BROADSTONE™ INSTALLATION GUIDE

VERSION 1.0 | PAVESTONE.COM

Creating Beautiful Landscapes®

Contents

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Overview of a Successful Project

The following procedure is recommended for the construction of segmental retaining walls over 3ft. 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 (pavements/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 or evaluation of the site soils by an engineer conducted to evaluate subsurface conditions of site, including soil types, characteristic properties, in situ state, groundwater conditions, overall slope stability, and 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

- Grading plan and geotechnical investigation provided to the Wall Design Engineer
- Wall Design Engineer must be a professional engineer licensed in the applicable State. The Design must synthesize all available information and include cross-section and/or elevation-view drawings, specifications, and site-specific construction details.

Pre-Construction meeting

- Pavestone recommends that all involved parties (Designers, Owner's Representative, General Contractor, Contractor, 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 (e.g. paving, installing fences) that could influence the wall, 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 segmental retaining wall (SRW) must be conducted by a qualified third-party engineer (called the Engineer of Record).

As much of the general review is geotechnical in nature (e.g. compaction testing, soil and groundwater assessment), it often makes the most sense to have the Site Geotechnical Engineer conduct a general review. Proper general review of construction should include all aspects of the installation. The scope of the Engineer of Record's responsibilities include, but are not limited to:

- Inspection of all materials used in construction (e.g., SRW units, backfill, drainage material, reinforcement, and other structures)
- Verification that the design is compatible with the site in all respects
- Identification of discrepancies between the plan and/or SRW design, actual site conditions, and subsequent notification of Wall 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 (geogrid lengths and type, wall heights, etc.)
- Finally, the Engineer of Record should provide a letter to the owner stating the wall was constructed in general conformance with the plans and specifications

Understanding the Design

Proper Installation

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

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 and safety guidelines set forth by your local government.

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

Typical Design – Not for Construction

A typical design is a non-site-specific wall cross section or design table selected based on preliminary information regarding proposed maximum wall height, use of structure, grading, etc. and is 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). It includes site-specific cross-section drawings, elevation views, specifications, quantity calculations, details, statement of limitations, etc. and is 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 the design, status of the design (preliminary or final), design assumptions, purpose of the wall, and potential construction issues.

Cross Section Drawing

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 often 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.

Elevation View Drawing

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 the 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.

Quantity Estimates

Most design reports contain a summary of quantities of block, geogrid, infill, etc. 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 detailed 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.

The BroadStone™ System

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

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

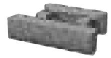
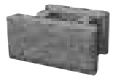
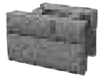
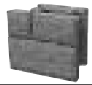
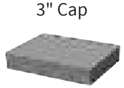
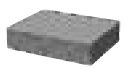
In landscape applications, the primary purpose of retaining walls is aesthetic in nature. Some examples of BroadStone™ landscape uses are: raised patios for outdoor kitchens and living spaces, slope management, erosion control, run-off water management, planters, garden areas, and terraced or privacy walls. Most landscape applications call for walls under 3 ft. in height (depending on soil conditions and loading, this maximum height may be reduced) with minimal loads being applied to the wall, therefore most landscape walls do not require geogrid.

In structural applications, the primary function of a retaining wall is to provide structure and strength to steep slopes or cuts. Some common structural uses for BroadStone™ retaining walls are high walls required to support parking, roads, or highways, and erosion protection along streams or lakes. In all of these cases, geosynthetic reinforcement (geogrid) is used.

Features & Advantages

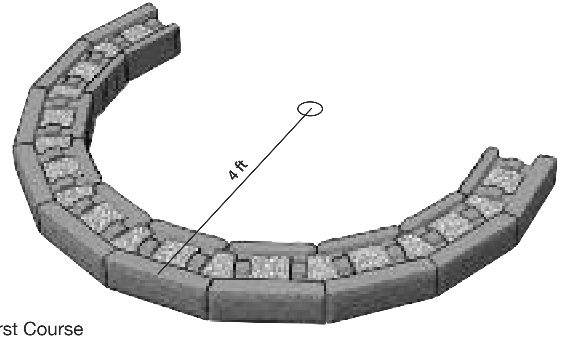
The BroadStone™ system has a number of unique features that have been developed to enable a faster and more accurate installation by the contractor and provide a stronger, more beautiful and more economical structure for the owner.

Feature	Benefit
Efficient shape with rounded grips throughout	• Only 72 lbs/FF* despite solid 2" webs and full 12" depth • Units are easy to handle and place
Near-vertical batter	• Expands usable site - only 1/4" setback per course • Makes a smooth and precisely-aligned wall face
Large central core	• Webs align for fast and complete filling • Superior pullout strength from large grid-to-fill interface
Integral shear lugs at front quarters	• No cost or hassle from pins or clips • Minimal batter increase in curves
Continuous shear channel	• Open channel profile for fast, accurate placement • Insensitive to lateral misalignment - less trimming
Site-made interlocking corner option	• Eliminates separate takeoffs, handling, and waste • Colors and heights match; always available on-site
Many texture options	
Traditional splitting technologies	• Straight: a crisp, planar split • Beveled: a three-faceted split
RockFace™ rustic splitting technology	• Single: a single-piece look • Triple: a three-piece look with single-piece installation speed • Ashlar: a six-piece, multiheight look with near single-piece speed

BroadStone™ Unit(s)	Height	Width	Depth	Face Foot	Block Cu. Ft.	Weight	Batter
BroadStone™ 4 	4"	18"	12	0.50	0.25	36	3.6
BroadStone™ 6 	6"	18"	12	0.75	0.38	54	2.4
BroadStone™ 8 	8"	18"	12	1	0.51	72	1.8
4 & 6 Ashlar 	10"	18"	12	1.25	0.63	90	2.9
4 & 8 Ashlar 	12"	18"	12	1.5	0.76	108	2.4
6 & 8 Ashlar 	14"	18"	12	1.75	0.89	126	2.0
3" Cap 	3"	18"	13.5	0.38	0.42	60	n/a
4" Cap 	4"	18"	13.5	0.5	0.56	80	n/a

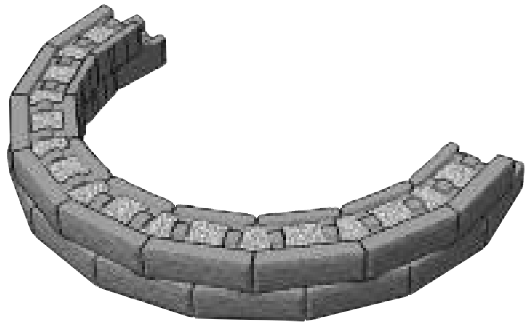
*Nominal at 142 pcf. Consult local plant for actual values, which may vary based on local material properties.

Convex Curves



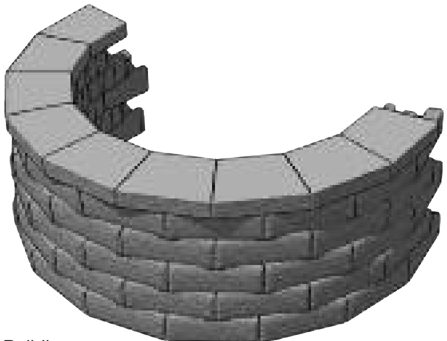
1 First Course

BroadStone™ is able to create a curve with a minimum 4 ft. radius to the face of the block. However, in preparation for the bottom course, remember that the radius will decrease by 1/4-1/2" every course. Therefore, the smallest curve will result on the uppermost course.



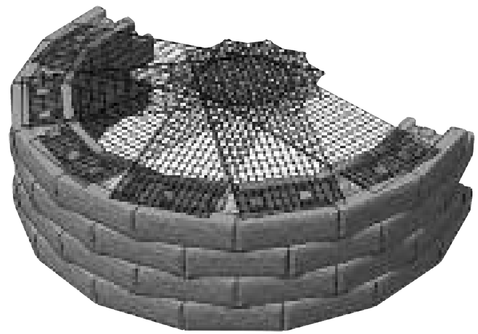
2 Second Course

Place additional courses.



3 Continue Building

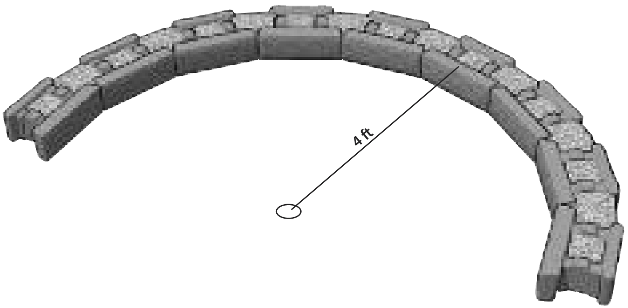
Repeat until desired wall height is achieved. It may be necessary to cut some units in the curve to maintain the joint pattern.



4 Geogrid Installation

Place geogrid within 1" of the front face of the block. The geogrid will overlap and should have 3" of compacted soil between the layers. The geogrid should be spaced on the BroadStone™ units so the geogrid does not overlap until it enters the soil zone.

Concave Curves

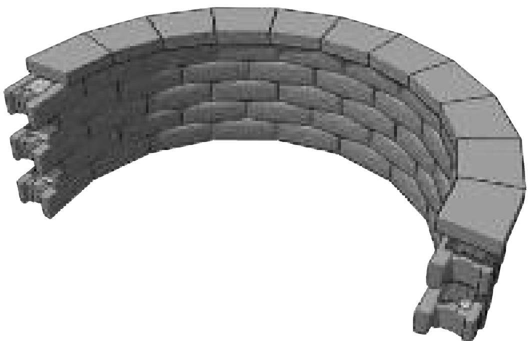


1 First Course

BroadStone™ is able to create a curve with a minimum 4 ft. radius to the face of the block. The smallest radius will occur on the bottom course. Each additional course will result in a 1/4-1/2" increase in the radius.

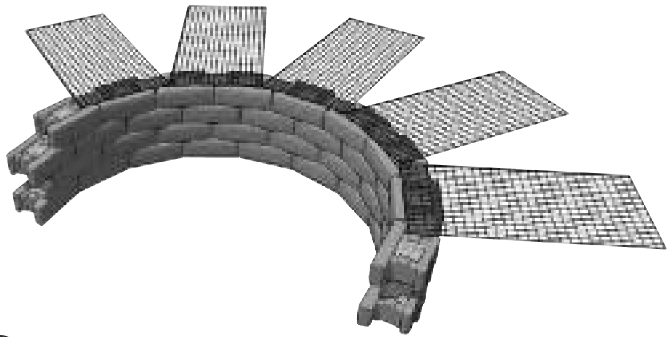
2 Second Course

Place additional courses.



3 Continue Building

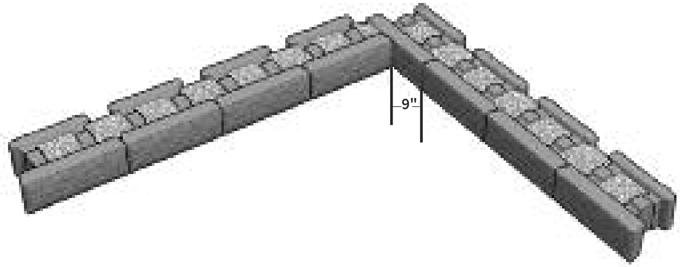
Repeat until desired wall height is achieved. It may be necessary to cut some units in the curve to maintain the joint pattern.



4 Geogrid Installation

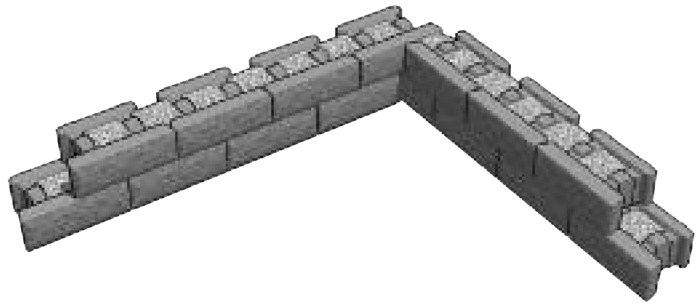
Place geogrid within 1" of the front face of the block. It will be necessary to have gaps between adjacent sections of geogrid. **At alternating geogrid elevations the geogrid sections should be positioned so they overlap the gaps in the geogrid on the layers below.**

Inside Corners



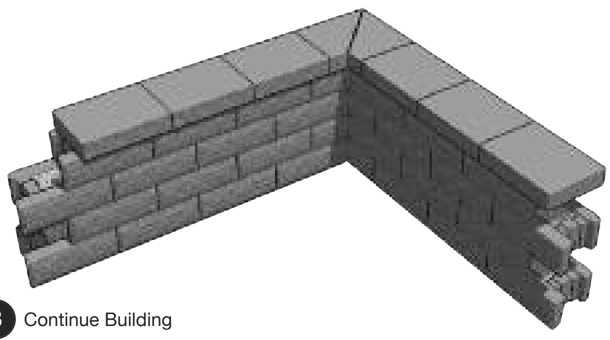
1 First Course

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.



