

The image shows a modern outdoor patio area featuring a retaining wall made of dark grey, rectangular stone blocks. The wall is built in a staggered pattern. In the background, there are lush green trees and a house with a grey roof. In the foreground, there is a wicker chair with a white cushion and a small table. The patio floor is paved with grey stone tiles. A red banner is at the top right, and another red banner is at the bottom left. The ZenWall Modern logo is in the top right, and the RisiStone logo is in the bottom right.

ZenWall™
Modern

Stylish Serenity

Installation Guide

gravity walls | retaining walls | residential & commercial | steps | planters | pillars | grill islands



RisiStone®
retaining wall systems

ZenWall™
Modern



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Overview of a Successful Project

The following Installation Guide has been provided to mainly address those aspects of Wall construction that are unique and/or proprietary to the ZenWall System. For all general Segmental Retaining Wall construction guidelines, Risi Stone Systems recommends the Contractor refer to the NCMA (*National Concrete Masonry Association*) *Segmental Retaining Walls Best Practice Guide for the Specification, Design, Construction, and Inspection of SRW Systems*. This excellent resource provides the comprehensive level of detail required for successful SRW Projects. Refer to www.ncma.org.

The following procedure is recommended for the construction of segmental retaining walls over 36"(1m) 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 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 Province or State. The Design must synthesize all available information and include cross section and/or elevation view drawings, specifications, calculations, quantities, and related construction details.
- The Design should be checked for Global Stability by the site Geotechnical Engineer.

Pre-Construction meeting

- For larger scale Projects, we recommend that all involved parties (*Designers, Owner's representative, General Contractor, Contractor, Inspecting Engineer, Supplier, etc.*) attend a pre-construction meeting to define schedules 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 (*called the General Review Engineer*).

As much of the General Review is Geotechnical in nature (compaction testing, soil and groundwater assessment) it often makes the most sense to have the Site Geotechnical Engineer conduct the General Review.

Proper General Review of Construction should include 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*).

Understanding the Design

- 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 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 GRE will provide a letter to the owner stating that “the Wall was constructed in General Conformance with the Plans and Specifications”.

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.

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. 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.

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.

Calculations and 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 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.

ZenWall™ Modern System

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

The unique appearance of ZenWall makes it ideal for smaller Landscape type applications, such as garden walls, raised patios, two-sided walls, planters or pillars.

The ZenWall System is a fully engineered, Structural Retaining Wall System. Constructed as either a “Gravity” wall (*no geogrid*) or a Geogrid Reinforced Wall, ZenWall can be used for applications up to 5ft(1.5m) or even higher with proper Design.

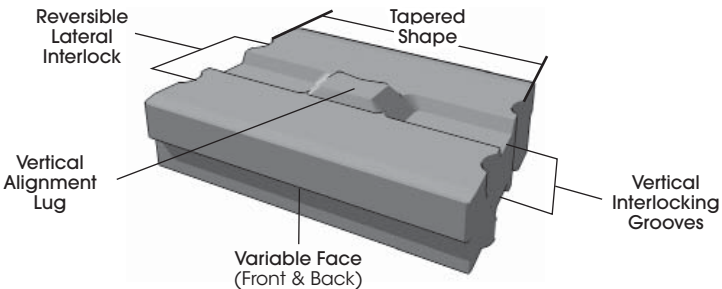
ZenWall™ Blocks	Width	Height	Depth	Weight
Standard				
	13" / 33cm	3" / 7.5cm	9" / 23cm	20lbs / 9kg
Corner				
	14¾" / 38cm	3" / 7.5cm	9" / 23cm	24lbs / 11kg
Cap				
	13" / 33cm	3" / 7.5cm	10¼" / 26cm	25lbs / 11kg
Closed-End Cap*				
	13" / 33cm	3" / 7.5cm	10¼" / 26cm	26lbs / 12kg

**Two (2) Closed-End Cap blocks are included with each pallet layer of Cap units.*

Features & Advantages

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

Feature	Benefit
Variable Appearance	<ul style="list-style-type: none">Wide array of variable faces (ledge size & protrusion) on the front & back of the blocks, provide a random mosaic of light and shadow
Reversible Lateral Interlock	<ul style="list-style-type: none">Designed to be installed Flipped or Rotated, to move ledge position UP or DOWNProvides superior lateral interlock, regardless of how the block is installed (flipped or rotated)
Vertical Interlocking Lug & Groove	<ul style="list-style-type: none">No separate pins or clips to installUnique Lug shape creates a perfectly vertical wall in curved configuration
Tapered Shape	<ul style="list-style-type: none">Allows curved wall configurationProduces final appearance of two block lengths in the wall
Closed-End Caps	<ul style="list-style-type: none">Provides straight factory finished edges, for corners, steps and step-downs.

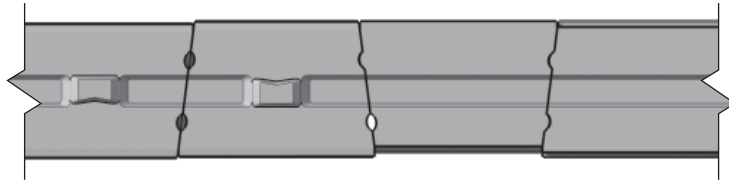


Simple Installation

ZenWall is a modern wall block that is specifically made to be flipped or rotated when installed to randomize protruding elements **UP** or **DOWN**. There are no pins or clips required, everything has been designed into the block. The following will provide easy installation and a beautiful random final appearance to the wall.

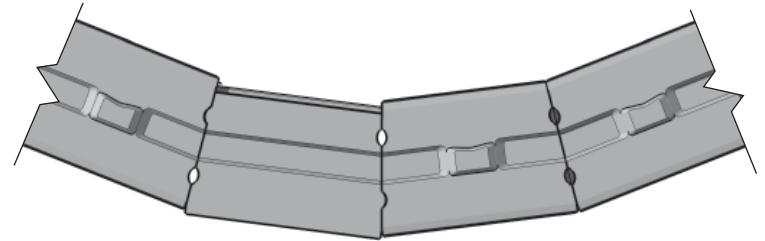
Straight Walls

1



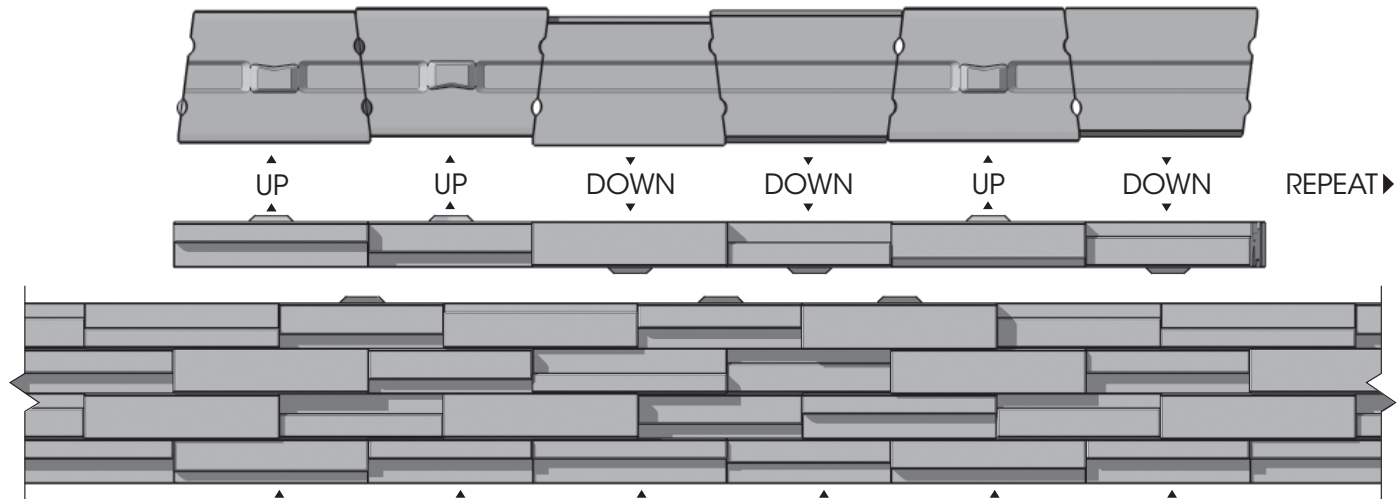
Curved Walls

2



Install blocks with top Alignment Knob in either **UP** or **DOWN** position with the following pattern. The final wall should have 50% of the blocks in the **UP** orientation and 50% in the **DOWN** orientation.

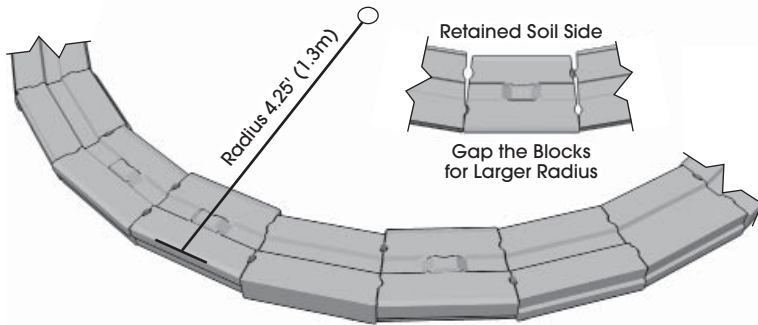
2 Up ► 2 Down ► 1 Up ► 1 Down ► Repeat...



Since the bottom course is normally buried, these blocks can be installed knob in all **UP** position for easier construction.

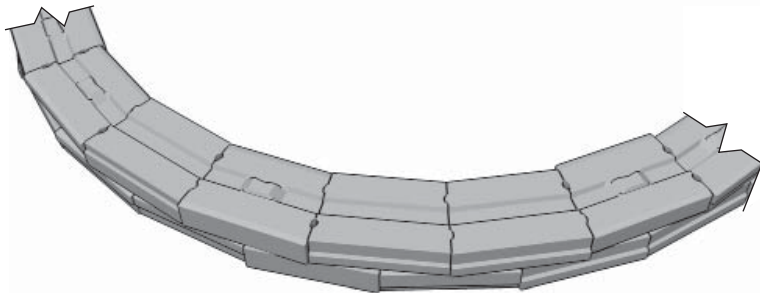
Curved Walls

First Course 1



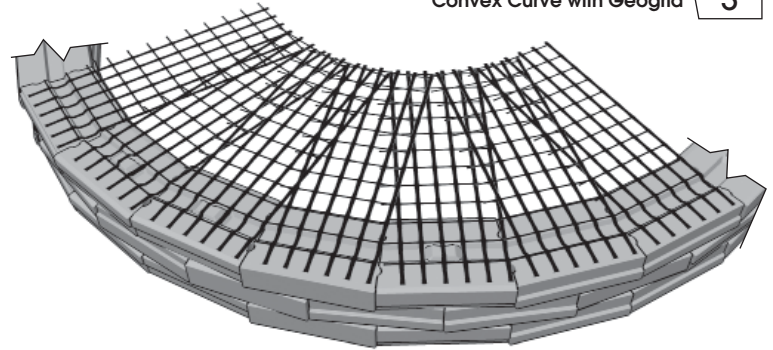
ZenWall will produce a perfect curve with a 4.25' (1.3m) radius. Alternative radius sizes may require cutting especially for seat-walls. Larger convex radius walls can be produced by gapping the blocks as shown.

Second Course 2



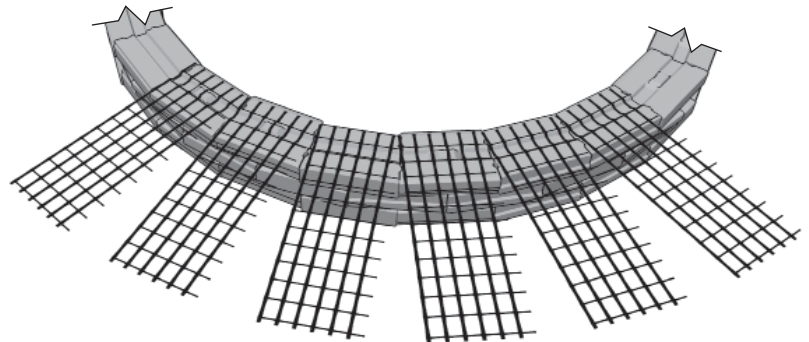
Commence second course placing blocks directly in the middle of the two blocks below. ZenWall's unique Lug shape is designed to automatically align the block in correct location for perfectly vertical walls. Repeat the steps until desired height is achieved, securing the final two courses with concrete adhesive. Finish the wall utilizing Cap blocks and secure with concrete adhesive.

Convex Curve with Geogrid 3



The Geogrid should be placed within 1" (2.5cm) of the front face of the block. Ensure the Geogrid is placed on the ZenWall units so the geogrid does not overlap until it enters the soil zone.

Concave Curve with Geogrid 4

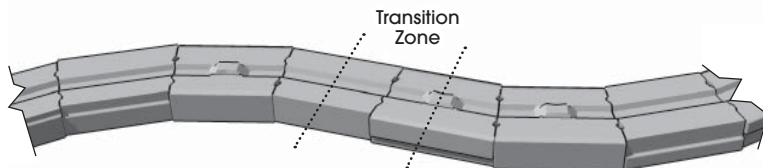


Geogrid should be placed within 1" (2.5cm) of the front face of the block. It will be necessary to have gaps between adjacent sections of geogrid so it does not overlap on top of the units.

