

A Contractor's Guide to Installing Segmental Retaining Wall Systems



CONCRETE PAVERS ■ LANDSCAPE RETAINING WALLS ■ GARDEN PRODUCTS



INTRODUCTION

Ideal is pleased to offer you this guide to installing segmental retaining walls. The information was compiled from a number of sources. They include Westblock Products, Risi Stone Systems, SRW® Products, National Concrete Masonry Association (NCMA), Pavetech Inc., Vibromax Equipment, and various trade articles, as well as our own experience of working with thousands of architects, engineers and contractors in the field for over 30 years.

We recognize that many contractors may have developed their own skills and unique techniques in building retaining walls and that many products have proprietary procedures. What we have attempted to do with this guide is to give you some of the best practices in the construction of segmental retaining walls. We hope that it will help improve your productivity and cost efficiencies, while achieving the best quality job that is possible.

Please bear in mind that Ideal provides general information on wall construction. This guide is intended to give you practical information, time saving tips and 'rules of thumb'. While it covers many aspects of segmental retaining wall construction, it is the user's responsibility to determine the suitability of the final design for the site. Walls 4' and higher, terraced walls, sites with weak soils, slopes and surcharges require special consideration and construction techniques, including the use of geogrid. We recommend the use of a qualified engineer familiar with wall construction for these situations. Always check with the local building department to assure compliance to their code provisions, including but not limited to, requirements for submittals, stamped drawings and site visits by a qualified engineer, steps, stairs and railings.

We value our relationship with our customers, and we seek to bring you innovative ideas and products that create income opportunities. We pride ourselves on our level of experience and the technical support we provide. Our active participation in industry organizations allows us to bring you the latest information and technology. We strive to offer the quality of service that covers your needs. We support you with the help you need...including design consultation, specification assistance, sales promotion, job site training and quality review...to help make your project a success. Please contact your Pavers by Ideal sales representative for additional information or visit our website at www.IdealConcreteBlock.com for details, design charts and cross-sections.

We welcome your comments and guidance to help us better serve your needs and support your growth.

© 1996-2015 Ideal Concrete Block Co.

Tumbled ScapeStone™, Olde Boston™ WallStone, and Ancestral™ Wall and Coping are trademarks of Ideal Concrete Block Co.
Sleeve-It™ is a trademark of Strata Systems, Inc.
SRW® is a trademark of SRW Products

Ideal is contracted to produce a number of products under exclusive license agreements:
• Pisa2®, Roman Pisa®, and ReversaCap® are registered trademarks of Risi Stone Systems
• Stonewall™, GravityStone® and Fat Face™ are registered trademarks of Westblock Products, Inc.



45 Power Road, Westford, MA 01886
232 Lexington Street, Waltham, MA 02154
(781) 894-3200 • Westford Fax (978) 692-0817 • Waltham Fax (781) 894-8526
www.IdealConcreteBlock.com

TABLE OF CONTENTS

History and Overview	1	Outside Corners using Pisa2/Roman Pisa.....	13
SRW Attributes	1	Inside Corners using Pisa2/Roman Pisa.....	13
How Segmental Walls Work	1	Stairs.....	13
Conventional Segmental Retaining Walls.....	2	The Cut Method.....	14
Engineered/Mechanically Stabilized Earth Segmental Retaining Walls.....	2	Treads.....	14
Components in SRW Systems Construction	2	Other Step Options with Pisa2/Roman Pisa.....	15
Design Principles	2	Terraced Walls.....	15
Good Soil is the Foundation to a Successful Wall!	2	Fences/Parking Areas.....	15
Gravity SRW Structures	3	Railings/Guards.....	15
Design Assumptions.....	3	Geo-grid-Reinforced MSE Structures	16
Other Site Conditions	3	Geo-grid Placement Procedures.....	16
Slopes.....	3	Corners.....	16
Surcharges.....	4	Additional Design Information.....	16
Water.....	4	GravityStone	17
Seepage.....	4	Getting Started	17
Water Applications.....	4	Components	17
Some Common Sense	4	GravityStone Cellular Assembly	17
An Engineer's Role	5	Choice of Systems	18
Ideal Concrete Block Co. SRW Products	5	Design Selection	18
Physical Characteristics	5	Construction	18
SRW Units	5	Excavating.....	18
Pisa2.....	5	Installing and Compacting the Base.....	18
Roman Pisa.....	5	Installing the First Course.....	19
Stonewall.....	6	Inserting the Alignment Plugs.....	19
GravityStone.....	6	Filling the Cells.....	19
Fat Face.....	6	Laying the Wall.....	20
Coping Units	6	Capping the Wall.....	20
Ancestral.....	6	Finish Grading.....	21
Universal Coping Stone.....	6	Multi-Cell Assembly	21
Pisa2/Roman Pisa Full Caps.....	6	Details	21
ReversaCap.....	6	Curves.....	21
Stonewall Caps.....	6	Layout.....	21
Roman Pisa Coping.....	6	Concave Walls.....	21
Corner/Half Units	6	Convex Walls.....	21
Specialty Units	7	Outside Corners.....	22
Garden Wall Products	7	Inside Corners.....	22
Ancestral Wall.....	7	Step-Ups.....	22
Olde Boston Wall.....	7	Ending the Wall.....	22
General Construction.....	7	Stairs.....	22
Construction	8	Treads.....	23
General Conditions.....	8	Free-Standing Walls	23
Planning.....	8	GravityStone with Geogrid Reinforcement	23
Excavating.....	8	Estimating	25-30
Installing and Compacting the Base.....	9	GravityStone Pillars	31
Installing the First Course.....	10	Glossary of Commonly Used Terms	35
Laying the Wall.....	10	Design/Estimating Charts	37
Capping the Wall.....	12	GravityStone Modular.....	37
Finishing the Wall.....	12	GravityStone MSE.....	38
Details	12	Pisa2/Roman Pisa.....	39-40
Step-Ups.....	12	Stonewall.....	41-42
Ending the Wall.....	12	SRW Preliminary Design Request Form	43
Curved Walls.....	12	Construction Observation Checklist	44
Corners.....	12		
Outside Corners using Stonewall or Fat Face.....	13		
Inside Corners using Stonewall or Fat Face.....	13		

For additional details, design charts and cross-sections, please visit our website at www.IdealConcreteBlock.com.

A Contractor's Guide to Installing Segmental Retaining Walls

HISTORY AND OVERVIEW

Retaining walls have been used for thousands of years as a means of utilizing marginal land. In the past decade, the cost of land has spiraled as building and development continues to consume prime real estate. As a result, landscape retaining walls have grown in popularity as a primary method of maximizing existing land space.

Until the development of segmental wall systems, the construction and landscape industries often used traditional materials and construction techniques to build retaining walls. Poured in-place concrete, conventional mortared masonry walls, or timber walls made of pressure treated wood or recycled railroad ties were the popular materials of choice. In the mid 1980's, a new technology emerged and segmental retaining wall systems were created to answer the need for a simplified, easy to install retaining wall. Their appeal continues to grow as property owners look to enhance the value of their property through beautification.

Most segmental retaining wall (SRW) systems are suitable for straight or curved walls, corners, and stairs, and they provide the ideal way to accommodate grade changes in any landscape or garden project. Uses include landscaping walls, terrace walls, tree rings, flowerbeds, planters, and more. SRWs are especially functional for developers because they save space and allow the property to be utilized to its maximum capacity. In heavy-duty structural applications, SRWs can accomplish grade changes, provide erosion control, serve as bridge abutments, and support parking areas. They also offer effective retainment for ponds, creeks, lakes, and stream channelization.

SRW ATTRIBUTES

Segmental retaining walls offer distinct advantages over other types of retaining wall products.

Aesthetics - SRWs are available in a wide choice of colors, shapes, styles, and configurations. Typically, segmental retaining wall units have a split face which offers a sculptured texture that subtly captures the changing hues of the day's light. Some faces have a beveled shape for a curved contour, while others are split straight across on a more uniform plane. Tumbling adds a new dimension by imparting an authentic appearance of natural stone. The units are produced in natural earthtone colors that blend beautifully with their surroundings.

Easy To Use - To borrow a term from another industry, segmental retaining walls are "user-friendly". They have been designed for fast and easy construction and do not require the skills of experienced stone masons. Years of training are not essential to build beautiful and professional looking landscape walls.

Performance - Because they are flexible structures, SRWs can

tolerate movement and settlement without cracking and can be used in a variety of applications and wall heights. As a result, it is not necessary for SRW walls to sit below the frost line.

Durability - In order to withstand New England's harsh winter climate, segmental retaining wall units should be made from concrete with compressive strengths of at least 4500 psi (pounds per square inch). Segmental retaining wall units are environmentally safe and they won't rot or decay. You can be assured of lasting durability, structural integrity, and years of lasting beauty with little or no maintenance.

Design Flexibility - Most SRW systems can create curves - both concave (inside) and convex (outside). Some can create a circle as small as 6' in diameter. Tiered or terraced walls, stairs, corners, step-downs, and complex architectural layouts are also possible with many SRW systems.

Affordability - The method of construction allows better productivity and offers comparative or lower costs than most other types of walls including those constructed of wood ties.

Feature	Benefit
• Flexible structure	• Able to accommodate slight shifts
• High strength concrete	• Greater durability
• Factory-manufactured	• Consistent dimensions and strength
• Variety of colors and faces	• High aesthetic appeal
• Modular system	• Flexible design
• Simplified construction	• Minimal training/experience
• Dry stack	• Easy to install

HOW SEGMENTAL WALLS WORK

There are a number of types of segmental retaining wall systems available on the market. Many are proprietary and they vary with respect to size, shape, and appearance. One feature shared by all of the systems is they fit snugly together and step back when stacked. They are sometimes referred to as "dry-stack" or mortarless systems because they do not require mortar to hold them together. The means of interlock also varies with the particular segmental retaining wall system and most are proprietary. Some have a tongue and groove or rear lip molded into the units, while others use pins or plugs to connect the units.

