional 150mm (6") trench width allows for the placement of the drain.



Step the Base

When the grade in front of the wall slopes up or down, the base must be stepped to compensate. Working out the stepped base as the wall steps up in elevation, the foundation steps must be located to ensure the minimum embedment is achieved. The height of each step is 150mm (6") – the height of one course. The 19mm (¾") offset must be accounted for at each step.



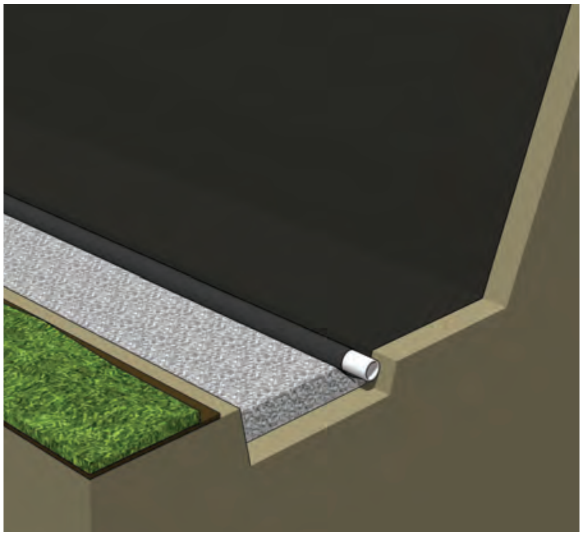
Place Filter Cloth

Lay the approved filter fabric (geotextile) along the bottom of the rear (150mm [6"]) of the excavation and extend up the exposed cut face to the proposed wall height. Leave adequate material at the top to fold back towards the wall (completely containing the infill material). Stake the filter cloth against the slope during construction.

Place The Drain

Various options for drain placement may exist, depending on how the pipe is to be outlet (refer to Drainage). The drain may be outlet through the wall face or connected to a positive outlet (storm drain).

The drainage system is extremely important and outlets must be planned prior to construction. In the case of connecting to a positive outlet, the drain should be placed at the lowest possible elevation and sloped at a minimum of 2%. At the rear of the base, allow the granular material to slope down on the sides towards the drain trench. In the 150mm (6") area behind the base, place the approved drain tile (perforated drain with filter sock) on top of the filter cloth and minimal granular coverage.

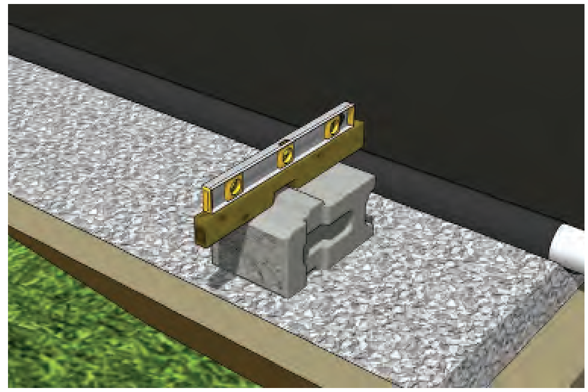


True dimensions are in Metric, Imperial dimensions are soft conversions.

Place the First Course

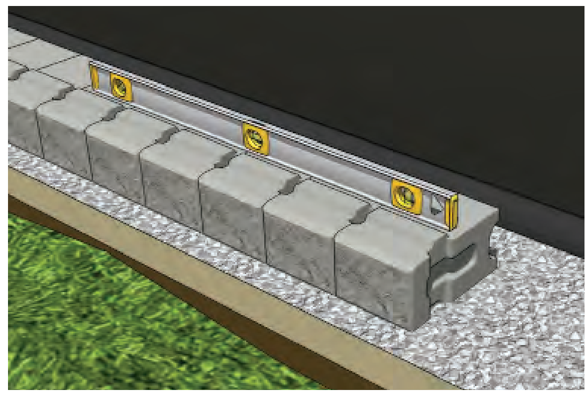
Position a level string to mark location of first course (should be 450mm [18"] from the front edge of the granular base). Place the first course of PisaLite® units side-by-side (touching) on the granular base.

Ensure units are level front to back and left to right. Extra care should be taken at this stage as it is critical for accurate alignment.



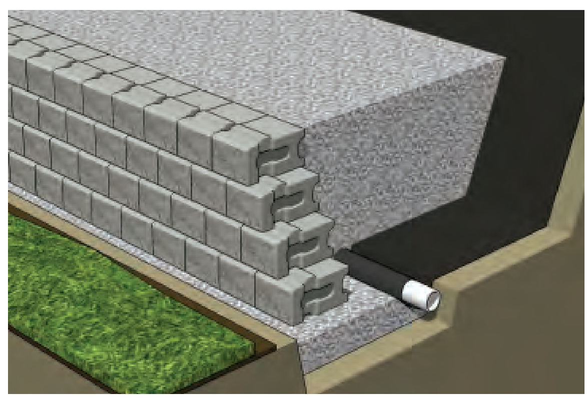
Stack Units

Sweep top of underlying course and stack the next course so that the joints don't align. Continue stacking courses up to the elevation of the first layer of geogrid or to a maximum of four courses (600mm [24"]) before backfilling.



Backfill

Begin backfilling the wall. Risi Stone Systems recommends using a well-graded, free-draining (less than 8% fines), angular granular material. The infill material is placed in maximum 150mm–200mm (6"–8") lift thicknesses and compacted to a minimum of 95% SPD. The compaction must be checked by the GRE at regular intervals. Continue backfilling up to the elevation of the first layer of geogrid reinforcement. Caution must be taken to ensure the allowable lift thickness is not exceeded and/or heavy compaction equipment is not operated within 1m (3.25') of the back of the wall (only hand-operated plate compactor). Overcompaction behind the wall facing will result in an outward rotation of the units and poor vertical alignment. Refer to Alternate Backfill Materials for other infill options.



Install Geogrid Reinforcement

Ensure the geogrid reinforcement specified in the design matches the product on site (no substitutes are acceptable without consent of design engineer). Cut the geogrid from the roll to the specified length, ensuring the geogrid is being cut perpendicular to the direction of primary strength. Ensuring the PisaLite® units are free of debris, lay the geogrid on top of the units to within 25mm (1") of the face. Place the next course of PisaLite® units (as described above) to secure the geogrid in place. Pull the geogrid reinforcement taut across the infill material to its full length and stake in place to maintain tension. The backfill material should be level with the back of the PisaLite® unit, allowing the geogrid to be laid out horizontally.

Backfill Over Geogrid Reinforcement

Backfill next lift of granular infill material on top of the geogrid reinforcement, placing the loose material at the front of the wall, and raking it back, away from the face (this method maintains tension in the geogrid during backfilling). Continue stacking and backfilling until the next layer of geogrid reinforcement is reached.

Continue Stacking and Backfilling

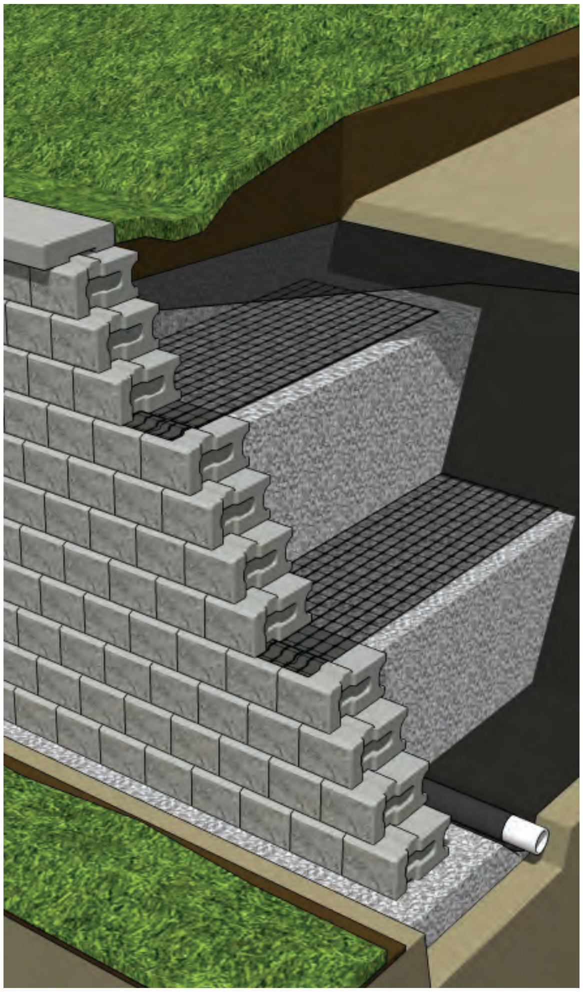
Continue placing the PisaLite® units, backfilling, and laying the geogrid reinforcement as described above until the desired wall height is reached.

Place Cap Unit

Concrete adhesive must be applied to the top course in order to fix the cap units in place. Place the cap unit firmly on top of the adhesive, ensuring both surfaces are free of debris, and apply pressure to secure. Follow adhesive manufacturer's installation guidelines.

Encapsulate The Granular Infill And Finish Grading

Fold the excess filter fabric over the top of the infill zone (reinforced zone) and extend up the back face of the cap unit. Ideally, place an impervious layer of soil on top of the filter fabric and compact manually, providing for the required grading and/or swales. For other treatments such as pavers, concrete, or asphalt, care must be taken to ensure that heavy compaction/paving equipment remains a minimum of 1.0m (3.25') from the back of the cap unit. Slope the surface above and below the wall to ensure water will flow away from and not accumulate near the wall units.



PisaLite®

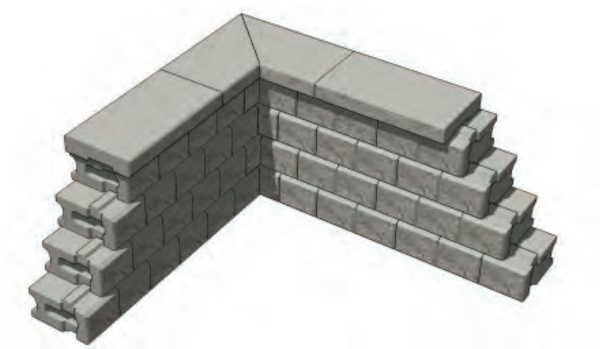
Building Corners

Inside 90° Corner

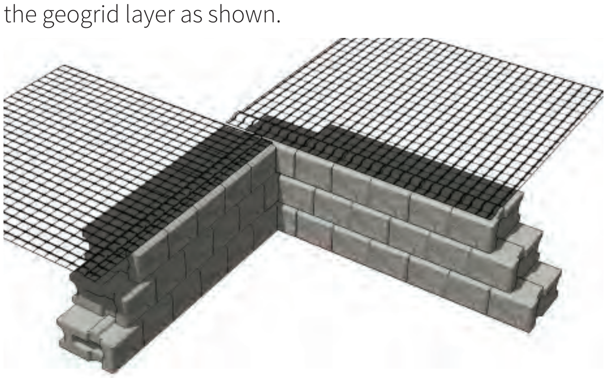
Place units on base course leading to the corner. Place corner unit so that the smaller rough face will be hidden in the final construction. It may be necessary to remove bumps and bulges from the larger rough face to achieve a tighter fit. Continue placing base course units on adjacent wall.

Commence second course by placing alternate corner unit to interlock corner. Place standard units to complete the course.

Repeat until desired wall height is achieved.



The geogrid should be placed within 25mm (1") of the face of the block. As it is only necessary to have geogrid extending directly away from the wall, a gap will result in the geogrid layer as shown.

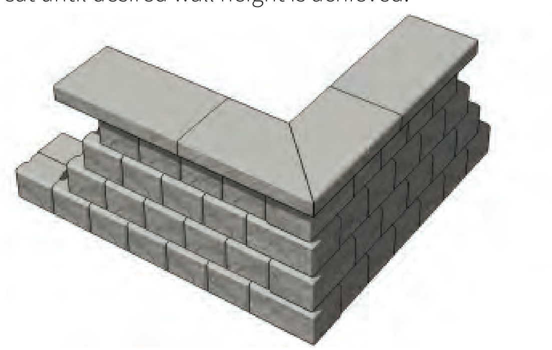


Outside 90° Corner

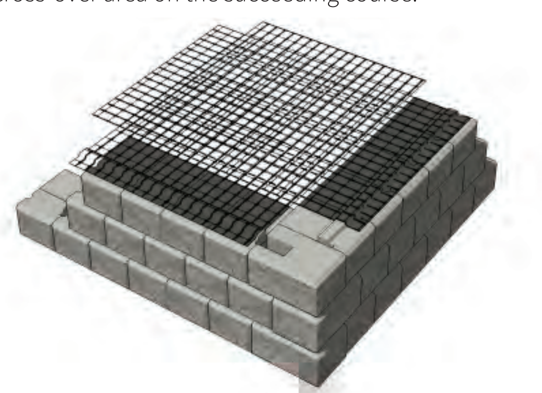
Place units on base course leading to the corner. Place corner unit (right corner shown) so both rough faces will be exposed in the final construction. Continue placing base course units on adjacent wall.

Commence second course by placing alternate corner unit to interlock corner. Place standard units to complete the course.

Repeat until desired wall height is achieved.



The geogrid from the two side walls will overlap and should be separated by a minimum of 75mm (3") of compacted soil. Alternatively, the geogrid reinforcement could be placed in the perpendicular principle direction in the cross-over area on the succeeding course.

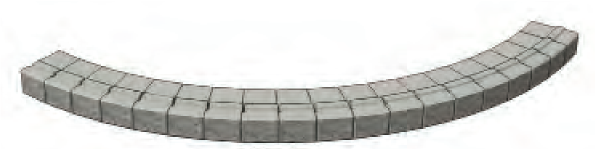


Creating Curves

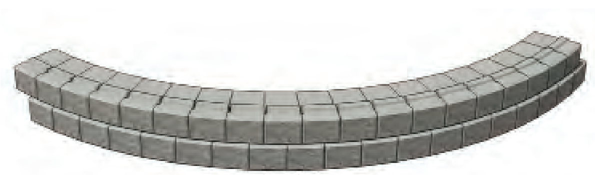
Convex Curve

The PisaLite® system is able to create a 2.4m (8') radius with the tapered units on a convex curve; however, in preparation for the bottom course, remember that the radius will decrease by 19mm (¾") every course. Therefore, the smallest curve will result on the uppermost course. Also, the vertical joints will start to line up on successive courses, making it necessary to place half units at random locations.

Once the radius to be used is decided upon and the necessary curve for the base course is calculated, the base can be roughly outlined with spray paint. Upon completion of the base, the starting and ending points of the curve can be staked. The curve should be marked with paint to ensure the proper radius is established. If the base course is installed with too tight a radius, the upper courses may have to be cut to fit.

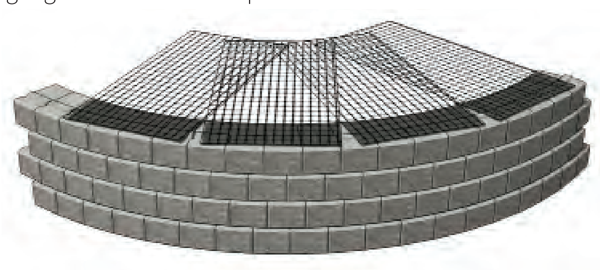


Place additional courses, remembering that the radius decreases by 19mm (¾") every course.



Repeat until desired wall height is achieved.

Geogrid layers should be placed within 25mm (1") of the front face of the block. The geogrid will overlap and should have 75mm (3") of compacted soil between the layers. The geogrid should be placed on the PisaLite® units so the geogrid does not overlap until it enters the soil zone.



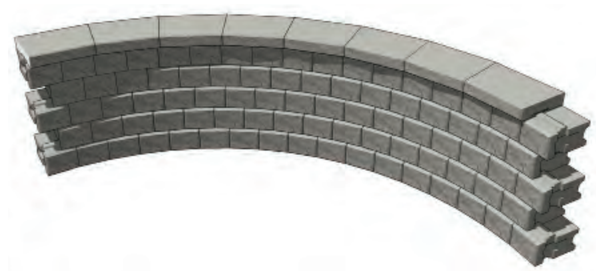
Concave Curve

For concave curves, the PisaLite® standard units are able to create a minimum 2.4m (8') radius. The smallest radius will occur on the bottom course. Each additional course will result in a 19mm (¾") increase in the radius. Also, the vertical joints will start to line up on successive courses, making it necessary to place half units at random locations.