Serpentine Walls

First Course

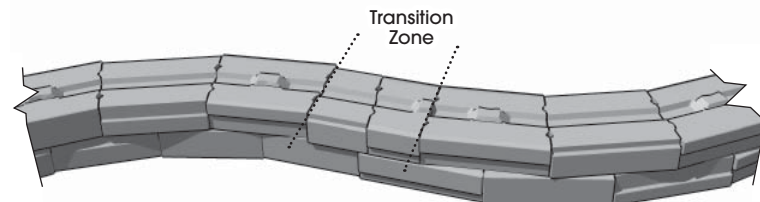
1



ZenWall is designed to create serpentes with a 4.25' (1.3m) curve radius. Layout the wall as shown installing blocks in the straight wall configuration at the Transition Zone. Alternative curve radiuses can be produced, but may require cutting (*Refer to Curved Walls page 9*).

Second Course

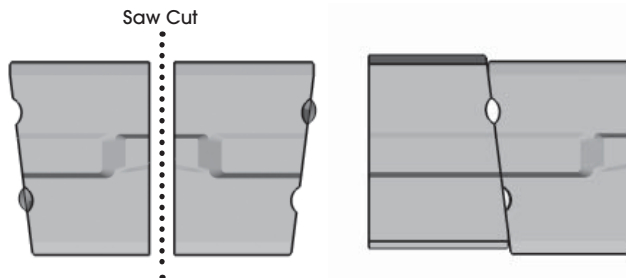
3



Install the two pieces of the cut block in the transition zone as shown. Remove the lateral interlocking Lug on the adjacent blocks.

Cutting Transition

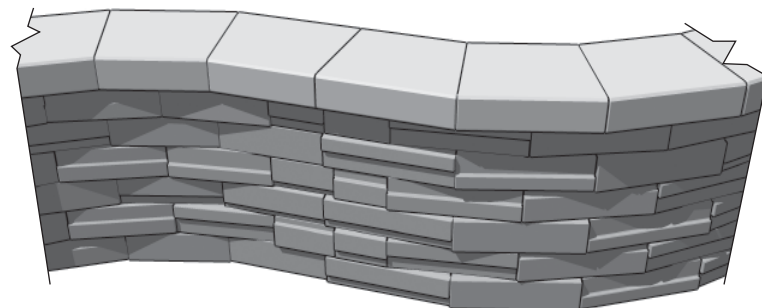
2



Measure and Saw Cut a standard block in half and remove the lateral interlocking Lugs. Install one half in the **DOWN** position.

Finish & Cap

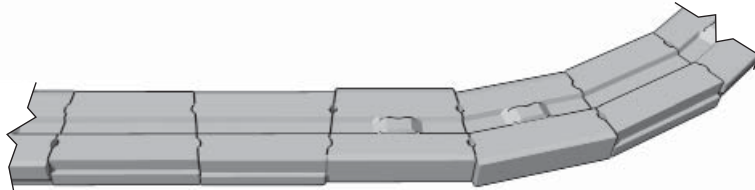
4



Continue to build the wall to desired height, repeating Steps 1-3, securing the final two courses with concrete adhesive. Place tapered Cap blocks as shown, installing in the straight wall configuration at the Transition Zone. Finish the wall utilizing Cap blocks, cut to fit if required. Secure all Caps with concrete adhesive.

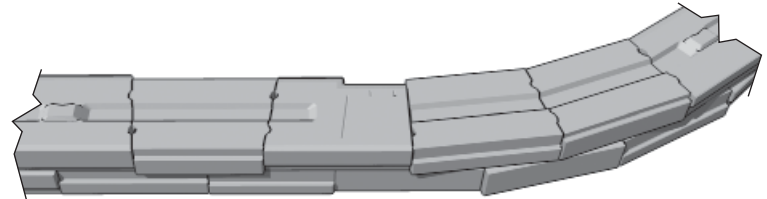
Straight to Curved Transition

First Course 1



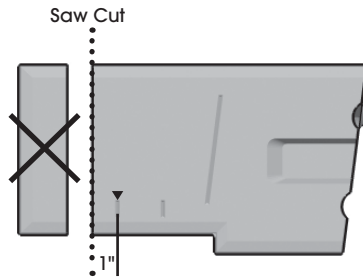
It is easy to transition from straight walls to curve walls using the following instructions. Install the first course as shown to ensure proper alignment.

Second Course 3



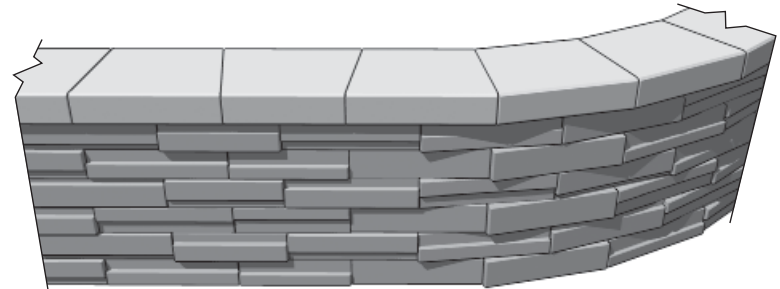
If present, remove the vertical alignment Lug on the previous course where the cut Corner block will be. Remove the lateral interlocking Lugs on the abutting Standard block and install Corner block as shown.

Cutting Transition 2



Using a Corner block, measure and saw cut 1" (2.5cm) from the outer groove Corner alignment mark as shown.

Continue Building 4

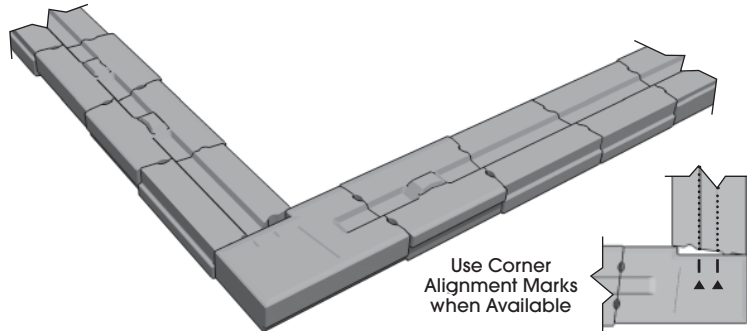


Repeat the steps until desired height is achieved, securing the final two courses with concrete adhesive. Finish the wall utilizing Cap blocks, cut to fit if required. Secure all Caps with concrete adhesive.

Outside 90° Corners

First Course

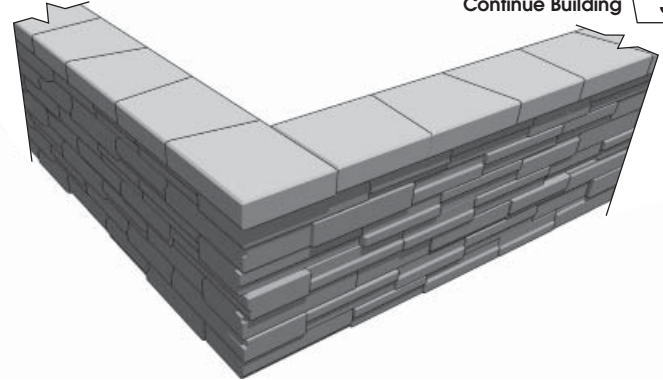
1



Corner blocks should randomly be installed in flipped **UP** or **DOWN** position. Place blocks on the base course leading to the corner and place a Corner block. Use the Corner Alignment marks when they are available for proper block position.

Continue Building

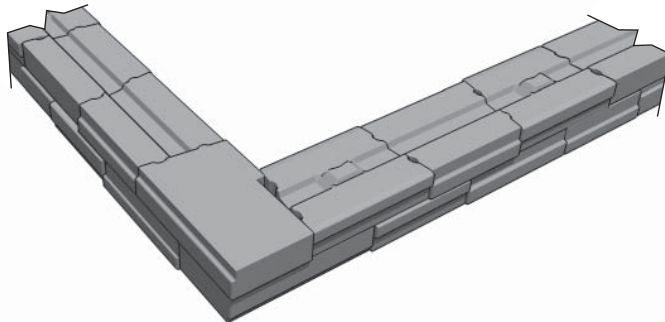
3



Repeat the steps until desired height is achieved, securing the final two courses with concrete adhesive. Finish the wall utilizing a Closed-End Cap in the corner for a finished appearance. Secure all Caps with concrete adhesive.

Second Course

2

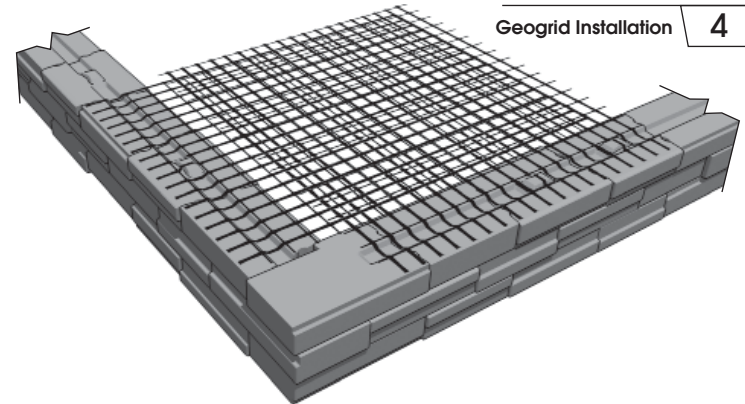


Commence second course by flipping a Corner block and placing it in the alternate direction. Place Standard blocks to complete the course.

Corner block should randomly be installed in UP or DOWN configuration for the best finished appearance.

Geogrid Installation

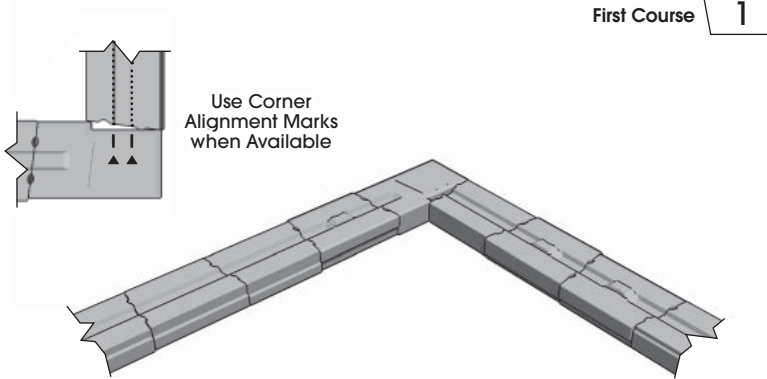
4



The geogrid should be placed within 1" (2.5cm) of the face of the block. Overlap geogrid as shown where the Design requires.

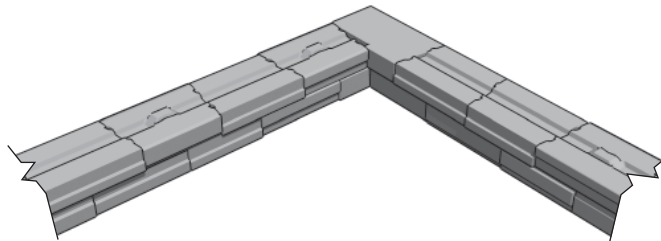
Inside 90° Corners

First Course 1



Corner blocks should randomly be installed in flipped **UP** or **DOWN** position. Place blocks on the base course leading to the corner and place a Corner block. Use the Corner Alignment marks when they are available for proper block position.

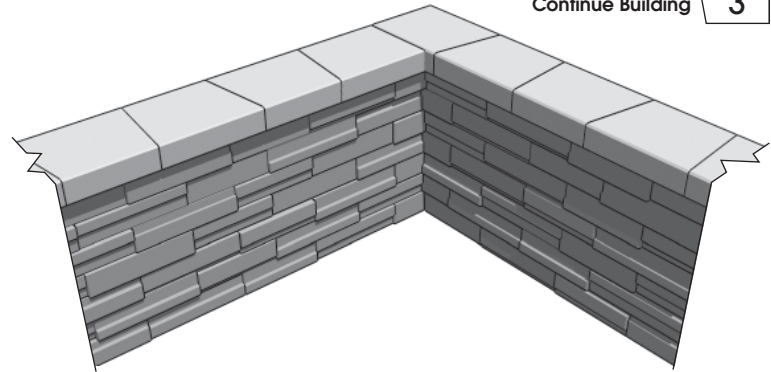
Second Course 2



Commence second course by flipping a Corner block and placing it in the alternate direction. Place Standard blocks to complete the course.

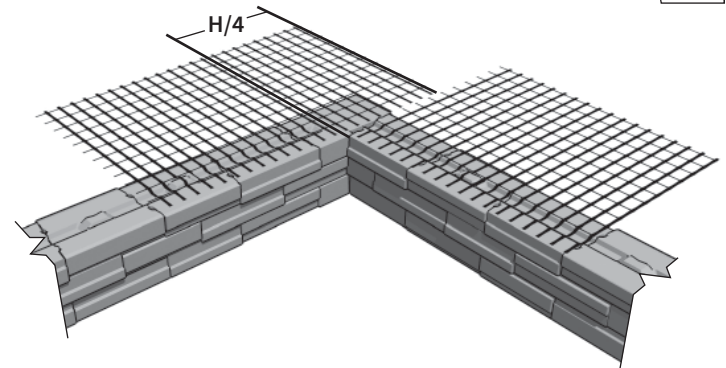
Corner block should randomly be Installed in UP or DOWN configuration for the best finished appearance.

Continue Building 3



Repeat the steps until desired height is achieved, securing the final two courses with concrete adhesive. Finish the wall utilizing a Closed-End Cap in the corner for a finished appearance. Secure all Caps with concrete adhesive.