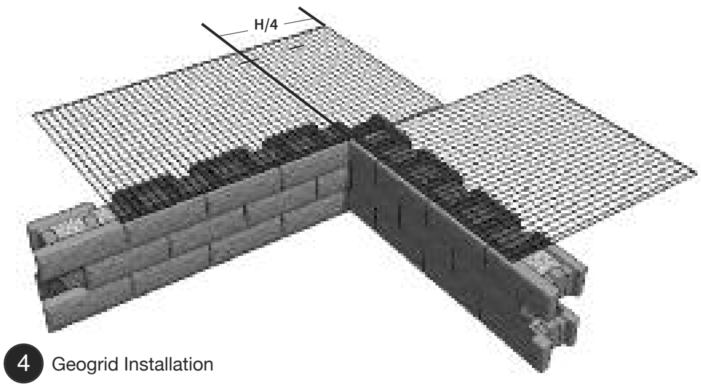
2 Second Course

Commence second course by placing alternate standard unit in corner. Place standard units to complete the course. Using a masonry chisel, remove the bottom lug of the unit in the corner.



3 Continue Building

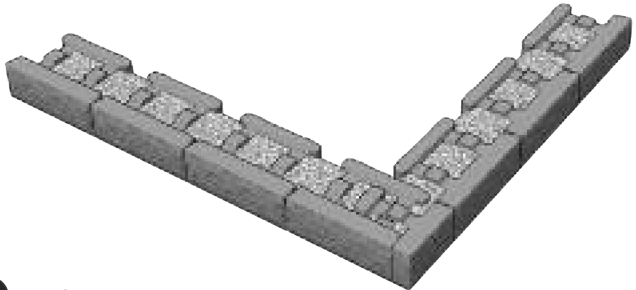
Repeat until desired wall height is achieved. Finish off with two 45° cut cap units.



4 Geogrid Installation

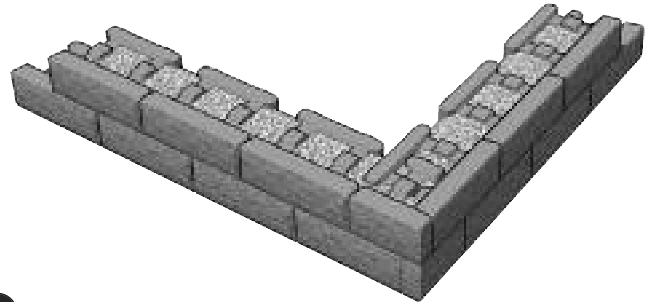
Place geogrid within 1" of the face of the block. As it is only necessary to have geogrid extending directly away from the wall, a gap will result in the geogrid layer as shown. **Alternate direction of geogrid reinforcement H/4 extension on subsequent geogrid layers.**

Outside Corners



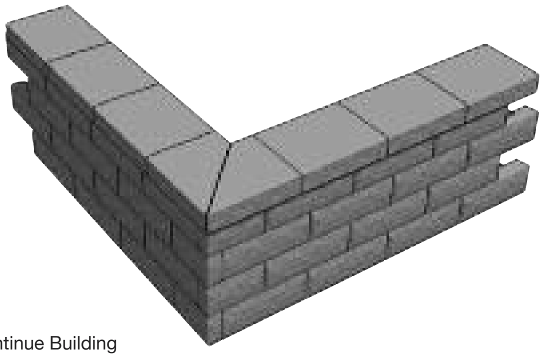
1 First Course

Use the instruction details on page 13 - Making Outside Corner Units
Start with the corner and continue outward, placing base course units on adjacent walls.



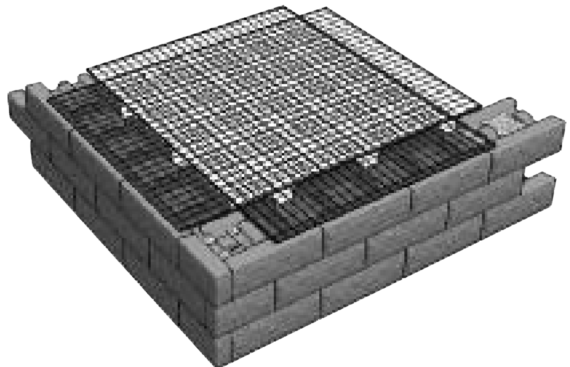
2 Second Course

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



3 Continue Building

Repeat until desired wall height is achieved. Finish off with two 45° cut cap units.



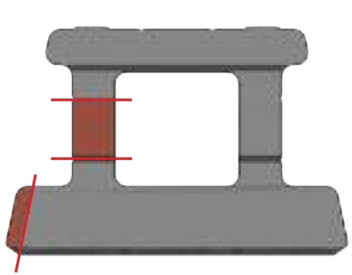
4 Geogrid Installation

The geogrid from the two side walls will overlap and should be separated by a minimum of 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.

Making Outside Corner Units

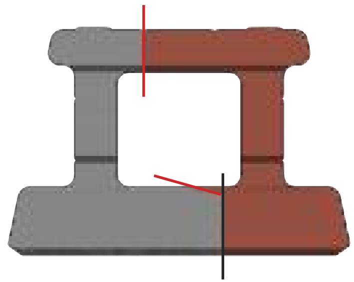
Remove — Saw Cut — Chisel

Interlocking Corner Units MUST be filled and tamped with washed ¼" angular chip gravel.



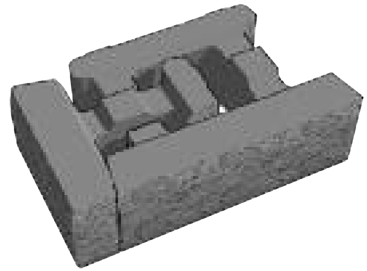
Corner Unit #1

Using pre-formed score lines on bottom and sides of block, saw cut and remove the sections as indicated.



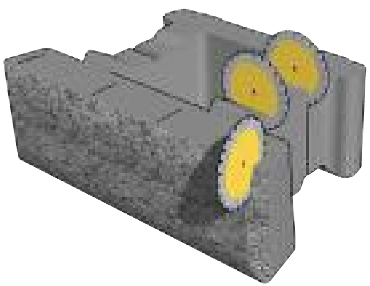
Corner Unit #2

Using pre-formed score lines on bottom and sides of block, saw cut at marking on the back of the block. Split the block as indicated to create a textured face.

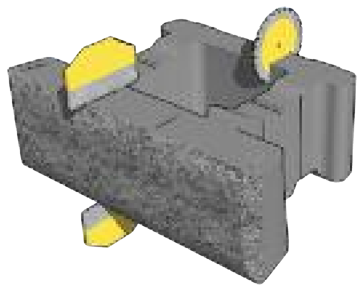


Flipping the unit on its side as shown, saw cut straight down to remove the small angled portion at the top of block. This will create a tight joint with Unit #1.

1



2



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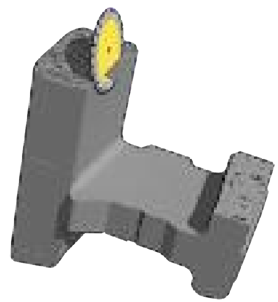
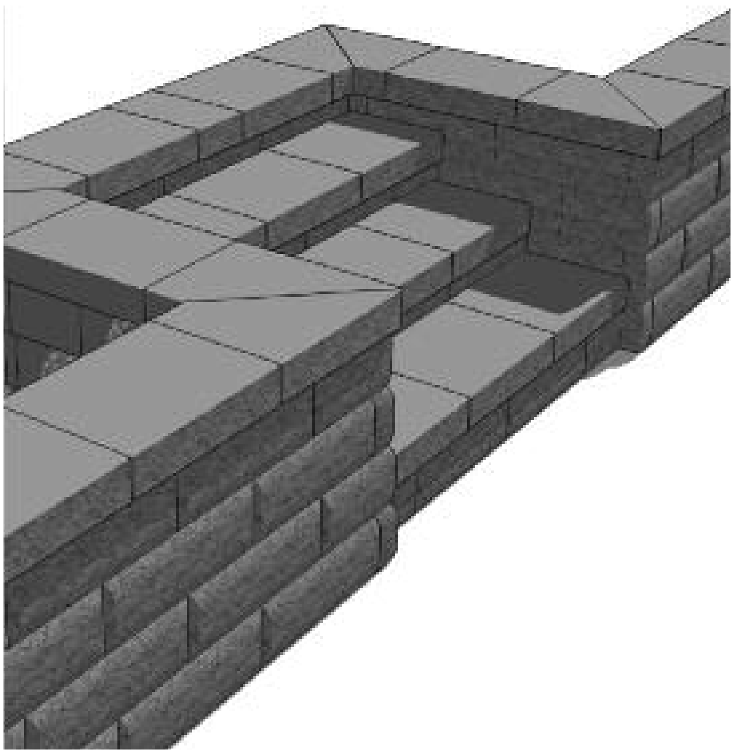
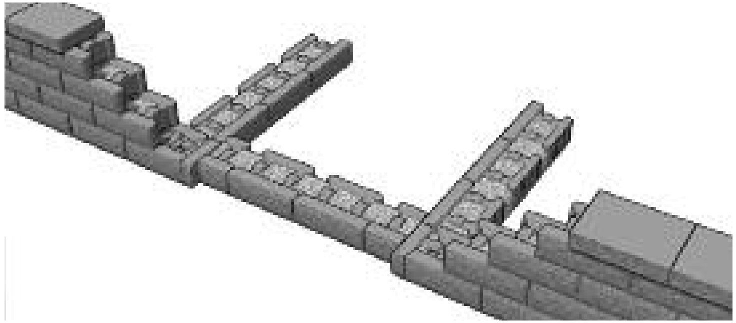


Inset Stairs

The following steps provide guidelines for the construction of inset stairs. Proper compaction within the walls and the use of geogrid to prevent settlement is critical to the long-term performance.

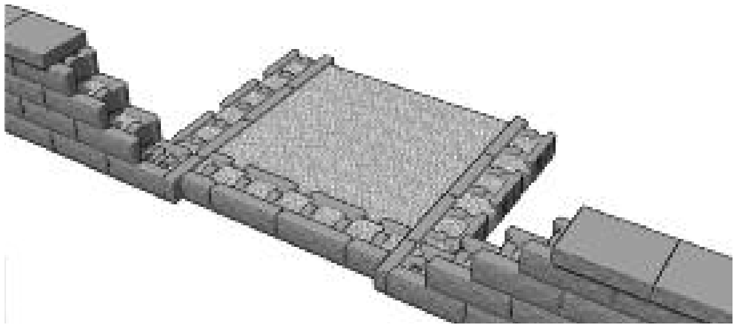
Consult your local building codes for limitations on riser height, step tread dimensions and handrail requirements. All stair components should be secured with concrete adhesive.





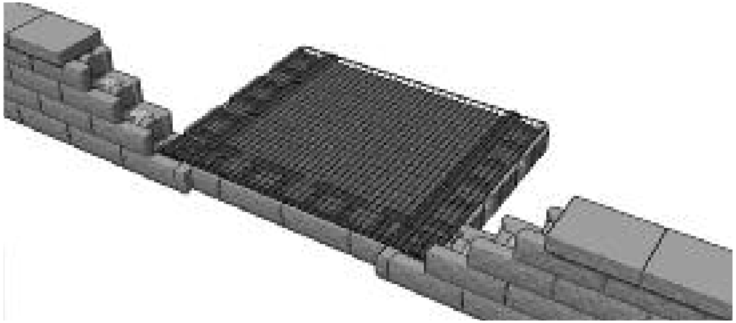
1 First Step

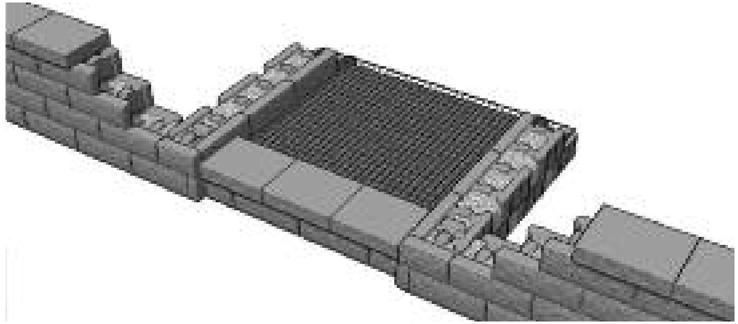
Start with two outside corner walls with a distance of one riser (step) length in between. Build up each wall according to specifications. The side walls can be stepped up following the steps, but the side of riser units must be in contact with the face of units in the side wall.



2 Gravel Fill & Compaction

Fill the reinforced zone with a washed 1/4" angular chip gravel and compact.



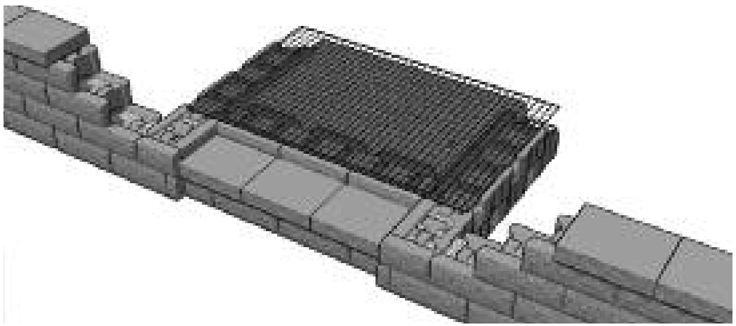


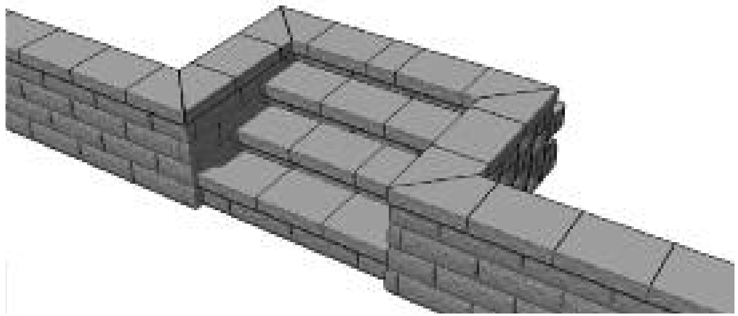
3 Geogrid Layer

Include geogrid reinforcement within each course of steps to reduce settlement.