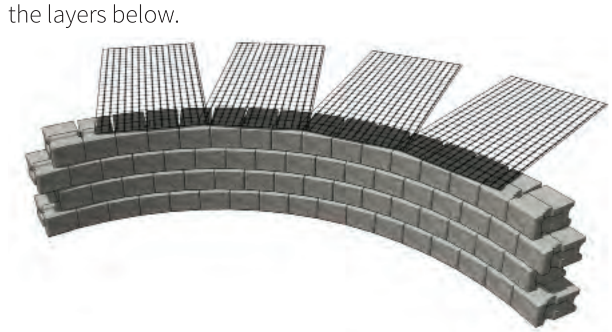
Once the radius to be used is decided upon and the necessary curve for the base course is calculated, the base can be roughly outlined with spray paint. Upon completion of the base, the starting and ending points of the curve can be staked. The curve should be marked with paint to ensure the proper radius is established.

Place additional courses, remembering that the radius decreases by 19mm (¾") every course.

Repeat until desired wall height is achieved.



Geogrid layers should be placed within 25mm (1") of the front face of the block. It will be necessary to have gaps between adjacent sections of geogrid. At alternating geogrid elevations the geogrid sections should be positioned so they overlap the gaps in the geogrid on the layers below.



The OneStone™ Wall System

The OneStone™ system is a modular concrete retaining wall system that is used to stabilize and contain earth embankments, large or small.

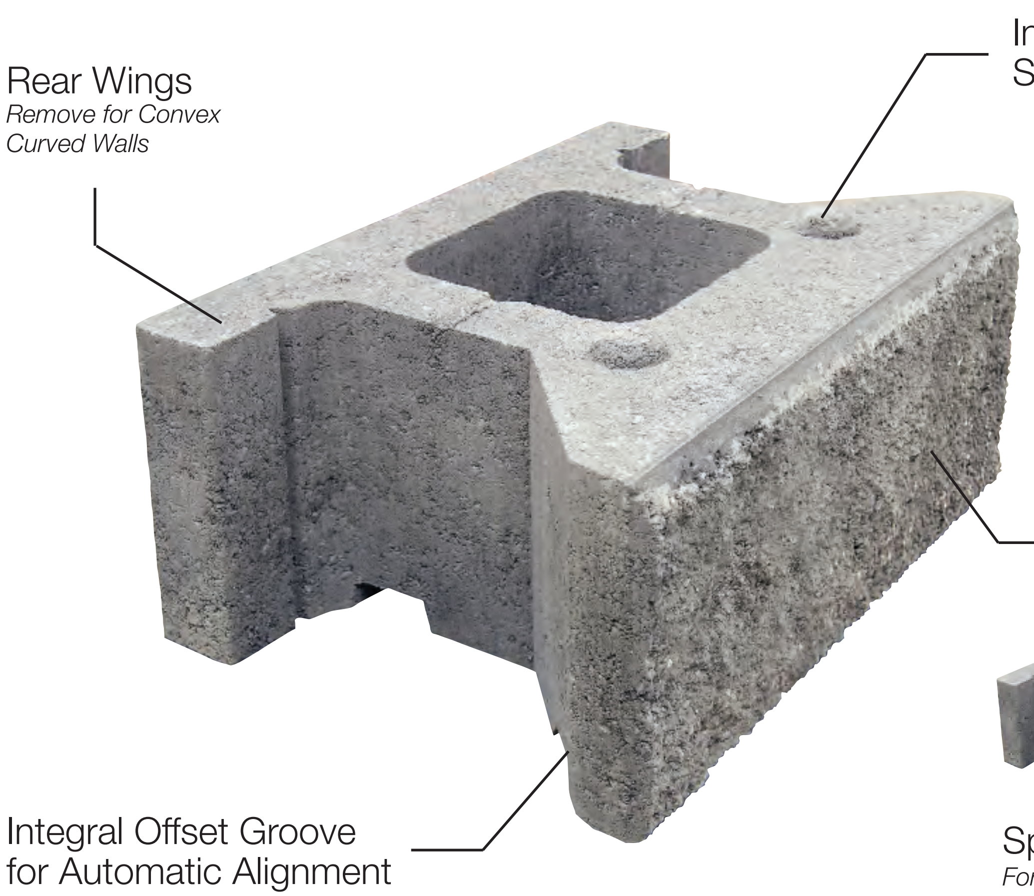
The OneStone™ system is based on the principles and designs of the PisaStone system developed in the 1970's. Since then, hundreds of successful installations were completed. During this period the requirements of designers, installers and owners were further refined and identified.

There are many applications for OneStone™ retaining walls. Most examples can be divided into two configurations: landscape applications and or structural applications.

In landscape applications, the primary purpose of retaining walls is aesthetic in nature. Some examples of OneStone™ landscape uses are: raised patios for outdoor kitchens and living spaces, slope management, erosion control, run-off water management, planters, garden areas, and terraced or privacy walls. Most landscape applications call for walls under 1.0m (3') in height, with minimal loads being applied to the wall, therefore most landscape walls do not require geogrid.

In structural applications, the primary function of retaining walls is to provide structure and strength to steep slopes or cuts. Some common structural uses for OneStone™ retaining walls are high walls, some in excess of 4.0m (12'); walls required to support parking, roads, or highways; and erosion protection along streams or lakes. In all of these cases, geosynthetic reinforcement is used.

The OneStone™ system is supported by Abbotsford Concrete Products and Risi Stone Systems. Abbotsford Concrete Products will make every attempt to answer your general questions and they will gladly provide customers with answers for site-specific applications. The Vespa.RS design software also helps to provide solutions for specific site designs. Unique applications often necessitate the assistance of a professional engineer. Risi Stone Systems can provide these solutions through its Engineering Design Assistance program.



Split-Face Unit

For Variable Patterns

OneStone™

Features & Advantages

The OneStone™ system has a number of features that make the system unique. Each of these features has been developed to give a OneStone™ retaining wall the advantages of increased beauty, simplified installation, and greater strength. These features benefit the owner by lowering the entire cost of the retaining wall, both during installation and well into the future.

Modular Retaining Wall System

Wall is flexible, yet retains its structural characteristics.

- The wall can absorb minor movements due to frost or settlement.
- Requires minimal embedment below grade.

A compacted granular base is all that is required.

- Reduces the cost by not requiring an expensive structural footing.
- Ensures maximum resistance to overturning forces.
- Saves time and money.

Manufactured From 35 MPA (5000 PSI) Concrete

- Provides wall with greater durability.
- Less susceptible to freeze-thaw deterioration.
- Less likely to be broken by handling or in transit.

Integrated Interlock

Interlocking mechanism moulded into the units so there are no separate pins or clips.

- Installation rates increase.
- Ensures maximum shear connection between units.

Units are dry-stacked.

- Lower costs because no mortar is used in the construction.
- Minimal training is required to achieve excellent installation results.

Units are self-aligning and self-battering.

- Once the first course is laid flat and levelled, there is no need for continual measuring and adjusting.

Creates a continuous interlock throughout the wall face.

- Makes a stronger, more damage-resistant wall.

Chamfered Face

The face of the OneStone™ stone is chamfered on the top and sides only.

Size and Weight

The 34 Kg (75 Lbs) units are well-balanced, easy to handle.

- Units can be installed by a single person.

Manufacturing method ensures a uniform height for each unit.

- Courses remain at fixed elevations and should only require minimal shimming..

OneStone™ with Geogrid Reinforcement

Ability to construct higher walls.

- Can utilize site soil to infill the geogrids, consequently lowering disposal and extra material charges.
- Can use the same facia throughout a site on lower conventional SRWs and higher geogrid reinforced SRWs.

90º Corner Units

Manufactured to speed construction.

- Offers a finished appearance to the wall.
- Initiates the correct running bond pattern.
- Increases the strength of corners.
- Saves time during installation.

Technical Support and Engineering Design Assistance

Technical expertise developed over forty years through experience and testing is available to customers.

- Ensures that retaining walls are correctly designed and constructed.
- Advanced software is available to help designers generate stable retaining wall structures.

Block Details

OneStone™ System Units		Width *mm / inches*	Height *mm / inches*	Depth *mm / inches*	Weight *Kg / Lbs*
	Standard	458 / 18"	203 / 8"	305 / 12"	34 / 75
	Split-Face *(Left & Right)*	458 / 18"	203 / 8"	305 / 12"	34 / 75
	Corner	458 / 18"	203 / 8"	229 / 9"	35 / 77
	Cap	610 / 24"	80 / 3 ⅛"	330 / 13"	33 / 73

True dimensions are in Imperial, Metric dimensions are soft conversions.

Colors

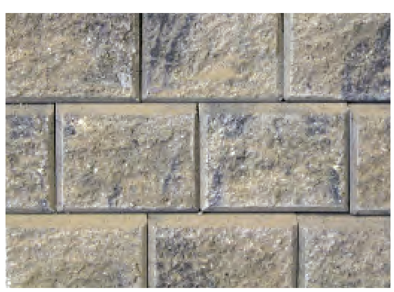
Abbotsford Concrete Products manufactures OneStone™ in six attractive color blends that can be used individually or can be combined with each other to create a unique palette to complement any project.


Granite


Charcoal


Natural


Moroccan Sunset


Sandalwood


La Jolla

Patterns

Laying Pattern

Offset Runner Bond

100% Standard

Pattern One

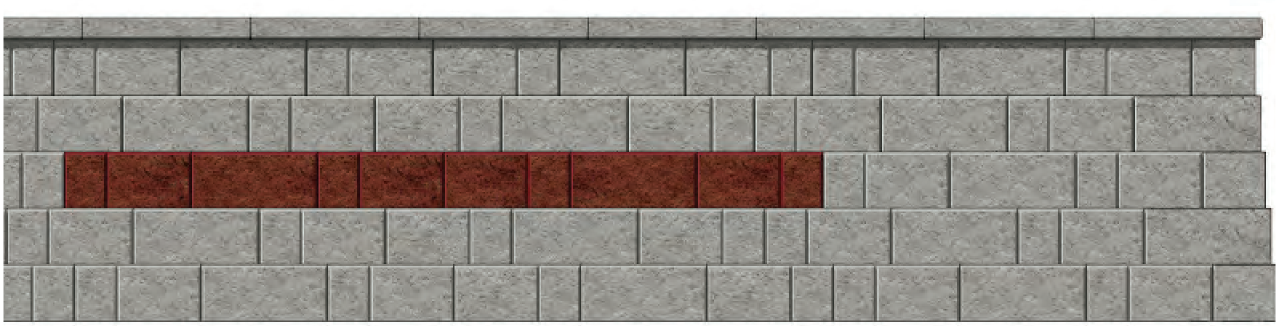
50% Standard | 25% Left Split-Face | 25% Right Split-Face

Pattern Two

34% Standard | 33% Left Split-Face | 33% Right Split-Face

Pattern Three

34% Standard | 33% Left Split-Face | 33% Right Split-Face



Gravity Wall Installation

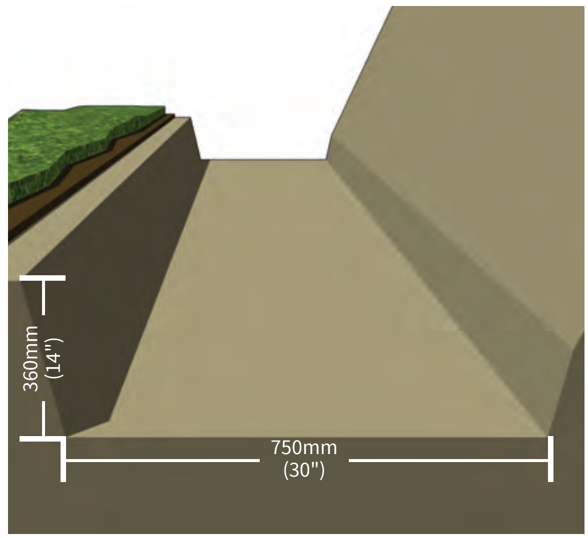
The following are the basic steps involved in constructing a conventional (non-geogrid reinforced) OneStone™ segmental retaining wall. These steps are to be used in conjunction with all relevant details. Refer to Overview of a Successful Project before beginning. All block cores must be filled with approved drainage fill (level with top surface) and compacted to a dense state.

Plan

With your final design in hand, begin to establish the wall location and proposed grades. Locate all utilities and contact local utility companies before digging. Mark a line where the front of the wall will be placed, keeping in mind the 19mm (¾") setback per course.

Excavate

Excavate a trench down to the foundation grades specified in the design. The front of the trench should be 150mm (6") from the planned face of the wall. The trench should be a minimum of 750mm (30") wide (front to back) and 360mm (14") deep. This depth assumes one unit is buried (unit height of 203mm [8"]) plus the compacted granular base minimum depth of 150mm (6"). As wall height increases, depth of embedment also increases, normally about 10% of the wall height. Greater embedment depths may be required to account for slopes more than 3H:1V in front of the wall, scour protection in water applications, global stability, or as specified in the design. The rear 150mm (6") of the trench is excavated to account for the drainage layer. Excavations should be conducted in accordance with local codes under direction of the General Review Engineer (GRE).

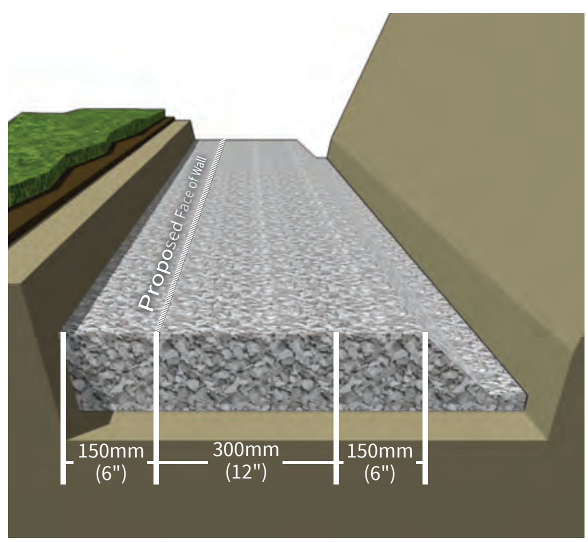


Verify Foundation Subgrade

Once the foundation trench has been excavated to the specified elevations, the native foundation soil must be checked by the GRE. The foundation soil must have the required allowable bearing capacity specified in the design.

Prepare the Compacted Granular Base

Start the base at the lowest elevation of the wall. The base should be composed of well-graded, free-draining (less than 8% fines), angular granular material (commonly referred to as ¾" minus or road base) and compacted to a minimum of 98% SPD. The minimum base thickness is 150mm (6") or as required by the GRE to reach competent founding soil. A layer of unreinforced concrete (50mm [2"] thick) may be placed on top of the of the granular material to provide a durable levelling surface for the base course. At the direction of the GRE, geotextile might be required under the granular base. The minimum base dimensions are 600mm (24") wide (front to back) and 150mm (6") deep. The additional 150mm (6") trench width allows for the placement of the drain.

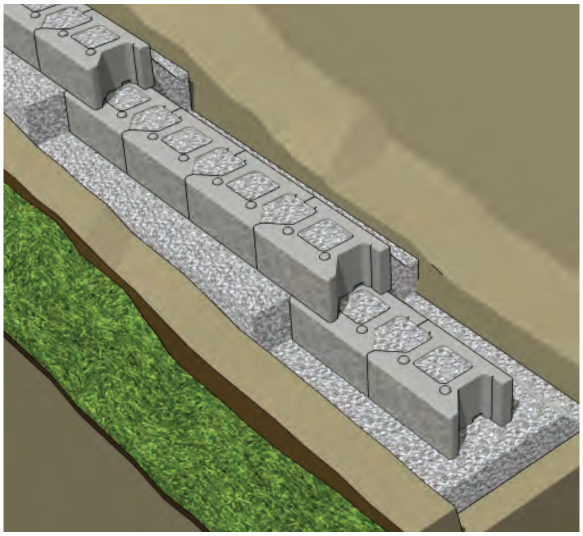


True dimensions are in Metric, Imperial dimensions are soft conversions.

OneStone™

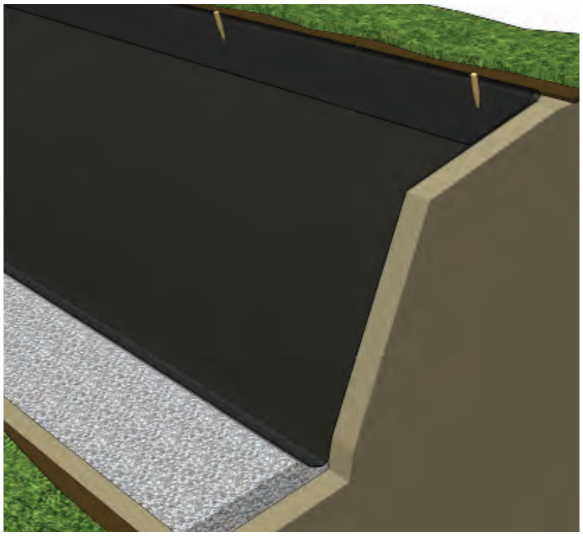
Step the Base

When the grade in front of the wall slopes up or down, the base must be stepped to compensate. Working out the stepped base as the wall steps up in elevation, the foundation steps must be located to ensure the minimum embedment is achieved. The height of each step is 203mm (8") – the height of one course. The 19mm (¾") offset must be accounted for at each step.