Geogrid Installation 4



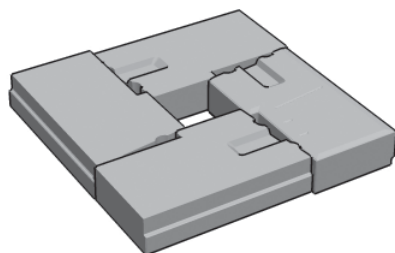
The geogrid should be placed within 1" (2.5cm) of the face of the block. As it is only necessary to have geogrid extending directly away from the wall, a gap will result in the geogrid layer as shown. **Alternate direction of geogrid reinforcement H/4 extension on subsequent geogrid layers.**

Pillars

Pillars provide a beautiful aesthetic to enhance your finished project. 22"(65cm) Pillars can easily be created in a few minutes using the ZenWall Corner block. The center hole can accommodate up to a 4x4" post (independently secured) for pergolas and other elements, or can be used to run electrical for lighting.

Note: Concrete adhesive should be used on every course.

Below are a few examples of layer patterns that can be used to construct pillars.



First Course

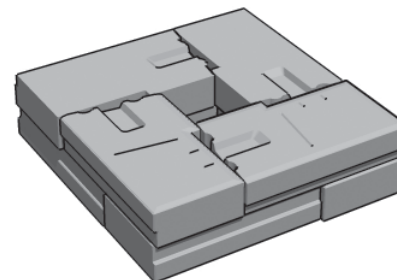
1

To prevent settlement, it is recommended to use a pillar cap or large patio stone as base block. Start the first course by placing Corner blocks in a circular pattern as shown randomizing Corner Blocks **UP** or **DOWN**.

In areas where frost heave is a potential issue, increase the compacted granular base thickness. Refer to Base Course (Page 24)

Second Course

2



Commence the second course installing the Corner blocks by placing them in a circular pattern going the opposite direction to create overlap. The interior hole should align perfectly with the course below to ensure proper positioning.



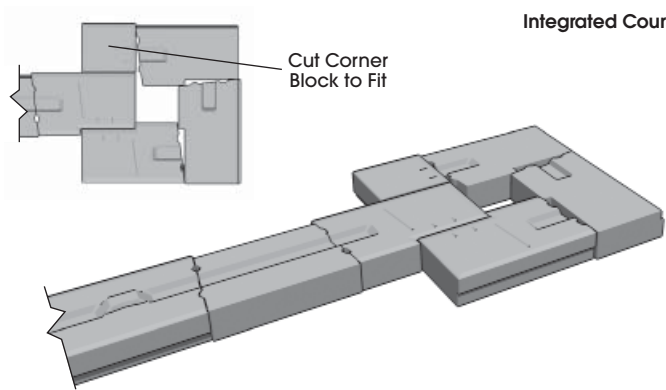
Finish & Cap

3

Repeat the steps until desired pillar height is achieved and finish off using a 24" pillar cap and secure with concrete adhesive.

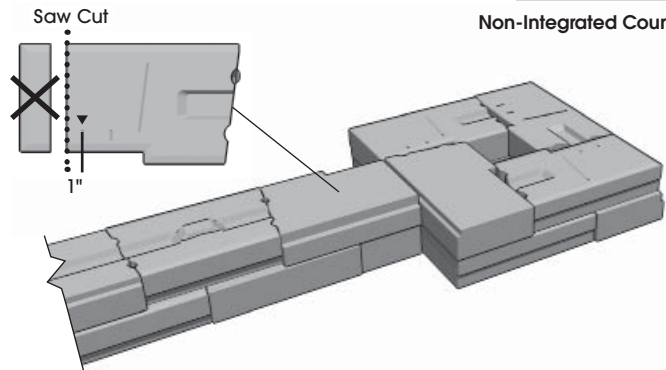
Integrating Pillars

Integrated Course 1



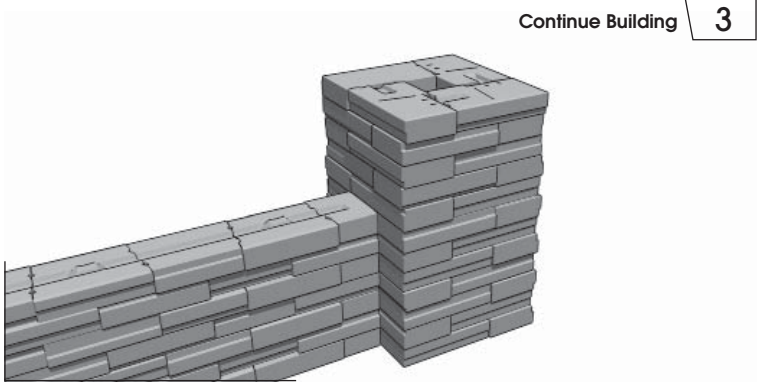
Refer to Pillars (page 14) for more information. End the wall with a Corner block and interlock another Corner block going the opposite direction as shown. Continue placing Corner blocks in a circular pattern. Measure and cut the end off a Corner block to fit.

Non-Integrated Course 2



Using a Corner block, measure and saw cut 1" (2.5cm) from the outer groove Corner alignment mark and install in the wall as shown. Place four Corner blocks in a circular pattern going the opposite direction to create overlap.

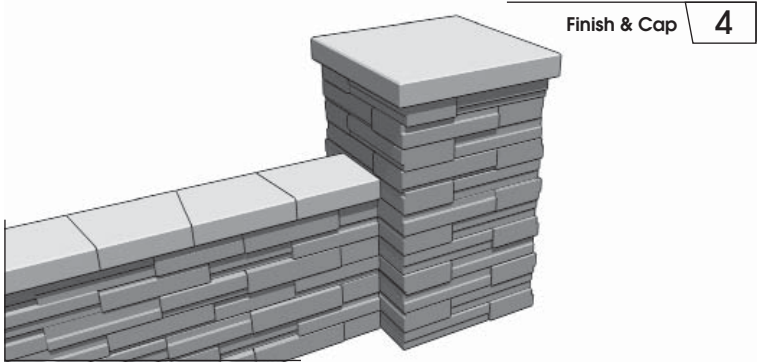
Continue Building 3



Repeat steps 1 & 2 until the desired wall height has been achieved and secure the final two courses with concrete adhesive.

Use the stand alone Pillar instructions (page 14) to construct the remaining top portion of the pillar if required by design.

Finish & Cap 4



Finish off using a 24" pillar cap and secure with concrete adhesive.

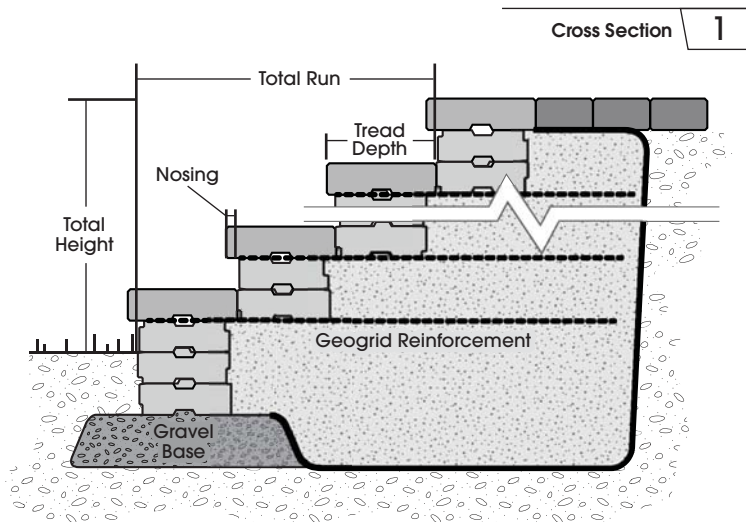
Inset Steps

The following instructions provide guidelines for the construction of inset or inside steps. Proper compaction within the walls and under the treads, along with the use of geogrid to prevent settlement, is critical to the long-term performance.

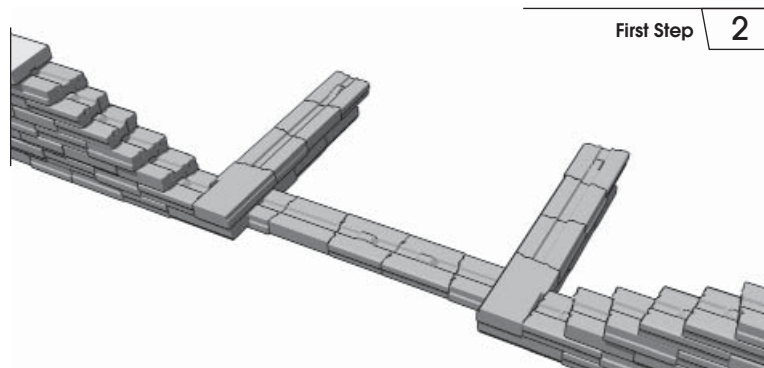
Ensure to consult your local Building Codes for limitations on Riser Height, Step Tread dimensions and handrail requirements. All stair components should be secured with concrete adhesive.

Number of Steps = Total Height / [5.9"(15cm)]

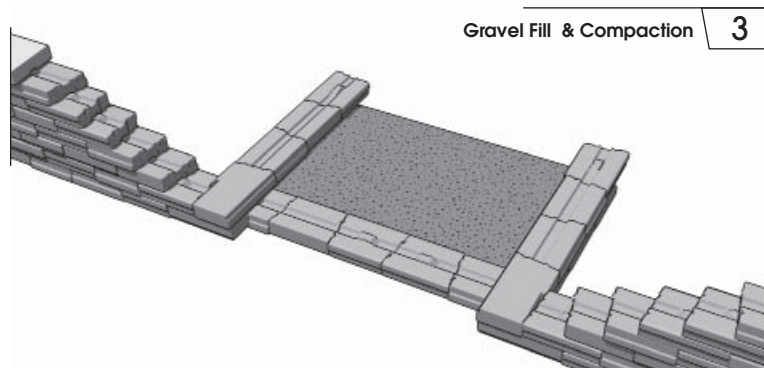
Total Run = Number of Steps x [Tread Depth - Nosing]



To prevent settlement, it is recommended to include geogrid to properly support each step.

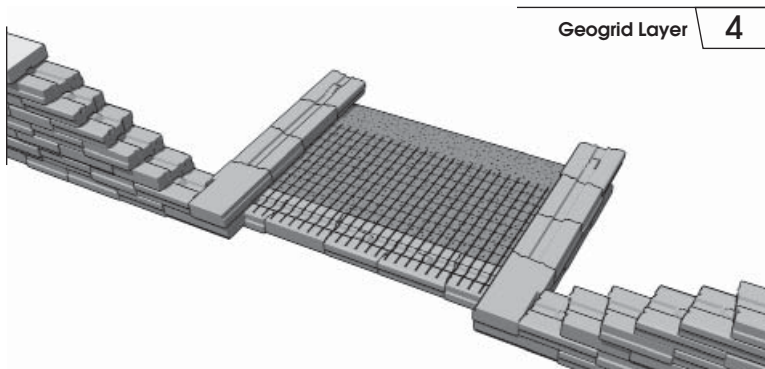


Start the wall with two outside 90° corners (*page 12*) distanced as specified in the Design. Place Standard blocks between to form the first step riser, measure and cut if required.



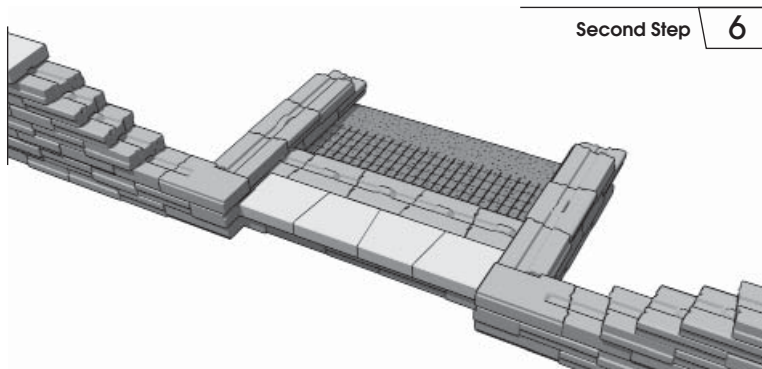
Fill the reinforced zone with imported, free draining gravel and compact to 95% SPD.

It is recommended to use a washed ¼" angular chip gravel. This material requires less rigorous compaction and will help prevent outward movement of the blocks due to compaction pressures during construction. (ASTM#8)



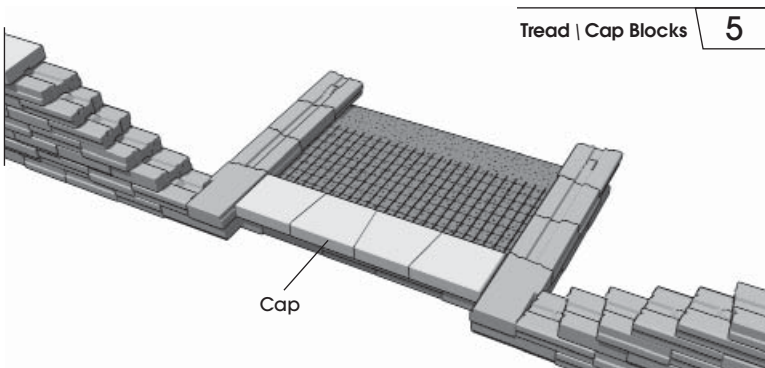
Geogrid Layer **4**

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



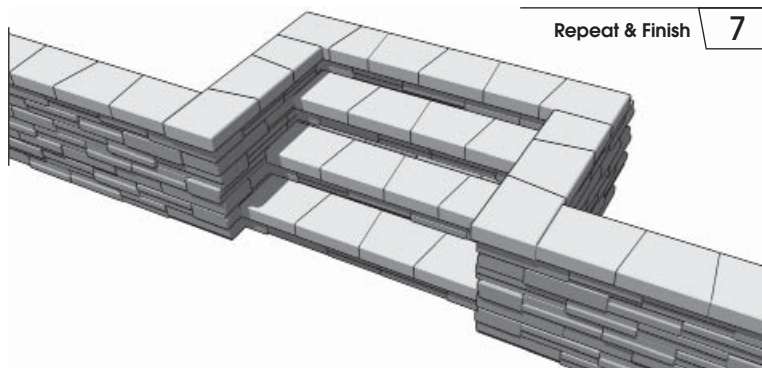
Second Step **6**

Install Standard blocks in all **UP** position at the desired tread depth. Place another course normally to create the riser. For best results offset the bond pattern with the step below. Fill the reinforced zone with imported, free draining gravel and compact to 95% SPD. Place a geogrid reinforcement layer.