Segmental retaining walls under 4' high work by the principle of gravity where the combined weight of the wall units resists the weight of the earth being retained. This type of system is commonly referred to as a gravity wall structure. Walls that exceed this height require additional construction techniques such as terracing or the use of geogrid reinforcement and are known as reinforced or engineered wall structures. They are also referred to as MSE or mechanically stabilized earth walls.

Regardless of the type, all segmental retaining wall systems work by the same principles!

Gravity Wall Structures

Gravity segmental retaining wall structures resist the pressures of the earth they are intended to retain by **weight, batter** (setback), **depth** and the **friction** between the concrete units. Conventional segmental retaining walls are generally effective as gravity structures for most *non-critical* wall applications under 4' high measured from the top of the footing/base.

Grid Wall Structures

Grid wall structures are mechanically stabilized earth (MSE) walls consisting of SRW units used in combination with geosynthetic reinforcement which serves to increase the mass of the structure. This mechanically stabilized wall system offers the resistance required to support external forces associated with taller walls, surcharged structures, or poor soil conditions. We recommend the services of a qualified design professional to determine grid strength, length and spacing between layers. Properly designed "engineered" walls can be built as high as 40'.

COMPONENTS IN SRW SYSTEMS CONSTRUCTION

The basic elements of each segmental retaining wall system are: the foundation soil, gravel base or footing, segmental wall units, retained soil, drainage fill, and for soil-reinforced SRWs, the geogrid reinforcement.

Foundation soil - The subgrade soil supporting the gravel base, SRW units, and the reinforced soil zone of a MSE wall.

Base/footing - The base (footing) distributes the weight of the SRW units over the foundation soil and provides a working surface for construction. Typically, the base consists of granular material, such as 1 1/2" processed gravel or 3/4" crusher run, although non-reinforced concrete or flowable fill can be used.

Segmental wall units - The concrete masonry units used to create the mass necessary for structural stability, and to provide stability, durability, and visual enhancement at the face of the wall.

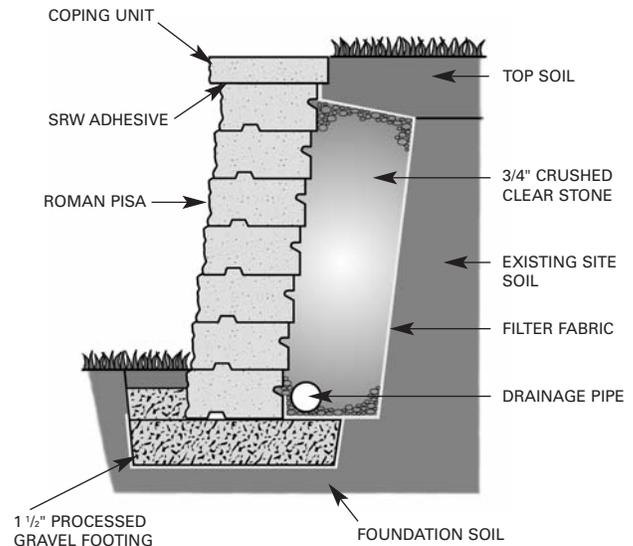
Drainage Stone - Typically 3/4" crushed stone which is placed behind the wall to facilitate the removal of groundwater and minimize buildup of hydrostatic pressure on the wall. It is also used to fill the cores of open-cell units in order to increase the weight and shear capacity. Geotextile fabric is typically installed between the drainage stone and the infill soil to prevent fines from clogging the stone.

Infill Soil - The backfill material that is placed and compacted in the area immediately behind the drainage zone.

Reinforced Soil - The compacted backfill material containing the horizontal layers of geogrid placed behind the drainage zone.

Retained soil - The undisturbed soil for "cut" walls or the backfill soil compacted behind the infill or reinforced soils zone.

Typical Gravity Retaining Wall Cross Section



DESIGN PRINCIPLES

Segmental design concepts are based on proven engineering principals of standard soil mechanics. Proper wall design should always begin with a thorough review of the site, and in many cases, should employ the services of a qualified civil or geotechnical engineer.

Although many of the SRW systems on the market are proprietary in nature and have their own design methods and recommendations, many users assume that walls under 4' high never require the services of a qualified soils engineer. *Not true!* This height is simply a "rule of thumb" and assumes the best case scenario.

Sound judgement must be exercised in analyzing existing soil and groundwater conditions, global stability, external and internal stability, surcharge loads and seismic requirements. The topography of the site also plays a role in deciding wall height, embedment depth, and the profile of the wall. If the calculations show that conditions exceed factors of safety in the design, *use of geogrids may be necessary regardless of wall height.* In other circumstances, the strength of the geogrid may need to be increased or longer lengths and/or additional layers may be required. Water applications such as lakefronts, seawalls and storm water runoff channels require additional specialized engineering considerations.

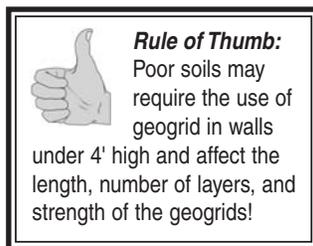
GOOD SOIL IS THE FOUNDATION TO A SUCCESSFUL WALL!

The performance and construction of most retaining walls is highly dependent on the type and condition of the on-site soils and the contractor's placement and compaction of these soils behind and under the walls.

“Quick Soil-Typing Guide” from Vibromax Equipment

What to look for	Granular soils, fine sands, silts	Plastic (cohesive) soils, clay
Visual appearance and feel.	Coarse grains can be seen; feels gritty when rubbed between fingers.	Grains cannot be seen by naked eye; feels smooth & greasy when rubbed between fingers.
Movement of water in the spaces.	When a small quantity is shaken in the palm of the hand, water will appear on the surface of the sample. When shaking is stopped, water gradually disappears.	When a small quantity is shaken in the palm of the hand, it shows no sign of water moving out of the voids.
Plasticity when moist.	Very little or no plasticity.	Plastic & sticky; can be rolled.
Cohesion in dry state.	Little or no cohesive strength in dry state; will crumble readily.	Has a high dried strength; crumbles with difficulty & disintegrates slowly in water.

Unless you are working with a soil borings/report and a set of plans that have been developed by a qualified engineer, you may be faced with making a judgement as to the suitability of the site to support a retaining wall.



Therefore, it is important to know the properties of various types of soil and understand how they might effect your estimate. To get a better understanding about soils, we have included this section to discuss soil types and properties.

Soil Types - Soils are divided into three groups:

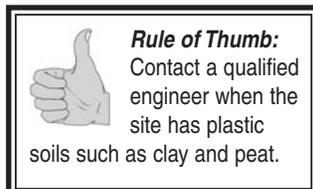
- **Granular** - sands and gravel consisting of grains down to .002"
- *Best for strength and support*
- **Clay** - very fine particles, > 50% passing #200 sieve
- *May cause settlement*
- **Organic** - loam, peat that is made up of moss, leaves and vegetable matter, and top soil
- *Must be removed*

Dig A Hole: If test borings are not available, one of the simplest ways to determine the type of soil you will encounter during excavation is to dig a few holes with a hand shovel. The chart shown above will help to identify soil types.

From a design and construction standpoint, the soils can be classified as follows (Unified Soil Classification Designation):

Excellent: Sand & Gravel (GW, GP, SW, SP)	36° (ϕ)
Good: Sand & Gravel mixed with Clay & Silt (GM, GC, SM, SC)	33° (ϕ)
Moderate: Fine Sands & Silty Sand (SP, SP-SM, SP-SC)	30° (ϕ)
Poor: Low Plastic Silts & Clay (ML, CL)	27° (ϕ)
Bad: High Plastic Silts & Clay, (CH, MH)	23° (ϕ)
Bad: Peat & Organic Soils (OL, OH, PT)	n/a

Bear in mind that excessive wall movement or settlement can occur due to poor soil conditions under or behind the wall structure regardless of the geogrid design.

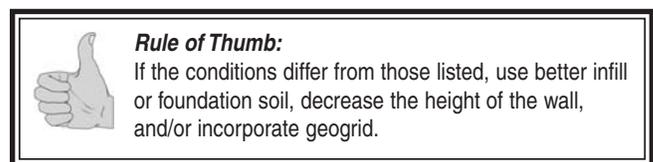


GRAVITY SRW STRUCTURES

Design Assumptions

The design methodology for conventional gravity walls is based upon the following assumptions and conditions.

1. There is no slope behind the wall.
2. Surcharge loads applied at the top of the wall are limited to foot traffic where the applied forces will be between 0-50 psf.
3. There is good surface and subsurface drainage to prevent hydrostatic pressures at the back of the wall fascia and the reinforced soil zone.
4. The site soil has adequate strength to support the wall and good draining soils will be used behind the wall. In addition the ground water table is assumed to be well below the reinforced zone.
5. The cubic foot weight of the soil is the moist unit weight that includes the weight of water occurring naturally in the soil.
6. Seismic loading is not considered.
7. The site can support the weight of the wall.
8. The foundation soil will not settle or deform to cause failure.