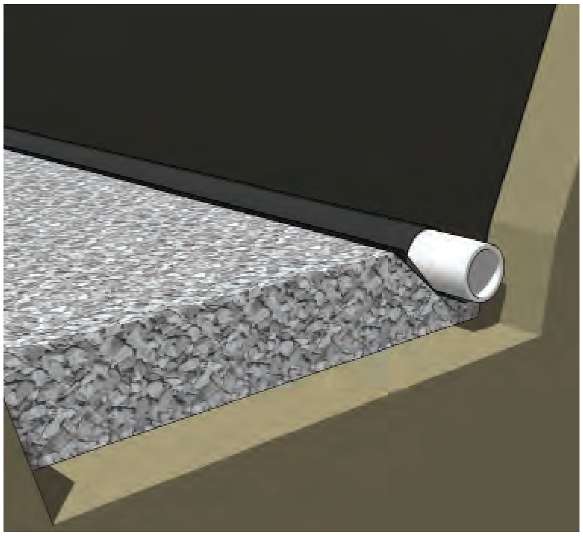
Place Filter Cloth

Lay the approved filter fabric (geotextile) along the bottom of the rear of the trench and extend up the exposed excavation to the proposed wall height. Leave adequate material at the top to fold back towards the wall (completely containing the drainage material). Stake the filter cloth against the slope during construction.



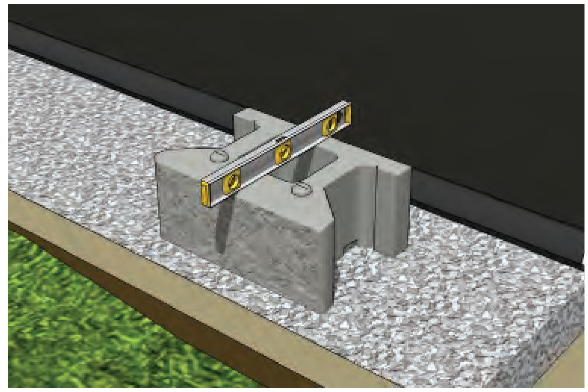
Place the Drain

Various options for drain placement may exist, depending on how the pipe is to be outlet (refer to Drainage). The drain may be outlet through the wall face or connected to a positive outlet (storm drain). The drainage system is extremely important and outlets must be planned prior to construction. In the case of connecting to a positive outlet, the drain should be placed at the lowest possible elevation and sloped at a minimum of 2%. At the rear of the base, allow the granular material to slope down on the sides towards the drain trench. In the 150mm (6") area behind the base, place the approved drain tile (perforated drain with filter sock) on top of the filter cloth and minimal granular coverage.

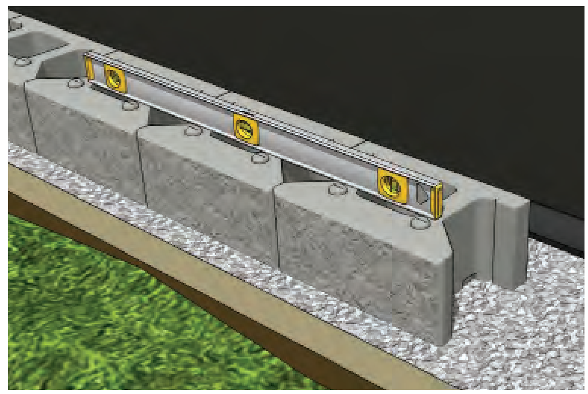


Place the First Course

Position a level string to mark location of the back of the first course (should be 300mm [12"] from the proposed wall face). Place the first course of OneStone™ units side-by-side (touching) on the granular base.

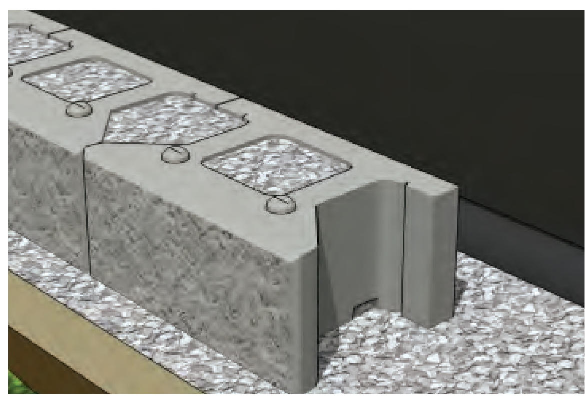


Ensure units are level front to back and left to right. Extra care should be taken at this stage as it is critical for accurate alignment.



Filling the Cores

Fill block cores with a free-draining, 19mm (¾") clear stone gravel drainage material and tamp to dense state. Gravel fill must be level with the top of the block.

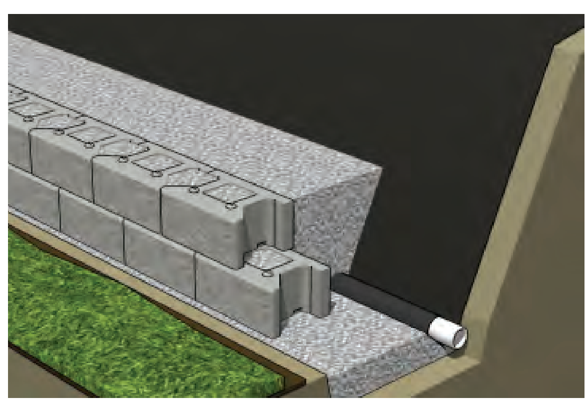


Stack Units

Sweep top of underlying course and stack next course in a running bond pattern so that middle of the unit is above the joint between adjacent units below (100mm [4"] offset). Continue stacking courses to a maximum of four courses (813mm [32"]) before backfilling.

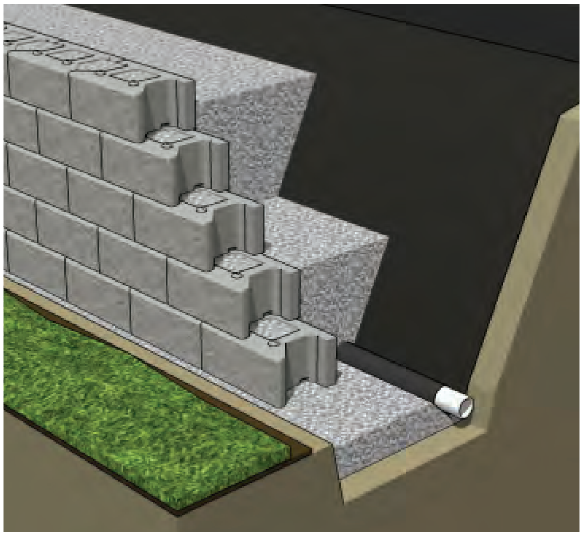
Backfill Drainage Material

A free-draining, 19mm (¾") clear stone drainage material is placed immediately behind the wall facing and compacted with a light manual tamper. The drainage layer must be a minimum of 300mm (12") thick and protected from the native material by the filter cloth.



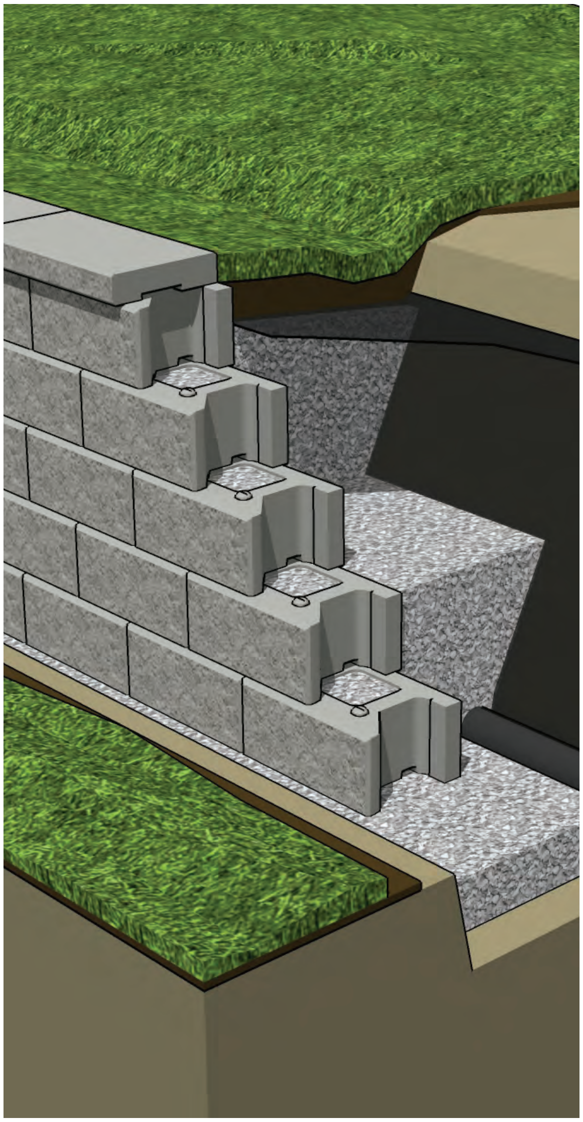
Continue Stacking and Backfilling

Continue stacking units and backfilling as described above until the desired height is reached, based on the design.



Place Cap Unit

A layer of concrete adhesive must be applied to the top course in order to fix the cap units in place. Place the cap unit firmly on top of the adhesive, ensuring both surfaces are free of debris, and apply pressure to secure. Follow adhesive manufacturer's installation guidelines.



Encapsulate the Drainage Layer and Finish Grading

Fold the excess filter fabric over the top of the drainage layer and extend up the back face of the cap unit. Ideally, place an impervious layer of soil on top of the filter fabric and compact manually, providing for the required grading and/or swales. For other treatments such as pavers, concrete, or asphalt, care must be taken to ensure that heavy compaction/paving equipment remains a minimum of 1.0m (3.25') from the back of the cap unit. Slope the surface above and below the wall to ensure water will flow away from and not accumulate near the wall units.

Reinforced Wall Installation

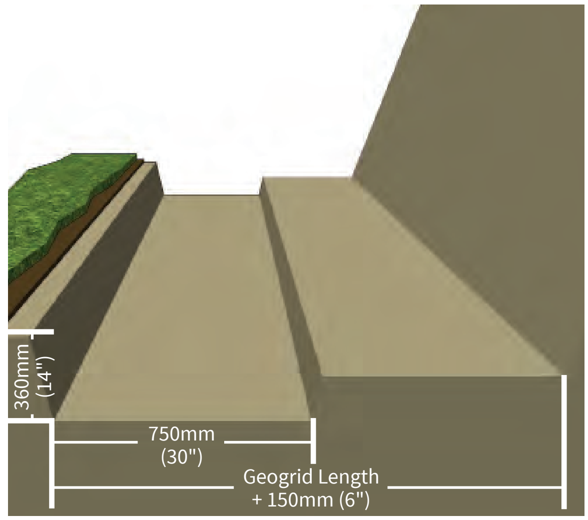
All block cores must be filled with approved drainage fill (level with top surface) and compacted to a dense state.

Plan

With your final design in hand, begin to establish the wall location and proposed grades. Locate all utilities and contact local utility companies before digging. Mark a line where the front of the wall will be placed, keeping in mind the 19mm (¾") setback per course.

Excavate Reinforced Zone

The excavation must be carefully planned and consider several elements. Based on the type of soil being excavated, the GRE must determine the maximum allowable "cut" angle the excavation can sustain. This angle ensures the stability of the excavation during construction. The required geogrid length (as shown in the design) plus 150mm (6") defines the minimum width at the base of the excavation. Measuring from 150mm (6") in front of the wall face, extend a line back the base width determined above. At the rear of the base dimension, an imaginary line should be extended up the slope at the allowable angle. Where this line breaks the slope surface is the beginning of the excavation. Excavation must then begin at the top of the slope and progress downwards at the acceptable angle. Excavation continues until the slope is cleared and a flat area at the base is exposed extending 150mm (6") past the proposed face of the wall.



Excavate Granular Base

Excavate a trench for the granular base. The front of the trench should be 150mm (6") from the planned face of the wall. The trench should be a minimum of 750mm (30") wide (front to back) and 360mm (14") deep. This depth assumes one unit is buried (unit height of 203mm [8"]) plus the compacted granular base minimum depth of 150mm (6"). As wall height increases, depth of embedment also increases, normally about 10% of the wall height. Greater embedment depths may be required to account for slopes more than 3H:1V in front of the wall, scour protection in water applications, global stability, or as specified in the design. The rear 150mm (6") of the trench is excavated to account for the drain.

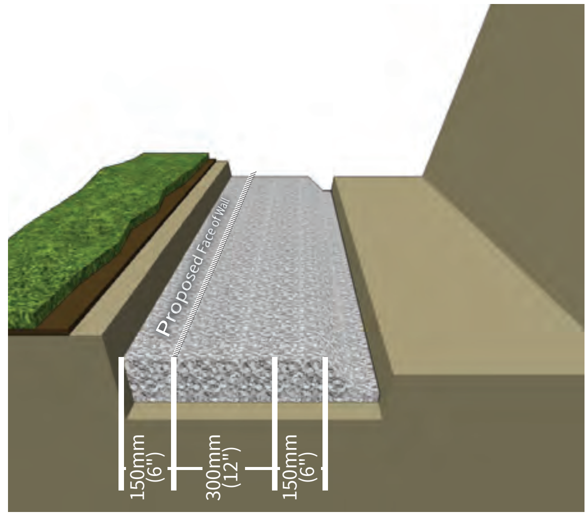
Verify Foundation Subgrade

Once the wall has been excavated, the native foundation soil must be checked by the GRE. The foundation soil in a geogrid-reinforced SRW is considered to be the material underneath both the facing and reinforced zone – that is, the entire wall footprint. This verification should not just be limited to the soil underneath the granular footing. The foundation soil must have the required allowable bearing capacity specified in the design.

True dimensions are in Metric, Imperial dimensions are soft conversions.

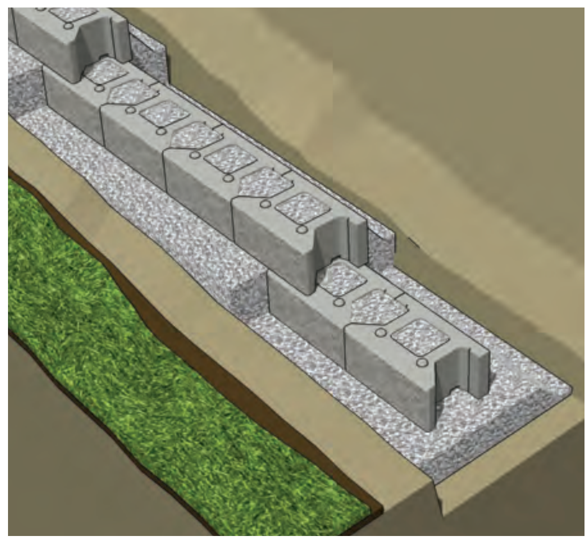
Prepare the Compacted Granular Base

The base should be started at the lowest elevation of the wall. The base should be composed of well-graded, free-draining (less than 8% fines), angular granular material (commonly referred to as ¾" minus or road base) and be compacted to a minimum of 98% SPD. The minimum base thickness is 150mm (6") or as required by the GRE. A layer of unreinforced concrete (50mm [2"] thickness) may be placed on top of the granular material to provide a durable levelling surface for the base course. The minimum base dimensions are 600mm (24") wide (front to back) and 150mm (6") deep. The additional 150mm (6") trench width allows for the placement of the drain.



Step the Base

When the grade in front of the wall slopes up or down, the base must be stepped to compensate. Working out the stepped base as the wall steps up in elevation, the foundation steps must be located to ensure the minimum embedment is achieved. The height of each step is 203mm (8") – the height of one course. The 19mm (¾") offset must be accounted for at each step.



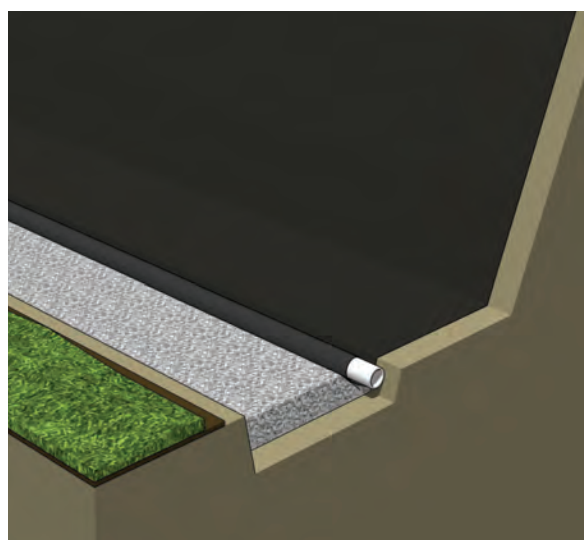
Place Filter Cloth

Lay the approved filter fabric (geotextile) along the bottom of the rear (150mm [6"]) of the excavation and extend up the exposed cut face to the proposed wall height. Leave adequate material at the top to fold back towards the wall (completely containing the infill material). Stake the filter cloth against the slope during construction.