4 Tread/Cap Units

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





5 Second Step

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. **Riser units do not rest on the course below.**

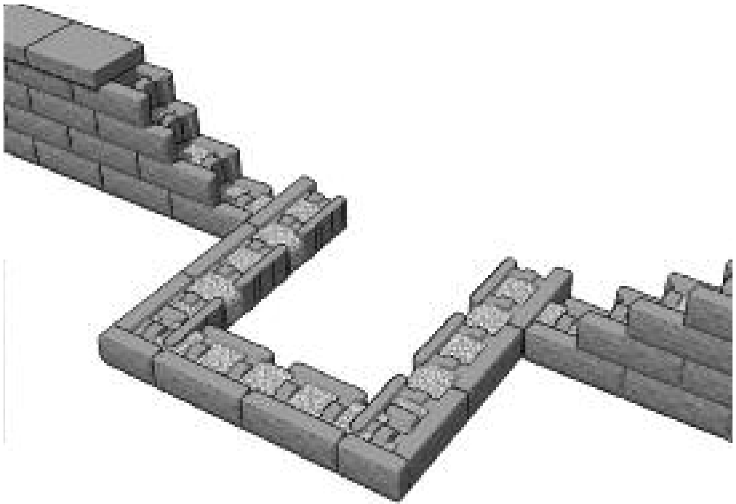
6 Repeat

Repeat until desired stair height is achieved.

Protruding Stairs

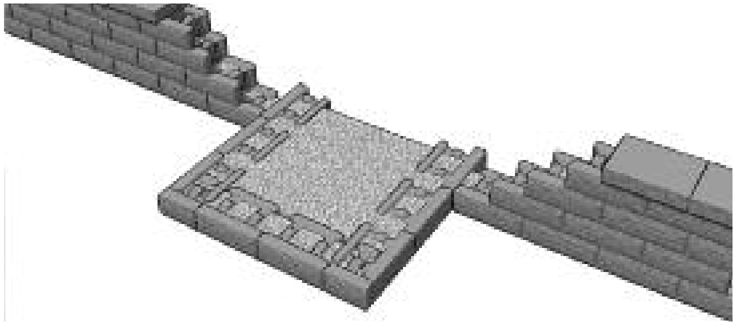
The following steps provide guidelines for the construction of protruding stairs. Proper compaction within the walls and the use of geogrid to prevent settlement is critical to the long-term performance.

Ensure to consult your local building codes for limitations on riser height, step tread dimensions, and handrail requirements. All stair components should be secured with approved concrete adhesive.



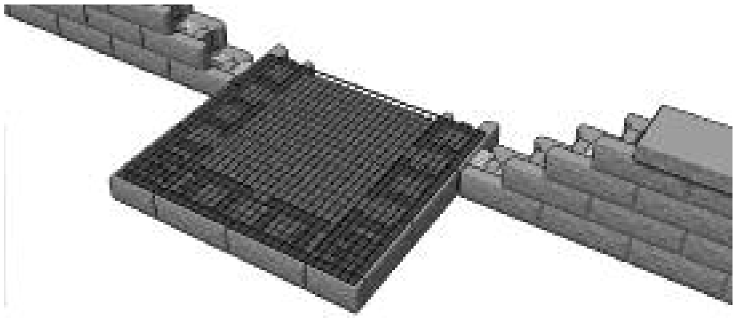
1 First Step

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



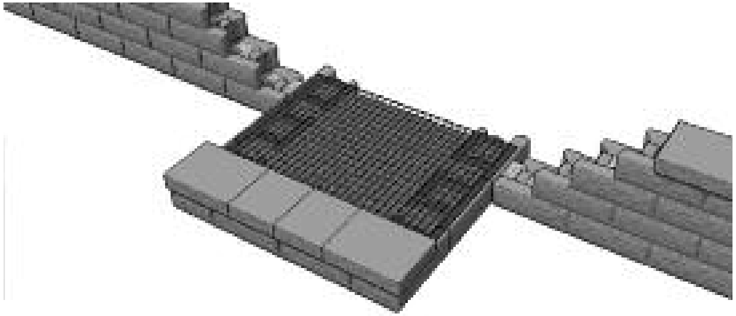
2 Gravel Fill & Compaction

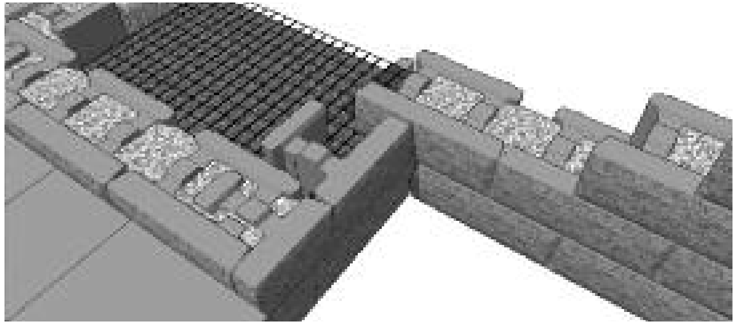
Fill the reinforced zone with a washed 1/4" angular chip gravel and compact.



3 Geogrid Layer

Include geogrid reinforcement within each course of steps to reduce settlement.



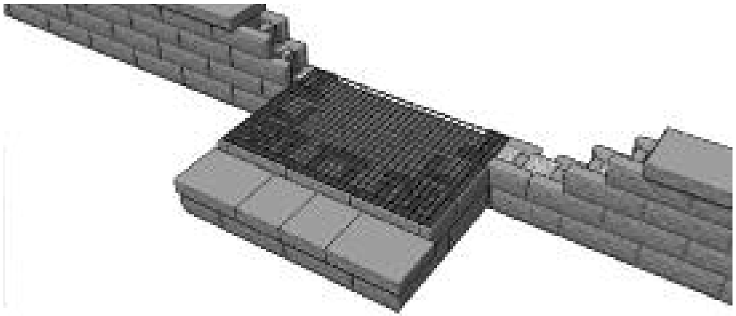


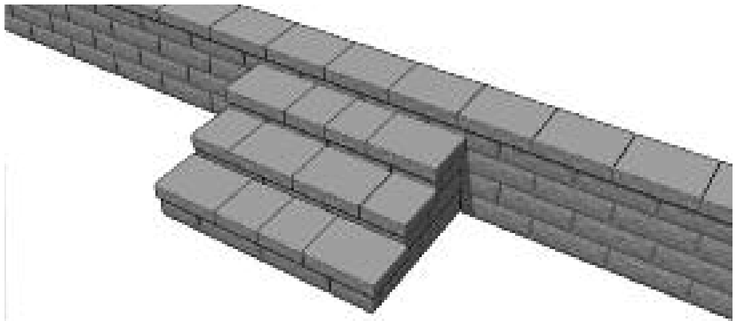
4 Tread/Cap Units

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 3/4" on either side.

5 Second Step & Cutting

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. **Riser units do not rest on the course below.**





6 Gravel Fill, Compaction & Geogrid Layer

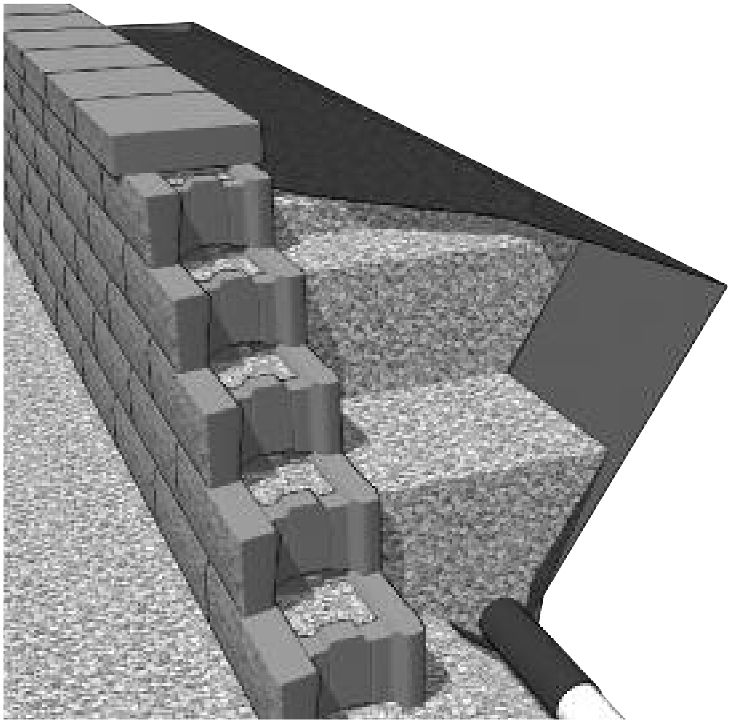
Fill with gravel, compact, and place another layer of geogrid reinforcement.

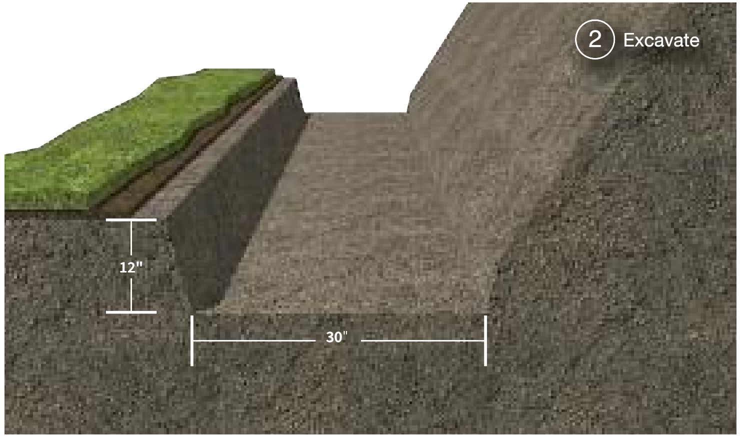
7 Repeat

Repeat until desired stair height is achieved. **Railing may be required, depending on local building codes.**

Gravity Wall Installation

The following are the basic steps involved in constructing a conventional (non-geogrid reinforced) BroadStone™ 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.



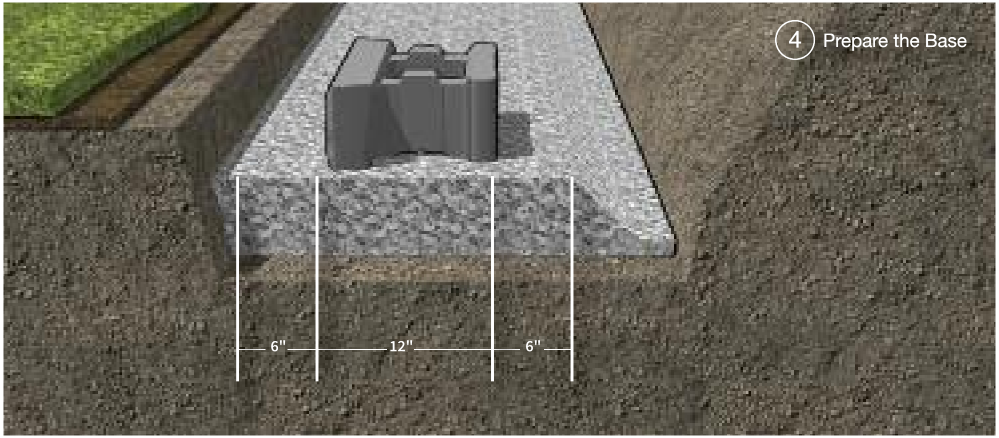


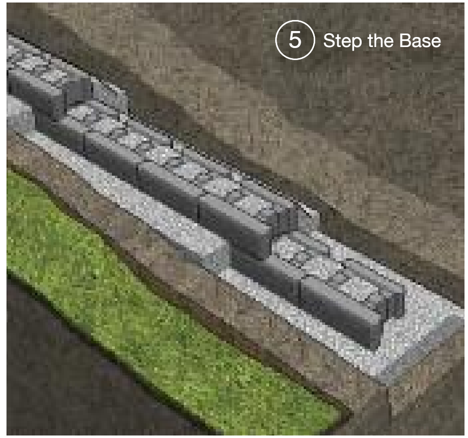
Plan Your Wall

With your final design in hand, 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 1/4" setback per course.

Excavate

Excavate a trench for the granular base. The front of the trench should be 6" from the planned face of the wall. The trench should be a minimum of 24" wide (front to back) and minimum 12" deep. This depth assumes at least one unit is buried (NCMA requires a minimum 6" embedment) plus the compacted granular base minimum depth of 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 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 Engineer of Record.