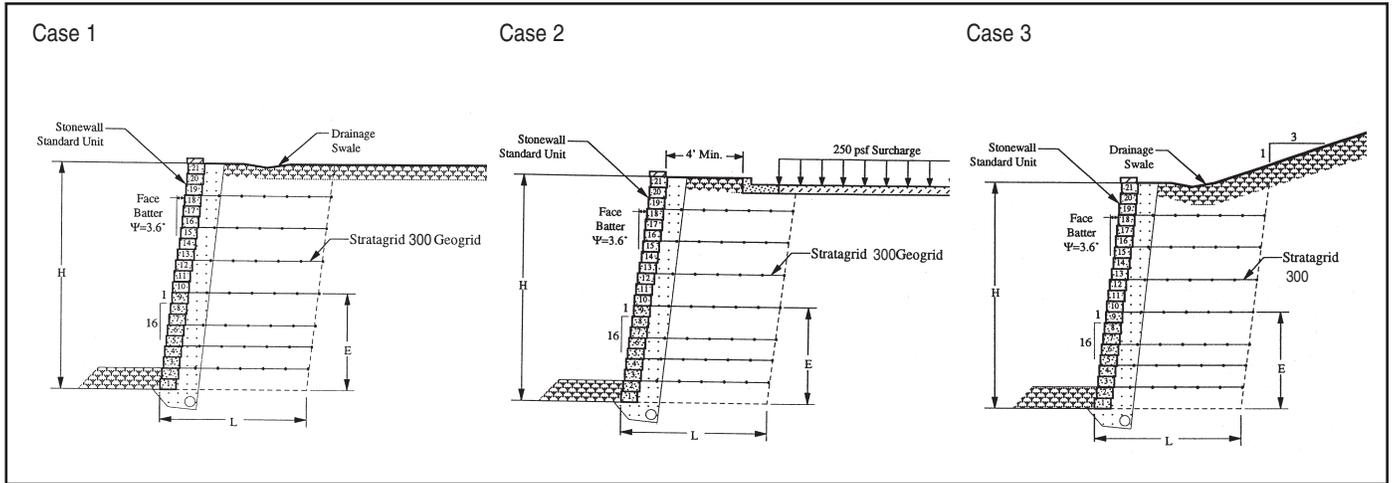


OTHER SITE CONDITIONS

When faced with the responsibility of designing and constructing a SRW wall, it is important to know the topography in front of and behind the wall, as well as the type of loads that might be imposed on the wall.

Slopes

A slope above the wall will create an additional load that must be considered in the design. The loads imposed by sloping embankments vary depending upon the angle of the slope. A slope is the ratio of the height of the rise to the length of the run and is the angle between the slope surface and the horizontal plane.



For example, a 2:1 slope means that for every 2' it goes back, the slope rises 1'. In the case of gravity wall structures, the use of geogrid may be needed, or in engineered walls that include geogrid, additional embedment may be required.

Slopes in front of a wall also can cause failure. Additional courses should be buried to a depth equal to the elevation of the slope when measured out 6' from the front of the wall. Geogrid may be required even with conventional gravity walls, and longer lengths may be needed for grid walls.

Surcharges

It is important to know what other types of loads might be expected to occur. Typically, there are two types of surcharges.

Live loads: These are typically construction traffic, parking, vehicle traffic, or pedestrians. These loads are transient and can not be considered to contribute any stabilizing forces to the retaining walls structure.

Dead loads: Other retaining walls, back slopes, or buildings on top of the retaining wall are examples of this type of load. Structures and dwellings in close proximity also impose loads on walls. Since they may be present for the entire life of the retaining wall, it is allowable to consider the load as a stabilizing force in certain cases.

Backslope	Liveload
2H:1V 26°	Pedestrian - 50 psf
3H:1V 18°	Cars & Light truck traffic - 100 psf
4H:1V 14°	Truck Traffic – 250 psf
	Construction Equipment – 500 psf

Water

Water can add excessive weight to the soil behind a wall that can ultimately cause the wall to fail even at low heights. In fact, if allowed to totally saturate the soil, water can increase the density by almost 60 lb/cu ft! When water cannot be directed over or around the wall by drainage swales, water must be directed through the wall. In addition to the 3/4" crushed stone drainage zone immediately behind the wall units, the wall infill zone may require a blanket drain (below the wall) and/or

chimney drain (behind the wall) to collect and remove the water from the wall structure. It is also important to identify sites where the water table is near the base of the wall.

Seepage

Certain soil conditions, such as stratified layers of clay and sand, can act as natural conduits for water. The amount of water these layers may carry can be very significant. If you discover these during excavation, additional drainage materials should be incorporated into the retaining wall. Typically a chimney drain will be installed along the vertical cut face to intercept, collect, and direct the water into a drain which will take the water away from the wall.

Water Applications

Segmental retaining walls can be built at sites such as ponds where the bottom of the wall is submerged. Construction techniques include:

- Using open-graded stone for the base/footing aggregate
- Using Turfstone™ as the footing and/or to contain the open-graded stone aggregate
- Placing geotextile fabric over infill material in front of wall and cover with riprap or Turfstone
- Gapping the units 3/4" apart at the low water level
- Back-filling an area approximately equal to the height of the wall with free draining 3/4" stone

Contact your **Ideal** sales representative for more information.

SOME COMMON SENSE

When it comes to the design and construction of segmental retaining walls, it is always better to take a conservative approach.

Remember, when any of the SRW manufacturers say that walls can be built to 4' high without grid, it is predicated on the basis that the wall will be built under the best conditions.



Rule of Thumb:

If you have any concern as to whether the site offers the best conditions, you should consider using the services of a qualified soils engineer.

AN ENGINEER'S ROLE

Engineers serve an important role in SRW design. First, they must meet their client's needs to minimize costs and fulfill the functional requirements of a project, and second, they are obligated to protect the public by ensuring project safety and compliance with regulations.

An engineer provides important assistance to an owner and contractor by:

1. Examining the site - inspecting the soil and groundwater conditions and providing input parameters.
2. Developing a specific design to meet to the conditions of the site and ensuring that it complies with state and local building codes.
3. Specifying and inspecting the materials used in the retaining wall structure to ensure they are appropriate.
4. If retained, an engineer can observe, test, and examine the installation to ensure compliance with project specifications and wall drawings.



Tip: In some cases, state and local building codes may require a stamped drawing and/or site visits by a registered design professional.

By using a qualified engineer, the owner and contractor can be assured that the wall will perform as intended and they can expect a reduction in the total cost of the project. In addition, the engineer will significantly reduce the owner and contractor's liability.



Rule of Thumb:

If the engineer designs, inspects, and approves the structure, the engineer will be responsible and liable for the retaining wall if built to the engineer's design.

IDEAL CONCRETE BLOCK CO. SEGMENTAL WALL UNITS

Most of the information presented to this point has been generic in nature and applies to all types of SRW systems, regardless of the manufacturer. While the performance characteristics are similar, the design methods and recommendations of the various systems are proprietary in nature and should not be transferred from one to another. Some manufacturers may choose to use conservative standards and calculate designs using a higher factor of safety, while others may choose to use the best case conditions in their assumptions. For this reason, the following section will deal with the specifics of the SRW products **Ideal** manufactures.

Ideal Concrete Block Co. manufactures a variety of SRW products to suit a wide range of applications. All of our systems fit securely together without mortar and automatically step back when stacked. **Stonewall™** utilizes pins to align the units, while our **Pisa2®** and **Roman Pisa®** incorporate a tongue and groove connection. **GravityStone®** is a crib wall system that can be

built as a multiple-depth structure, eliminating the need for geogrid. **Stonewall™**, **Pisa2®, Fat Face,™** and **Roman Pisa®** may be used for conventional gravity walls up to 4' high or for MSE segmental retaining walls in excess of 20' high. A **GravityStone®** single-cell wall can be built as high as 8' without geogrid. Our smaller units are limited to wall applications less than 2 1/2' high and are generally used for simple garden type applications.

PHYSICAL CHARACTERISTICS

All of our concrete segmental wall units are manufactured at our Westford facility using a special concrete mixture formulated to withstand New England's harsh winter climate and freeze-thaw environment.

Ideal's wall units are dimensionally accurate and have a textured split-face appearance reminiscent of natural stone. Our units meet or exceed North American standards, including ASTM C 1327 Standard Specification for Segmental Retaining Wall Units. The typical characteristics offer:

- Minimum Compressive Strength 4500 psi
- Maximum Water Absorption 13%
- Freeze Thaw (150 cycles ASTM C 1262) Pass

PRODUCT INFORMATION

SEGMENTAL RETAINING WALL UNITS

Pisa2®

8" w x 6" h x 12" d • 43 lb/pc • 3 pcs/sf
Batter 1:8 (1 1/2" per ft)



Pisa2 offers a textured face that is elegant in its simplicity. **Pisa2** is uniformly split and molded with subtle chamfers to create a wall with distinct horizontal lines. A continuous offset tongue and groove automatically steps **Pisa2** back and securely locks the units together.

Roman Pisa®

8" w x 6" h x 12" d • 42 lb/pc • 3 pcs/sf
Batter 1:8 (1 1/2" per ft)



Roman Pisa is an upscale segmental wall unit that offers the natural appearance and texture of weathered stone. We use an innovative technology that creates a "stone-rocked" finish that imparts a unique character to each piece, while preserving the structural integrity of its tongue and groove connection. **Roman Pisa** has the practicality and functionality of **Pisa2** and can be used as a gravity system in walls under 4' high or as a MSE segmental system for walls well over 4' high!

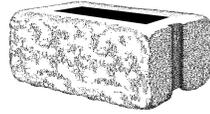
Pisa2 and Roman Pisa

- Convex curve - 15' min. diameter
- Concave curve - 12' min. diameter
- Diameter of ashlar pattern for convex wall - 30'
- Set back - 1 1/2" per foot or 9°

Roman Pisa® Jumbo Unit

12" w x 6" h x 8" d • 32 lb/pc • 2 pcs/sf

The **Roman Pisa Jumbo Unit** is a larger size block that can be used vertically to create a variety of appealing Ashlar patterns.