Place The Drain

Various options for drain placement may exist, depending on how the pipe is to be outlet (refer to Drainage). The drain may be outlet through the wall face or connected to a positive outlet (storm drain).

The drainage system is extremely important and outlets must be planned prior to construction. In the case of connecting to a positive outlet, the drain should be placed at the lowest possible elevation and sloped at a minimum of 2%. At the rear of the base, allow the granular material to slope down on the sides towards the drain trench. In the 150mm (6") area behind the base, place the approved drain tile (perforated drain with filter sock) on top of the filter cloth and minimal granular coverage.

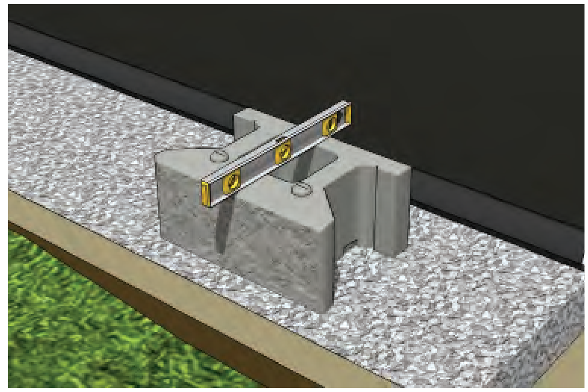


True dimensions are in Metric, Imperial dimensions are soft conversions.

Place the First Course

Position a level string to mark location of first course (should be 450mm [18"] from the front edge of the granular base). Place the first course of OneStone™ units side-by-side (touching) on the granular base.

Ensure units are level front to back and left to right. Extra care should be taken at this stage as it is critical for accurate alignment.

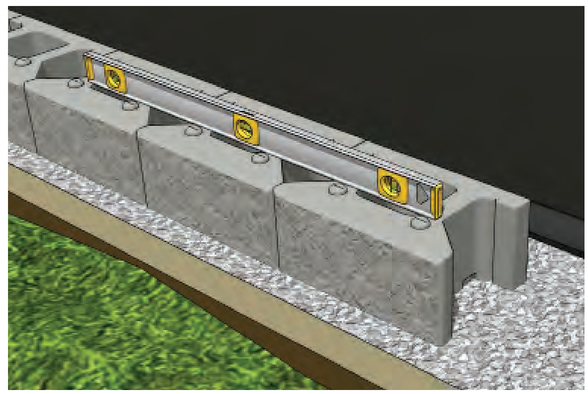


Filling the Cores

Fill block cores with a free-draining, 19mm (¾") clear stone gravel drainage material. Gravel fill must be level with the top of the block.

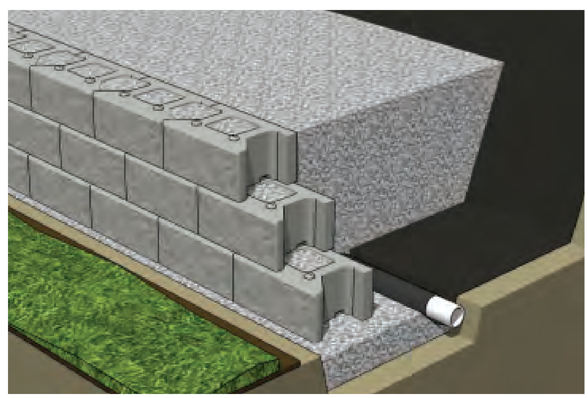
Stack the Units

Sweep top of underlying course and stack next course in a running bond pattern so that the middle of the unit is above the joint between adjacent units below. Continue stacking courses up to the elevation of the first layer of geogrid or to a maximum of four courses (813mm [32"]) before backfilling.



Backfill

Begin backfilling the wall. Risi Stone Systems recommends using a well-graded, free-draining (less than 8% fines), angular granular material. The infill material is placed in maximum 150mm–200mm (6"–8") lift thicknesses and compacted to a minimum of 95% SPD. The compaction must be checked by the GRE at regular intervals. Continue backfilling up to the elevation of the first layer of geogrid reinforcement. Caution must be taken to ensure the allowable lift thickness is not exceeded and/or heavy compaction equipment is not operated within 1m (3.25') of the back of the wall (only hand-operated plate compactor). Overcompaction behind the wall facing will result in an outward rotation of the units and poor vertical alignment. Refer to Alternate Backfill Materials for other infill options.



Install Geogrid Reinforcement

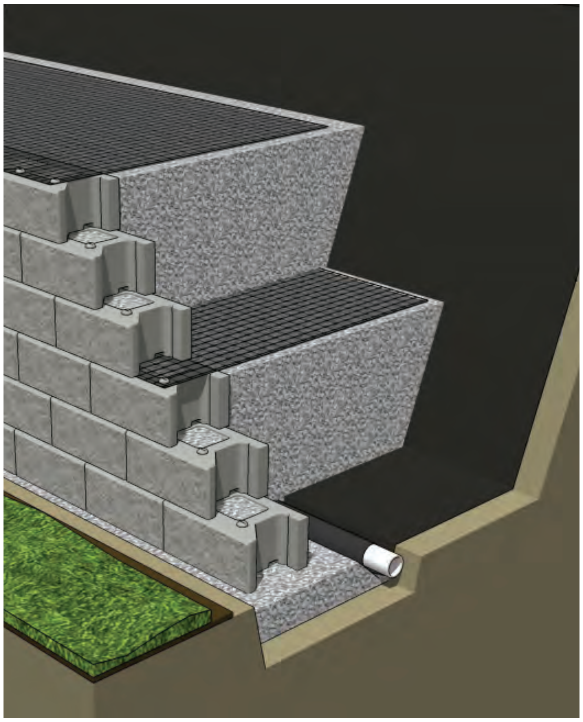
Ensure the geogrid reinforcement specified in the design matches the product on site (no substitutes are acceptable without consent of design engineer). Cut the geogrid from the roll to the specified length, ensuring the geogrid is being cut perpendicular to the direction of primary strength. Ensuring the OneStone™ units are free of debris, lay the geogrid on top of the units to within 25mm (1") of the face. Place the next course of OneStone™ units (as described above) to secure the geogrid in place. Pull the geogrid reinforcement taut across the infill material to its full length and stake in place to maintain tension. The backfill material should be level with the back of the OneStone™ unit, allowing the geogrid to be laid out horizontally.

Backfill Over Geogrid Reinforcement

Backfill next lift of granular infill material on top of the geogrid reinforcement, placing the loose material at the front of the wall, and raking it back, away from the face (this method maintains tension in the geogrid during backfilling). Continue stacking and backfilling until the next layer of geogrid reinforcement is reached.

Continue Stacking and Backfilling

Continue placing the OneStone™ units, backfilling, and laying the geogrid reinforcement as described above until the desired wall height is reached.

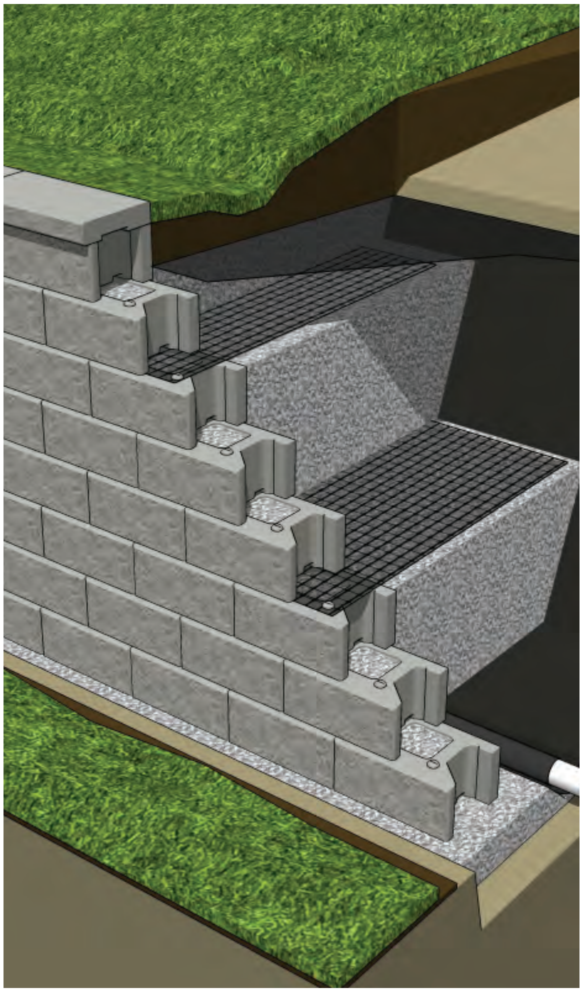


Place Cap Unit

Concrete adhesive must be applied to the top course in order to fix the cap units in place. Place the cap unit firmly on top of the adhesive, ensuring both surfaces are free of debris, and apply pressure to secure. Follow adhesive manufacturer's installation guidelines.

Encapsulate the Granular Infill and Finish Grading

Fold the excess filter fabric over the top of the infill zone (reinforced zone) and extend up the back face of the cap unit. Ideally, place an impervious layer of soil on top of the filter fabric and compact manually, providing for the required grading and/or swales. For other treatments such as pavers, concrete, or asphalt, care must be taken to ensure that heavy compaction/paving equipment remains a minimum of 1.0m (3.25') from the back of the cap unit. Slope the surface above and below the wall to ensure water will flow away from and not accumulate near the wall units.



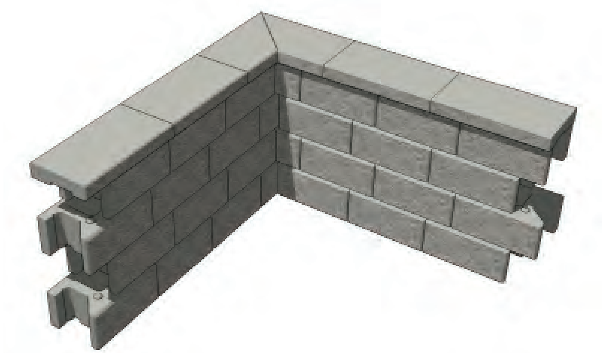
Building Corners

Inside 90° corner

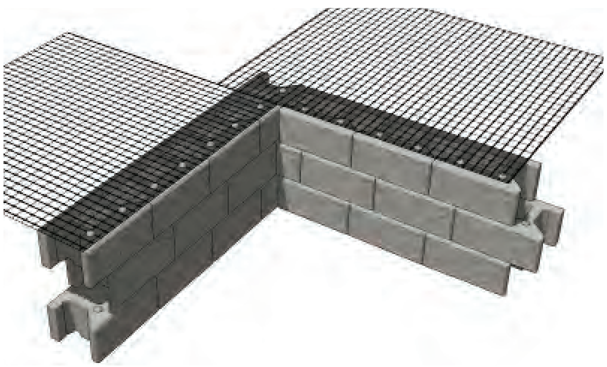
Place units on base course leading to the corner. It may be necessary to remove bumps and bulges from the larger rough face to achieve a tighter fit. Continue placing base course units on adjacent wall.

Commence second course by placing alternate standard unit in corner. Place standard units to complete the course.

Repeat until desired wall height is achieved.



The geogrid should be placed within 25mm (1") of the face of the block. As it is only necessary to have geogrid extending directly away from the wall, a gap will result in the geogrid layer as shown.

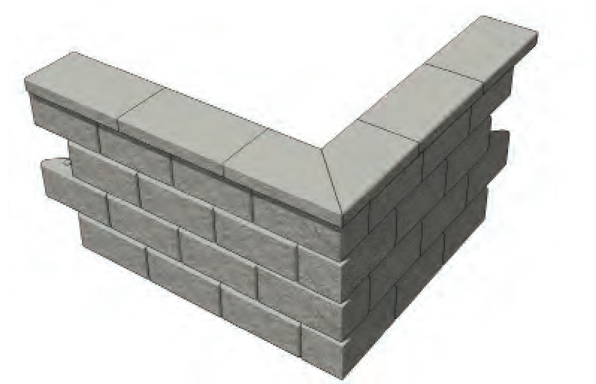


Outside 90° corner

Place units on base course leading to the corner. Place corner unit (left corner shown) so both rough faces will be exposed in the final construction. Continue placing base course units on adjacent wall.

Commence second course by placing alternate corner unit to interlock corner. Place standard units to complete the course.

Repeat until desired wall height is achieved.



The geogrid from the two side walls will overlap and should be separated by a minimum of 75mm (3") of compacted soil. Alternatively, the geogrid reinforcement could be placed in the perpendicular principle direction in the cross-over area on the succeeding course.

Creating Curves

Convex Curve

The OneStone™ system is able to create a 1.2m (4') radius by simply removing the wings from the back of the block; however, in preparation for the bottom course, remember that the radius will decrease by 19mm (¾") every course. Therefore, the smallest curve will result on the uppermost course. Be aware that on walls with significant elevations the vertical joints will start to line up, making it necessary to place some cut units at random locations.

Once the radius to be used is decided upon and the necessary curve for the base course is calculated, the base can be roughly outlined with spray paint. Upon completion of the base, the starting and ending points of the curve can be staked. The curve should be marked with paint to ensure the proper radius is established. If the base course is installed with too tight a radius, the upper courses may have to be cut to fit. Use hammer to remove the rear wings from units.

Place additional courses, remembering that the radius decreases by 19mm (¾") every course.

Repeat until desired wall height is achieved.

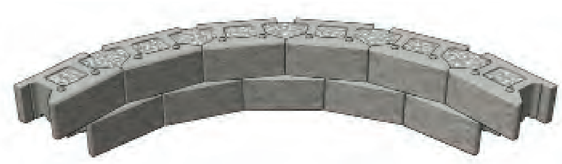
Geogrid layers should be placed within 25mm (1") of the front face of the block. The geogrid will overlap and should have 75mm (3") of compacted soil between the layers. The geogrid should be placed on the OneStone™ units so the geogrid does not overlap until it enters the soil zone.

Concave Curve

For concave curves, the OneStone™ standard units are able to create a minimum 1.2m (4') radius. The smallest radius will occur on the bottom course. Each additional course will result in a 19mm (¾") increase in the radius. Be aware that on walls with significant elevations the vertical joints will start to line up, making it necessary to place some cut units at random locations.

Once the radius to be used is decided upon and the necessary curve for the base course is calculated, the base can be roughly outlined with spray paint. Upon completion of the base, the starting and ending points of the curve can be staked. The curve should be marked with paint to ensure the proper radius is established.

Place additional courses, remembering that the radius decreases by 19mm (¾") every course.



Repeat until desired wall height is achieved.

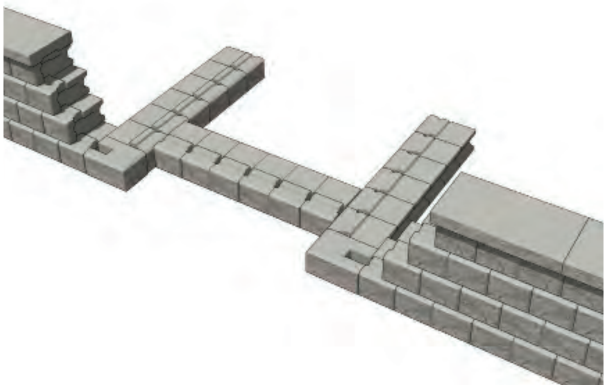
Geogrid layers should be placed within 25mm (1") of the front face of the block. It will be necessary to have gaps between adjacent sections of geogrid. At alternating geogrid elevations the geogrid sections should be positioned so they overlap the gaps in the geogrid on the layers below.

Steps

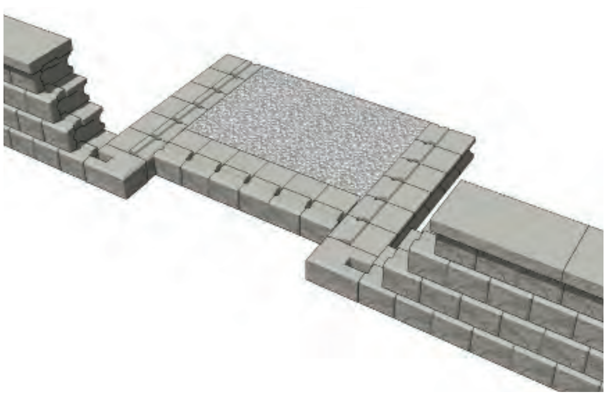
Due to most public building codes requiring a step height of no more than a nominal 180mm (7"), it is recommended to utilize PisaLite® when constructing stairs for both PisaLite® and OneStone™ projects. These steps are to be used in conjunction with all relevant details. All OneStone™ block cores must be filled with approved drainage fill (level with top surface) and compacted to a dense state.