Verify Foundation Subgrade

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

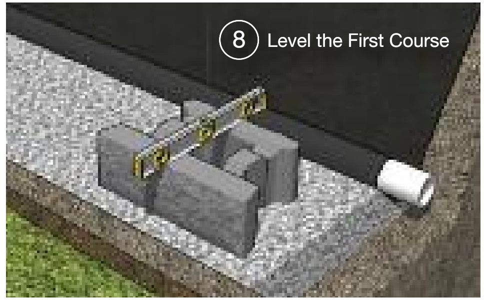
Prepare the Compacted Granular Base

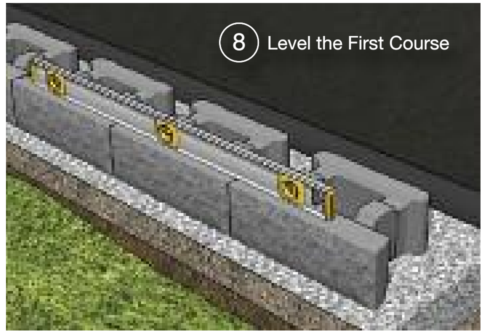
Start the base at the lowest elevation of the wall. The base should be composed of well-graded, free-draining (less than 5% fines), angular granular material (commonly referred to as 3/4" minus or road base) and typically compacted to between 95% Standard Proctor Density or as directed by the Engineer of Record. The minimum base thickness is 6" or as required by the Engineer of Record to reach competent founding soil. A layer of unreinforced concrete 2" thick may be placed on top of the granular material to provide a durable levelling surface for the base course. At the direction of the Engineer of Record, geotextile might be required under the granular base. The minimum base dimensions are 24" wide (front to back) and 6" deep. The additional 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. Always work from the lowest to highest elevation. 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 the unit height of the course. The 1/4" offset (batter) must be accounted for at each step.

TIP For more information on drainage, refer to the Internal Drainage section on page 40.





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.

TIP The first course of BroadStone™ units can be flipped upside down when placing on a concrete base. This eliminates the need to remove the lugs.

Place the Drain

Various options for drain placement may exist, depending on how the pipe is to be outlet. 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 6" area behind the base, place the approved drain tile on top of the filter cloth and minimal granular coverage.

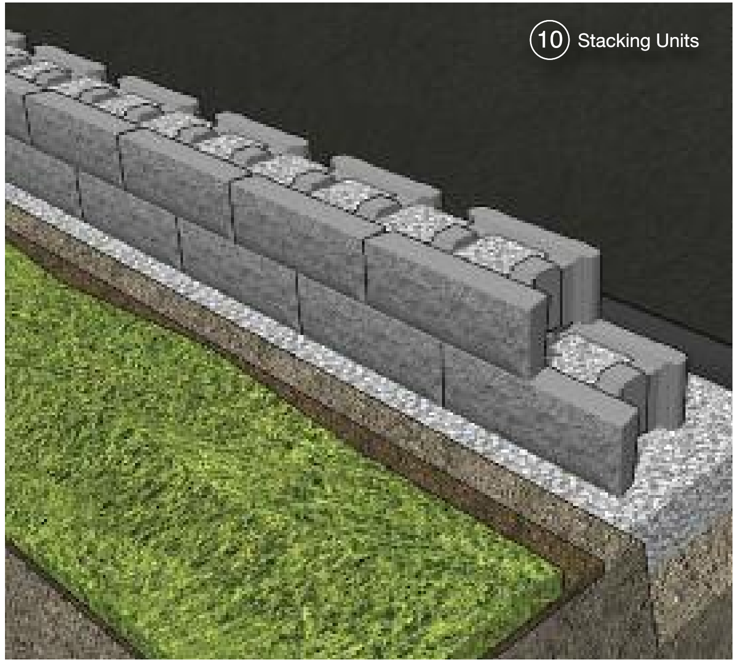
Place the First Course

Position a level string to mark location of the back of the first course (should be 12" from the wall face). Place the first course of BroadStone™ 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.

Fill Cores

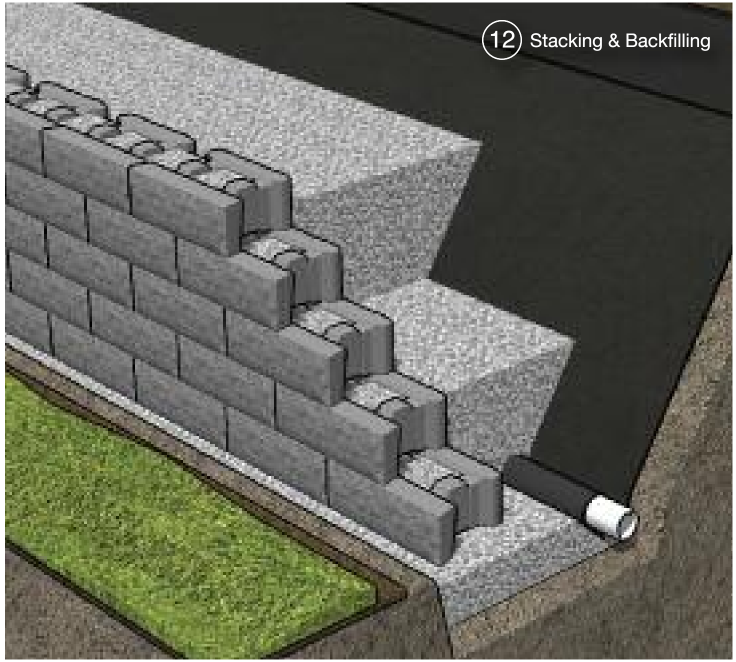
Fill block cores with a free-draining, gap graded gravel. Ideally a 1/4-1/2", washed, angular material should be used. Tamp the fill level with the top of the BroadStone™ units.



Stack Units

Sweep debris from the 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.

TIP BroadStone™ cores align in a 50% overlap running bond for easy core filling and compaction.



Backfill Drainage Material

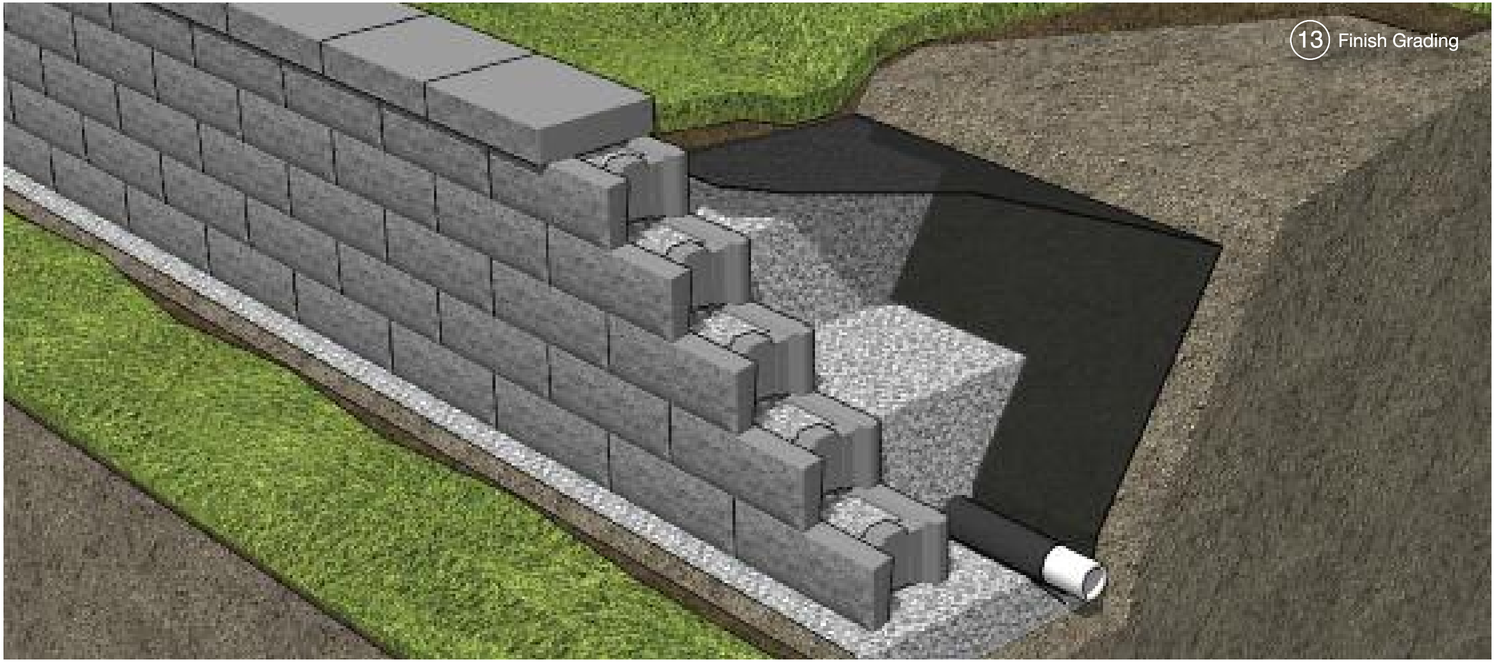
A free-draining, gap graded gravel (1/4-3/4" washed, angular) drainage material is placed immediately behind the wall facing and compacted with a light manual tamper. The drainage layer must be a minimum of 12" thick and protected from the native material by filter cloth.

Continue Stacking and Backfilling

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

Place Cap Units

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



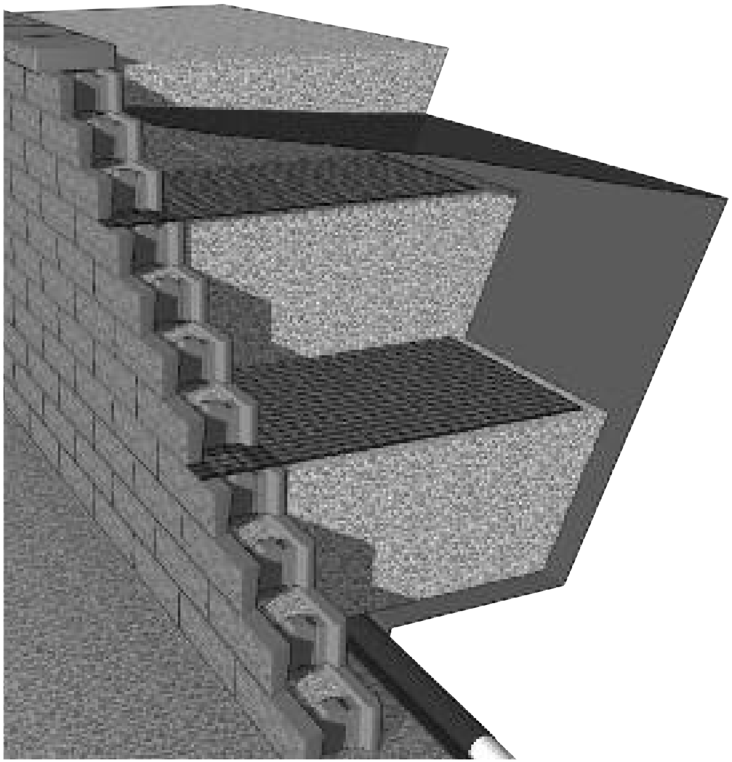
Encapsulate the Drainage Layer and Finish Grading

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 3 ft. 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 behind the wall units.

TIP For more information on proper swale requirements, refer to the External Drainage Section on page 42.

Geogrid Reinforced Wall Installation

The following are the basic steps involved in constructing a geogrid reinforced BroadStone™ 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, 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 ¼" setback per course.

Excavate Reinforced Zone

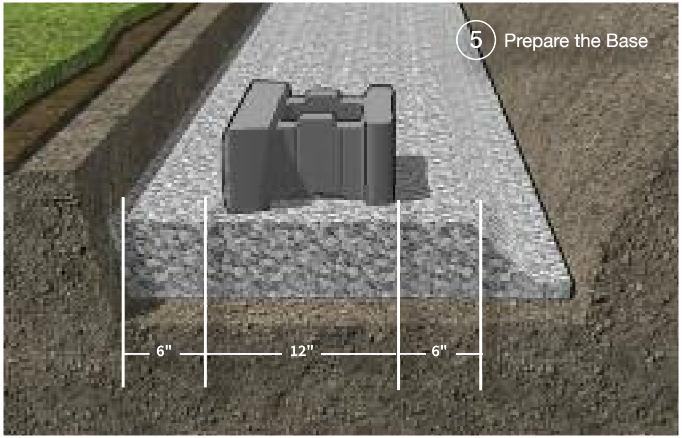
The excavation must be carefully planned and consider several elements. Based on the type of soil being excavated, the Engineer of Record must determine the maximum allowable "cut" angle the excavation can sustain. This angle ensures the stability of the excavation during construction. The required geogrid length (as shown in the design) plus 6" defines the minimum width at the base of the excavation. Measuring from 6" in front of the wall face, extend a line back to 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 6" past the proposed face of the wall.

Excavate

Excavate a trench for the granular base. The front of the trench should be 6" from the planned face of the wall. The trench should be a minimum of 24" wide (front to back) and minimum 12" deep. This depth assumes at least one unit is buried (NCMA requires a minimum 6" embedment or 10% of wall height) plus the compacted granular base minimum depth of 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 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 Engineer of Record. 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.



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 5% fines), angular granular material (commonly referred to as 3/4" minus or road base) and typically compacted to between 95% Standard Proctor Density or as directed by the Engineer of Record. The minimum base thickness is 6" or as required by the Engineer of Record. A layer of unreinforced concrete 2" thick may be placed on top of the granular material to provide a durable levelling surface for the base course. The minimum base dimensions are 24" wide (front to back) and 6" deep. The additional 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 the unit height of the course. The 1/4" offset must be accounted for at each step.

TIP For more information on drainage, refer to the Internal Drainage Section on page 40.