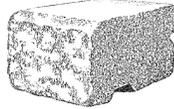


Pisa2® & Roman Pisa® Stretcher Caps

8" w x 6" h x 12" d • 43 lb/pc • 3 pcs/sf

1 1/2 pcs/lf

Stretcher Caps are the same size as the **Pisa2/Roman Pisa Stretcher Units** but do not have a tongue, so their top is flat. *Stretcher Caps* are available in a tapered configuration and must be used for the last course when finishing the wall with our *Universal Coping*, **Roman Pisa Coping** or **Ancestral Coping** units.



Stonewall™ & Tumbled Stonewall™

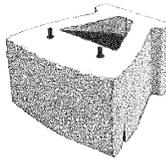
12" w x 8" h x 12" d • 50 lb/pc • 1.5pcs/sf

Batter 1:16 (3/4" per ft)

Min. diameter - 6' • Caps min. diameter - 12'

Set back - 3/4" per foot or 4.5"

Stonewall is available in a Curved Face or a Straight Face profile. Nylon pins align the units as they stack for consistent and accurate construction. **Tumbled Stonewall** features our Drum-Roll Tumbled® antiqued process in a straight face configuration. Otherwise it has the same features as our **Stonewall** split-face.



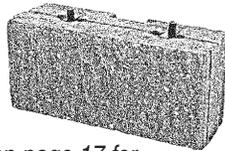
GravityStone®

18" w x 8" h x 6" d • 59 lb/pc • 1 pc/sf

Min. diameter single-cell unit - 12 1/2'

Min. diameter mini-cell unit - 8 1/2'

Please see the *GravityStone* section on page 17 for more information on all the components comprising this system.



GravityStone combines the simplicity of easy-to-handle dry stack units with the superior earth retention capabilities of crib wall structures. It also can be used to build free-standing, double-sided walls up to 8' high and pillars! Available with a *split-face texture* or our *Drum-Roll Tumbled®* finish.

Fat Face™

18" w x 8" h x 12" d • 78 lb/pc • 1 pc/sf

Min. diameter - 8 1/2'

Batter: 3/4" per foot in set-back position

Fat Face offers a straight, split face that provides a beautiful wall with an attractive natural stone appearance. Plugs align the units in a vertical or set-back position as they stack for consistent and accurate construction.



COPING UNITS

Roman Pisa® Coping Stone

16" w x 3 5/8" h x 13" d • 62 lb/pc

1.33 lf/pc

The **Roman Pisa Coping** units match the tumbled appearance of **Roman Pisa**.



Ancestral™ Tapered Coping

"A" unit: 16"/13" l x 3 5/8" h x 13" d

55 lb/pc

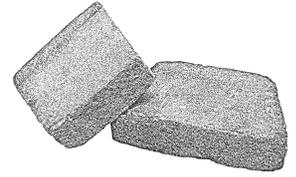
"B" unit: 13"/10" l x 3 5/8" h x 13" d

49 lb/pc • 2.16 lf per pair

Outside Radius: 126"

Inside Radius: 100"

9 sets plus cut piece 4 7/8"



The 13" depth of **Ancestral** units provides an attractive 1" overhang that accentuates the finish of our **Roman Pisa**, **Stonewall**, **Fat Face** and **Ancestral** wall styles. As a tapered coping, the paired set are alternated for straight walls or arranged in a combination to follow a serpentine curve.

Universal Coping Stone™

16" w x 3 5/8" h x 13" d • 57 lb/pc

1.33 lf/pc

Universal Coping Stone is an attractive cap unit that provides a beautiful finish for **Stonewall**, **Fat Face**, **Pisa2**, and **GravityStone** walls. One edge is split, while the opposite edge is smooth, giving you two styles from which to choose. A right-handed or left-handed corner is easily made by splitting a 4" piece off one of the ends.



Stonewall™ Caps

Radius - 12" w x 4" h x 8" d • 30 lb/pc • 1 pc/lf

Straight - 12" w x 4" h x 8" d • 33 lb/pc • 1 pc/lf

Available in straight or radius units.



Note: When used as stair treads, coping units must be treated with a penetrating sealer.

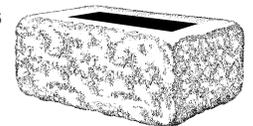
CORNER/HALF UNITS

Pisa2® and Roman Pisa® Corners

8" w x 6" h x 12" l • 32 lb/pc

1 per course per corner

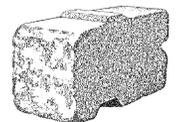
Both the **Pisa2** and **Roman Pisa** *Corners* provide a split-face finish along an 8" width and 12" length to match the appearance of the *Stretcher* units in the wall. **Pisa2** is available in *Left & Right Hand* units, which are alternated in every course to maintain the running bond with minimal cutting. **Roman Pisa** *Corners* are reversible.



Pisa2® and Roman Pisa® Half Units

4" w x 6" h x 12" d • 22 1/2 lb/pc • 6 pcs/sf

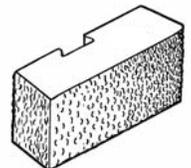
Use **Pisa2** and **Roman Pisa** *Half Units* for creating combination running bond, as well as ashlar patterns.



Fat Face/GravityStone Corners

6" w x 8" h x 15" l • 52 lb/pc • 1 per course

Reversible - Available in a split-face or tumbled finish.



Stonewall™ Corners/Halves

6" w x 8" h x 12" l • 35 lb/pc

This single unit can be used for all corners and wherever a half piece is required in **Stonewall** wall applications.



SPECIALTY UNITS

Pisa Lite™ and Pisa Sounds™

Pisa Lite and Pisa Sounds are innovative illumination and sound systems that have been designed to match the look and color of **Pisa2/Roman Pisa** units. As you build the wall, simply replace a regular wall unit with one of these specially made units wherever you want a light or a speaker!

OTHER WALL UNITS AND STYLES

Garden Wall Products

We differentiate our garden wall products from our conventional segmental retaining wall units by application and ability to retain loads and surcharges. Planter beds and low-height retaining walls 32" or less are typical examples of garden wall applications and, for some styles, free-standing, double sided walls, seat walls, barbecue islands, pillars and pilasters.

Ancestral™ WallStone

3" high unit: 1.2 sets/sf • .83 sf/set

6" high unit: .6 sets/sf • 1.66 sf/set

Depth 10"

Nominal Lengths 16"/14" • 14"/12" • 12"/10" (Tapered)



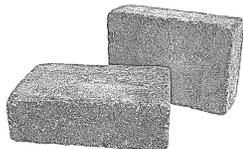
The **Ancestral WallStone** modular wall system is available in 3" and 6" heights and is packed as a set of three lengths to create straight or curved retaining walls, free-standing walls, and seat walls. Split on 2 faces then antiqued through our Drum-Roll Tumbled® process, **Ancestral WallStone** suggests the craft of dry laid stone.

Olde Boston™ Wall

8" w x 4" h x 12" l • 28 lb/pc

3.1 pcs per sf

The 4" x 8" x 12" modular dimensions of the single unit allow for placement in four different orientations - horizontal, vertical, on edge, and on end. It offers the ability to create a variety of patterns, including running bonds, random and ashlar for design flexibility.



General Construction Guidelines

Garden Wall units derive their versatility as a dry-stack system where integrity between courses is augmented by adhesive instead of an integral method of connection. Traditional retaining wall construction is discussed starting on page 8. The general construction guidelines for Garden Wall units are as follows:

Excavation: Units are set in the middle of the footing, so plan on digging a trench 20"- 24" wide when locating the front of your wall. Excavate about 10" deep if using gravel for the footing or 7" deep if using **Turfstone**, which will provide added stability. Remove loam, roots, and large rocks.

Base Preparation: Compact the subgrade soil thoroughly and cover the trench with a sheet of landscape fabric. For a gravel footing, use 1 1/2" processed gravel or 3/4" crusher run road base type aggregate. Place the gravel in 3"-4" layers and firmly compact until the footing is 6" thick. If using **Turfstone**, set the units directly on the compacted subgrade. Carefully level and fill with gravel. The top of either type of footing should be about 4" below grade as one course of units is buried.

First Course: Place units side-by-side in the center of the base for the length of the footing, leveled front-to-back and side-to-side. If **Turfstone** was used for the footing, secure the units to the **Turfstone** with a construction-grade adhesive. To achieve a strong bond, brush dust, grit, or stone from the surfaces to be adhered. (Follow the directions on the label of the tube.) Fill the space in front of and behind the wall units with gravel to grade. Place perforated pipe (holes facing down) behind the block for the entire length of the wall. Slope pipe and drain to daylight.

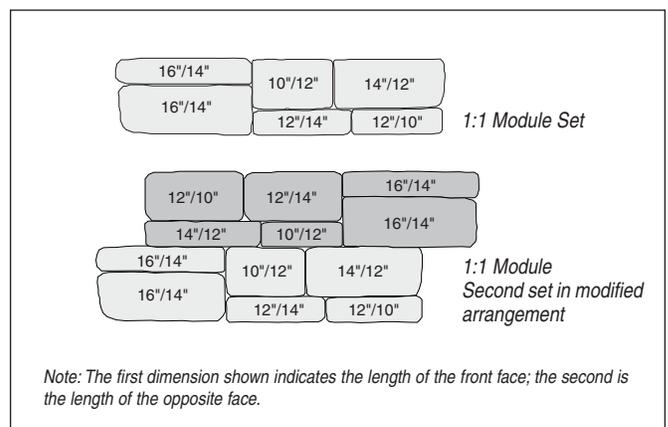
Additional Courses: Securing courses together with construction grade adhesive provides additional stability. Brush the surfaces clean then apply several 3/8" beads of adhesive and immediately place the units onto the course below. Use pressure to firmly seat into position. Position the units in the desired pattern. Offset the joints from the course below as you follow the alignment of the wall. Cut units to modify the stagger and to terminate the course at the ends of the wall.