Tread | Cap Blocks **5**

Place a layer of Cap blocks to form the step tread and secure with concrete adhesive. If necessary cut the Caps to fit flush with the sidewalls. Place base blocks to fully support the above step.



Repeat & Finish **7**

Repeat until desired step height is achieved. Finish off with Cap blocks, securing all blocks with concrete adhesive.

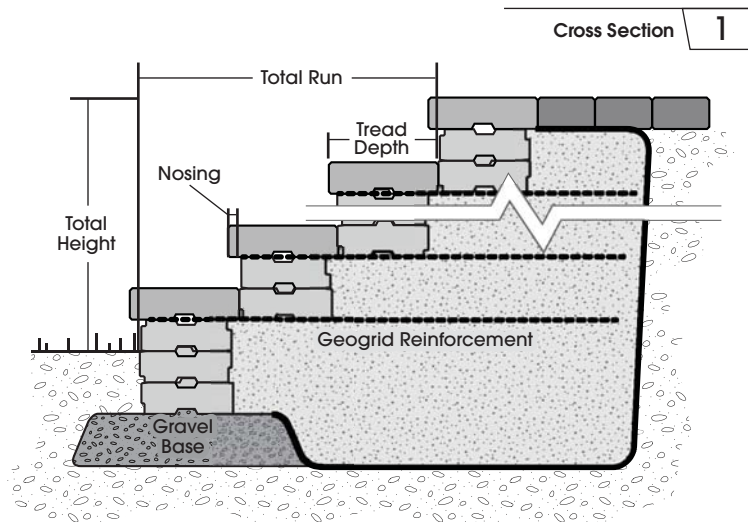
Protruding Steps

The following instructions provide guidelines for the construction of protruding or outside steps. Proper compaction within the walls and under the treads, along with the use of geogrid to prevent settlement, is critical to the long-term performance.

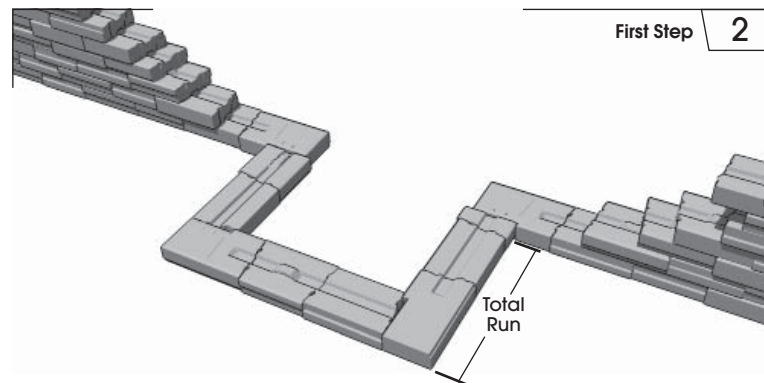
Ensure to consult your local Building Codes for limitations on Riser Height, Step Tread dimensions and handrail requirements. All stair components should be be secured with concrete adhesive.

Number of Steps = Total Height / [5.9" (15cm)]

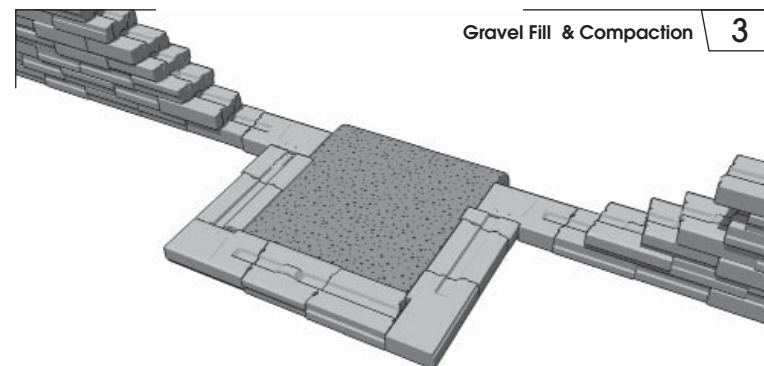
Total Run = Number of Steps x [Tread Depth - Nosing]



To prevent settlement, it is recommended to include geogrid to properly support each step.

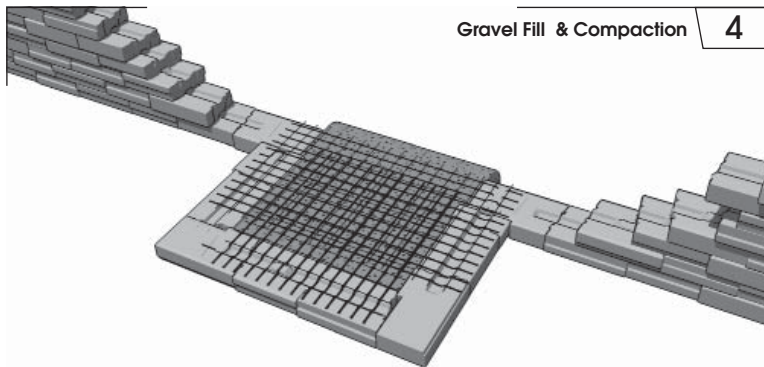


Start the wall with two inside 90° corners (page 13) and two outside 90° corners (page 12). Use the Total Run formula to determine the distance out from the face of the wall where the front of the first riser should be placed.



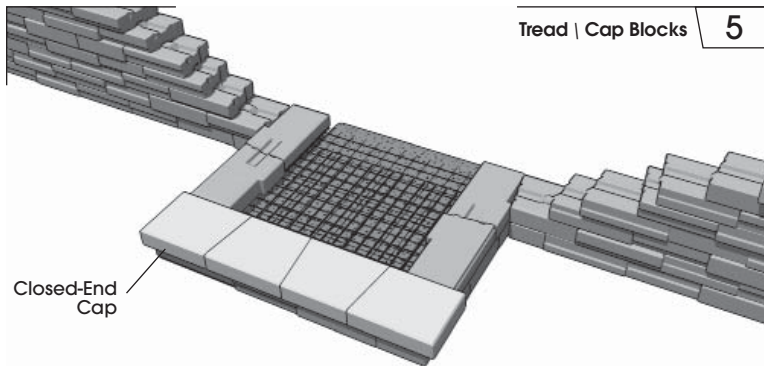
Fill the reinforced zone with imported, free draining gravel and compact to 95% SPD.

It is recommended to use a washed ¼" angular chip gravel. This material requires less rigorous compaction and will help prevent outward movement of the blocks due to compaction pressures during construction. (ASTM#8)



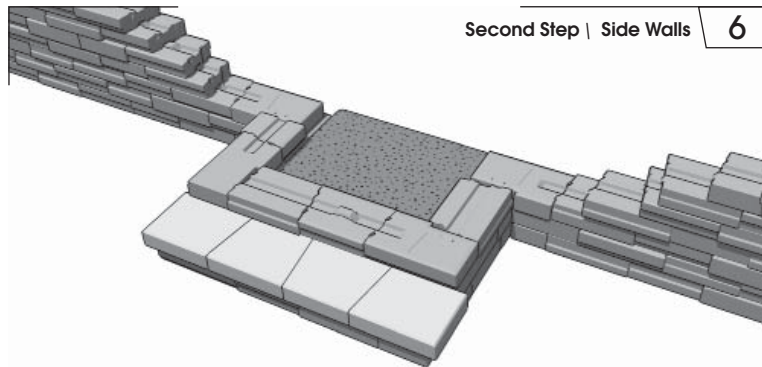
Gravel Fill & Compaction **4**

Experience has shown that the inclusion of geogrid reinforcement within each course of steps reduces the effect of settlement. It is recommended to include an additional geogrid layer every other step, placed in the perpendicular principal direction as shown (*Alternatively use Biaxial Geogrid in the steps*).



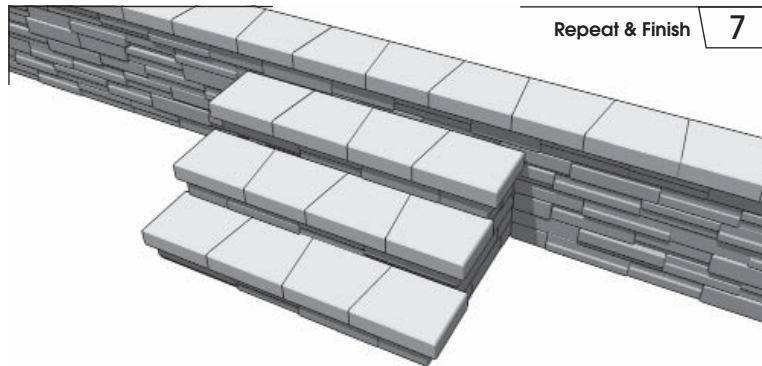
Tread | Cap Blocks **5**

Place a layer of Cap blocks to form the step tread and secure with concrete adhesive. Utilize the Closed-End Caps on the end for a finished appearance and overhang the sidewall by 1"(2cm) on either side. Install Standard blocks in all **UP** position at the desired tread depth to support the steps above.



Second Step | Side Walls **6**

Build up the next course of the sidewalls, and integrate into the retaining wall following the Inside 90° Corners Instructions (*page 13*).



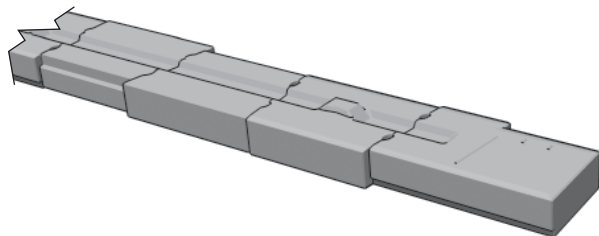
Repeat & Finish **7**

Repeat until desired step height is achieved. Finish off with Cap blocks, securing all blocks with concrete adhesive.

Ending Two-Sided Seat-Walls

First Course

1

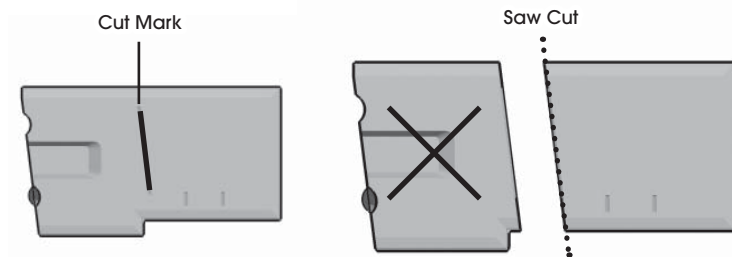


ZenWall utilizes the three sided Corner block to end two-sided seat-walls. This provides beautiful factory edges with minimal cutting required. Construct the wall normally and end the wall with a Corner block as shown.

Concrete adhesive should be used on every course in the seat-wall.

Cutting the End

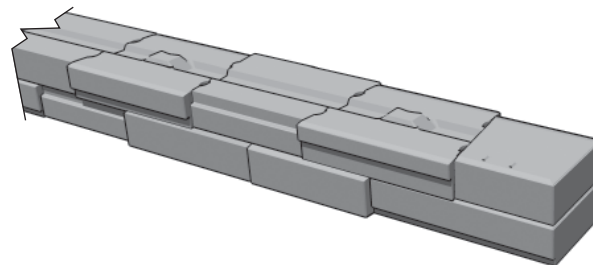
2



Using a Corner block, saw cut the unit at the cut mark groove on top of the block as indicated.

Second Course

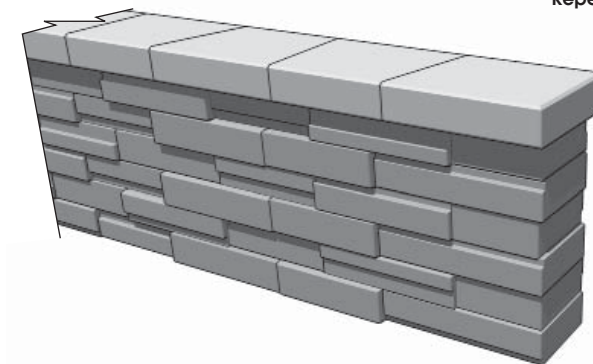
3



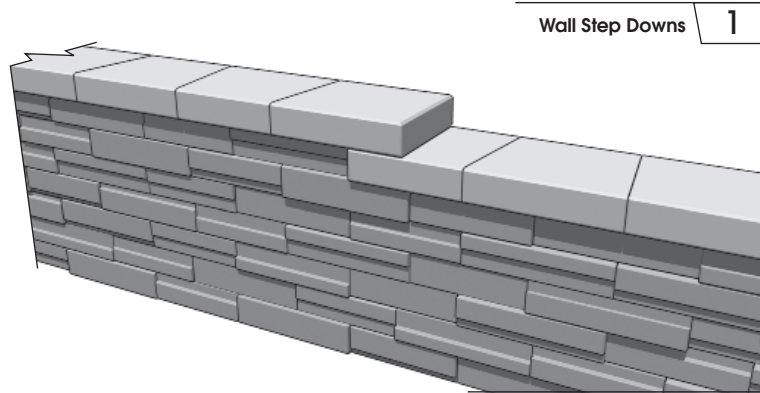
Install the cut Corner block end and secure with concrete adhesive. The block should be positioned with previous course to create random protrusions to match the rest of the wall. Remove the interfering Lateral Alignment Lug from the Standard block and install as shown.