Place Filter Cloth

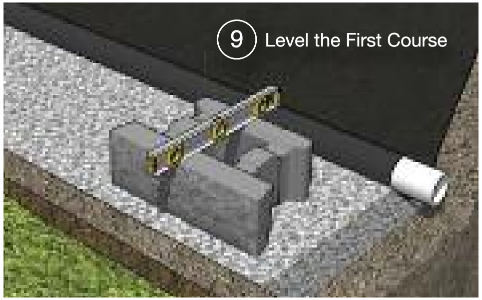
Lay the approved filter fabric (geotextile) along the bottom of the rear 6" of the excavation and extend up the exposed cut face to the proposed wall height. Leave adequate material at the top to fold back towards the wall (completely containing the infill material). Stake the filter cloth against the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

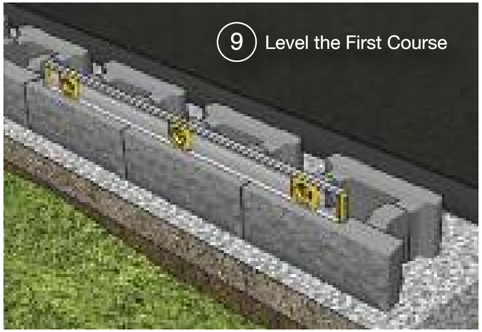
TIP The first course of BroadStone™ units can be flipped upside down when placing on a concrete base. This eliminates the need to remove the lugs.

Place the Drain

Various options for drain placement may exist, depending on how the pipe is to be outlet. 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 6" area behind the base, place the approved drain tile on top of the filter cloth and minimal granular coverage.

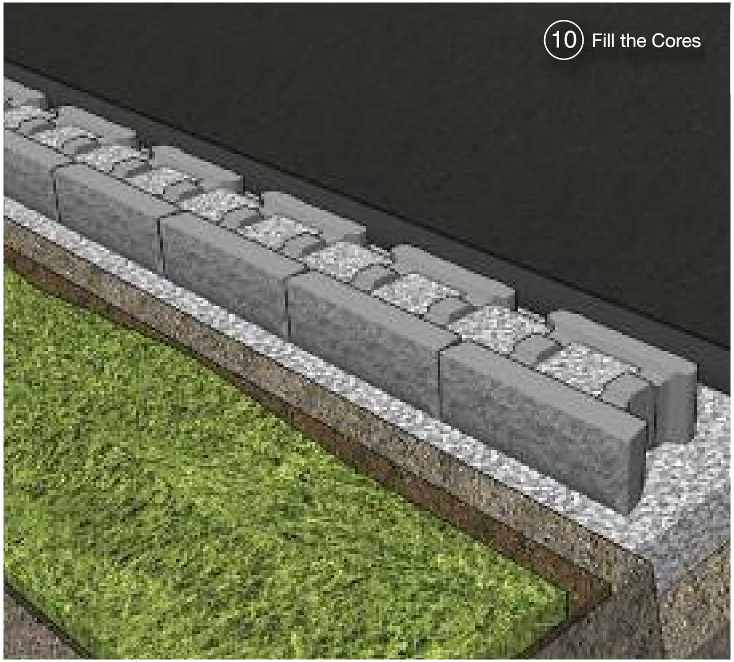


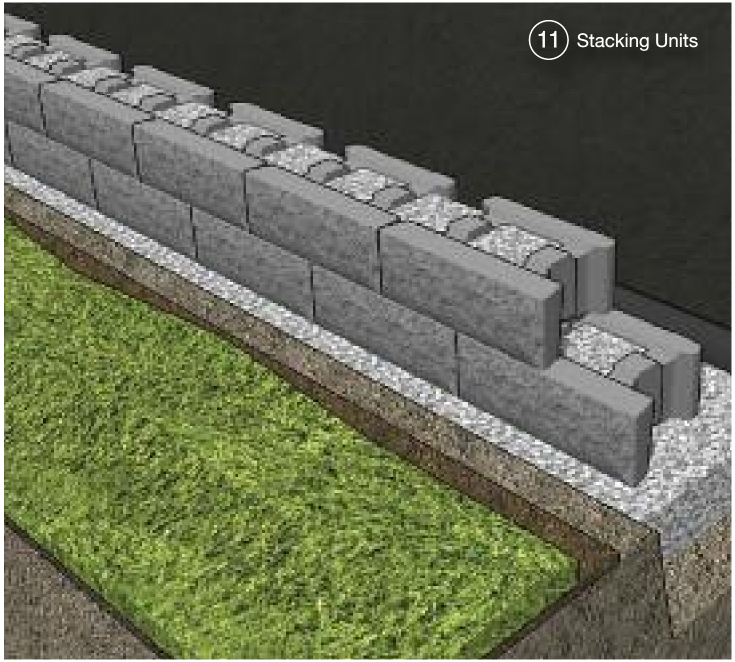


Place the First Course

Position a level string to mark location of the back of the first course (should be 12" from the wall face). Place the first course of BroadStone™ 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.





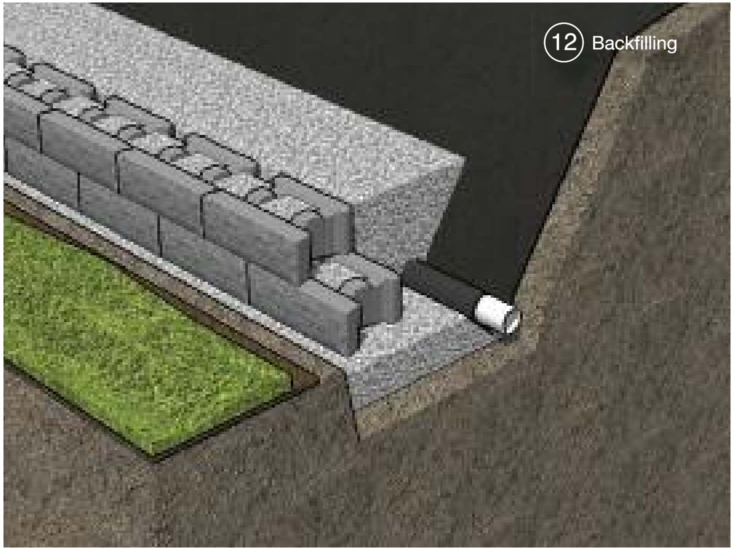
Fill Cores

Fill block cores with a free-draining, gap graded gravel. Ideally a 1/4-1/2", washed, angular material should be used. Tamp the fill level with the top of the BroadStone™ units.

Stack Units

Sweep debris from the 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.

TIP BroadStone™ cores align in a 50% overlap running bond for easy core filling and compaction.



Backfill Drainage Material

Begin backfilling the wall, using an imported, well-graded, free-draining (less than 5% fines), angular granular material. In cases where the on-site material meets the minimum standards set out by the NCMA (Refer to NCMA Design Manual, 3rd Edition), it is possible to use native soils as backfill. However, additional considerations are required for drainage, reinforcements requirements, etc. The native soils must be properly assessed and the applicable design parameters provided to the Engineer of Record.

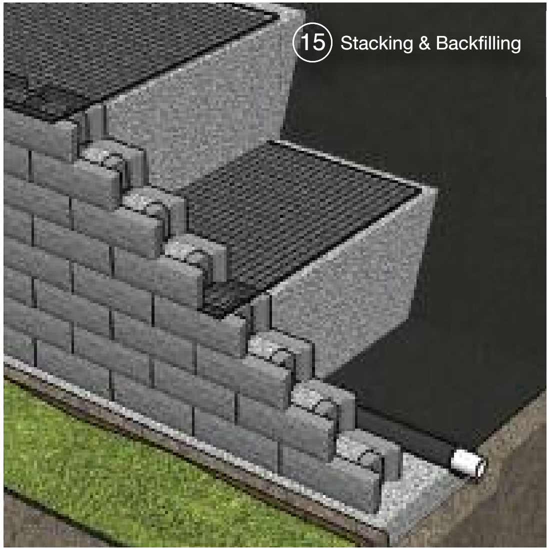
The infill material is placed in maximum 6-8" lift thicknesses and compacted to a minimum of 95% Standard Proctor Density. The compaction must be checked by the Engineer of Record at regular intervals. Continue backfilling up to the elevation of the first layer of geogrid reinforcement. Caution must be taken to ensure the allowable lift thickness is not exceeded and/or heavy compaction equipment is not operated within 3 ft. 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.

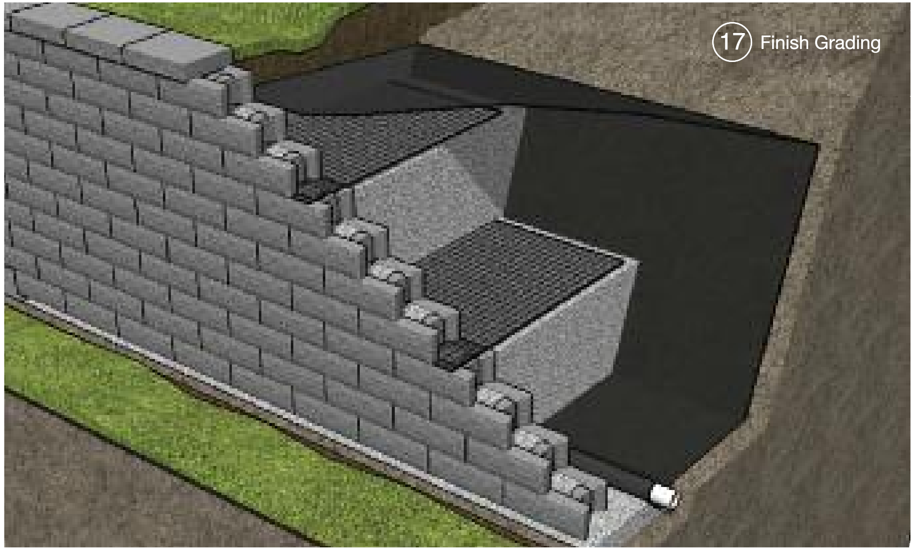
Install Geogrid Reinforcement

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 BroadStone™ units are free of debris, lay the geogrid on top of the units to within 1" of the face. Place the next course of BroadStone™ 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 BroadStone™ unit, allowing the geogrid to be laid out horizontally.

Backfill Over Geogrid Reinforcement

Backfill the 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 BroadStone™ units, backfilling, and laying the geogrid reinforcement as described above until the desired wall height is reached.

Place Cap Units

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

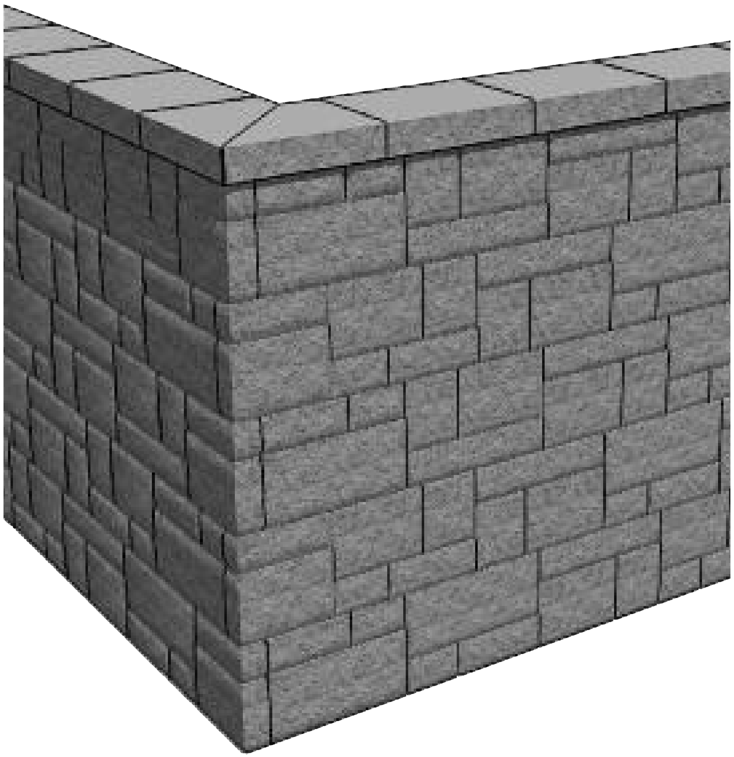
Encapsulate the Granular Infill and Finish Grading

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 3 ft. 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 behind the wall units.

TIP For more information on proper swale requirements, refer to the External Drainage Section on page 42.

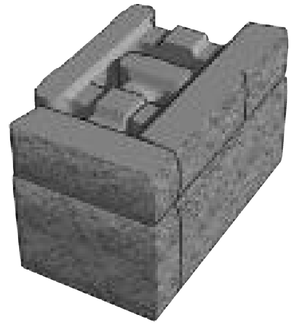
Ashlar Pattern Walls

A multi-height, ashlar pattern is easily made by stacking BroadStone™ units of different heights. **Always complete a stack before beginning the adjacent stack.**



Ashlar Outside Corners

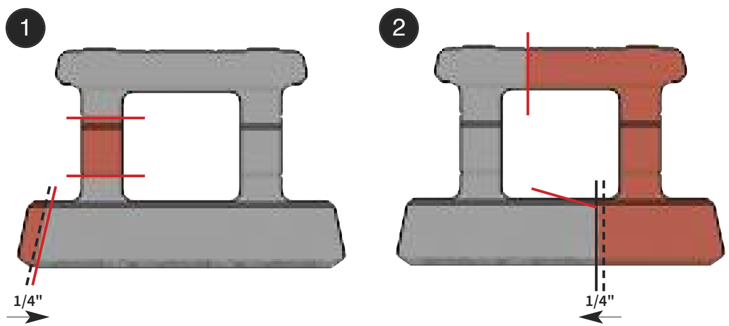
When making corners with the ashlar pattern stacks, the bottom unit of the stack is made using the normal procedure (refer to Making Outside Corner Units). However, the top blocks in the stack require a slightly different cut pattern to ensure the top and bottom unit edges are flush, allowing for a tight fit when abutting the adjacent stack. Using the pattern below, cut and chisel the units 1/4" inwards from the pre-formed score line as indicated.