Inset

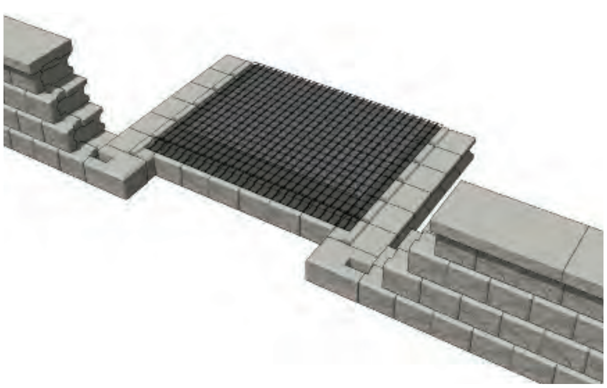
Start with two outside corner walls with a distance of one riser (step) length in between. Build up each wall according to specifications. The side walls can be stepped up following the steps, but the side of riser units must be in contact with the face of units in the side wall.



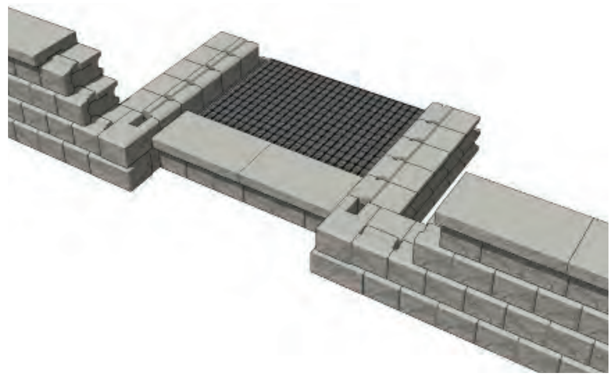
Fill the reinforced zone with a washed ¼" angular chip gravel and compact.



Experience has shown that the inclusion of geogrid reinforcement within each course of steps reduces the effect of settlement.

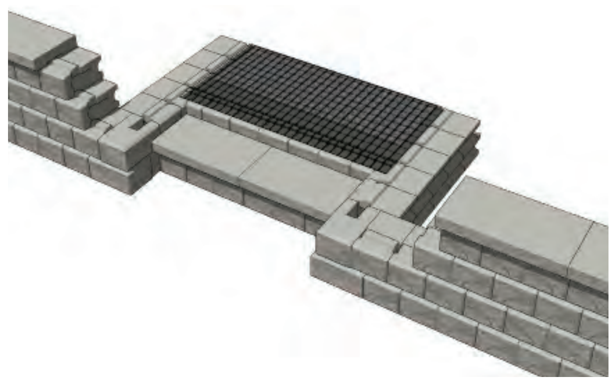


Place a layer of cap units to form the step tread and secured with concrete adhesive. If necessary cut the cap to fit flush with the side walls.

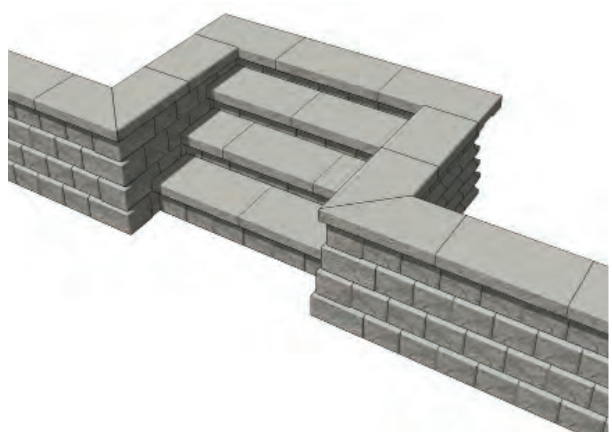


Place the first course of step units on the same foundation elevation as the side walls. A unit may have to be cut to make the riser fit between the side walls. Fill with gravel, compact and place another layer of geogrid reinforcement.

Note: *Riser units do not sit on the course below.*

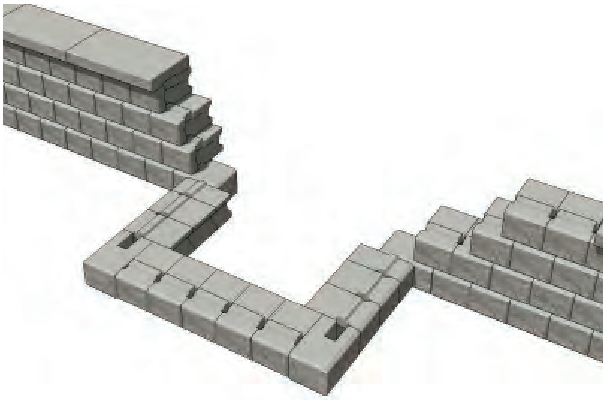


Repeat until desired stair height is achieved.

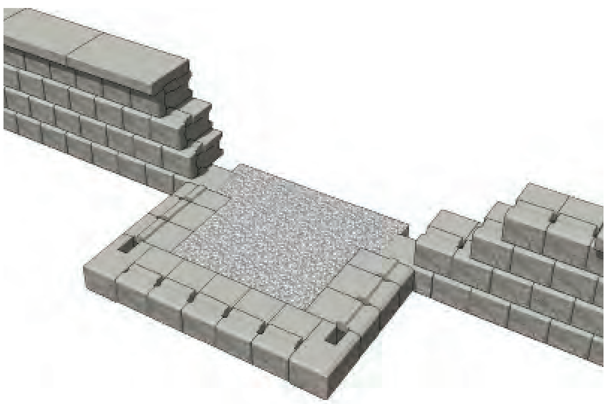


Protruding

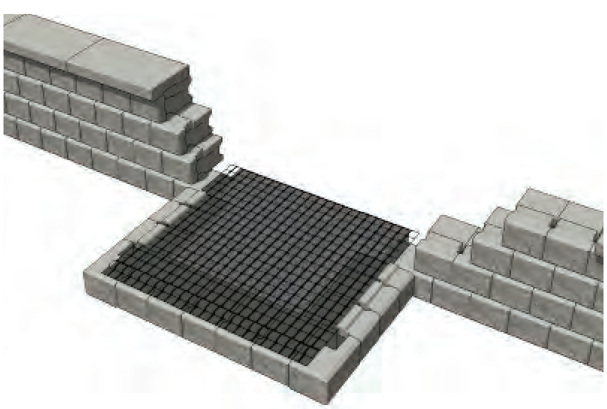
Start the wall with two inside 90° corners and two outside 90° corners.



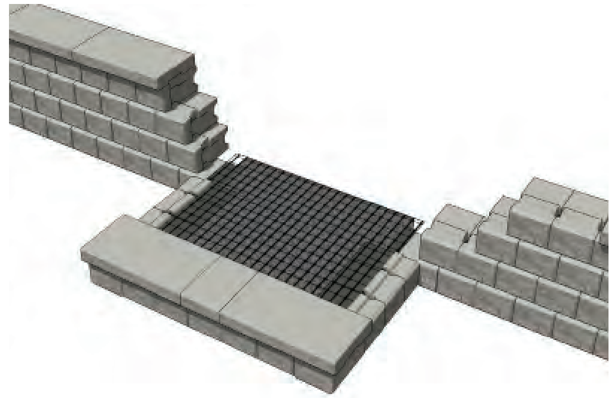
Fill the reinforced zone with a washed ¼" angular chip gravel and compact.



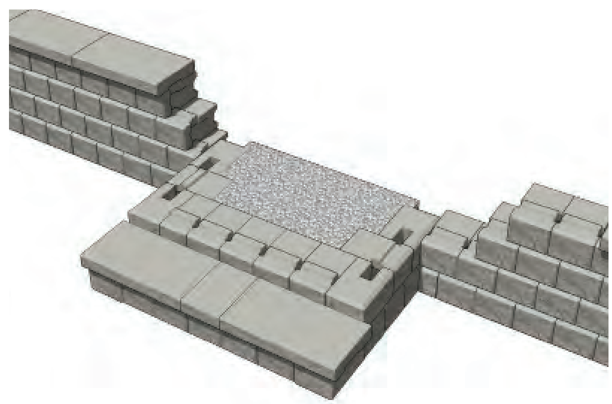
Experience has shown that the inclusion of geogrid reinforcement within each course of steps reduces the effect of settlement.



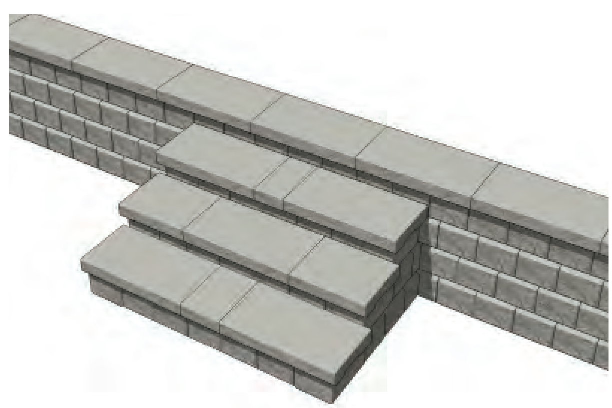
Place a layer of cap units to form the step tread and secured with concrete adhesive. If necessary cut the cap to fit over hanging the side wall by 19mm (¾") on either side.



Place the next riser on the base with the face of units in contact with the back of the cap units at the first riser. Some cutting will be necessary for the positioning of left and right corner units. Fill with gravel, compact and place another layer of geogrid reinforcement.



Repeat until desired stair height is achieved.



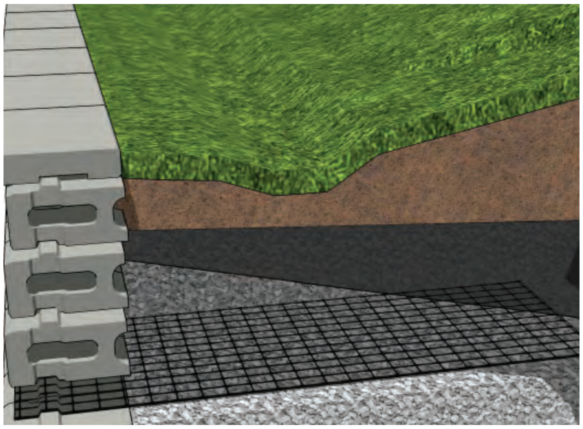
Drainage

Proper drainage of a segmental retaining wall is one of the most critical aspects of design and construction. Unless otherwise stated, the design assumes that no hydrostatic pressures exist behind the wall. To ensure this condition is met, water flow from all directions and sources must be accounted for in the design through proper grading and drainage measures, diverting water away from the wall whenever possible.

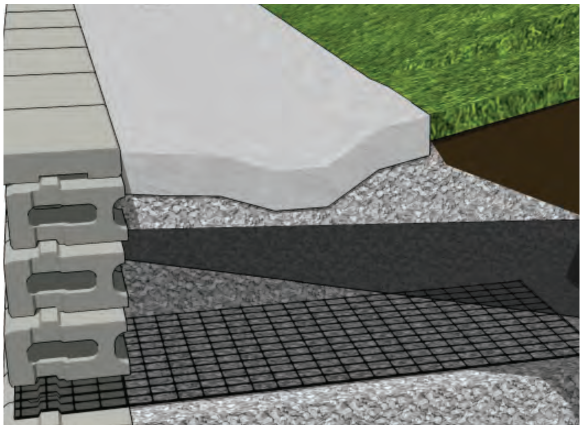
External Drainage

The use of swales above and below the walls to divert water away is an effective, low-cost method of ensuring good drainage. The swale must be composed of an impervious or low permeability material (asphalt / concrete or approved clay). The swale must be designed (dimensioned) by the Civil Engineer as part of the overall site drainage plan.

Clay Swale



Concrete Swale



Internal drainage

This chart explains and illustrates the four different internal drainage possibilities.

Non-Free–Draining Reinforced Zone

If the infill material being used to construct the reinforced zone is not considered to be free draining (>8% fines), a drainage layer is required immediately behind the face of the wall. The drainage material must be a minimum of 300mm (12") thick, composed of a gap-graded, free-draining, angular clear stone (19mm [¾"]). An approved filter cloth must be placed between the drainage layer and the infill material to prevent the migration of fines and contamination of the drainage material. At each geogrid layer, the filter cloth must be pulled back into the reinforced zone a minimum of 150mm (6") and cut. The drainage layer must be fully encapsulated with a 150mm (6") overlap at each geogrid elevation as shown.

Free-Draining Reinforced Zone

As the construction of a separate drainage layer immediately behind the facing units can be cumbersome and reduce efficiency, a popular option is to use a free-draining, granular material for the reinforced zone. It is recommended that this material be well-graded, with less than 8% fines. An approved filter cloth should be placed between the reinforced zone and retained/foundation soil to prevent the migration of fines. The use of an imported granular material in the reinforced zone has many other advantages besides its good drainage properties.

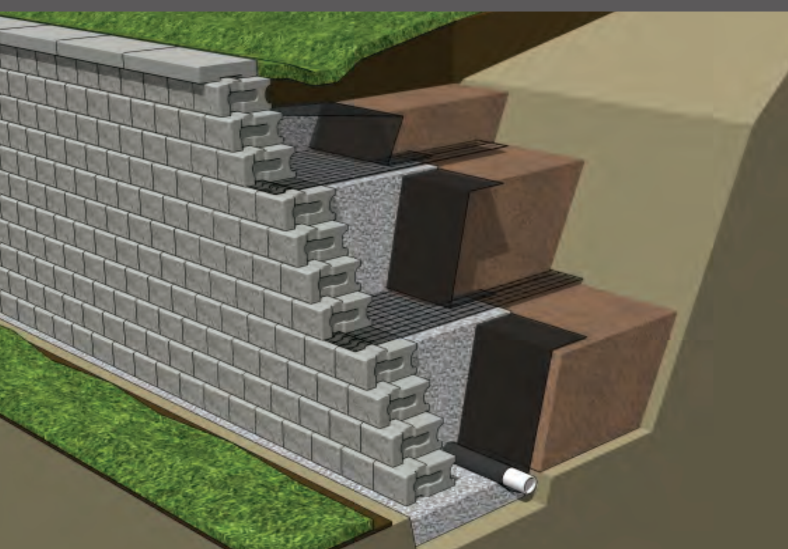
Outlet to Catch basin / Drain

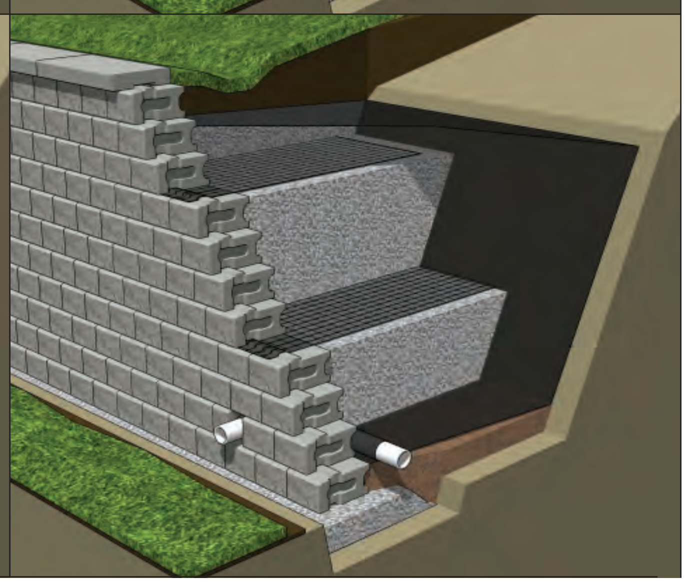
If the drain is being connected to a catchbasin or other positive outlet, it should be located at the lowest elevation possible. Placing the drain at the founding elevation ensures better drainage of the base and subsoils. A minimum 2% slope is recommended.

Outlet Through Face

If the drain is being outlet through the face of the wall, it is recommended that an approved, less pervious engineered fill material be compacted under the drain up to the grade in front of the wall. This measure collects water percolating through the reinforced zone and directs it to the drain, rather than allowing the base to become saturated. The outlet pipe should be a non-perforated PVC (connected through a T-joint) placed a minimum of 15m (45') on centre (or as required by the design). Cutting a unit in half allows the pipe through the wall face without losing the running bond pattern.

It is recommended that the area around the pipe be grouted to prevent the washout of fines. A concrete splash pad at the outlet pipe locations is recommended if large water flows are anticipated.





Posts, Guide Rails & Obstructions

Gravity SRWs

Handrails/fences are usually required for walls over 600mm (2') in height where pedestrians have access (check with your local building code). These handrails must act to resist potential lateral pedestrian loads.