Always wear proper safety equipment when cutting or sawing concrete products. For drainage, backfill the 12" space behind the wall with 3/4" stone using care to avoid shifting the units. Position the landscape fabric between the stone and the earth as you build the wall.

Finishing the Wall: When building with garden wall units, the last course typically serves as the coping. Secure these units with adhesive. Fold the fabric over the stone, cover with soil and add mulch, flowers or plants.

Ancestral Wall Patterns

The following is one of the many patterns for Ancestral Wall. The easy to arrange 1:1 module creates an interesting ashlar pattern. To give the facade of additional segments, split random units into varying lengths.



CONSTRUCTION

1. General Conditions

The success of any segmental retaining wall installation depends on complete and accurate field information, careful planning and scheduling, the use of quality materials, and proper construction procedures.

It is good practice to have the retaining wall location verified by the owner. If working with an architect or engineer, confirm the existing and proposed finished grades to ensure the heights are in agreement with the project-grading plan. Check the contract document to see what type of submittals may be required. Often, you will be asked to submit product information. If site preparation is part of the contract, be prepared to conduct tests for compaction and density.

There are several ways to measure compaction. The most common is the Proctor method, which is conducted by a testing company. The procedure requires a technician to take a soil sample from the site and test its optimum density in the lab. He will then return and test the density of the soil at the site to compare it to the laboratory value. If within a certain percent, it is considered passing. Another method is the nuclear density test where a lab technician uses a nuclear instrument that emits radioactive waves to determine the density of the soil at the site. Although both tests bear an added cost to the project, they can help you avoid costly expenses at a later date if excessive settlement and movement occur.

If you are providing design assistance to your customer, first determine the height, length and configuration of the wall they want you to build. Make a drawing showing any adjoining structures, fences, stairs, and paved areas. Be sure to include an accurate sketch of the area you want the wall to retain, noting the slope and drainage patterns. Once the plan is complete, check with your local building department to determine if a permit is necessary. In some cases, a stamped drawing may be required, which means you need the services of a professional engineer. The authorized *Ideal* dealer in your area may be able to help you obtain this type of service. Otherwise, they can help determine the quantity of SRW units, gravel, crushed stone, and other materials you will need to complete your project. You can also refer to the handy charts included in the **Estimating Section**.

Usually, it is the contractor's responsibility to coordinate the delivery and storage of materials at the site to ensure unobstructed access to the work area and materials. Remember that delivery trucks are heavy, so select a location where the material can be placed. The SRW units will arrive on pallets, while the gravel and crushed stone will be delivered by separate trucks. Be sure to inspect the shipment as soon as the material arrives to make sure it matches your order for shape, color, size and quantity. Every cube comes with tags that provide important information about the product. Be sure to read them carefully. If there is a problem, contact your supplier immediately. Do not install the units in the wall, as use will constitute acceptance.

2. Planning

Before beginning any excavation, contact your local utility companies such as *Dig Safe* or *Call Before You Dig* and request that they mark underground cables or pipes. These services are usually free, but may require 72 hours notice.

NOTE!!!! The following instructions are suitable for walls under 4' high when measured from the first course of units placed on the base. Sites with poor drainage, excessive groundwater, sloping embankments, or walls 4' and higher are conditions that require additional preparation or construction techniques such as terracing or the inclusion of geogrid. These are considered "**engineered walls**" and a section discussing some of the parameters involved in their construction has been included. **We recommend that you contact a qualified soil engineer if any of these conditions exist.**

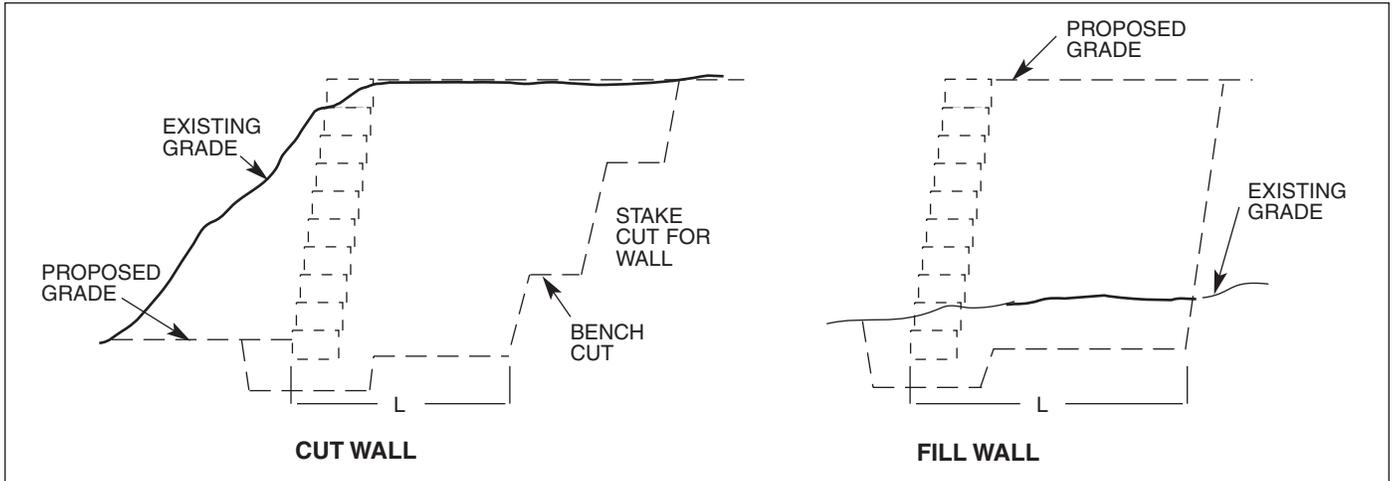
It is a good idea to develop a method to handle surface storm-water runoff before, during, and immediately after completion of a wall. When ground cover is disturbed by excavation, the soil is susceptible to becoming saturated during heavy rain events. Stormwater run-off should be diverted around the excavation and wall installation area to prevent erosion, potential wall collapse, and a delay in the work schedule. These diversions should funnel the stormwater into a temporary erosion control system and remain intact until the wall is deemed completed by the owner.

3. Excavating

The structural integrity of any retaining wall starts from the ground up and the key to good construction is preparing a firm foundation for support. Segmental retaining wall units are considered flexible structures, so the footing does not need to be placed below the frost line.

There are two basic topographical conditions under which SRWs may be constructed: "cut" and "fill". A "cut" wall is a site where the banking already exists and at least a portion of which must be removed. A "fill" wall is erected on fairly level ground and requires back filling to bring the embankment to grade. If your project is a "cut" wall, excavate the area to the lines and grades shown on the approved plans. Take precautions not to over-excavate and always maintain safe slope parameters per OSHA requirements. Also, carefully consider the effects that the construction will have on structures and parking areas nearby. Make sure not to undermine or encroach upon the soils supporting these structures in any way.

Until now, the construction information we have provided is applicable to any wall system. The next section will provide the complete information you will need to construct a conventional **SRW** wall using **Stonewall**, **Fat Face** or **Pisa2/Roman Pisa**. Please note that **Pisa2** and **Roman Pisa** are identical in size and configuration. Except where noted, the construction methods and techniques for them are interchangeable. The steps involved in the construction of a **GravityStone** wall will be shown separately.



Staking out the wall - Start by staking out the location of your wall, allowing for the automatic step back of $\frac{1}{2}$ " with every course of **Stonewall** and $\frac{3}{4}$ " with **Pisa2**, **Roman Pisa** and **Fat Face**. If building your wall in front of an existing embankment, allow enough room to maintain 12" of space behind the wall. This is called the drainage zone, which will be filled with $\frac{3}{4}$ " stone as you build the wall. The wall location is especially important on outside (convex) curves where the step-back of the units will decrease the radius of the curve as the wall goes higher. See the section on **Curved Walls** for more information.

Cut Walls - Follow OSHA guidelines for dimensions of Bench Cut based on soil types when excavating or no steeper than 1H:2V when not stipulated.

Trench - Once you have staked out the location of your wall, excavate a trench at least 14" deep by 24" wide for **Stonewall** and **Fat Face** and 12" deep by 24" wide for **Pisa2/Roman Pisa**. You will need to dig deep enough to allow for a 6" thick gravel base and the first row of units that will be embedded below finished grade. If the wall is to step-up into a slope at different levels, start at the lowest point and excavate each rise in elevation in 8" increments for **Stonewall** and 6" increments for **Pisa2/Roman Pisa**. If the wall has multiple step-ups, be sure to allow for the $\frac{1}{2}$ " step-back per each 8" increase in height for **Stonewall** and $\frac{3}{4}$ " step-back per each 6" increase in height for **Pisa2** and **Roman Pisa**.

Stonewall and Fat Face Note: If the height of your wall above finished grade is 2' or less, the gravel base can be reduced to 4" thick and the first course of units can be buried just 4" below finished grade. If your wall is greater than 4' high, you will need to bury your first course an additional 1" for every course of wall units over 4' high, so it will be necessary to excavate deeper. For example, for a 6' high wall, you will need to dig the trench at least 17" deep in order to bury the entire first course, plus 3" of the second course of units.