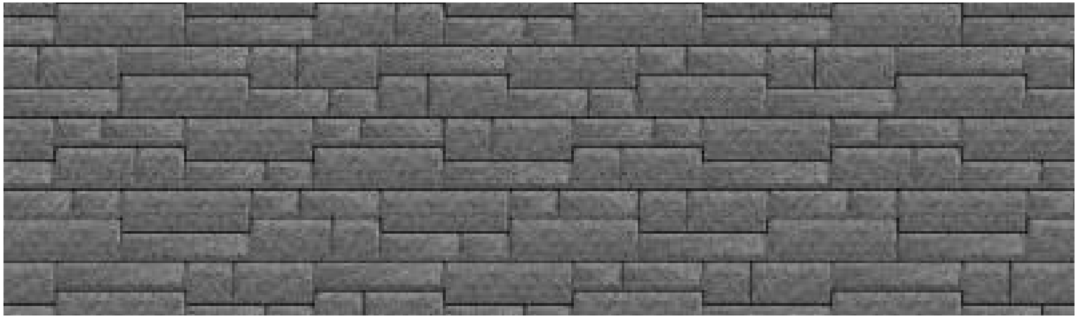
Top Unit Cut Pattern

Interlocking corner units MUST be filled and tamped with washed 1/4" angular chip gravel.

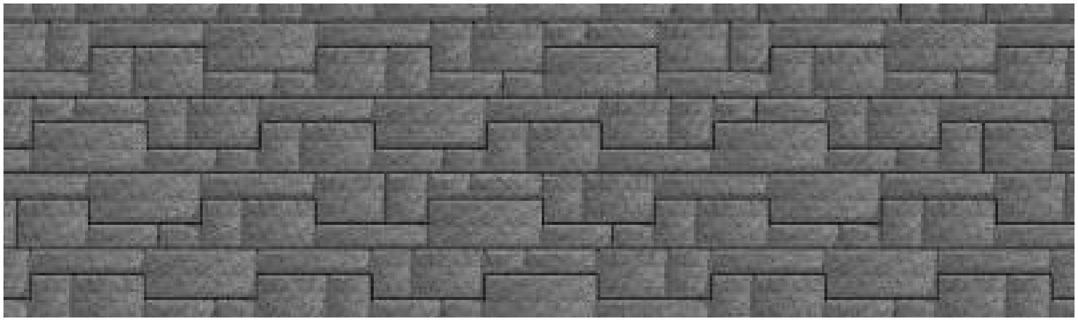
Remove — Saw Cut — Chisel - - - - Score Line



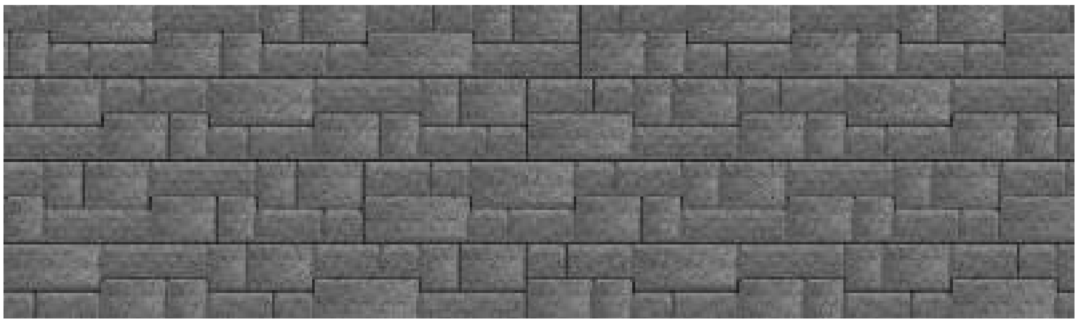
4 & 6
Ashlar



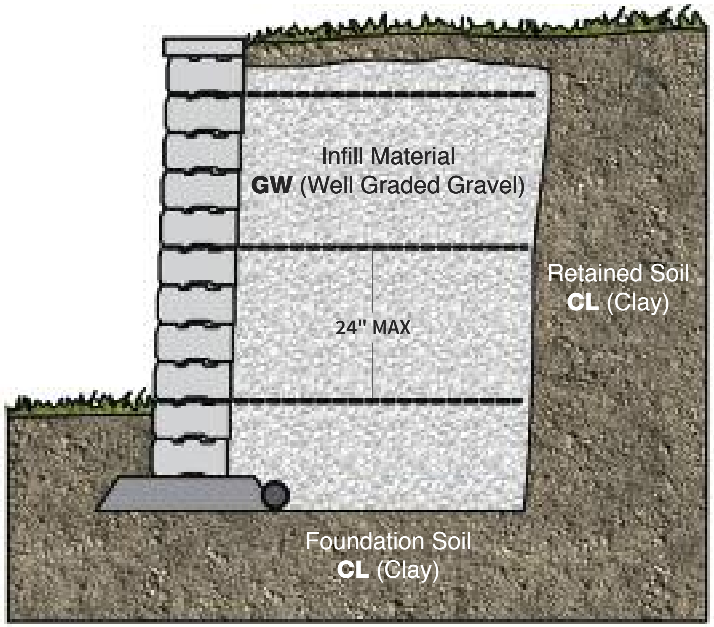
4 & 8
Ashlar



6 & 8
Ashlar

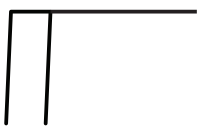


Soil Type: Imported Gravel & Clay



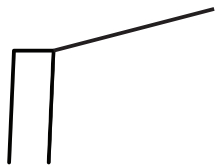
Soil Condition	Description	Φ-degrees	Unit Weight (g-Lb/cu.ft)
Infill (Reinforced)	**GW** Well graded gravel, gravel sand, max 5% fine content	35	140
Retained	**CL** Inorganic clays, low-med plasticity	28	125
Foundation	**CL** Inorganic clays, low-med plasticity	28	125
Drainage	**N/A** Infill zone assumed to be free draining material	N/A	N/A

Flat | Pedestrian Load



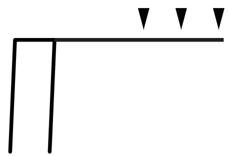
- Nominal 50 psf pedestrian load
- Typical for raised patios & sidewalks

Slope | 3H:1V



- 3H:1V = 18.4° slope above the wall
- Generally a clay or concrete swale is required for proper drainage

Heavy Traffic

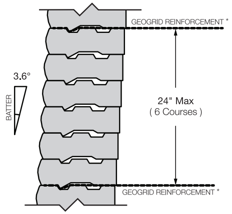


- NCMA traffic load of 250 psf
- Assumes 2 ft. offset at top
- Traffic barrier is typically required

* Geogrid reinforcement to be Mirafi 3XT or approved equivalent.
[1] Drainage layer to be constructed utilizing approved filter fabric.
The above design information is being provided for preliminary estimate and feasibility purposes only, and should not be used for construction. Prior to wall construction, a final design must be supplied by a qualified Engineer licensed in the applicable State. Handrails and/or traffic barriers are not shown but are typically required.

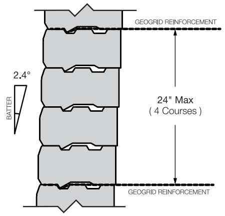
Geogrid Layers | Standard Pattern: Imported Gravel & Clay

BroadStone™ 4



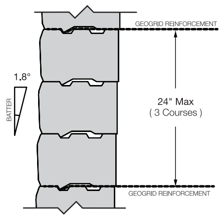
Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
2.8	3.25	2	4	4	4
3.8	4.25	2	4	4	4
4.7	5.25	2	4	4.5	4
5.6	6.25	3	4.5	5	5
6.5	7.25	3	5	5.5	5.5
7.4	8.25	4	5.5	6.5	6
8.3	9.25	4	6.5	7	6.5
9.2	10.25	5	7	7.5	7.5

BroadStone™ 6



Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
2.8	3.25	2	4	4	4
3.8	4.25	2	4	4	4
4.7	5.25	2	4	4.5	4
5.6	6.25	3	4.5	5	5
6.5	7.25	3	5	5.5	5.5
7.4	8.25	4	6	6.5	6
8.3	9.25	4	6.5	7	7
9.2	10.25	5	7	8	7.5

BroadStone™ 8

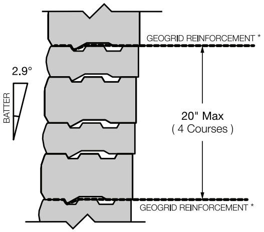


Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
3.1	3.58	2	4	4	4
3.8	4.25	2	4	4	4
4.4	4.92	2	4	4	4
5.0	5.58	2	4	4.5	4.5
5.6	6.25	3	4.5	5	5
6.2	6.92	3	5	5.5	5.5
6.8	7.58	3	5.25	6	6
7.4	8.25	4	5.75	6.5	6.5
8.0	8.92	4	6	7	6.5
8.6	9.58	4	6.5	7.5	7
9.3	10.25	5	7	8	7.5

Soil Type: Imported Gravel & Clay

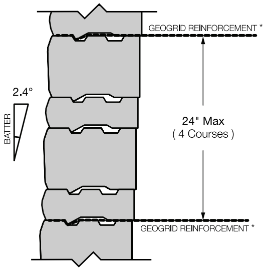
Geogrid Layers | Ashlar Pattern: Imported Gravel & Clay

4 & 6 Ashlar



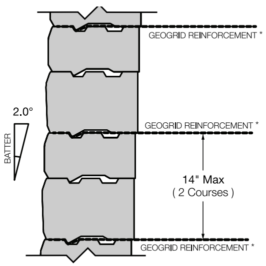
Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
3.1	3.58	2	4	4	4
3.9	4.42	2	4	4	4
4.7	5.25	3	4	4.5	4.5
5.5	6.08	3	4.5	5	5
6.2	6.92	4	5	5.5	5.5
7.0	7.75	4	5.5	6.5	6
7.7	8.58	5	6	7	6
8.5	9.42	5	6.5	7.5	6.5
9.2	10.25	6	7	8	7

4 & 8 Ashlar



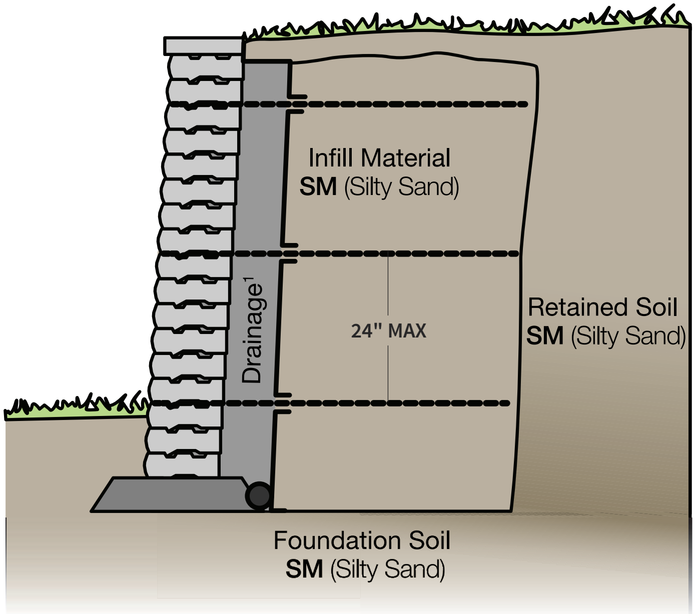
Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
2.8	3.25	2	4	4	4
3.8	4.25	2	4	4	4
4.7	5.25	2	4	4	4
5.6	6.25	3	4.5	5	5
6.5	7.25	3	5	5.5	5.5
7.4	8.25	4	6	6.5	6
8.3	9.25	4	6.5	7	7
9.2	10.25	5	7	8	7.5

6 & 8 Ashlar



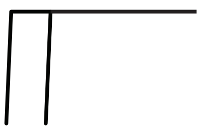
Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
3.3	3.75	2	4	4	4
4.4	4.92	3	4.5	4.5	4.5
5.5	6.08	4	5	5.5	5
6.5	7.25	5	5.5	6.5	5.5
7.6	8.42	6	6.5	7	6.5
8.6	9.58	7	7	8	7
9.7	10.75	8	8	9	8

Soil Type: Silty Sands



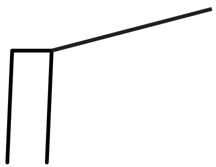
Soil Condition	Description	Φ-degrees	Unit Weight (g-Lb/cu.ft)
Infill (Reinforced)	**SM** Silty Sands	30	125
Retained	**SM** Silty Sands	30	125
Foundation	**SM** Silty Sands	30	125
Drainage	**Free Draining Material** in accordance with NCMA recommendations	N/A	N/A

Flat | Pedestrian Load



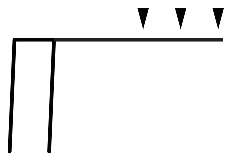
- Nominal 50 psf pedestrian load
- Typical for raised patios & sidewalks

Slope | 3H:1V



- 3H:1V = 18.4° slope above the wall
- Generally a clay or concrete swale is required for proper drainage

Heavy Traffic

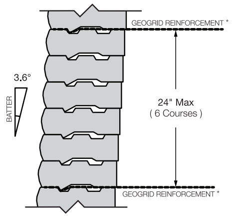


- NCMA traffic load of 250 psf
- Assumes 2 ft. offset at top
- Traffic barrier is typically required

* Geogrid reinforcement to be Mirafi 3XT or approved equivalent.
[1] Drainage layer to be constructed utilizing approved filter fabric.
The above design information is being provided for preliminary estimate and feasibility purposes only, and should not be used for construction. Prior to wall construction, a final design must be supplied by a qualified Engineer licensed in the applicable State. Handrails and/or traffic barriers are not shown but are typically required.