Repeat & Finish

4

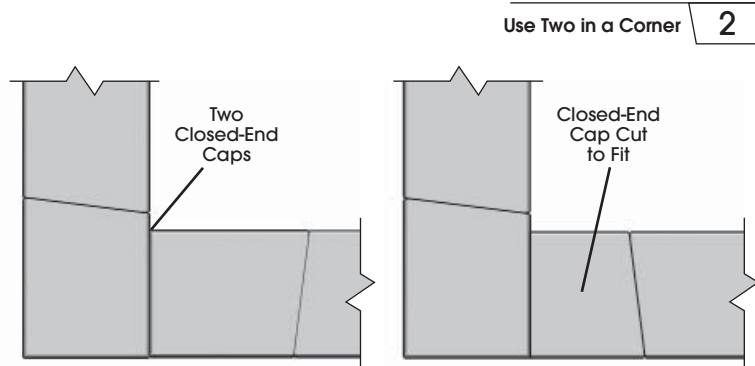


Repeat the steps until desired height is achieved, secure the final two courses with concrete adhesive. Finish the wall utilizing a Closed-End Cap, overhanging the wall end by 1" (2.5cm). Secure all Caps with concrete adhesive.



Wall Step Downs **1**

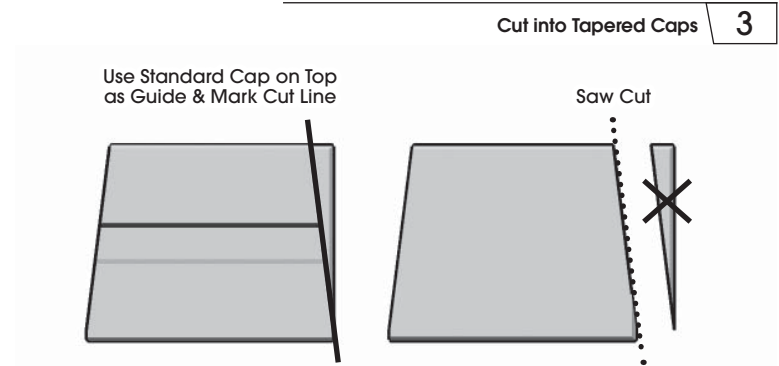
ZenWall's Closed-End Cap blocks are ideal for wall step downs. They eliminate the unsightly groove at the bottom normally visible with other wall products and provide a beautiful finished appearance.



Use Two in a Corner **2**

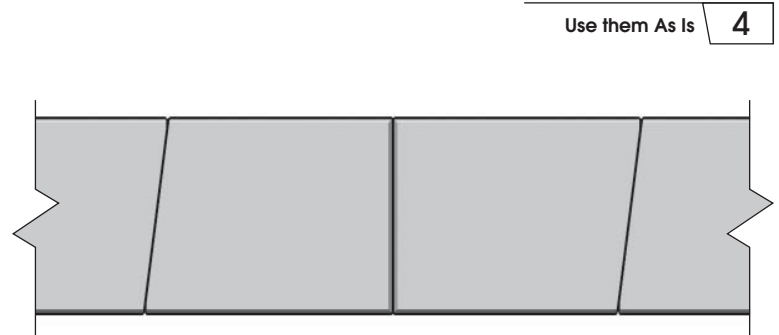
Two Closed-End Caps can be abutted together in corners where cutting is not required. Or use a Closed-End Cap instead of a standard where cutting is required to fit.

Closed-End Cap Alternative Uses



Cut into Tapered Caps **3**

If you find you have too many Closed-End Cap blocks, they can easily be cut into Standard Caps. Mark the cut line by flipping and aligning a Standard Cap on top. Saw cut the Closed-End Cap at the mark and use as a Standard Cap on the wall.

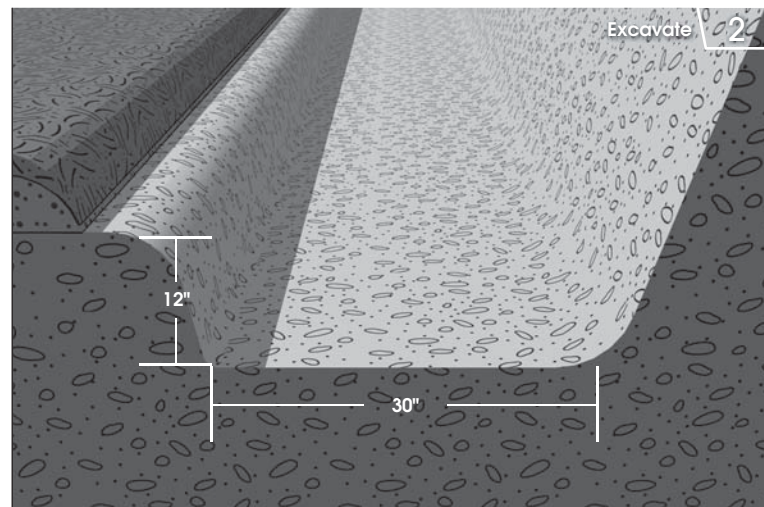
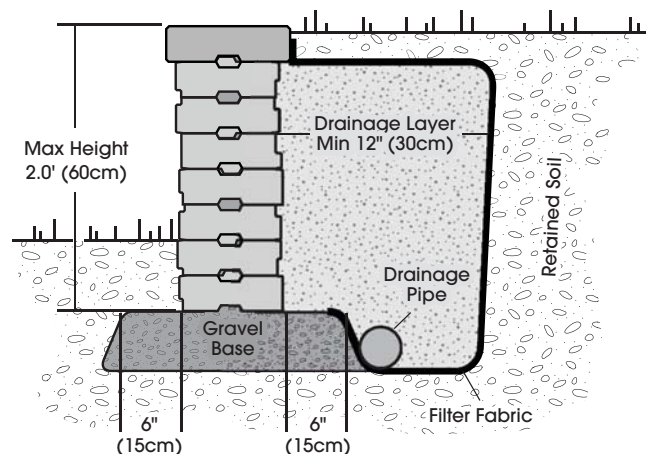


Use them As Is **4**

Closed-End Caps can also be used in the wall AS IS, without cutting by abutting two together along the straight edge. This may not have the same final appearance as the joints will not match the rest of the wall.

Gravity Wall Installation

The following are the basic steps involved in constructing a conventional (*non-geogrid reinforced*) ZenWall segmental retaining wall. These steps are to be used in conjunction with all relevant details. Refer to Overview of a Successful Project (*page 4*) before beginning.

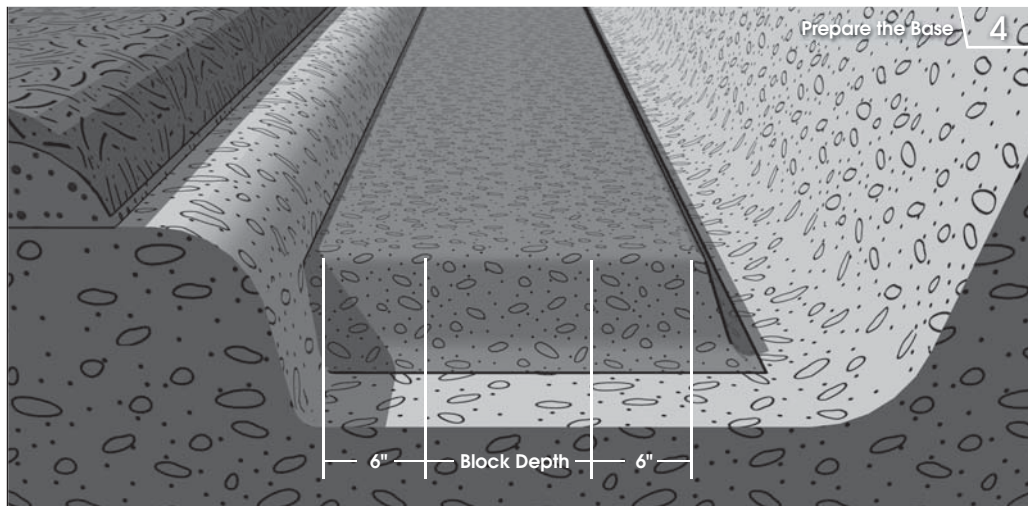


Planning Your Wall

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.

Excavate the Base

Excavate a trench down to the foundation grades specified in the Design. The front of the trench should be 6" (15cm) from the planned face of the wall. The trench should be a minimum of 30" (75cm) wide (*front to back*) and a minimum 12" (30cm) deep. This depth assumes at least two blocks are 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 General Review Engineer (GRE).

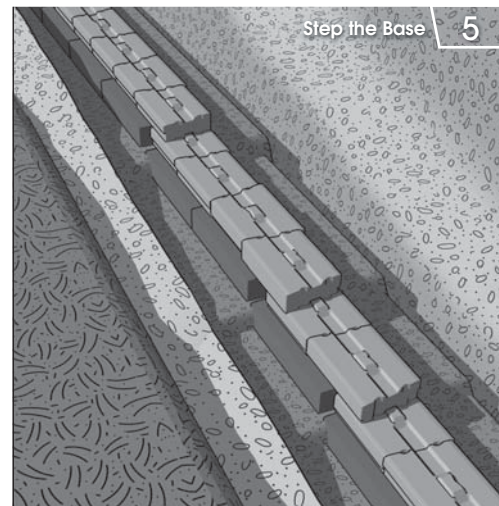


Verify Foundation Subgrade

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

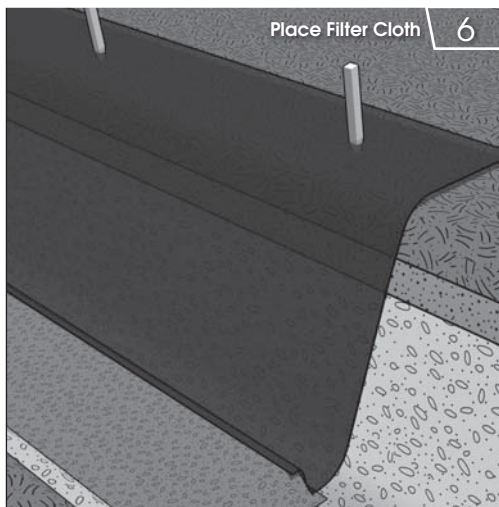
Start the base at the lowest elevation of the wall. The base should be composed of well-graded, well-draining (*less than 8% fines*), angular granular material (*commonly referred to as ¾" minus or road base*) and compacted to a minimum of 98% SPD. The minimum base thickness is 6" (15cm) or as required by the GRE to reach competent founding soil. A layer of unreinforced concrete 2" (5cm) thick may be placed on top of the granular material to provide a durable leveling surface for the base course. At the direction of the GRE, geotextile might be required under the granular base. The minimum base dimensions are 22" (55cm) 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. The foundation steps must be located to ensure the minimum embedment is achieved. The height of each step is the block height of the course.

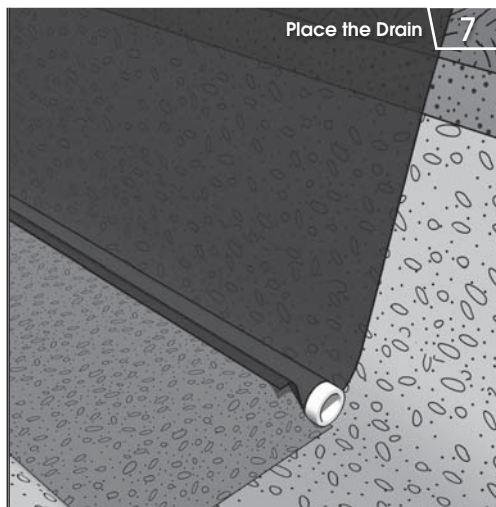
TIP: Whenever possible, start constructing the wall from the lowest point and step up



Place Filter Cloth (as required by Design)

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. In some cases, if the Design permits, the Filter Fabric requirement can be avoided if the Drainage Material is graded to promote a natural soil filter system. **Refer to Design**

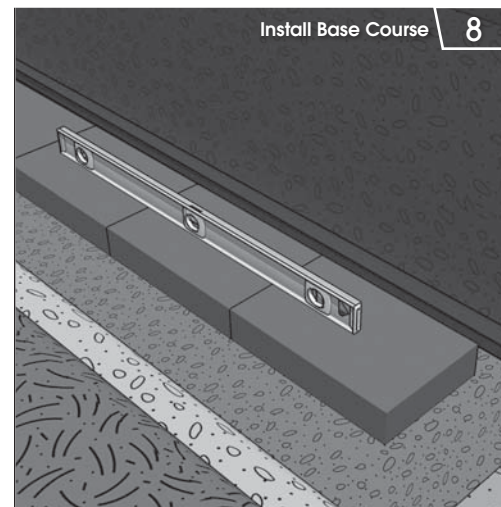
TIP: Since the bottom course is normally buried, blocks on the first course can be installed knob in all UP position for easier construction.