Note: *Handrails must not be secured to the PisaLite® or OneStone™ retaining wall.*

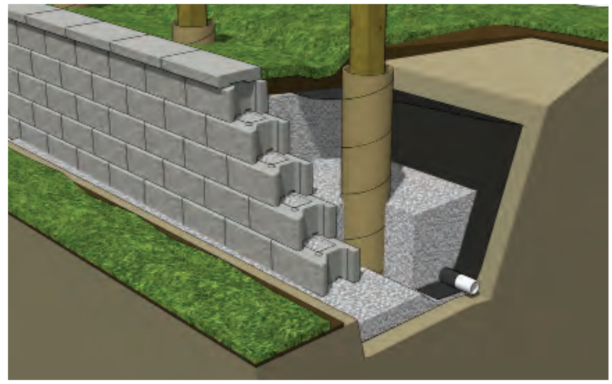
Concrete sonotubes, placed behind the wall, should be utilized to found the handrail into undisturbed native ground. Wood/vinyl fences (solid) that take a wind load produce extremely high loads and footing depth must be designed accordingly. The sonotubes must extend below the base of the wall into a firm "socket" of soil. The depth must be sufficient to independently (i.e. without the aid of the retaining wall) resist the lateral handrail loads. This depth is normally a minimum of 1.2m (4.0') below the bottom of the wall for non-solid handrails, and deeper for solid (wood/vinyl) fences.

Excavate, prepare base, lay filter cloth against cut face, and define location of base course (*see Gravity Wall Installation*).

Identify the proposed location of the handrail foundations (sonotubes). Take into account the batter (setback) of the wall (19mm [¾"] per course) and the required offset at the top. It is preferable to leave a 300mm (12") buffer zone between the outside of the sonotube and the back of the wall. If this is not possible, expansion joint material must be placed between the back of the cap unit and concrete sonotube. Refer to the design for the required depth, and auger the foundation hole into the native subgrade. The sonotube length is equal to the total wall height plus the required embedment. Place the sonotube into the "socket" of competent subgrade.

Construct the conventional SRW, stacking units and backfilling with drainage material. The recommended drainage material (¾"clear stone) should be lightly compacted with a hand tamper, ensuring proper confinement around the sontotube.

Secure the cap unit and fold filter cloth back over drainage material. Cut filter cloth at centerline of sonotube to allow the sonotube through, ensuring complete coverage of drainage material. Cover sonotubes prior to concrete pour to prevent debris from entering.



Pour concrete in foundations in accordance with handrail design (reinforcing steel and/or dowels may be required). Install fence and finish grading.

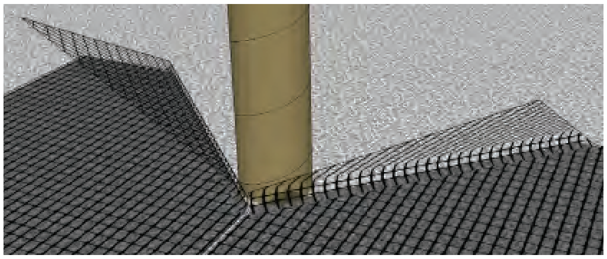
Geogrid-Reinforced SRWs

Handrails/fences are usually required for most walls over 600mm (2.0') in height where pedestrians have access (check with your local building code). These handrails must act to resist potential lateral pedestrian loads. Handrails must not be secured to the retaining wall. Concrete sonotubes, placed behind the wall, should be utilized to place and set the handrail/fence into the reinforced soil zone.

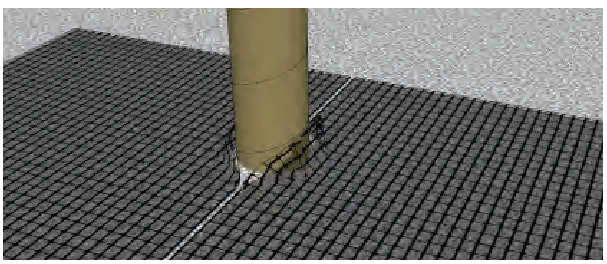
Loads created by pedestrians and/or wind on the handrails/fences must be incorporated into the geogrid design. As the sonotube depth increases, the additional lateral force generated in each geogrid is reduced. Wood/vinyl fences (solid) that take a wind load produce extremely high loads. Generally, foundations for these types of structures should extend more than the height of the fence into the reinforced soil, and the geogrid layout designed accordingly. For handrails that allow wind to pass through, normal depth is approximately 1.2m (4').

Construct the geogrid reinforced SRW up to the elevation corresponding to the underside of the handrail/fence foundation (concrete sonotube).

Identify the proposed location of the handrail/fence foundations (sonotubes). Take into account the batter (setback) of the wall (19mm (¾") per course) and the required offset at the top (It is preferable to leave a 300mm [12"] buffer zone between the outside of the sonotube and the back of the wall. If this is not possible, expansion joint material must be placed between the back of the cap unit and concrete sonotube). Place the sonotube and backfill around it to hold it in place. Continue stacking units, backfilling and compacting to 95% SPD until the next geogrid layer is reached.



Cut the geogrid perpendicular to the wall along the centerline of the sonotube, creating two geogrid panels – one on each side of the sonotube. Lay the geogrid flat in front of the sonotube. At the intersection with the sonotube, fold the geogrid flat against vertical side of the sonotube and then around the back, maintaining the edge of the geogrid along the centerline of the sonotube. Lay the geogrid flat behind the sonotube and pull taut. Secure the geogrid in place at the face (with the next course) and at the rear (with stakes) and continue backfilling.



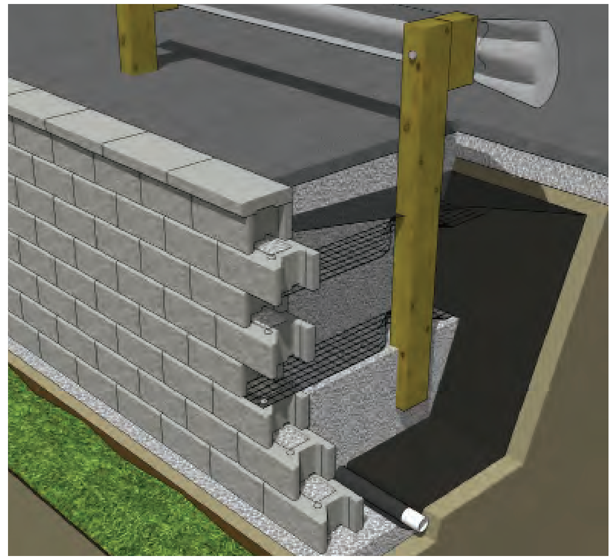
Repeat the previous step for each layer of geogrid encountered by the sonotube.

Secure the cap unit and fold filter cloth back over drainage material. Cut filter cloth at centerline of sono-tube to allow the sonotube through (similarly to method used to allow sonotube to penetrate geogrid layer), ensuring complete coverage of reinforced material. Cover sonotubes prior to concrete pour to prevent debris from entering.

Pour concrete in foundations in accordance with fence/handrail design (reinforcing steel and/or dowels may be required). Install fence and finish grading.

Guide Rails

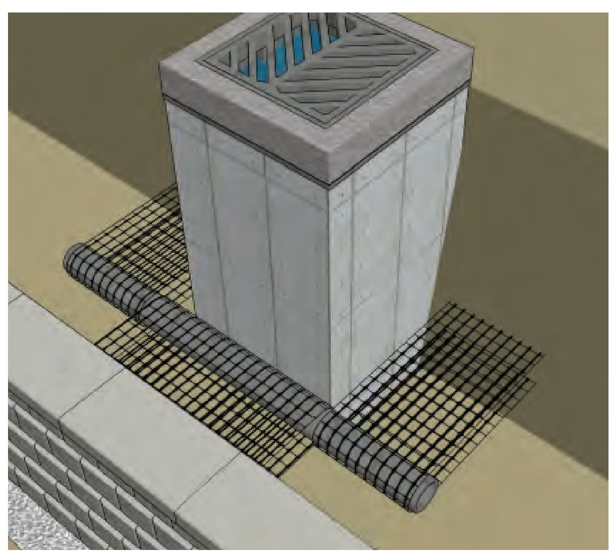
For areas adjacent to roadways and parking lots, flexible steel beam guiderails may be placed behind a geogrid reinforced wall SRW in accordance with the applicable governing standards. Additional "crash" loads must be accounted for in the design of the wall. Accepted procedures usually require the guiderail posts to be offset a minimum of 1m (3') from the back of the wall, extending a minimum of 1.5m (5') into the reinforced zone. It is recommended that the posts be placed as the wall is constructed (refer to post/handrail construction) and compaction surrounding the posts be carefully monitored to ensure optimum confinement.



Catch Basin

When a catch basin is interfering with the placement of the geogrid reinforcement as specified by the site-specific design, the following steps can be taken.

Select an appropriately sized steel pipe with a length of at least twice the width of the catch basin. Extend the geogrid from the specified layer and wrap it around the pipe back to the course below. Place a width of geogrid reinforcement (half the catch basin width) on either side of the catch basin, wrap around the pipe and extend into the infill material. Ensure that the geogrid extends the distance into the infill material as specified in the design.



Specification

Part One • General

1.01 Description

A. The work covered by this section includes the furnishing of all labour, materials, equipment, and incidentals for the design, inspection, and construction of a modular concrete Segmental Retaining Wall ("SRW") including drainage system and geosynthetic reinforcement as shown in the Construction Documents and as described by this Specification. The work included in this section consists of, but is not limited, to the following:

1) Design of an SRW system.
2) Review of the site conditions with respect to suitability of the SRW Design.
3) Inspection of all construction operations and materials related to the SRW.
4) Excavation and foundation soil preparation.
5) Furnishing and placement of the Leveling Base.
6) Furnishing and placement of the Drainage system.
7) Furnishing and placement of Geotextile Filter.
8) Furnishing and placement of SRW units.
9) Furnishing and placement of Geosynthetic Reinforcement.
10) Furnishing, placement, and compaction of Reinforced, Drainage, and Retained Fills.
11) Furnishing of final grading.

1.02 Related Work

A. Section 31 10 00 - Site Preparation

B. Section 31 20 00 - Earth Moving

1.03 Reference Standards

A. Segmental Retaining Wall Design

1) Design Manual for Segmental Retaining Walls, National Concrete Masonry Association, Second Edition which will be referred to as the "NCMA Design Manual"

B. Segmental Retaining Wall Units

1) ASTM C140-06, "Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units"
2) ASTM C1262-05a, "Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units"
3) ASTM C1372-2006e1, "Standard Specification for Dry-Cast Segmental Retaining Wall Units"
4) ASTM D6638-06, "Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)"
5) ASTM D6916-06c, "Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks)"

C. Geotextile Filter

1) ASTM D4491-99a(2004)e1, "Standard Test Methods for Water Permeability of Geotextiles by Permittivity"
2) ASTM D4751-04, "Standard Test Method for Determining Apparent Opening Size of a Geotextile"
3) ASTM D5261-92(2003), "Standard Test Method for Measuring Mass per Unit Area of Geotextiles"

D. Geosynthetic Reinforcement

1) ASTM D5262-06, "Standard Test Method for Evaluating the Unconfined Tension Creep Rupture Behavior of Geosynthetics"
2) ASTM D6637-01, "Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method"
3) ASTM D6706-01, "Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil"

E. Soils

1) ASTM D422-63(2002)e1, "Standard Test Method for Particle-Size Analysis of Soils"
2) ASTM D698-00ae1, "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))"
3) ASTM D2487-06 "Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)"
4) ASTM D4318-05, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils"
5) ASTM D4972-01, "Standard Test Method for pH of Soils"

F. Drainage Pipe

1) ASTM D3034-06, “Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings”
2) ASTM F405-05, “Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings”

G. Where specifications and reference documents conflict, the Owner or Owner’s Representative shall make the final determination of applicable document.

1.04 Delivery, Material Handling, and Storage

A. The Installer shall check all materials delivered to the site to ensure that the materials specified in the Construction Documents have been received and are in good condition.

B. The Installer shall store and handle all materials in accordance with manufacturer’s recommendations and in a manner to prevent deterioration or damage due to moisture, temperature changes, contaminants, handling, or other causes.

1.05 The design and construction of the Segmental Retaining Wall shall be undertaken by the following three entities:

A. The term Installer shall refer to the individual or firm that will construct the SRW. The Installer must have the necessary experience and understanding of SRWs for the project and have successfully completed projects of similar scope and size.

B. The term General Review Engineer refers to the individual professional engineer or professional engineering firm that has a comprehensive understanding of the design and construction of SRWs. The General Review Engineer may retain the services of other professionals to augment their own capabilities, skills, and knowledge. The General Review Engineer is retained by the Installer to provide the following services:

1) Inform the Designer in writing that they will be acting as the General Review Engineer for the project prior to construction.
2) Evaluate the site conditions to ensure the parameters used in the SRW Design are appropriate. SRW Design parameters that have assumed values must be verified to be accurate for the site.
3) Determine if the SRW Design requires additional analysis, with respect to compound stability and global stability.
4) Testing and acceptance of all materials used to construct the SRW.
5) Inspection of the methods used to construct the SRW.
6) Determine if the wall is constructed in general conformance with the Construction Documents.

C. The term Designer refers to the individual professional engineer or professional engineering firm that is experienced in the design of SRWs and is responsible for generating a sealed SRW Design based on information that is provided to the Designer, created in accordance with Section 3.01. The Designer may retain the services of other professionals to augment their own capabilities, skills, and knowledge.

1.06 Submittals - per Contract Documents.

1.07 Measurement for Payment - per Contract Documents.

Part Two • Materials

2.01 Definitions

A. Segmental Retaining Wall ("SRW") is the entire retaining wall structure(s) including: SRW Units, Cap, Drainage Pipe, Geotextile Filter, Geosynthetic Reinforcement and Drainage, Reinforced, Retained, and Base Fills. A Segmental Retaining wall structure can be classified as a:

1) Conventional SRW - SRW Units stacked on a Leveling Base with a Drainage system behind.
2) Multi-Depth SRW - SRW Units of different depths with larger units at the bottom, and smaller units at the top, stacked on a Leveling Base with a Drainage system behind.
3) Reinforced SRW - SRW Units stacked on a Leveling Base with a Drainage system, Reinforced Fill including Geosynthetic Reinforcement located behind.
4) Crib SRW - SRW Units stacked parallel and perpendicular to the SRW direction forming bin like structures, built on a Leveling Base with a Drainage system behind.

B. Segmental Retaining Wall Units are modular, solid, dry-cast concrete blocks, designed specifically for the task of earth retention, that form the external facia of an SRW system.

C. Cap Units are the last course of concrete units used to finish the top of the SRW.

D. Leveling Base is the compacted granular soil, or if specified in the Construction Documents, an unreinforced concrete footing, placed beneath the first course of SRW units.

E. Drainage Fill is a free draining aggregate with high permeability placed directly within and/or behind the modular concrete units. This will include a Drainage Pipe and may be separated from other Fill with a suitable Geotextile Filter.

F. Reinforced Fill is placed directly behind the Drainage Fill, placed in layers and compacted, that will include horizontal layers of Geosynthetic Reinforcement.

G. Retained Fill is the soil placed between the Reinforced Fill and the Retained Soil in Reinforced SRWs or between the Drainage Fill and Retained Soil in Conventional SRWs.

H. Retained Soil in cut situations is the undisturbed native soil embankment. In soil fill situations this will be the compacted engineered site fill.

I. Foundation Soil is the undisturbed native soil or engineered fill beneath the SRW structure.

J. Drainage Pipe is a perforated pipe used to carry water, collected from within the SRW, to outlets, to prevent pore water pressures from building up within the SRW and specifically behind the SRW Units.

E. Geotextile Filter is a permeable planar polymer structure that will allow the passage of water from one soil medium to another while preventing the migration of fine particles that might clog the downstream fill. Selection of a Geotextile Filter is based on the characteristics of the different soils used in and surrounding the SRW.

F. Geosynthetic Reinforcement is an open planar polymer structure having tensile strength and durability properties that are suitable for soil reinforcement applications. Geogrid is a commonly used type of Geosynthetic Reinforcement.

G. All values stated in metric units shall be considered as accurate. Values in parenthesis stated in imperial units are the nominal equivalents.

2.02 Approved Products

A. All approved products will be identified in the Construction Documents. No substitutions will be allowed unless approved in writing by both the Designer and General Review Engineer.