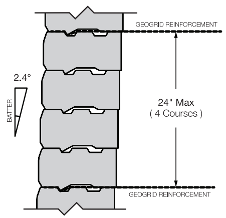
Geogrid Layers | Standard Pattern: Silty Sands

BroadStone™ 4



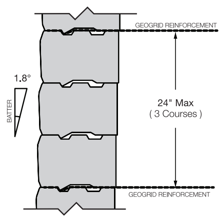
Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat |** Pedestrian Load Grid Length (ft.)	**Slope |** 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
2.8	3.25	2	4	4	4
3.8	4.25	2	4	4	5
4.7	5.25	2	4.5	4.5	5.5
5.6	6.25	3	5.5	5.5	6.5
6.5	7.25	3	5.5	6.5	6.5
7.4	8.25	4	6.5	7	7.5
8.3	9.25	4	7.5	8	8
9.2	10.25	5	8	9	9

BroadStone™ 6



Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat |** Pedestrian Load Grid Length (ft.)	**Slope |** 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
2.8	3.25	2	4	4	4
3.8	4.25	2	4.5	4.5	4.5
4.7	5.25	2	4.5	5	5.5
5.6	6.25	3	5.5	5.5	6.5
6.5	7.25	3	6	6.5	7
7.4	8.25	4	6.5	7.5	7.5
8.3	9.25	4	7.5	8	8.5
9.2	10.25	5	8	9	9

BroadStone™ 8



Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat |** Pedestrian Load Grid Length (ft.)	**Slope |** 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
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3.8	4.25	2	4.5	4.5	4.5
4.4	4.92	2	4.5	4.5	5.5
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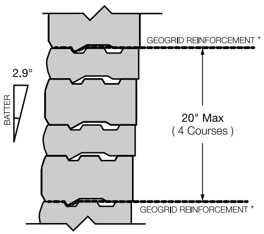
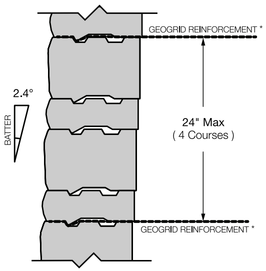
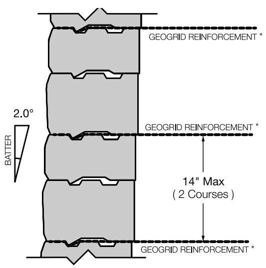
6.8	7.58	3	6.5	6.5	7.5
7.4	8.25	4	6.5	7.5	7.5
8.0	8.92	4	7	8	8
8.6	9.58	4	7.5	8.5	8.5
9.3	10.25	5	8	9	9

Geogrid Layers | Ashlar Pattern: Silty Sands

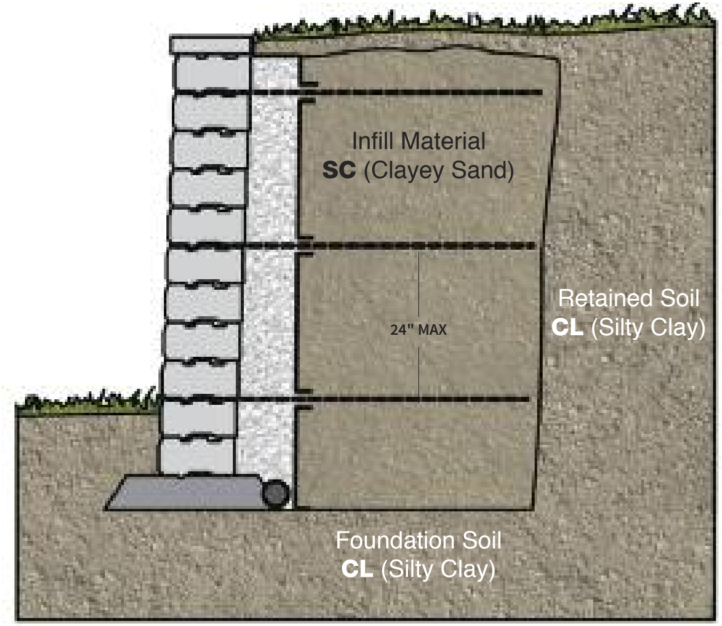
	Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
4 & 6 Ashlar	3.1	3.58	2	4	4	4
	3.9	4.42	2	4	4.5	5
	4.7	5.25	3	4.5	5	5.5
	5.5	6.08	3	5	5.5	6
	6.2	6.92	4	5.5	6.5	6.5
	7.0	7.75	4	6	7	7
	7.7	8.58	5	6.5	8	7.5
	8.5	9.42	5	7	8.5	8
	9.2	10.25	6	8	9	9
4 & 8 Ashlar	2.8	3.25	2	4	4	4.5
	3.8	4.25	2	4.5	4.5	4.5
	4.7	5.25	2	5	5	5.5
	5.6	6.25	3	5.5	5.5	6
	6.5	7.25	3	6	6.5	7
	7.4	8.25	4	6.5	7.5	7.5
	8.3	9.25	4	7.5	8	8
	9.2	10.25	5	8	9	9
6 & 8 Ashlar	3.3	3.75	2	4	4	4.5
	4.4	4.92	3	4.5	5	5
	5.5	6.08	4	5.5	6	6
	6.5	7.25	5	6	7	6.5
	7.6	8.42	6	7	8	8
	8.6	9.58	7	7.5	9	8.5
	9.7	10.75	8	8.5	10	9.5





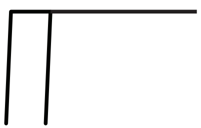


Soil Type: Clays & Sands



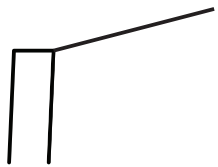
Soil Condition	Description	Φ-degrees	Unit Weight (g-Lb/cu.ft)
Infill (Reinforced, Pl<15,<35% fines)	**SC** Clayey Sands	28	125
Retained (Pl<50)	**CL** Silty Clay	23	120
Foundation (Pl<50)	**CL** Silty Clay	23	120
Drainage	**Free Draining Material** in accordance with NCMA recommendations	N/A	N/A

Flat | Pedestrian Load



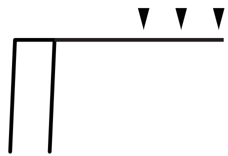
- Nominal 50 psf pedestrian load
- Typical for raised patios & sidewalks

Slope | 3H:1V



- 3H:1V = 18.4° slope above the wall
- Generally a clay or concrete swale is required for proper drainage

Heavy Traffic



- NCMA traffic load of 250 psf
- Assumes 2 ft. offset at top
- Traffic barrier is typically required

* Geogrid reinforcement to be Mirafi 3XT or approved equivalent.
[1] Drainage layer to be constructed utilizing approved filter fabric.
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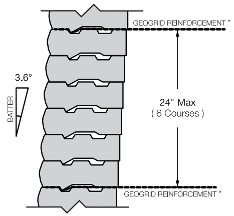
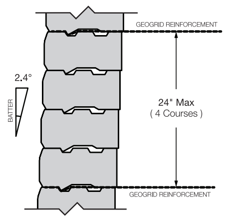
Geogrid Layers | Standard Pattern: Clays & Sands

BroadStone™ 4



Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
2.8	3.25	2	4	4	5
3.8	4.25	2	4.5	5.5	5.5
4.7	5.25	2	5	7	6
5.6	6.25	3	5.5	8.5	6.5
6.5	7.25	3	6.5	9.5	7.5
7.4	8.25	4	7	11	8
8.3	9.25	4	7.5	12	8.5
9.2	10.25	5	8.5	13.5	9.5

BroadStone™ 6



Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
2.8	3.25	2	4	4	4.5
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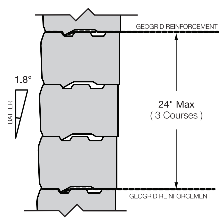
4.7	5.25	2	5	7	6
5.6	6.25	3	6	8.5	6.5
6.5	7.25	3	6.5	9.5	7.5
7.4	8.25	4	7	11	8
8.3	9.25	4	8	12	9
9.2	10.25	5	8.5	13.5	9.5

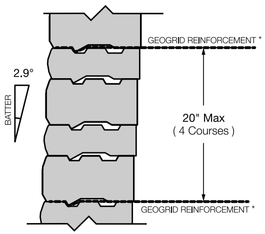
BroadStone™ 8



Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
3.1	3.58	2	4	4.5	4
3.8	4.25	2	4.5	5.5	5
4.4	4.92	2	5	6.5	6
5.0	5.58	3	5.5	7.5	6.5
5.6	6.25	3	6	8.5	6.5
6.2	6.92	3	6.5	9	7.5
6.8	7.58	4	7	10	8
7.4	8.25	4	7.5	11	8.5
8.0	8.92	4	8	12	9
8.6	9.58	5	8.5	13	9.5
9.3	10.25	5	9	14	10

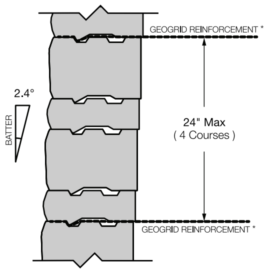
Geogrid Layers | Ashlar Pattern: Clays & Sands

4 & 6 Ashlar



Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
3.1	3.58	2	4	4.5	4.5
3.9	4.42	2	4.5	5.5	5.5
4.7	5.25	3	5	7	6
5.5	6.08	3	5.5	8	6.5
6.2	6.92	4	6	9.5	7
7.0	7.75	4	7	10	8
7.7	8.58	5	7.5	11.5	8.5
8.5	9.42	5	8	12.5	9
9.2	10.25	6	8	14	9.5

4 & 8 Ashlar



Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
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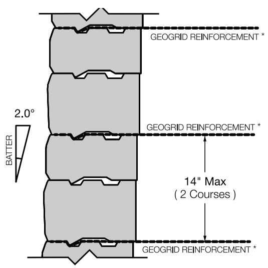
3.8	4.25	2	5	5.5	5.5
4.7	5.25	3	5.5	7	6
5.6	6.25	3	6	8.5	6.5
6.5	7.25	4	7	10	7.5
7.4	8.25	4	7.5	11	8.5
8.3	9.25	5	8.5	12.5	9
9.2	10.25	5	9	13.5	9.5

6 & 8 Ashlar



Exposed Wall Height (ft.)	Total Wall Height (ft.)	No. Geogrid Layers	**Flat** | Pedestrian Load Grid Length (ft.)	**Slope** | 3H:1V Grid Length (ft.)	**Heavy Traffic** Grid Length (ft.)
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4.4	4.92	3	4.5	6.5	5.5
5.5	6.08	4	5.5	8	6.5
6.5	7.25	5	6.5	9.5	7.5
7.6	8.42	6	7	11	8
8.6	9.58	7	7.5	13	9
9.7	10.75	8	8.5	14.5	9.5

Internal Drainage

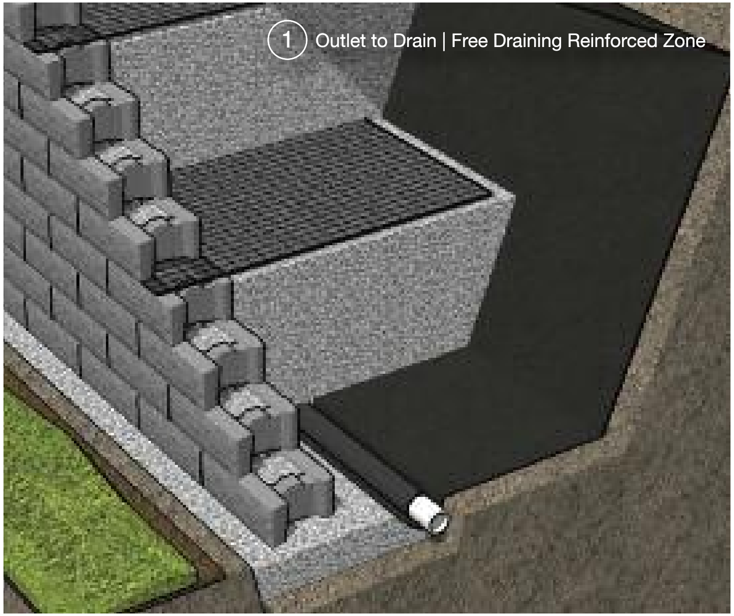
Proper drainage of a segmental retaining wall is one of the most critical aspects of design and construction. Unless otherwise stated, the design assumes that no hydrostatic pressures exist behind the wall. To ensure this condition is met, water flow from all directions and sources must be accounted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

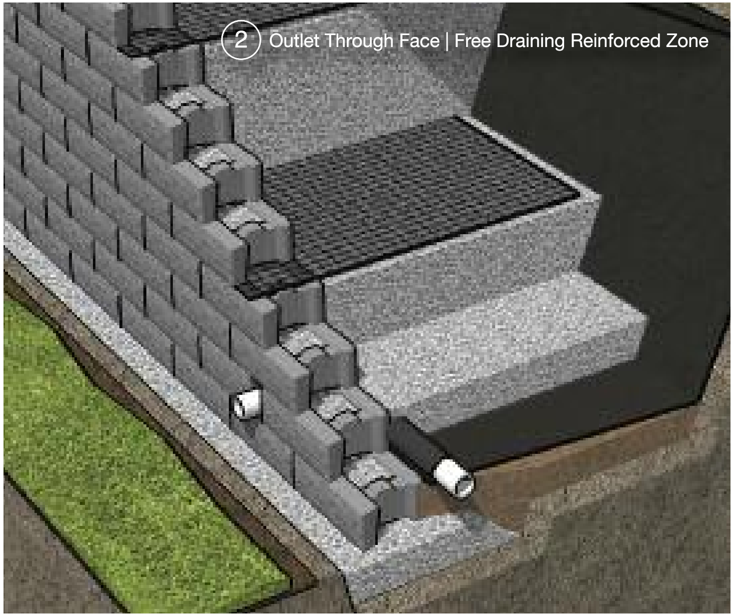
Outlet to Catch Basin / Drain

If the drain is being connected to a catch basin 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 45 ft. on center (or as required by the design). Trimming the shoulders from adjacent units allows the pipe through the wall face without losing the running bond pattern. Seal around the pipe outlet to ensure backfill does not escape.