Place the Drain

Various options for drain placement may exist, depending on how the pipe is to be outlet in the Design. 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" (15cm) area behind the base, place the approved drain tile (*perforated drain with filter sock*) on top of the filter cloth and minimal granular coverage

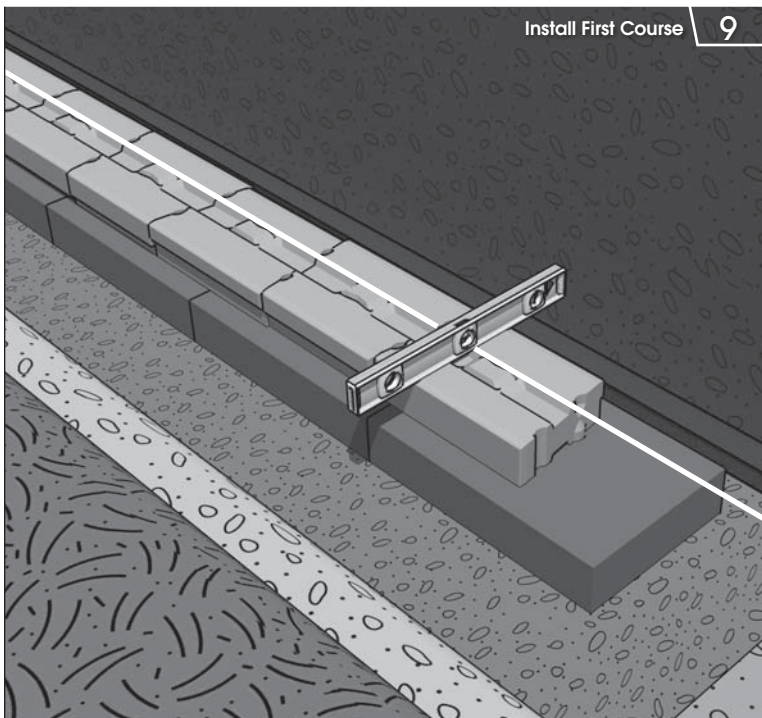


Base Course

It is recommended that a "Base Block" be used to create the first, or "base" course of the Wall. While the Standard ZenWall block can be used as a base course, using a Base Course that is easier to level will save time and provide better performance.

The Manufacturer may produce a "Universal" base unit, which is typically a 2-3" (5-8cm) high block that is relatively longer than the Standard ZenWall blocks. The increased unit length makes it easier to level and helps distribute base loads better.

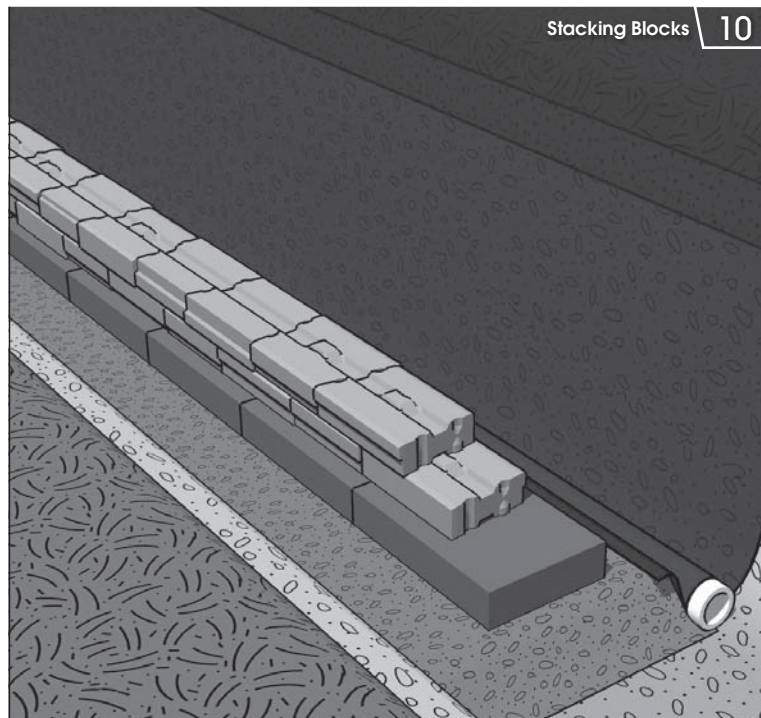
Alternatively, a PisaStone® Cap block (3"x12"x24") is ideal for this type of application where available.



Install First Course 9

Place the First Course

Place the first course of ZenWall blocks side-by-side (*touching*) on the base. Ensure blocks are level front to back and left to right. Extra care should be taken at this stage as it is critical for accurate alignment. Use a string line along one side of the top groove, to ensure proper alignment.



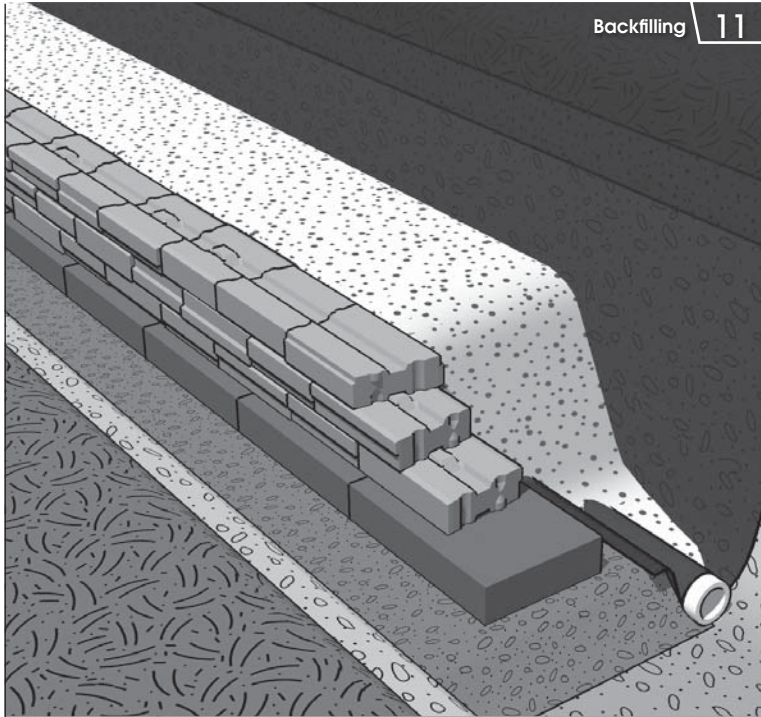
Stacking Blocks 10

Stacking Blocks

Sweep the top of underlying course and stack next course in a running bond pattern. No more than 3 courses of Wall should be stacked before backfilling.

Tip: Blocks can be installed randomly with top Alignment Knob in either UP or DOWN position or use the following pattern (Page 8):

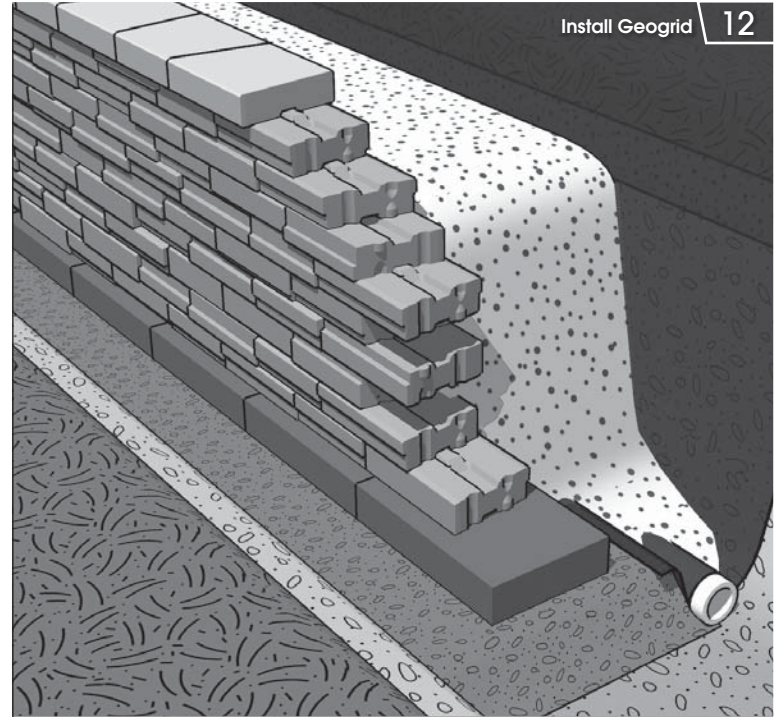
2 Up ▶ 2 Down ▶ 1 Up ▶ 1 Down ▶ Repeat...



Backfilling 11

Backfill Drainage Material

A free-draining, gap-graded gravel ($\frac{1}{4}$ " - $\frac{3}{4}$ " 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" (30cm) thick and protected from the native material by the filter cloth or as required by the Design.



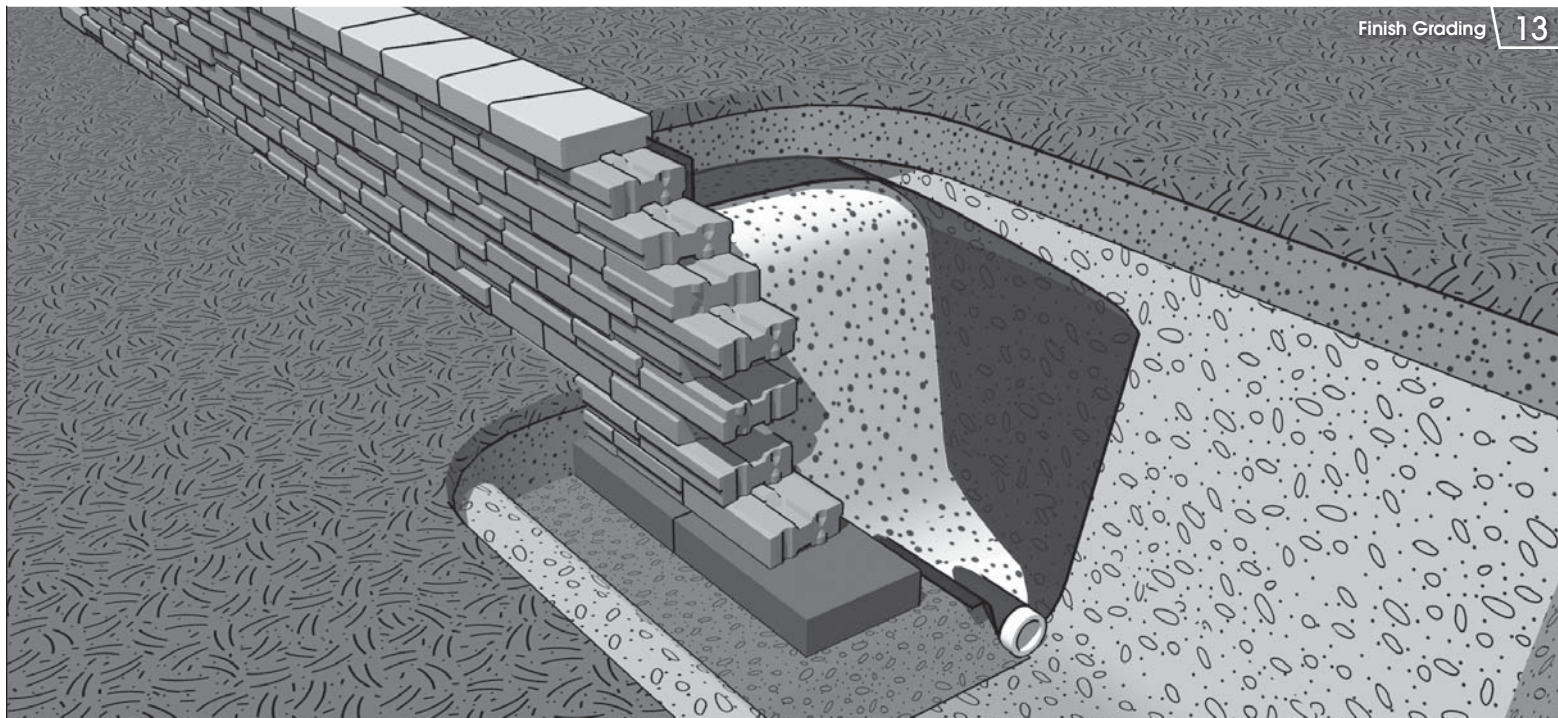
Install Geogrid 12

Continue Stacking and Backfilling

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

Place Cap Blocks

A layer of concrete adhesive must be applied to the top two courses in order to lock the wall together and fix the Cap blocks in place. Place the Cap block firmly on top of the adhesive, ensuring both surfaces are free of debris, and apply pressure to secure. Follow the adhesive manufacturer's installation guidelines.



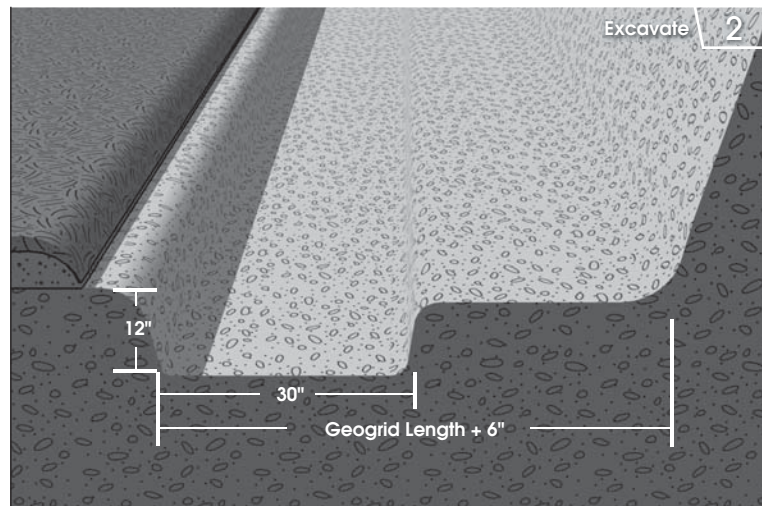
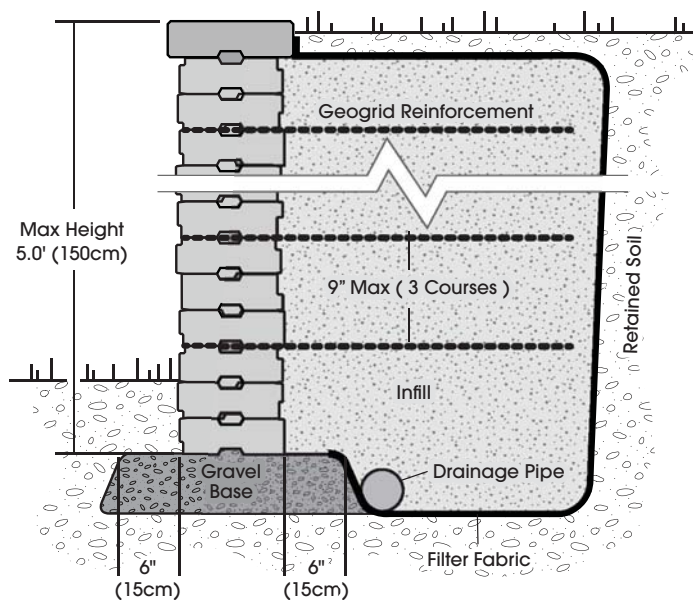
Encapsulate the Drainage Layer and Finish Grading

Fold the excess filter fabric (*if required*) over the top of the drainage layer and extend up the back face of the Cap block. 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 36" (1m) from the back of the Cap block. Slope the surface above and below the wall to ensure water will flow away from, and not accumulate near the wall units.