Pisa2 and Roman Pisa Note: If the height of your wall above finished grade is 2' or less, make the gravel base only 4" thick and bury the first course of units just 3". If your wall is greater than 4' high, you will need to bury your first course an additional 1" for every course of units over 4' high, so additional excavation is needed. For example, a 6' high wall will require a trench at least 16" deep in order to bury the entire first course and 4" of the second course.



Rule of Thumb:
If the wall is greater than 4' high, you will need to bury your first course of wall units an additional 1" for every course over 4' high.

The soil at the bottom of the trench must be firm and stable. Remove all loam, grass, roots and large rocks. If necessary, continue to excavate until you reach a granular soil such as GP, GW, SP, or SW soil types (see page 3) for support and drainage. Compact with the plate compactor or hand tamper until the bottom of the trench is level and firmly packed. Next, place filter fabric over the bottom and sides of the trench. To prevent soil from washing into the drainage soil, extend the fabric up the slope to completely cover the embankment. Overlap sections of the fabric by at least 12".

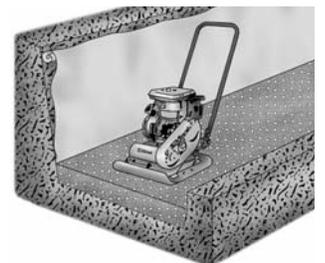




Rule of Thumb:
Foundation soil shall be compacted to at least 95% Standard Proctor Density.

4. Installing and Compacting the Base

The material for the base, or footing as it is sometimes called, should be a well-draining gravel consisting of coarse granular material. We recommend either **1 1/2" processed gravel** or **crusher run**. Fill the trench with about 3" of gravel then level and compact it thoroughly with the plate compactor. When the gravel has been thoroughly compacted, add the next layer. Add and compact enough gravel until the base is 6" thick and the top 8" below grade for **Stonewall** and **Fat Face** and 6" thick and the top 6" below grade for **Pisa2** and **Roman Pisa**. As noted earlier, the elevation of the base will be deeper for walls over 4' high.





Tip: To facilitate the compaction process, wet but do not saturate the gravel with water.



Rule of Thumb:

The base shall be compacted to at least 95% Standard Proctor Density.



Tip: For long walls with minimal elevation changes, you might consider using Flowable Fill to construct the base instead of compacted gravel.



Rule of Thumb:

Foundation soils with a low bearing capacity, areas with the water table close to the foundation, or submersed foundations require different designs and stabilization techniques. Contact an Ideal representative.

5. Installing the First Course

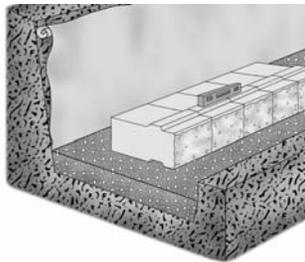
The first course of wall units is the most important and takes the longest time to install. Once you have positioned and leveled the units in this row, you will be able to place subsequent courses quickly and easily.



Tip: To make leveling easier, spread and compact up to 1/2" of coarse concrete sand on top of the compacted base material.

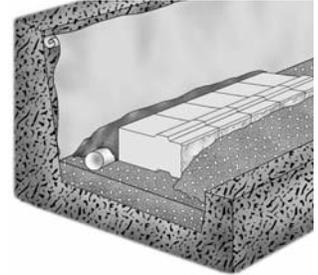
Start by placing the units directly on the base in the center of the trench. For **Stonewall** and **Fat Face**, the slot should be on the bottom with holes facing up. If using **Pisa2** or **Roman Pisa Stretcher** units, place the units with the groove side down. If your wall steps up, begin at the lowest level of the excavation. Use a carpenter's level to align and level each block side to side and a torpedo level front to back.

Lay the units side by side along the length of the footing, taking care to follow the desired alignment of the wall. Adjust the spacing between units for curved sections as needed. If your wall has 90° corners, it is best to start from a corner. See the **Details Section** for more information on building corners. You can also start next to a fixed structure such a house foundation.



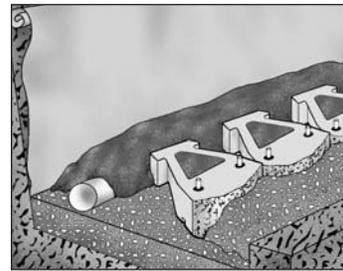
Drainage Pipe - After the first course has been installed, place 4" diameter (minimum) perforated pipe behind the wall to help collect incidental water and drain it away. Position the pipe, with the holes facing down, on the base behind the wall units along the entire length of the wall. It should be sloped in a manner that allows water to drain by gravity to daylight or an outlet beyond the wall. Drain pipe outlets can be under the wall units, through

the wall units or out the end of the wall. Outlets through the face of wall should be spaced between 20 to 50 feet. An outlet must be placed at the lowest point of the retaining wall and a minimum of every 50 feet. When the base acts as a blanket, drain pipe is placed in the open-graded stone.



Tip: When building straight walls, you may want to begin by setting the first units at each end of your trench. Level each unit and pull a string line between them along the back of the units. Use this line to align the rest of the units in the row, carefully leveling each unit as it is placed. If needed, use some gravel or coarse concrete sand to shim the units. **Never tilt the unit forward.**

Drainage Stone - If using **Stonewall** and **Fat Face**, fill the cores and the space between the units with 3/4" crushed stone, which should be uniform in size and should not contain fines. Next, backfill the trench behind the **Stonewall, Fat Face** or **Pisa2/ Roman Pisa** units with 3/4" crushed stone. Tamp the stone level



to the top of the units being careful not to move the units in any way. Now, fill and compact the trench on the front side of the units by using the same 1 1/2" processed gravel used for the base. Sweep the top of the units clean, and if

using **Stonewall** or **Fat Face**, insert the nylon pins/plugs into the holes in the top of the units. Use a hammer to tap open the holes and seat the pins/plugs with the smooth portion of the stem pointing up. Two pins/plugs are required for each unit.

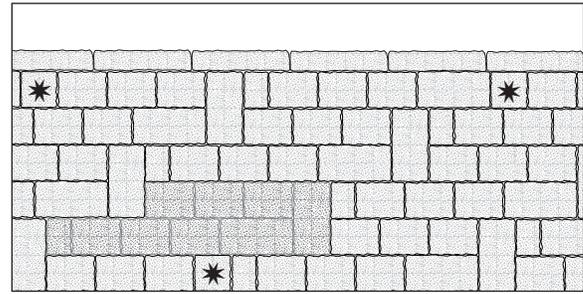
6. Laying the Wall

Place the second course of SRW units onto the first course, taking care to engage the connection mechanism. For **Stonewall** and **Fat Face**, fit the slot in the bottom of the units over the pins/plugs protruding from the units in the first row. For **Pisa** and **Roman Pisa** units, place the second course of wall units by fitting the groove onto the tongues of the units below. Position the units in a "running bond" pattern, staggering them so the joints occur over the middle of the unit below. Align the units to achieve a uniform appearance - the design of both the slot and tongue and groove allows some play for adjustment. As you lay successive courses, you may need to use *Half* units to maintain the bond and it may be necessary to cut some units. While a perfect "running bond" is not necessary, always maintain some stagger to the joints. Trim the face of the units as needed using a 3lb hammer and mason's chisel or brick-set. **ALWAYS EXERCISE CAUTION AND WEAR SAFETY GLASSES AND A NIOSH APPROVED RESPIRATOR!**



Tip: Occasionally, it may be necessary to shim block to maintain level coursing. Small pieces of plastic, asphalt shingles, or galvanized wall ties work well for this purpose.

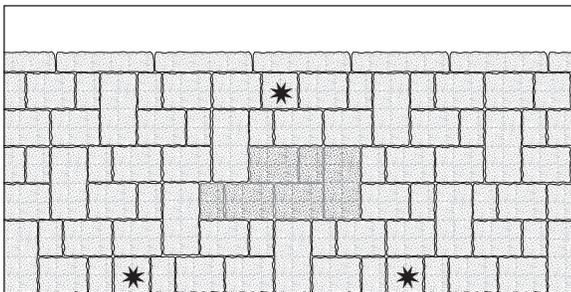
Roman Pisa Ashlar Patterns - So far, we have described the steps involved in the construction of a **Stonewall, Pisa2, or Roman Pisa** wall installed a running bond pattern using regular *Stretcher* units. If building a **Roman Pisa** wall in an ashlar pattern, you will be combining *Half* and 12" *Jumbo* units with regular *Stretchers*. Although they may look complicated, ashlar patterns are easy to assemble by simply repeating the basic pattern throughout the wall. Follow the layouts shown for the configuration of the pattern you have chosen. You can even create your own custom pattern by interchanging *Stretcher* and *Half* units with *Jumbo* units. Grooves molded into the 12" length and 8" side of the *Jumbo* unit allow it to be placed either horizontally or vertically in the wall. Always place several $\frac{3}{8}$ " beads of **SRW Adhesive** on the top surface of the *Jumbo* and *Half* units immediately prior to placing the next course. One 10 oz tube will be required for approximately every 10sf of wall area for ashlar patterns. *Stretcher Cap* units will be used in the last course to seat the coping.