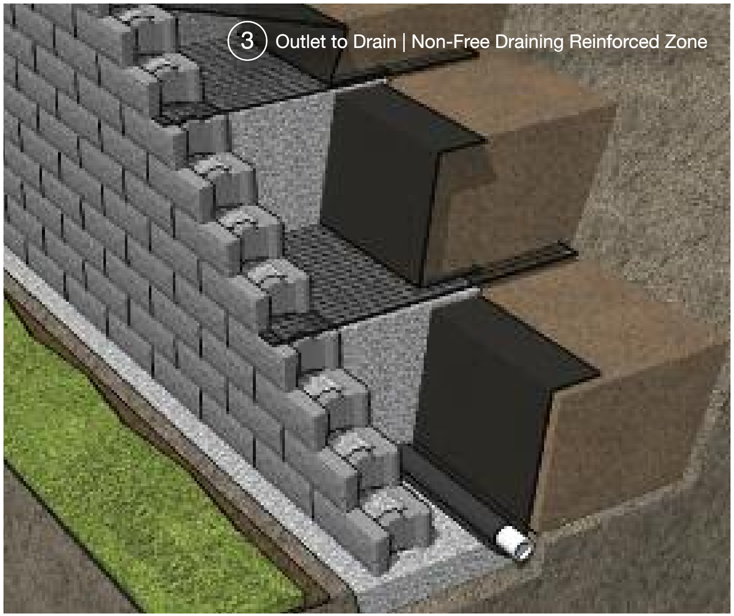


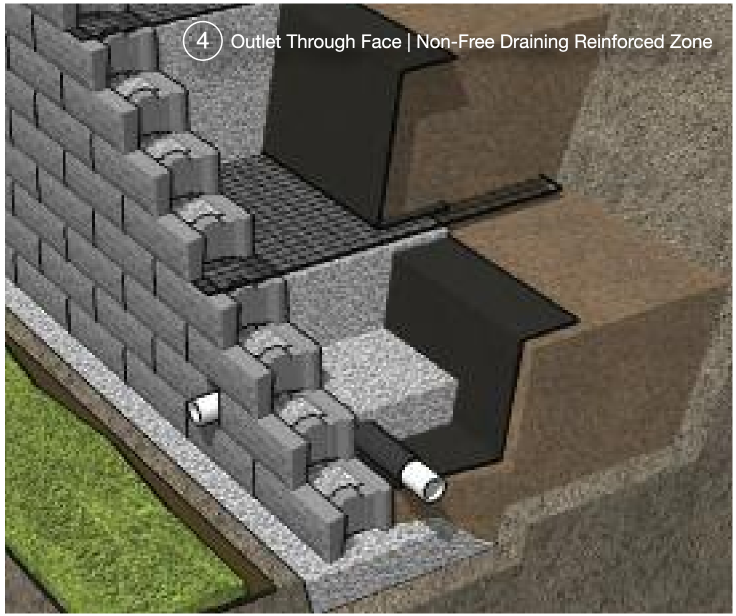
Free-Draining Reinforced Zone

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 10% fines. An approved filter cloth may be required between the reinforced zone and retained/foundation soil and on top of the fill to prevent the migration of fines, depending on the relative gradation of each material. The use of an imported granular material in the reinforced zone has many other advantages besides its good drainage properties.

Non-Free Draining Reinforced Zone

If the infill material being used to construct the reinforced zone is not considered to be free draining (>10% fines), a drainage layer may be required immediately behind the face of the wall. The drainage material must be a minimum 12" thick, composed of a gap-graded, free-draining, angular clean stone. 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 6" and cut. The drainage layer must be fully encapsulated with a 6" overlap at each geogrid elevation as shown.

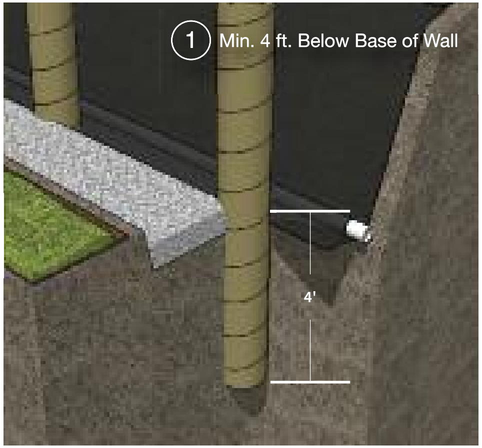


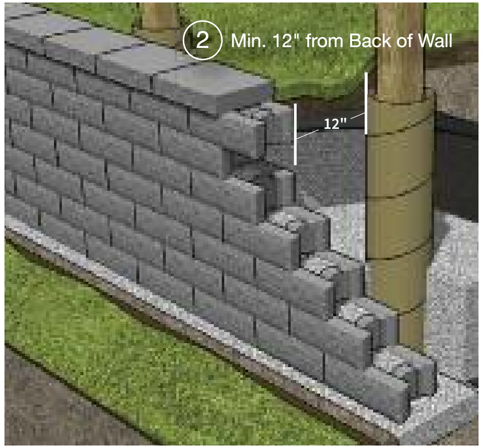


External Drainage

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.

Posts & Obstructions





Gravity SRWs

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

Concrete form tubes, such as QUIKRETE® QUIK-Tube's, 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 form tubes 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 4 ft. 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 (form tubes). Take into account the batter (setback) of the wall and the required offset at the top. It is preferable to leave a 12" buffer zone between the outside of the form tube 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 form tube. Refer to the design for the required depth, and auger the foundation hole into the native subgrade. The form tube length is equal to the total wall height plus the required embedment. Place the form tube into the "socket" of competent subgrade.

Construct the conventional SRW, stacking units and backfilling with drainage material. The recommended drainage material should be lightly compacted with a hand tamper, ensuring proper confinement around the sono-tube. Secure the cap unit and fold filter cloth back over drainage material. Cut filter cloth at centerline of form tube to allow the form tube through, ensuring complete coverage of drainage material. Cover form tubes prior to concrete pour to prevent debris from entering.

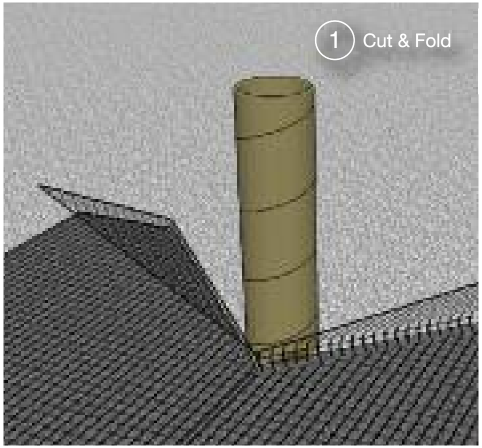
Pour concrete in foundations in accordance with handrail design (reinforcing steel and/or dowels may be required). Install fence and finish grading.

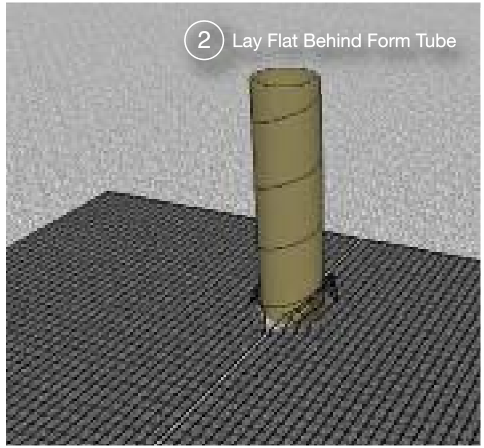
Geogrid-Reinforced SRWs

Loads created by pedestrians and/or wind on the handrails/fences must be incorporated into the geogrid design. As the form tube 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 4 ft.

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

Identify the proposed location of the handrail/fence foundations (form tubes). Take into account the batter (setback) of the wall and the required offset at the top. It is preferable to leave a 12" buffer zone between the outside of the form tube 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 form tube. Place the form tube and backfill around it to hold it in place. Continue stacking units, backfilling, and compacting to 95% Standard Proctor Density until the next geogrid layer is reached.



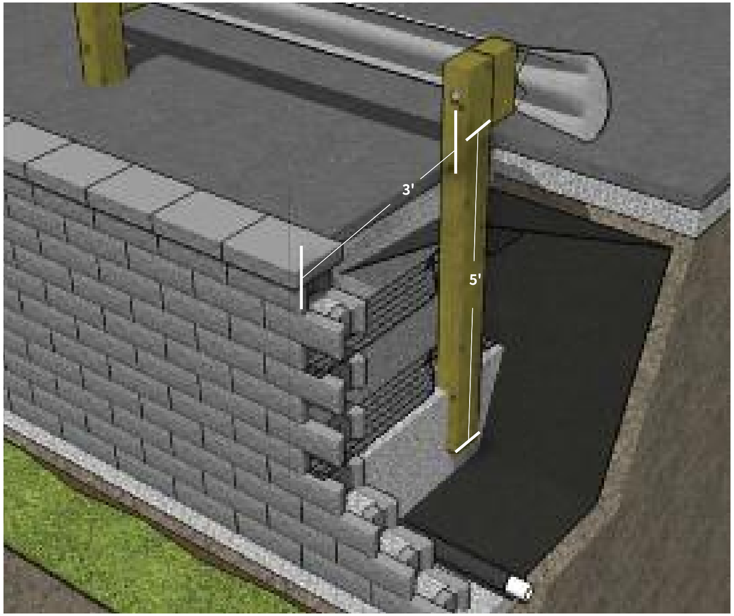


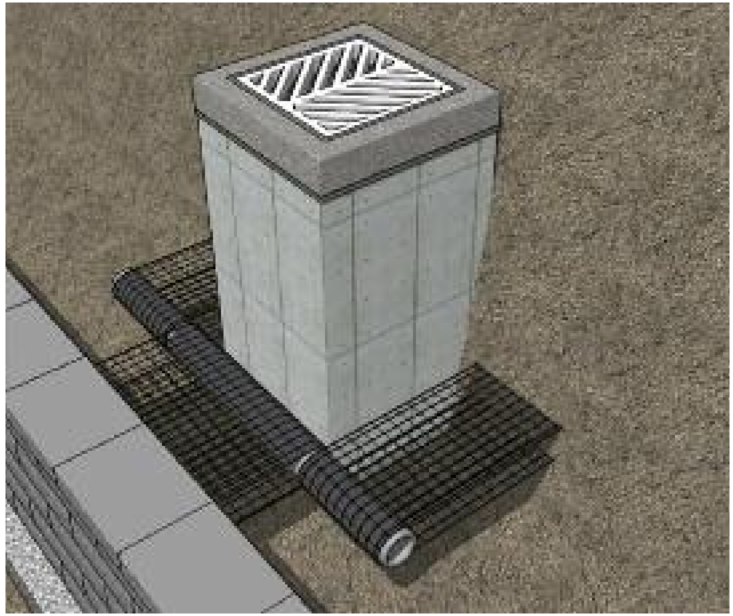
Cut the geogrid perpendicular to the wall along the centerline of the form tube, creating two geogrid panels – one on each side of the form tube. Lay the geogrid flat in front of the form tube. At the intersection with the form tube, fold the geogrid flat against vertical side of the form tube and then around the back, maintaining the edge of the geogrid along the centerline of the form tube. Lay the geogrid flat behind the form tube 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 form tube.

Secure the cap unit and fold filter cloth back over drainage material. Cut filter cloth at centerline of sono-tube to allow the form tube through (similarly to method used to allow form tube to penetrate geogrid layer), ensuring complete coverage of reinforced material. Cover form tubes 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.





Guard Rails

For areas adjacent to roadways and parking lots, flexible steel beam guard rails may be placed behind a geogrid reinforced 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 guard rail posts to be offset a minimum of 3 ft. from the face of the wall, extending a minimum of 5 ft. 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

Select an appropriately sized steel, galvanized 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.

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