B. The SRW units will be specified in the Construction Documents which shall include the manufacturer's name, product name, dimensions, colour, and finish. Additionally the SRW units must:

1) Meet the minimum standard as defined by ASTM C1372 for:
   a) Strength
   b) Absorption
   c) Freeze - Thaw durability
   d) Permissible variation in dimensions
   e) Finish and Appearance

2) Meet the physical properties listed below as tested using ASTM C140:
   a) Dimensional tolerance shall be +/- 3mm (1/8") for height, width, and length.
   b) The minimum 28-day compressive strength of 35 MPa (5000 psi).
   c) The maximum moisture absorption shall be 1.0 kN/cubic m (6.5 lbs/cubic ft).
3) Use an integral shear key connection that shall be offset to create, as specified in the Construction Documents, either:
   a) A minimum batter as stated in the Construction Documents, or
   b) A near vertical alignment. Special construction procedures are required for vertical SRWs. See Section 3.04.D.
4) If required, summary test data shall be provided with the SRW Design and shall include:
   a) SRW Unit shear strength as per ASTM D6916
   b) SRW Unit - Geosynthetic Reinforcement connection strength as per ASTM D6638

C. Reinforced Fill

1) If the SRW Units by themselves provide sufficient stability, the Designer may choose to omit the Reinforced Fill
2) The Reinforced Fill shall be specified in the Construction Documents as “select imported fill”
   a) Unified Soil Classification System designation as per ASTM D2487
   b) % passing #200 sieve
   c) Effective friction angle (direct shear or triaxial test)
   d) Minimum compacted density
3) Additional information may be required which could include:
   a) Soil gradation curve (ASTM D422)
   b) Liquid limit, plastic limit, and plasticity index (ASTM D4318)
   c) Soil pH (ASTM D4972)
   d) Permeability coefficient “Q”

D. Leveling Base

1) The leveling base material shall be non-frost susceptible, well-graded, compacted angular gravel-sand mixture (GW as per ASTM D2487).
2) Additional information may be required which could include:
   a) Effective friction angle (direct shear or triaxial)
   b) Soil gradation curve (ASTM D422)
   c) Soil pH (ASTM D4972)
   d) Permeability coefficient “Q”
   e) Potential for consolidation
3) Alternately, the Construction Documents may specify the leveling base shall be an unreinforced concrete footing with specified dimensions.

E. Drainage Fill

1) If the Reinforced Fill has adequate drainage characteristics, the Designer may choose to omit the Drainage Fill.
2) The Drainage Fill shall be a free-draining angular, gravel material of uniform particle size smaller than 25mm (1") and greater than 6mm (1/4"). If shown in the Construction Documents, the Drainage Fill shall be separated from the Reinforced Fill or Retained Fill by a specified Geotextile Filter.
3) Additional information may be required which could include:
   a) Effective friction angle (direct shear or triaxial)
   b) Soil gradation curve (ASTM D422)
   c) Soil pH (ASTM D4972)
   d) Permeability coefficient “Q”
   e) Potential for consolidation
4) If Required, fill the block core with approved drainage fill (level with top surface) and compact to dense state.

F. Drainage Pipe

1) The Drainage Pipe shall be specified in the Construction Documents and shall either be a perforated corrugated polyethylene or perforated PVC pipe, with a minimum diameter of 100 mm (4"), protected by a Geotextile Filter to prevent the migration of soil particles into the Drainage Pipe.

G. Geotextile Filter

1) If the gradation of adjacent soils permits, the Designer may choose to omit the Geotextile Filter.
2) The Geotextile Filter shall be specified in the Construction Documents and shall include the manufacturer’s name and product name.

3) If required, summary test data shall be provided with the SRW Design and shall include:
   a) Apparent opening size "AOS" (ASTM D4751)
   b) Unit weight (ASTM D5261)
   c) Coefficient of permeability (ASTM D4491)

   Note: *There are many different types of Geotextile Filters. Geotextile Filters made from similar materials, using a similar method of manufacture will have similar performance characteristics. Some common examples are non-woven needle-punched, woven slit film or monofilament.*

   Although selection of the appropriate geotextile is specific to site soil conditions, a commonly used geotextile for filtration is a non-woven needle-punched geotextile that will have an Apparent Opening Size ranging between 0.149 and 0.212 mm (U.S. Sieve Sizes #100 to #70) and a minimum unit weight of 135 grams per square metre (5.0 oz per square yard). The coefficient of permeability will typically range between 0.1 and 0.3 cm/second.

H. Geosynthetic Reinforcement

1) If the SRW Units by themselves provide sufficient stability, the Designer may choose to omit the Geosynthetic Reinforcement.
2) The Geosynthetic Reinforcement shall be specified in the Construction Documents and shall include the manufacturer's name, product name, and Long Term Design Strength ("LTDS") as calculated according to section 3.01.A.5.
3) If required, summary test data shall be provided with the SRW Design and shall include:
   a) Tensile strength (ASTM D6637)
   b) Creep potential reduction factor (ASTM D5262)
   c) Installation damage reduction factor
   d) Durability reduction factor (chemical and biological)
   e) Soil pullout resistance (ASTM D6706)
   f) Connection strength (ASTM D6638)
   g) Coefficient of interaction "ci"
   h) Coefficient of interaction "cds"

I. Concrete Adhesive

1) If the Cap Unit by itself provides sufficient stability, the Designer may choose to omit the Cap Adhesive.
2) The adhesive is used to permanently secure the cap unit to the top course of the SRW. The adhesive must provide sufficient strength and remain flexible for the expected life of the SRW.

Part Three • Execution

3.01 Segmental Retaining Wall Design

A. Design Standard

1) The Designer is responsible for providing an SRW Design based on the proposed site development documents and shall consider the external stability, internal stability, and local stability of the SRW system. The design life of the structure shall be 75 years unless otherwise specified in the Construction Documents.
2) The Designer shall create the SRW Design in accordance with recommendations of the NCMA Design Manual. The following is a summary of the minimum factors of safety for the various modes of failure evaluated in the proposed design.

External Mode	Min.	Internal Mode	Min.	Local Mode	Min.
Base Sliding	1.5	Tensile Overstress	1.0	Facing Shear	1.5
Overturning	2.0	Pullout	1.5	Connection	1.5
Bearing Capacity	2.0	Internal Sliding	1.5	Unreinforced Overturning	1.5

3) If required, an alternate design method may be used and must be identified in the SRW Design. The alternate design method must be comprehensive and adequately evaluate all possible modes of failure.
4) The lateral earth pressure which the SRW must resist is calculated using the Coulomb equation which will include the effect of a sloping surface above the SRW. This defines a theoretical critical linear slip failure plane external to the SRW structure and another internal to the SRW structure. Additionally the SRW must have the room to move forward so that it may fully develop an active lateral earth pressure.
5) The SRW's design height, "H", at a given section, shall be measured from the top of the Leveling Base to the top of the SRW where ground surface intercepts the SRW facia.
6) The Designer is not responsible for analyzing the global stability of the SRW structure for circular slip failure and multi-part slip failure planes that are completely external or partially external (referred to as compound failure mechanisms) to the SRW structure. See Note 3 in Section 3.02.B.2 for additional information.

B. Design Assumptions

1) An SRW Design will typically assume the following and shall be noted on the SRW Design drawings:
   a) The foundation soils will produce acceptable total and differential settlement given the applied load of the SRW.
   b) The maximum groundwater elevation is at least 2/3 x H (height) below the base of the SRW unless otherwise stated in the Construction Documents.
   c) There will be no hydrostatic pressure within or behind the SRW.
   d) The surrounding structures will not exert any additional loading on the SRW (i.e. an adjacent structural foundation is at or below proposed Leveling Base or outside of a theoretical zone of influence as determined by the General Review Engineer).
   e) There are no structures (utilities such as gas/water mains, storm sewers, electrical/communications cables, etc.) to be placed within or below the Reinforced Fill during or after construction.

C. Design Parameters

1) Site Parameters
   a) The length, height, and overall elevations of the SRW Design must be derived from the provided site grading plan, elevation details, cross-section details, and station information.
   b) Surcharges, anticipated usage and slopes above, as well as slopes below, all sections of the SRW must be indicated on the site grading plan.
   c) The minimum SRW embedment shall be the greater of:
      i. The height of an SRW unit, or
      ii. The minimum embedment required based on the slope below the SRW.

Slope Below SRW	Min. Embedment
No Slope	H/10
3 : 1 (18.4 deg)	H/10
2 : 1 (26.5 deg)	H/7

      iii. The Designer or General Review Engineer may determine it is necessary to increase embedment due to erosion potential or global stability requirements.

2) Site Soil Parameters
   a) All site soil parameters used in the design shall be stated in the SRW Design. This should include soil classification (ASTM D2487), effective friction angle, compacted density, and cohesion.
   b) Site-specific soil parameters obtained from site geotechnical investigations shall be used in the design calculations. If a site geotechnical investigation is not available or does not provide specific parameters for the SRW, assumed soil parameters may be used and the SRW Design shall state the assumed values and that assumed soil parameters have been used.
   c) If select on-site soils are to be used as SRW fill materials, additional testing of the re-compacted soil will be required for the design calculations. Soil parameters for the select on-site fill shall be used in the design calculations. If fill parameters are not available, assumed fill parameters may be used and the Design Drawings shall state the assumed values and that assumed fill parameters have been used.
3) Product Design Parameters
   a) All relevant Product Design Parameters for materials incorporated in the SRW shall be obtained from the supplier or manufacturer and used in the design calculations. All values used shall be obtained from testing conducted in accordance with the Reference Standards identified in Section 1.03. If product test results are not available, assumed parameters may be used and the Design Drawings shall state the assumed values and that assumed product design parameters have been used.

3.02 Segmental Retaining Wall Design Review

A. This section states the minimum review process that is required prior to construction of an SRW. Other parties such as municipalities, architects, developers, owners, and other designers should review the SRW Design prior to acceptance to ensure specific requirements of each party are met.

B. The General Review Engineer will need to

1) Review the SRW Design to ensure:
   a) The design assumptions are not contrary to the conditions on the site.
   b) The site geometric parameters used in the SRW Design are appropriate for the site.
   c) The site soil parameters used in the SRW Design are appropriate for the soil conditions on the site.
   d) The foundation soils will not require special treatment to control total and differential settlement.
   e) The fill parameters used in the SRW Design are appropriate for the materials to be used in the construction of the SRW.
   f) The SRW Design complies with local building and health and safety regulations.
2) The General Review Engineer is responsible for ensuring the global stability of the SRW structure including circular slip failure and multi-part slip failure planes that are completely external or partially external (also called compound failure mechanisms) to the SRW structure is adequately investigated.

   Note: *As recommended by the NCMA, it is the General Review Engineer's responsibility to ensure the global stability of the SRW structure for circular slip failure and multi-part slip failure planes that are completely external or partially external (referred to as compound failure mechanisms) to the SRW structure. This analysis will extend beyond the region of the SRW structure (natural or man made slopes that extend well beyond the area of SRW construction, geotechnical conditions that may promote deep seated instability, etc.).*

   Experience has shown that in most cases, the geotechnical reports conducted to provide "general" information about a site, provided to the Installer for bidding purposes and the Designer to generate the SRW Design, do not provide sufficient information to accurately assess global or compound stability. Additional excavation, test pits, and/or boreholes that are conducted for the specific purpose of assessing the global and compound stability may be required.

   The General Review Engineer may request the Designer to assist with the global stability analysis.
3) The General Review Engineer must contact the Designer to address any outstanding issues, questions, or concerns regarding the SRW Design and resolve these issues prior to issuing Construction Documents or authorize the SRW Design to be used as Construction Documents.

C. The Project Civil Engineer must be provided with a copy of the SRW Design so they may review it for general compatibility with the site.

1) Review should including the following specific elements:
   a) All surface drainage must direct water away from the SRW including slopes and paved surfaces.
   b) The SRW drainage system delivers outflow to approved locations.
   c) All site services must be located outside of SRW construction area.
   d) The SRW structure or excavation limits must not cross over property boundaries.

e) All structures located near the SRW must be shown in the Construction Documents.
f) Anticipated use above wall during and after construction must be as shown in the Construction Documents.

Note:

Surface drainage - The SRW Design will typically require that surface water be directed away from the SRW. If a slope exists behind the SRW, a swale system will be required which must be included as part of the site grading plan. If the inclusion of a swale was not considered in the site grading plan, the Civil Engineer must provide for this, including required dimensions based on the anticipated volume of water to be collected as well as any grading changes required to accommodate the swale (i.e. potential minor increases in SRW height). The dimensions of the swale are dependent on the anticipated water flow and must be determined by the Civil Engineer responsible for site drainage. A swale can be constructed from concrete or a soil with a low permeability to restrict the rate of water infiltration into the SRW structure. The low permeability material used to cap off the top of the SRW is typically between 200mm (8") and 400mm (16") thick.

Drainage of other structures - The design requires that other structures such as pavements adjacent to the SRW have independent drainage systems (perimeter drain) to ensure the SRW drainage system is not relied on to perform an outletting function for these other structures. Further to this, down spouts from buildings must be outlet away from the SRW into other specified drains.

Outletting/connection of internal drainage system pipes - The Civil Engineer must provide direction as to the connection points or outletting of the SRW internal and external drainage system as part of the overall site drainage plan. This must be provided to the Installer.

Utilities beneath and adjacent to the SRW - The design does not typically allow for utilities within the Reinforced Fill of the SRW. Furthermore, it is advisable to locate all utilities (catch basins, water lines, hydro, communications, etc.) outside of the general SRW area (assume a 1H:1V cut from the back of the Reinforced Fill) to allow future access to the utilities. Also, utilities existing or proposed to be located beneath or through (as in the case of a culvert pipe) the SRW must be verified as capable of supporting the applied loads. The applied SRW load is listed on the cross-section drawing as the minimum allowable bearing capacity needed to support the SRW.

Property lines - The SRW must not encroach on property lines unless consent is given by all stakeholders. Temporary access may be required during excavation and must be confirmed prior to start of construction. The proposed excavation and final structure location (including depth of Geosynthetic Reinforcement, SRW batter and stepping of SRW, actual block thickness) must be reviewed and approved by the Civil Engineer for the site. Temporary shoring may be required to ensure compliance with property line restrictions, building and safety regulations.

Other structures - Unless specifically in the Construction Documents, other structures such as buildings, light standards, fences, parking lots and roadways, signage, curbs, and barriers, etc., that are within the area of the SRW must be highlighted to the Designer, as these must be taken into account in the SRW Design or provisions provided for in the design of the other structures to prevent additional loading on the proposed SRW(i.e. offsetting the structures or extending the depth of the foundations below the bottom of the SRW).

Use of area above/around SRW - The SRW was designed for the loading specified in the SRW Design. This loading was chosen based on the site grading plan and identified use. The design requires that the Civil Engineer verify that the assumed use is acceptable for the site. Also, it must be determined if the area above the SRW will ever be used as a depot for the storage of other materials or equipment during or after construction.

Snow dumps present particular hazards to SRW structure - SRWs are typically not designed to bear the unknown weight of a snow storage area, nor has the drainage system been designed to accommodate the subsequent snow melt.

2) The Project Civil Engineer must contact the Designer to address any outstanding issues, questions, or concerns regarding the SRW Design and resolve these issues prior to the General Review Engineer issuing Construction Documents or authorising the SRW Design to be used as Construction Documents.

D. The Project Landscape Architect must be provided with a copy of the SRW Design so they may review it for general compatibility with the site.

1) The review should include the following specific elements:
   a) Ensure plant and tree species to be placed above the SRW are suited to the environment created by the SRW.
   b) Limit irrigation near SRW structure.
   c) Grading above and below the SRW structure.

d) It may be necessary to incorporate a root barrier (as required by others) to prevent the migration of tree roots into the drainage layer.
e) Larger plants and trees must be kept outside of the Reinforced Fill to ensure
   i. The Geosynthetic Reinforcement is not damaged by excavation for the root ball
   ii. The SRW is not subjected to any additional load from plants or trees.

Note: The SRW will be designed to remove water from the SRW area in order to limit water's effect on the SRW structure. Irrigation systems are counter-productive to the details of the SRW Design. The SRW will be designed to promote runoff and drain quickly, leaving little moisture in the soil. The topsoil layer above the SRW will be of a nominal thickness 0.2m - 0.3m (8"-12").The plants must have a shallow root system so they do not interfere with the drainage systems.

2) The Project Landscape Architect must contact the Designer to address any outstanding issues, questions, or concerns regarding the SRW Design and resolve these issues prior to the General Review Engineer issuing Construction Documents or authorising the SRW Design to be used as Construction Documents.

E. After the review of the SRW Design is completed by all associated parties and all issues are resolved by revisions to the SRW Design, the General Review Engineer will issue sealed Construction Documents based on the SRW Design or authorize the SRW Design to be used as the Construction Documents.

3.03 Inspection

A. Testing and inspection services shall be performed by trained and experienced technicians currently qualified for the work to be performed.

B. The Owner may engage a testing and inspection agency for their own quality assurance, but this does not replace the General Review Engineer's inspection function described below.