TIP: Gardening & Planting details above or below the wall should be discussed with the Design Engineer

Geogrid Reinforced Wall Installation

The following are the basic steps involved in constructing a Geogrid Reinforced ZenWall segmental retaining wall. These steps are to be used in conjunction with all relevant details. Refer to Overview of a Successful Project (page 4) 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.

Excavate Reinforced Zone

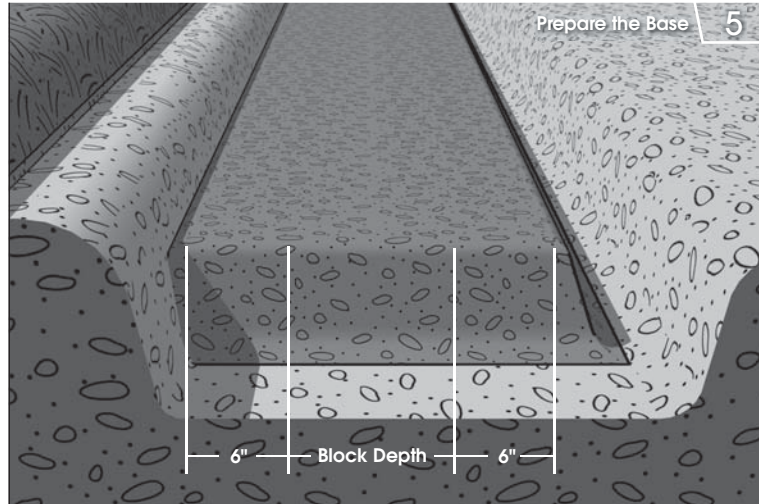
The excavation must be carefully planned; considering several elements. Based on the type of soil being excavated, the GRE must determine the maximum allowable "cut" angle the excavation can sustain. This angle ensures the stability of the excavation during construction. The required geogrid length (*as shown in the Design*) plus 6" (15cm) defines the minimum width at the base of the excavation. Measuring from 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 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 6" (15cm) from the planned face of the wall. The trench should be a minimum of 30" (75cm) wide (*front to back*) and a minimum of 12" (30cm) deep. This depth assumes at least two blocks are 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.

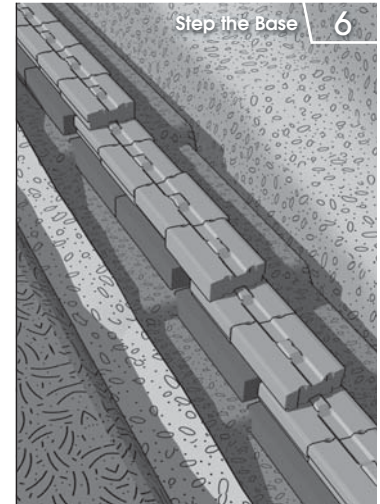
Verify Foundation Subgrade

Once the wall has been excavated, the native foundation soil must be checked by the GRE. The foundation soil in a geogrid reinforced SRW is considered to be the native (*or fill*) material underneath both the facing and reinforced zone. The foundation soil must have the required allowable bearing capacity specified in the Design as verified by the GRE.



Prepare the Compacted Granular Base

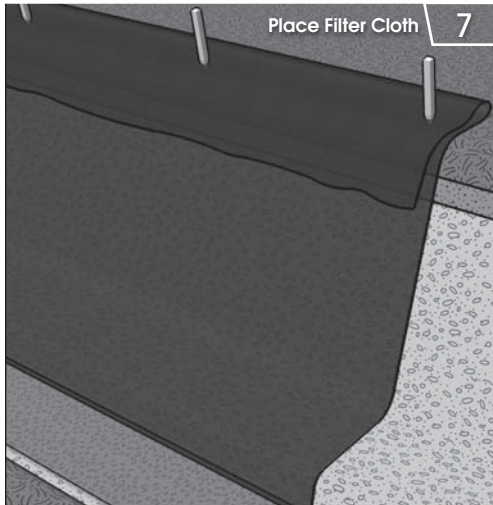
The base should be started at the lowest elevation of the wall. The base should be composed of well-graded, well-draining (*less than 8% fines*), angular granular material (*commonly referred to as ¾" minus or road base*) and be compacted to a minimum of 98% SPD. The minimum base thickness is 6" (15cm) or as required by the GRE. A layer of unreinforced concrete 2" thickness may be placed on top of the granular material to provide a durable leveling surface for the base course. The minimum base dimensions are 22" (55cm) 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. The foundation steps must be located to ensure the minimum embedment is achieved. The height of each step is the block height of the course.

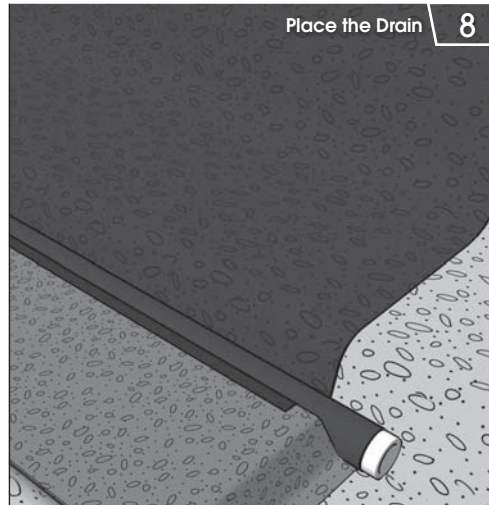
TIP: Whenever possible, start constructing the wall from the lowest point and step up



Place Filter Cloth (as required by Design)

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. In some cases, if the Design permits, the Filter Fabric requirement can be avoided if the Drainage Material is graded to promote a natural soil filter system. **Refer to Design**

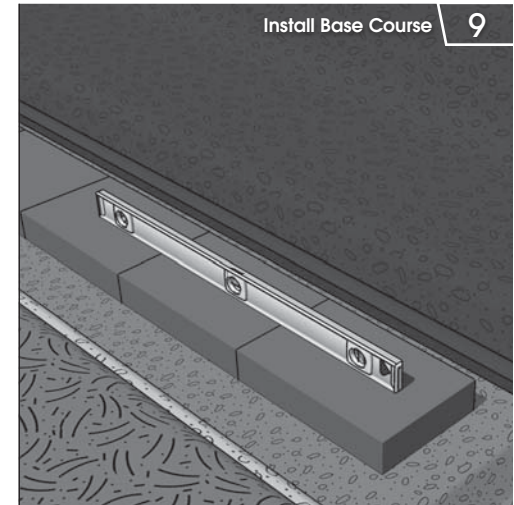
TIP: Since the bottom course is normally buried, blocks on the first course can be installed knob in all UP position for easier construction.



Place the Drain

Various options for drain placement may exist, depending on how the pipe is to be outlet in the Design. 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" (15cm) area behind the base, place the approved drain tile (*perforated drain with filter sock*) on top of the filter cloth and minimal granular coverage.

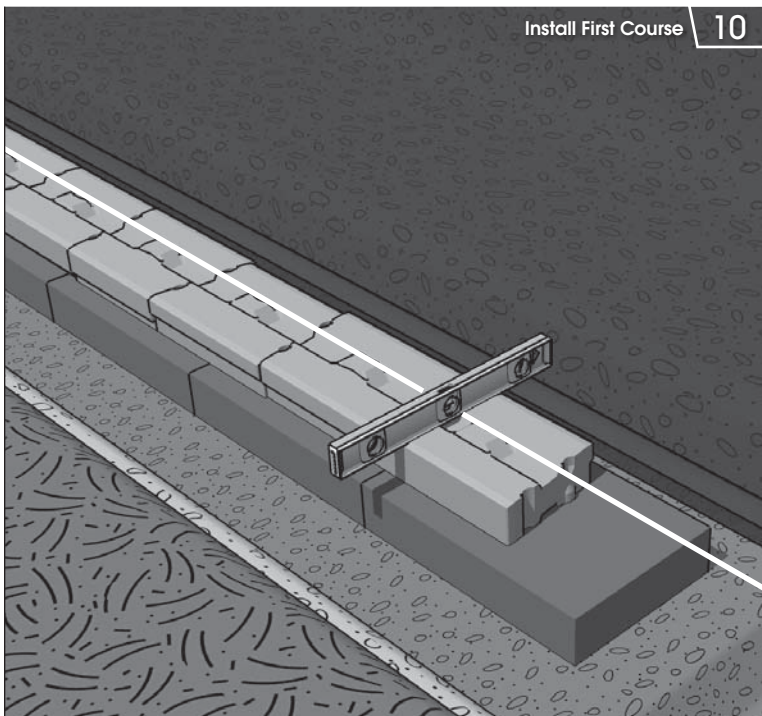


Base Course

It is recommended that a "Base Block" be used to create the first, or "base" course of the Wall. While the Standard ZenWall block can be used as a base course, using a Base Course that is easier to level will save time and provide better performance.

The Manufacturer may produce a "Universal" base unit, which is typically a 2-3" (5-8cm) high block that is relatively longer than the Standard ZenWall blocks. The increased unit length makes it easier to level and helps distribute base loads better.

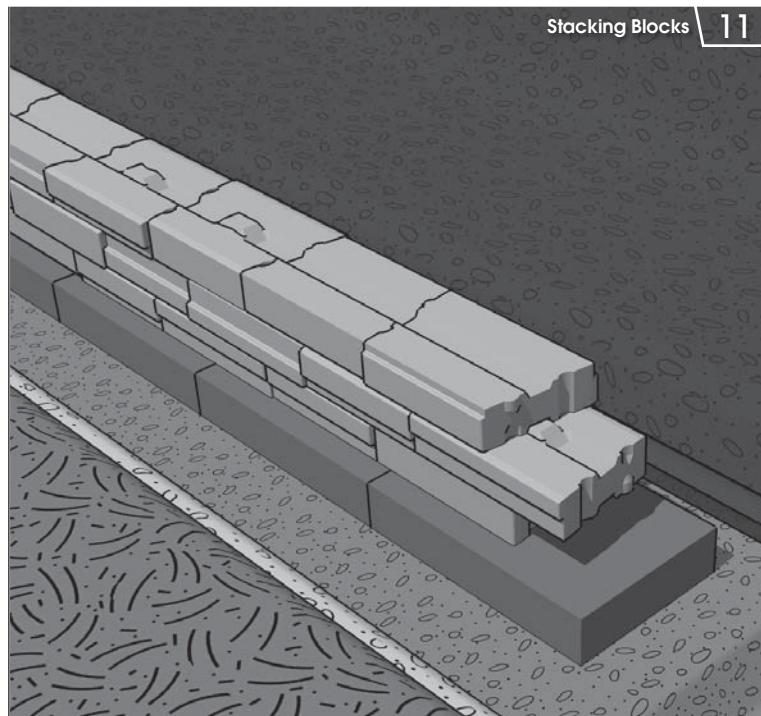
Alternatively, a PisaStone® Cap block (3"x12"x24") is ideal for this type of application where available.



Install First Course 10

Place the First Course

Place the first course of ZenWall blocks side-by-side (*touching*) on the base. Ensure blocks are level front to back and left to right. Extra care should be taken at this stage as it is critical for accurate alignment. Use a string line along one side of the top groove, to ensure proper alignment.



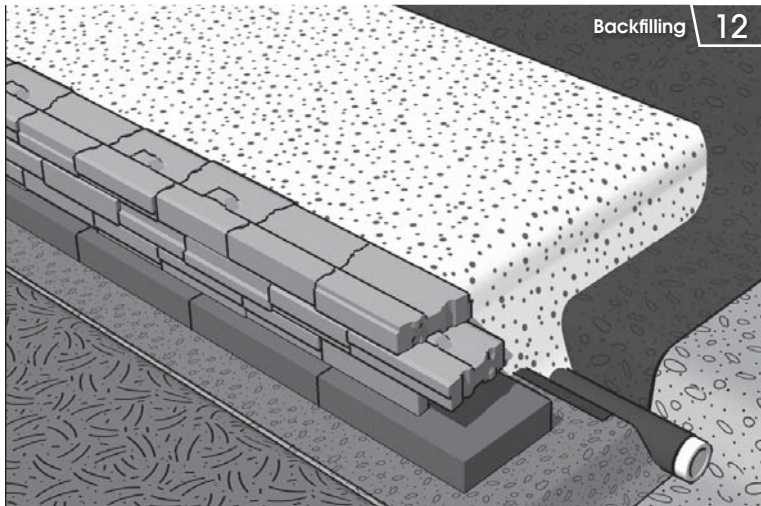
Stacking Blocks 11

Stacking Blocks

Sweep the top of underlying course and stack next course in a running bond pattern. No more than 3 courses of Wall should be stacked before backfilling.