ASHLAR PATTERN 4

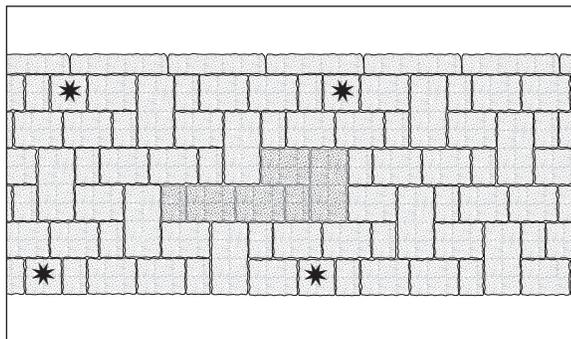
168 *Stretcher**, 30 *Half* and 60 *Jumbo* units per 100sf
 *Includes 11 *Stretcher Cap* units for every 10' of closure row.

* Denotes 12" *Jumbo* units cut in half to 6" x 6" squares for the starting and closure courses.



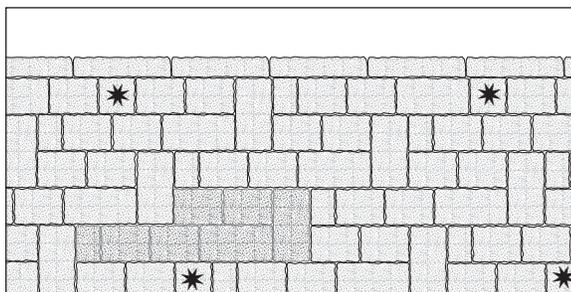
ASHLAR PATTERN 1

164 *Stretcher**, 110 *Half* and 56 *Jumbo* units per 100sf
 *Includes 9 *Stretcher Cap* units for every 10' of closure row.



ASHLAR PATTERN 2

164 *Stretcher**, 110 *Half* and 56 *Jumbo* units per 100sf
 *Includes 9 *Stretcher Cap* units for every 10' of closure row.



ASHLAR PATTERN 3

160 *Stretcher**, 42 *Half* and 80 *Jumbo* units per 100sf
 *Includes 8 *Stretcher Cap* units for every 10' of closure row.

Successive courses - After you have installed the second course, fill the cores (if using **Stonewall** or **Fat Face**) and backfill at least 12" of space behind the units with $\frac{3}{4}$ " crushed stone as described earlier. Then you will need to backfill the bank behind the crushed stone drainage zone. Pull the filter fabric over the front of the wall and place a 3"-4" layer of 1 $\frac{1}{2}$ " processed gravel (or native soil excavated from the site) and compact thoroughly. Add enough gravel or soil until it is even with the top of the units. If necessary, add more $\frac{3}{4}$ " drainage stone and tamp level. The key is to consolidate the stone and backfill material as much as possible to avoid future settlement.



Tip: Place a piece of plywood between the crushed stone and the banking to keep the $\frac{3}{4}$ " stone and backfill material as separated as possible. Slide the plywood up as you backfill.



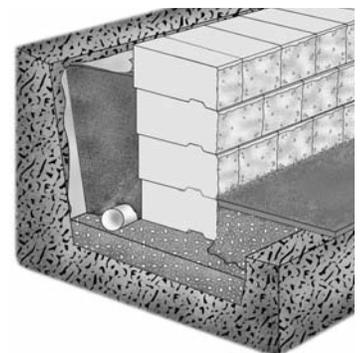
Tip: Always select block from several pallets as you are installing to distribute the color uniformly.



Rule of Thumb:

The infill soil should be placed in 3"-4" lifts behind the crushed stone and compacted to a minimum 95% of Standard Proctor Density.

Repeat this procedure for the remaining courses until you have reached the desired height of your wall. Be sure to backfill after every course, taking care not to move the units out of alignment. Do not backfill the last course at this point.



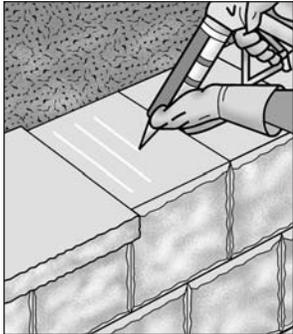


Rules of Thumb:

- Use only hand operated compaction equipment within 3' from the back of the wall.
- The completed wall shall be within +/- 1.25" when measured over a 10' distance, in either a horizontal or vertical direction, compared to the design line and grade control.

7. Capping the Wall

Finish the wall by using one of the five styles of cap units for the last row. Whichever type you select, secure them to the wall with our **SRW Adhesive** which is a construction grade sealant



that's been formulated for use with concrete. Simply apply several $\frac{3}{8}$ " beads to the top surface of the units in the last row. It's best to do only 3 or 4 units at a time to prevent the sealant from skinning over. To achieve the best bond, set and then lift and reset the units, applying firm pressure to secure them in place. Allow 24 hours or so for complete curing.

8. Finishing the Wall

To complete the project, fold the filter fabric over the $\frac{3}{4}$ " stone drainage zone at the mid-level of the next to last row and **add a layer of low-permeability soil** to minimize water infiltration. Finish the grading so that water does not pond behind the wall. If needed, construct a small drainage swale to collect and channel the water away, or grade the surface to direct water over the top and down the face of the wall. If landscaping is included, complete the project by placing topsoil, sod, or plants.

Congratulations! You have built a beautiful segmental retaining wall that will provide years of enjoyment and virtually maintenance free service for your customer.

DETAILS

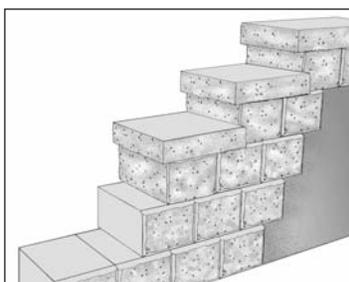
Step-ups

When building along the direction of a slope, the wall must be stepped in increments. With **Stonewall** and **Fat Face**, step each course in 8" increments, while **Pisa2/Roman Pisa** are stepped in 6" increments. Do not attempt to slant the wall to the angle of the slope.

Ending the Wall

There are several ways to end a wall along a slope. One is to turn the units into the grade, burying at least one complete unit along the incline.

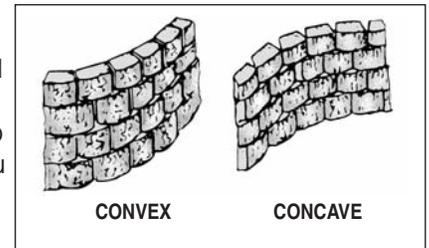
Another choice is to place a **Corner** unit at the end of



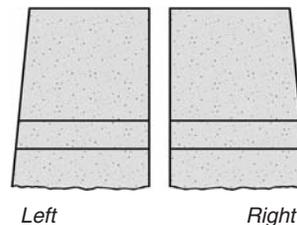
every course that steps down to expose the split face at the end of the wall. With **Pisa2/ Roman Pisa** walls, it will be necessary to remove the tongue from the units on which the Corner units will sit, or simply replace those units with **StretcherCaps**. Use a **Universal Coping Stone** to finish the wall by splitting it into the appropriate corner piece and positioning it onto the units to attain a 1" overhang. For **Roman Pisa**, use the **Roman Pisa Coping Stone**. Be sure to secure them with **SRW Adhesive** as shown under **Section 7 - Capping the Wall**.

Curved Walls

Stonewall creates graceful serpentine walls with concave and convex curves. The minimum radius is 3' to the face of the unit. You can build tree rings and planters as small as 6' in diameter from



face to face. When erecting walls over 4' high, the radius should be equal to or more than the height of the wall. For example, a 6' high wall will require a radius of 6'. When building walls with a radius, the first course must be wider to allow for the automatic step-back in subsequent courses. To minimize this, pull the unit forward against the pins in every course in order to lay the wall as vertical as possible. Otherwise, it will be necessary to cut some units in the upper courses to fit.



Pisa2 and Roman Pisa

Stretcher units are tapered 1" in width from front to back, so building curved walls is easy. They lay out to a minimum radius of $7\frac{1}{2}$ ' for convex curves. You'll note that the units are only tapered on

either the right or left side. Typically, the shipment includes about half of each type. When laying convex curves, only use units with the same taper in a row. It does not matter whether they are "rights" or "lefts" - just don't mix them together. Alternate them every course as you build the wall to get a $7\frac{1}{2}$ ' radius. Concave curves can be built with a radius as tight as 6' by laying the faces tight and opening the backs as much as possible. If building a convex wall in a **Roman Pisa** ashlar pattern, plan on laying out a radius of 15' to minimize cutting. Fill the space between the units with $\frac{3}{4}$ " crushed stone as you backfill.

Corners

As you lay out the location of the wall, mark the position of the corners with a stake and use string lines to indicate the line of the intersecting walls. When digging the trench, allow additional space at the corner location.

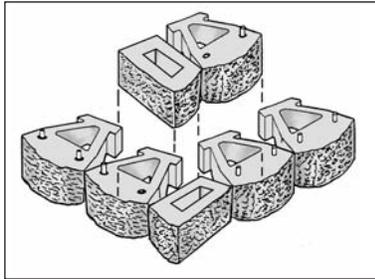
Once the gravel base has been placed and compacted to the desired elevation, mark the exact location of the corner. Use a builder's square to insure an accurate 90° angle, or lay it out using the 3-4-5 triangle method. It is best to start the wall in the corner and build outward.



Tip: Snap a chalk line directly on the gravel footing as a guide to align the wall.

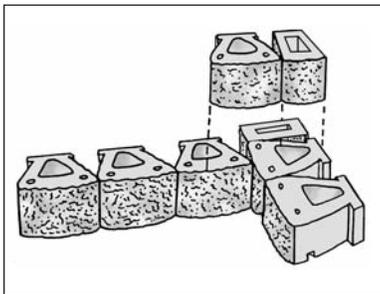
Outside Corners with Stonewall or Fat Face

When it comes to building outside corners, **Stonewall** or **Fat Face** give you two choices and both are easy to do. The corners can be a simple *convex* curve based on a radius discussed previously, or they can be built at a 90° angle. When incorporating 90° corners, you will need to order **Stonewall** or **Fat Face Corner** units. Follow these simple steps to construct 90° corners. Be sure to apply **SRW Adhesive** to the corner units in every course.