Note: In many cases, owner-sponsored construction quality assurance testing is generally insufficient in scope to address the inspection service required, and also to meet the detailed documentation requirements needed to establish a thorough geotechnical testing and general review program.

C. General Review Engineer's Inspection

1) The General Review Engineer shall ensure that the site conditions are in general conformance with those stated in the SRW Design.
2) The General Review Engineer shall ensure that the SRW is constructed in accordance with the Construction Documents.
3) The General Review Engineer shall inform the Designer in writing if conditions on site differ in any way or at any time from the Construction Documents. The Designer is to be consulted with regard to all discrepancies between the Construction Documents and actual site conditions to determine how the differences affect the SRW Design. Changes in conditions on site may include, but are not limited to:
   a) Seepage from the excavation, or
   b) Higher than assumed groundwater elevations,

   Note: If unexpected sources of water are identified, such as a higher water table or weeping soil layers, additional drainage structures may be required such as blanket drains or chimney drains. The specific details will need to be determined among the Designer, the General Review Engineer and the Project Civil Engineer and included in the Construction Documents.

   c) Soil conditions, both in situ and/or engineered,
   d) Surface drainage control on the site require measures greater than those specified,
   e) Site required SRW geometry (heights, alignment, lengths, etc.),
   f) Structures exist not shown in the Construction Documents that apply load to, interfere with, or are influenced by the SRW (catch basins, light standards, buildings, fences, etc.),
   g) Loading conditions (i.e. roadways or pathways closer to back of SRW than originally assumed),
   h) Slopes above or below the SRW that are steeper.
4) General Review of Construction Procedures:
   a) The General Review of Construction must be carried out in accordance with the guidelines set out by the governing professional engineering body. The purpose of the general review is to ensure, through periodic visits on a rational sampling basis, whether the work is in general conformity with the Construction Documents.
   b) Prior to construction the General Review Engineer should identify critical stages in the construction of the SRW at which the General Review Engineer must be present to observe and inspect the work. The General Review Engineer must be given sufficient notice prior to these events to ensure they will be on site.
   c) During construction the General Review Engineer should verify and continually monitor the following:
      i. Ensure materials and fill are of the type and strength specified and they are placed as specified in the Construction Documents.

Note: The General Review Engineer will provide field inspection and quality control services to ensure the Reinforced, Drainage, Retained, and Foundation Soils are in conformance with the Construction Documents and meet the minimum requirements for strength, unit weight, type, and consistency stated in the design. This is achieved through regular compaction testing, monitoring of fill placement and compaction procedures, inspection and testing of materials (USCS classification, fine content, plasticity), and verification of subgrade bearing capacity. The extent and scope of the testing program must be to the satisfaction of the General Review Engineer such that they are confident that the materials testing aspects of the overall construction inspection have been properly conducted. The ultimate goal of the materials testing program will be to reasonably ensure the assumed geotechnical parameters, specified soil types, bearing capacity requirements, compaction requirements, and water/groundwater assumptions included in the design have been met throughout the SRW. The extent of materials / compaction testing will be a function of the type of soil, weather conditions, consistency of results, General Review Engineer's judgment, etc. As a recommended minimum guideline, compaction tests should occur at the front of the Reinforced Fill (within 1.2m [4.0'] of the face) and near the back of the Reinforced Fill (for Reinforced Fill with depth greater than 1.5m) at least every 10m - 15m o/c horizontally along the length of the SRW. Vertically, tests should be performed on at least every second lift (300mm - 400mm) as the Reinforced Fill is placed and compacted. The type of material being used as Reinforced Fill must be constantly checked against the specification. For imported fill materials, documentation (tickets) from the aggregate supplier must be reviewed and kept by the General Review Engineer. When using approved on-site soils, depending on the homogeneity of the soils, the physical properties of the soils (type, plasticity, internal angle of friction, unit weight, permeability, etc.), must be checked on a regular basis to ensure those parameters assumed in the design are being met or exceeded on site (either through testing, visual inspection, or both).

ii. Identify loose or unsuitable foundation or retained soils and subsequent removal and replacement of these areas. See Section 3.04.A.6 for additional information.

Note: The allowable bearing capacity of the subgrade specified in the design must be verified under both the facing of the SRW and the Reinforced Fill (entire SRW footprint). The allowable bearing capacity of the subgrade must be verified at intervals not exceeding 3m along the length of the SRW or as determined suitable by the General Review Engineer.

iii. Ensure the other structural elements of the SRW, including Geosynthetic Reinforcements and SRW Units, are being installed in accordance with the Construction Documents.

Note: General Review of Geosynthetic Reinforcements (geogrid) would include ensuring the correct type (manufacturer and strength), length, placement in the SRW structure, and installation method. General Review of the SRW Units would include confirming the correct type, ensuring tolerances listed in this specification are being met on a random sampling basis, and the installation method. This also includes safe use of handling and placing equipment such as frictional clamps.

iv. Ensure the SRW and associated excavation remains outside of the loading influence of other adjacent structures, unless they have been specifically accounted for in the SRW Design and shown in the Construction Documents.

v. Ensure stability of excavations and conformance with applicable regulations.

vi. Ensure groundwater conditions and/or other water sources have been identified and compared with the assumptions made in the design. Additional water sources noted on site such as seepage from the cut embankment must be identified and the Designer notified if these are not noted in the Construction Documents.

vii. Ensure that surface water runoff and/or other sources of water are being controlled during construction and directed away from the SRW to a functioning drain.

viii. Ensure that all fill materials are adequately protected from the elements and frozen materials or materials that do not meet the moisture content requirements stated in the Construction Documents are not used in the construction of the SRW.

5) The General Review Engineer shall submit written reports of inspections and material testing to the Installer on a weekly basis, or more frequently, as agreed with the Installer. Such reports shall include description of the work observed, deficiencies noted in construction, and corrective action taken to resolve such deficiencies. Reports must make specific reference to the location, type, and results of all tests taken on the project.

6) At the completion of construction, the General Review Engineer shall provide a Letter of General Review to the Installer stating the completed SRW had been installed in general conformity with the Construction Documents.

D. Installer's Quality Assurance Program

1) The Installer is responsible to ensure the SRW is constructed in accordance with the Construction Documents. The Installer must be qualified in the construction of SRWs, knowledgeable of acceptable methods of construction, and have thoroughly reviewed and understood the Construction Documents.

Note: General installation guides illustrating proper methods and techniques for good construction are available to the Installer from Risi Stone Systems or Abbotsford Concrete Products upon request.

2) The Installer shall keep a construction journal to document the construction of the SRW as part of a thorough quality control program. The General Review Engineer shall be provided with copies of the construction journal throughout the construction process.

Note: The construction journal is the Installer's permanent record of all information related to the project. It should include a written account of each day's activities, weather conditions, specific tasks completed, materials received at the site, details of visitors to the site and discussions, material tags, and photographs.

3) The Installer's field construction supervisor shall have demonstrated experience and be qualified to direct all work related to the SRW construction.
4) The Installer must notify the General Review Engineer of critical stages in the construction of the SRW in order that they may be present to observe and inspect the work. The General Review Engineer must be notified reasonably well in advance of the scheduled date(s) for construction.

A. Construction Tolerances

1) Installation of SRW facia shall be within all the following acceptable tolerances:

Vertical Control	+/- 32mm (1.25") over a 3m (10') distance
Horizontal Control	Straight lines: +/- 32mm (1.25") over a 3m (10') distance
Rotation of the SRW Face	Maximum 2.0 degrees from established SRW plan batter or +/-10.0% from total established horizontal setback
Bulging	+/- 32mm (1.25") over a 3m (10') distance

3.04 Construction

A. Site Preparation

1) Comply with all current Federal, Provincial/State, and local regulations for execution of the work, including local building codes and excavation regulations. Provide excavation support as required to maintain stability of the area during excavation and SRW construction and to protect existing structures, utilities, landscape features, property, or improvements.
2) Prior to grading or excavation of the site, confirm the location of the SRW and all underground features, including utility locations within the area of construction. Ensure surrounding structures are protected from effects of SRW excavation.
3) Coordinate installation of underground utilities with SRW installation.
4) Control surface water drainage and prevent inundation of the SRW construction area during the construction process.
5) The Foundation Soil shall be excavated or filled as required to the grades and dimensions shown in the Construction Documents.
6) The Foundation Soil shall be proof rolled and examined by the General Review Engineer to ensure that it meets the minimum strength requirements specified in the Construction Documents. If unacceptable Foundation Soil is encountered, the General Review Engineer should contact the Designer to discuss options and determine the most appropriate course of action.

Note: The footprint of the SRW includes the Reinforced Fill and is not limited to the facing. Therefore, foundation treatments must encompass the entire SRW foundation and extend a minimum of 0.6m (24")(in front of the SRW facia and behind end of the Geosynthetic Reinforcement respectively. The replacement material must extend down at a 1H:1V line to competent native material.

7) In cut situations, the native soil shall be excavated to the lines and grades shown in the Construction Documents and removed from the site or stockpiled for reuse as Reinforced or Retained Fill as identified in the Construction Documents. Care should be taken not to contaminate or overly saturate the stockpiled fill material.

B. Installing Drainage System

1) If specified in the Construction Documents, the approved Geotextile Filter shall be set against the back of the first SRW Unit, over the prepared foundation soil extending towards the back of the excavation, up the excavation face and eventually over the top of the Drainage Fill to the back of the SRW Units near the top of the wall or as shown in the Construction Documents. Geotextile overlaps shall be a minimum of 300 mm (1') and shall be shingled down the face of the excavation in order to prevent the migration of particles from one fill type to another.
2) The Drainage Pipe shall be placed as shown in the Construction Documents, in accordance with the overall drainage plan for the site. The main collection drain pipe shall be a minimum of 100mm (4") in diameter. The pipe shall be laid to ensure gravity flow of water from the Reinforced Fill. Connect drainage collection pipe at a storm sewer catch basin or daylight along slope at an elevation lower than lowest point of pipe within Reinforced Fill mass, every 15 m (50') maximum.
3) If other sources of water are discovered during excavation or anticipated, other drainage measures/systems such as chimney or blanket drains may be required. The General Review Engineer should contact the Designer to discuss options and determine the most appropriate course of action.

C. Leveling Base or Spread Footing Placement

1) The Leveling Base shall be the specified material placed in the location to the dimensions shown in the Construction Documents.

D. Installation of Segmental Retaining Wall Units

1) The bottom row of SRW Units shall be placed on the Leveling Base as shown in the Construction Documents. The units shall be placed in the middle of the Leveling Base. Care shall be taken to ensure that the SRW Units are aligned properly, leveled from side to side and front to back, and are in complete contact with the Leveling Base. Depending on the SRW system in use, the installer may be required to fill the block cores with approved drainage fill (level with top surface) and compact to dense state.
2) The SRW Units above the bottom course shall be placed to interconnect the shear key and then pushed forward, creating the specified batter of the SRW face.
3) The SRW Units shall be swept clean before placing additional courses to ensure that no dirt, concrete, or other foreign materials become lodged between successive lifts of the SRW Units.
4) Successive courses shall be placed to create a running bond pattern with the edge of all units being approximately aligned with the middle of the unit in the course below it. Cut SRW Units may need to be placed to ensure the vertical line between adjacent SRW Units remains within the middle third of the SRW Unit below.
5) A maximum of three courses of SRW units can be placed above the level of the Reinforced Fill at any time.
6) The Installer shall check the level of SRW Units with each lift to ensure that no gaps are formed between successive lifts that may affect the performance of the SRW.
7) Care shall be taken to ensure that the SRW Units and Geosynthetic Reinforcement, where applicable, are not damaged during handling and placement.
8) No heavy equipment, for compaction, fill placement or other, shall be allowed within 1m (3') of the back of the SRW Units.

E. Drainage Fill

1) Drainage Fill may not be required as indicated in the Construction Documents.
2) The Drainage Fill will be placed within and/or behind the SRW Units with a minimum width of 300mm (1') and separated from other soils using the specified Geotextile Filter.
3) Drainage Fill shall be placed behind the SRW facing in maximum lifts of 150mm (6") and compacted to a minimum density of 95% Standard Proctor.

F. Reinforced Fill

1) Reinforced Fill may not be required as indicated in the Construction Documents.
2) Reinforced Fill shall be placed behind the SRW Units or Drainage Fill with a maximum lift thickness of 150mm (6") and compacted to a minimum density of 95% Standard Proctor Maximum Dry Density (ASTM D698) at a moisture content from 2% below to 2% above optimum.
3) The Reinforced Fill shall be placed and compacted level with the top of the SRW Units at the specified Geosynthetic Reinforcement elevations to ensure no voids exist under the Geosynthetic Reinforcement as it extends out over the Reinforced Fill.
4) Care shall be taken to ensure that the Geosynthetic Reinforcement lays flat and taut during placement of the Reinforced Fill. This is best achieved by placing the Reinforced Fill on top of the Geosynthetic Reinforcement near the SRW facia and spreading toward the back of the Reinforced Fill.
5) At the end of each day's operation, slope the last lift of Reinforced Fill away from the SRW facing to rapidly direct runoff away from the SRW facia. Do not allow surface runoff from adjacent areas to enter the SRW construction area.

G. Geosynthetic Reinforcement

1) Geosynthetic Reinforcement may not be required as indicated in the Construction Documents.
2) Verify type and primary strength direction of the Geosynthetic Reinforcement.
3) Cut Geosynthetic Reinforcement in sheets to the length shown in the Construction Documents.
4) Geosynthetic Reinforcement sheets shall be placed horizontally with the primary strength direction perpendicular to the SRW face, at the elevations shown in the Construction Documents. The sheets are to be placed adjacent to one another, without overlapping and without gaps between them.

Note: *Ensure the strong (machine) direction of the Geosynthetic Reinforcement is placed perpendicular to the SRW facing. Do not roll Geosynthetic Reinforcement out along the length of the SRW (parallel).*

5) Sweep the top of the SRW Units to ensure the SRW Units are clean and free of debris.
6) The Geosynthetic Reinforcement shall be placed over the compacted Reinforced Fill and the SRW Units with the outside edge extending over the shear key of the SRW Unit to within 25mm (1") of the front facing unit.
7) The next course of SRW Units shall be carefully placed on top of the lower course to ensure that no pieces of concrete are chipped off and become lodged between courses and the Geosynthetic Reinforcement is in complete contact with the top and bottom surfaces of the successive SRW courses.

8) With the Geosynthetic Reinforcement secured in place, the Geosynthetic Reinforcement shall be pulled taut away from the back the SRW Units during placement of Reinforced Fill. Alternatively, suitable anchoring pins or staples can be used to ensure that there are no wrinkles or slackness prior to placement of the Reinforced Fill. The Geosynthetic Reinforcement shall lay flat when pulled back perpendicular to the back of the SRW facia.
9) No construction equipment shall be allowed to operate directly on top of the Geosynthetic Reinforcement until a minimum thickness of 150mm (6") of fill has been placed. Equipment may drive on Reinforced Fill at slow speeds and should exercise care not to stop suddenly or make sharp turns. No heavy equipment shall be allowed within 1m (3') of the back of the SRW Units.

H. Retained Fill

1) Retained Fill may not be required as indicated in the Construction Documents.
2) Retained Fill shall be placed and compacted behind the Reinforced Fill or Drainage Fill in Conventional SRW applications, in maximum lift thickness of 150mm (6").

I. Continuing Wall Construction

1) Repeat section 3.04.D through to 3.04.H until the grades indicated in the Construction Documents are achieved.

J. Secure Cap

1) The Cap Adhesive may not be required as indicated in the Construction Documents.
2) Cap units shall be secured to the top of the SRW with two 10mm (3/8") beads of Concrete Adhesive positioned 50mm (2") in front and behind the tongue of the last course of SRW units.

K. Finishing SRW

1) Finish grading above the SRW to direct surface runoff water away from the SRW. A swale system must be used above the SRW if the grade slopes toward the back of the wall. Construct the swale with the materials and to the dimensions specified in the Construction Documents. Final grading must be established immediately to ensure the Reinforced Fill is protected from water infiltration.
2) Upon completion of the SRW, additional structures (fences, handrails, vehicular guardrails, buildings, pools/ponds, etc.) or changes to grading/loading (increased height, slopes, parking areas, changes in proximity to water flow, etc.), other than those shown in the Construction Documents, can not be installed/implemented without the review and consent of the General Review Engineer who will typically have to consult the Designer.
3) If the Installer is not responsible for the final landscaping and grading above or around the SRW, the Installer must ensure the firm who is responsible for the final landscaping and grading understands the SRW's limitations with respect to allowable depth of topsoil, excavation behind the SRW for planting, offset for heavy equipment and allowable surcharge. This also extends to firms who will be responsible for installations like handrails, fences, and signs that will apply additional loads to the SRW and will impact the SRW's performance.

Notes