Tip: Blocks can be installed randomly with top Alignment Knob in either UP or DOWN position or use the following pattern (Page 8):

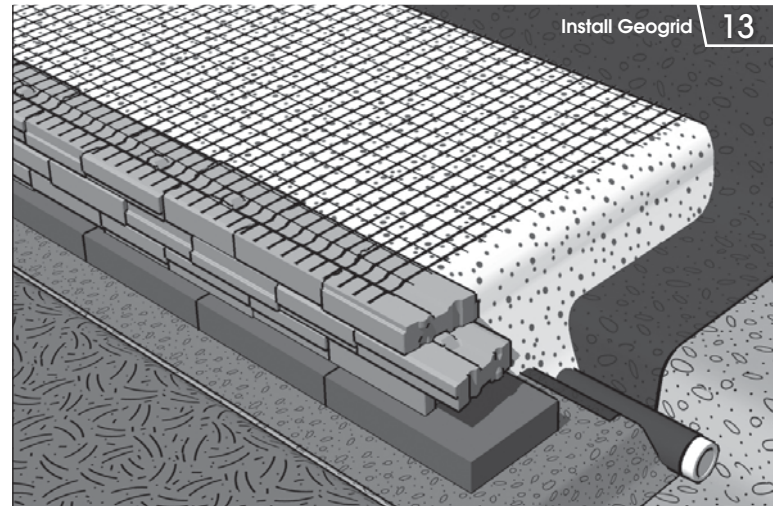
2 Up ▶ 2 Down ▶ 1 Up ▶ 1 Down ▶ Repeat...



Backfill Infill Material

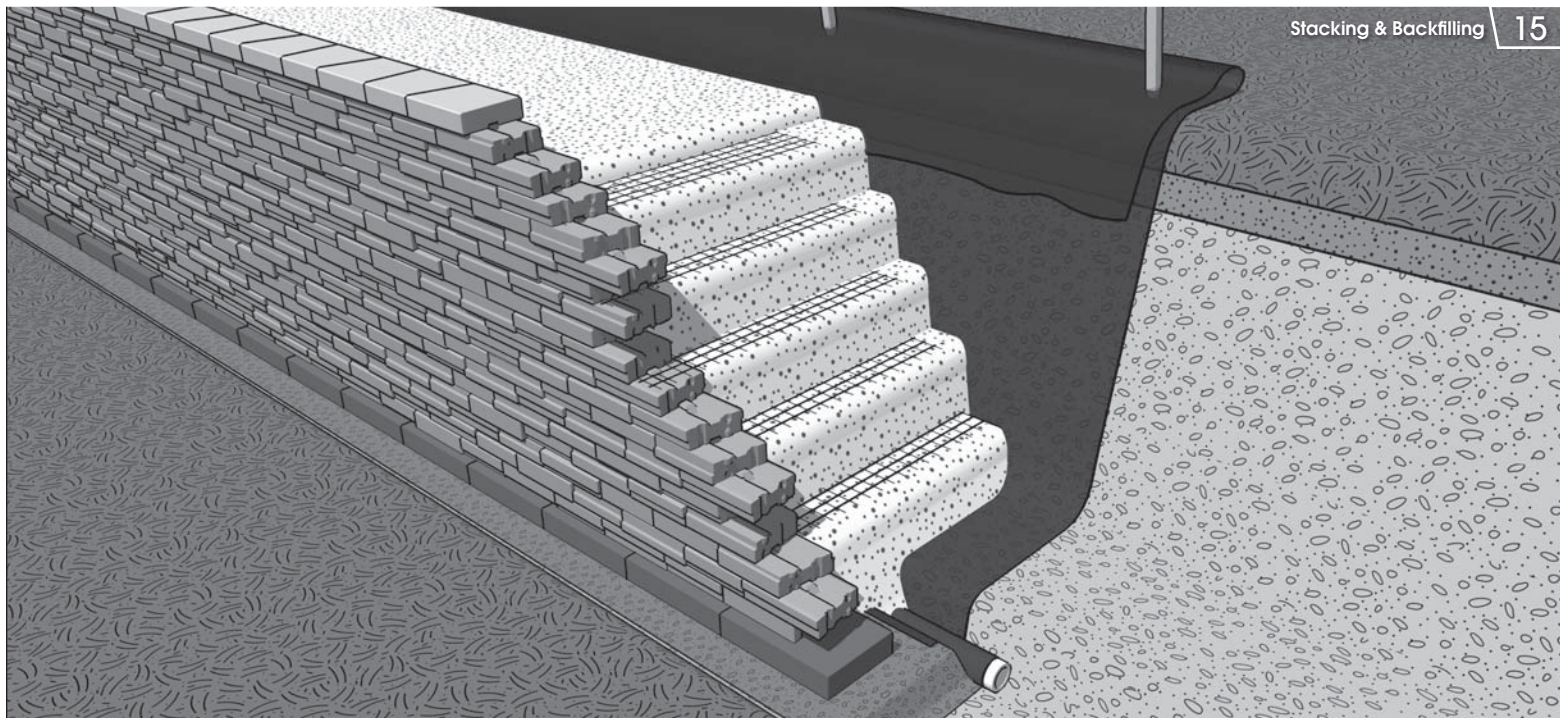
Begin backfilling the wall. Risi Stone recommends using an imported, well-graded, well-draining (*less than 8% fines*), angular granular material. In cases where the on-site material meets the minimum standards set out by the NCMA (*Refer to NCMA Design Manual, 3rd Edition*), it is possible to use native soils as backfill. However, additional considerations are required for drainage, reinforcement requirements, etc. The native soils must be properly assessed by the Site Geotechnical Engineer and the applicable Design parameters provided to the Wall Design Engineer.

The infill material is placed in maximum 6"-8" (15-20cm) 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 36" (1m) of the back of the wall (*only hand-operated plate compactor*). Over compaction behind the wall facing will result in an outward rotation of the blocks 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. Ensure the ZenWall blocks are free of debris, lay the geogrid on top of the blocks to within 1" (2cm) of the face. Install the next course of ZenWall blocks (*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 back-fill material should be level with the back of the ZenWall block, allowing the geogrid to be laid out horizontally.



Backfill Over Geogrid Reinforcement

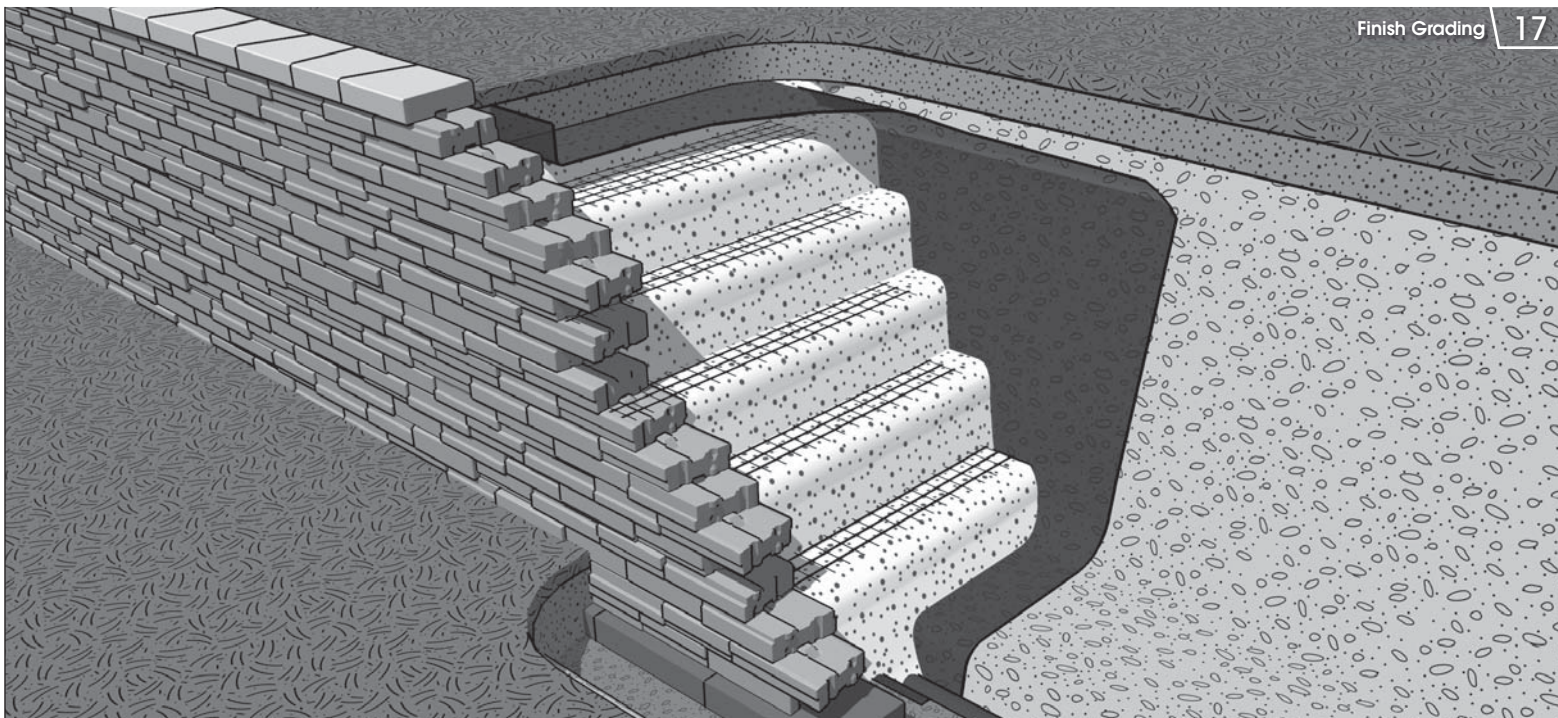
Backfill the next lift of granular infill material on top of the geogrid reinforcement, placing the loose material at the front of the wall, and raking it back away from the face (*this method maintains tension in the geogrid during backfilling*). Continue stacking and backfilling until the next layer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

Continue Stacking & Backfilling

Continue placing the ZenWall blocks, backfilling, and laying the geogrid reinforcement as described above until the desired wall height is reached. All Geogrid layers should be secured with concrete adhesive.

Place Cap Blocks

A layer of concrete adhesive must be applied to the top two courses in order to lock the wall together and fix the Cap blocks in place. Place the Cap block firmly on top of the adhesive, ensuring both surfaces are free of debris, and apply pressure to secure. Follow the adhesive manufacturer's installation guidelines.



Encapsulate the Granular Infill & Finish Grading

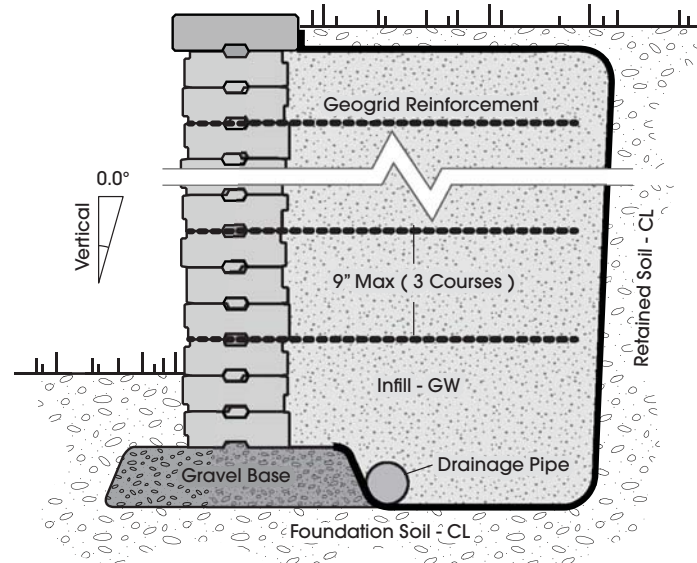
Fold the excess filter fabric over the top of the infill zone (*reinforced zone*) and extend up the back face of the Cap blocks. Ideally, place an impervious layer of soil on top of the filter fabric and compact manually, providing for the required grading and/or swales. For other treatments such as pavers, concrete, or asphalt, care must be taken to ensure that heavy compaction/paving equipment remains a minimum of 36" (1m) from the back of the Cap block. Slope the surface above and below the wall to ensure that water will flow away from, and not accumulate near the wall units.

TIP: Gardening & Planting details above or below the wall should be discussed with the Design Engineer

Soil Conditions Imported Gravel & Clay

NOT FOR CONSTRUCTION

Soil Condition	Description	Φ -degrees	Block Weight (g-Lb/cu.ft)
Infill (Reinforced)	GW Well graded gravel, gravel sand, max 5% fine content	35	140
Retained	CL Inorganic Clays, low-medium plasticity	28	125
Foundation	CL Inorganic Clays, low-medium plasticity	28	125



Exposed Wall Height	Embedment	Total Wall Height	No. Geogrid Layers	Flat Pedestrian Load (50psf / 2.4kPa)	Slope 3H:1V	Heavy Traffic (250psf / 12kPa)
(ft/m)	(ft/m)	(ft/m)		Grid Length (ft/m)	Grid Length (ft/m)	Grid Length (ft/m)
1.5 / 0.45	0.5 / 0.15	2.0 / 0.60	2	4.0 / 1.22	4.0 / 1.22	4.0 / 1.22
2.7 / 0.82	0.5 / 0.15	3.2 / 0.98	3	4.0 / 1.22	4.0 / 1.22	4.0 / 1.22
3.7 / 1.12	0.5 / 0.15	4.2 / 1.27	4	4.5 / 1.37	4.5 / 1.37	4.5 / 1.37
4.7 / 1.42	0.5 / 0.15	5.2 / 1.58	5	5.0 / 1.52	5.0 / 1.52	5.0 / 1.52

Disclaimer: Geogrid Reinforcement to be Miragrid® 3XT or engineer approved equivalent. 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/Province. Handrails and/or traffic barriers are not shown but are typically required and may influence the wall design. The above Design is not to be used with terraced walls, water applications or within the line of influence of other permanent structures.



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