1. Position a **Stonewall** or **Fat Face Corner** unit on the base exactly where the intersecting lines meet in the corner. Then place regular **Stonewall** or **Fat Face** units on each side of it. Using a level, align and plumb the units. Continue the wall on each side using regular units following the directions shown in **Section 5 - Installing the First Course** (pg. 10), however, do not put a pin in the closest hole of the unit sitting adjacent to the shortest face of the corner.
2. For the second course, position a **Stonewall** or **Fat Face Corner** unit in the alternate direction onto the *Corner* and regular unit below. Place regular **Stonewall** or **Fat Face** units on each side, following the directions shown in **Section 6 - Laying the Wall**. Once again, leave out a pin in the hole closest to the short face of the corner. Set each corner with **SRW Adhesive**.
3. Continue this procedure for each course, alternating the corner units 90° every course to maintain the running bond pattern. Use a *Universal Coping Stone* as a cap to finish the corner. Set with **SRW Adhesive**.

Inside Corners with Stonewall or Fat Face



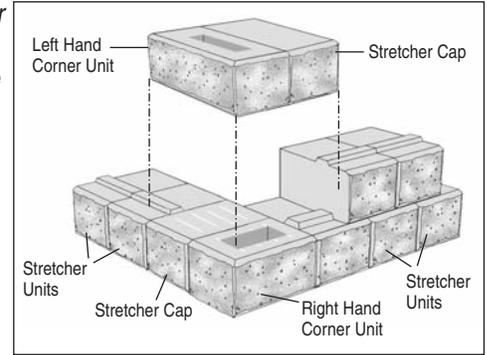
If your wall has inside corners, **Stonewall** or **Fat Face** gives you several choices here as well. You can build them as a *concave* curved wall or at 90°. When building them at 90°, one method is to abut one of the walls against the other using

Half units in every other course to keep it flush to the adjoining wall. Another way ties the walls into each other by overlapping units from one wall into the other in alternating courses. Be sure to apply **SRW Adhesive** to the corner units in every course.

Outside Corners with Pisa2/Roman Pisa

Building outside corners with **Pisa2** and **Roman Pisa** is also easy. They are constructed using *Stretcher Caps* and *Right* and

Left Hand Corner units. When ordering, be sure to specify the height in order to get the right amount of each type. Follow these simple steps to construct 90° corners.



1. Carefully position a *Right Hand Corner* unit first. Place a *Stretcher Cap* unit beside it to the left. Using a level, align and plumb the units. Continue the wall on each side using **Pisa2** or **Roman Pisa Stretcher**s as described in **Section 5 - Installing the First Course**.
2. For the second course, select a *Left Hand Corner* unit and position it onto the *Right Hand Corner* and *Stretcher Cap* below. Next place a *Stretcher Cap* beside it to the right and continue the second course using *Stretcher* units.
3. Continue this procedure for each course, alternating the *Right* and *Left Hand Corner* units every course to maintain the running bond pattern. Set each course with **SRW Adhesive**. When the wall reaches the desired height, use a *Universal Coping Stone* or **Roman Pisa Coping** as a cap to finish the corner. Set with **SRW Adhesive**.

Inside Corners with Pisa2/Roman Pisa

Inside corners are also easy to build. Use 2 *Stretcher Caps* for every course at the intersecting corners, alternating each course as you build. Apply **SRW Adhesive** for added strength.



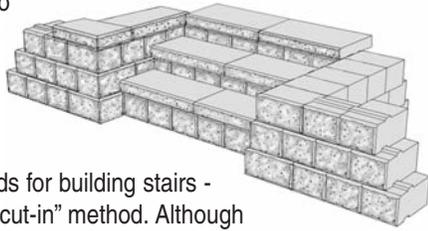
Alternating Courses

Note: Regardless of the type of system used, you must apply several $\frac{3}{8}$ " beads of **SRW Adhesive** to the top of each corner unit immediately prior to placing the successive corner block. If your wall has 90° corners on each end, it will be necessary to cut units within the wall to accommodate the wall batter and to maintain the running bond pattern.

Stairs

A stairway built into a segmental retaining wall adds a functional and beautiful dimension to any landscape design. Building stairs is relatively simple...SRW units are used for the side walls and risers and natural stone, such as limestone, bluestone and granite, or one of our coping styles, are used for treads. While stairs can be created in a number of configurations, the basic construction techniques are the same. Most stairs are 48" wide; otherwise

lay them out in multiples of 12" for **Stonewall** and 8" for **Pisa2** and **Roman Pisa**. You will also need to build a corner on each side of the stairs where you wish to incorporate them into the main wall. It is best to construct the corners and side walls independently of the risers.



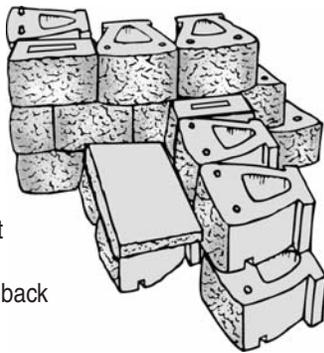
There are two methods for building stairs - the "fill" method and "cut-in" method. Although more units are required using the "fill" method, it may prove faster and easier, especially if there are a small number of steps. Simply excavate the entire stairway area straight back, then place and compact a 6" thick gravel base as a level foundation. Multiple courses of SRW units are then used to build up the risers for the number of steps you want. The rise with **Stonewall** will be 8", while with **Pisa2/Roman Pisa** the rise will be 6".

With either method, first determine the location of the stairway. Allow enough space behind the wall, as each stair will step-back 12". Usually, the corners and side walls are constructed independently of the risers.

The "Cut" Method

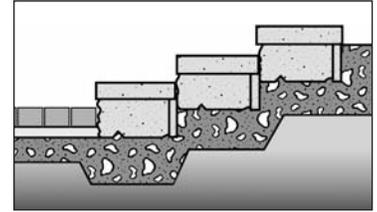
With the "cut" method, a gravel base is used under each stair. An advantage to this procedure is that it allows you to adjust the height of the rise. Generally, 6" to 8" is acceptable, although local building codes may specify the required height. The depth of the excavation will depend on the height required for the risers and the coping style used. The height of the first riser should measure from the top of the tread to the finished grade.

Stonewall or Fat Face- Start with the corners and build them as you normally would in the style you want, either curved or 90°. To avoid the automatic step-back as you construct the side walls, do not use the pins to connect the full size **Stonewall or Fat Face** units. Instead, lay each course **vertically, with no setback** and bond the units together using our **SRW Adhesive**. Otherwise, you will need to cut the riser and coping units to fit the space created by the step-back developed in the side walls.



Once the side walls have been erected, you can start the stairs at the front or set them in from the corners. At least one full size **Stonewall or Fat Face** is used under each stair tread to provide stability. The depth of the excavation will depend on the height required for the risers and coping style used. Install and compact a 6" gravel base as the footing. Place a row of **Stonewall or Fat Face** units onto the base across the width of the stair opening and level them front to back and side to side. Fill the open cores of the units and the spaces between them with 1 1/2" processed gravel and sweep the units clean. If you have decided to use two courses of **Stonewall or Fat Face** units for each stair, insert the pins/plugs and position the second row.

Construct the next riser assembly by placing and compacting another 6" thick gravel footing behind the first course of units. Now place a row of **Stonewall or Fat Face** units onto the base and position them directly behind the units in front. Finish as noted above. Install successive risers in the same manner for the number of stairs needed.

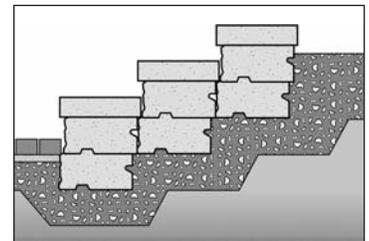


Pisa2/Roman Pisa - Risers are constructed using **Pisa2 or Roman Pisa Stretches**, a *Stretcher Cap* and a tread. Depending on the style you use, you must then determine the height of the rise.

Start by building corners, as described in the **Corner Section**, on each side of the stairs. To construct the side walls, we recommend using *Stretcher Caps* to avoid the automatic step-back created by the tongue and groove molded into the *Stretcher* units. Lay all the courses in the side walls **vertically, with no set-back**. Be sure to bond the units together with **SRW Adhesive**. Backfill with 3/4" stone as you go up, and don't forget to use filter fabric to keep the soil from infiltrating the stone.

Once the side walls have been erected, you can start the stairs at the front or set them in from the corners. The depth of the excavation will depend on the height required for the risers and the type of tread. The height of the first riser should measure from the top of the tread to the finished grade. Install and compact a 6" gravel base as the footing. Place a row of *Stretches* onto the base and carefully level them front to back and side to side. Next, place the second course using *Stretcher Caps*.

Construct the next riser assembly by placing and compacting another 6" thick gravel footing behind the first course of units. Now position a row of *Stretches* onto the base and position them directly behind the *Stretcher Caps* in front. Complete the riser by placing *Stretcher Caps* for the second course. Install successive risers in the same manner for the number of stairs needed.



Treads

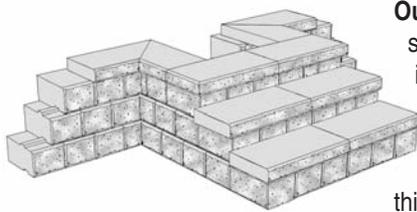
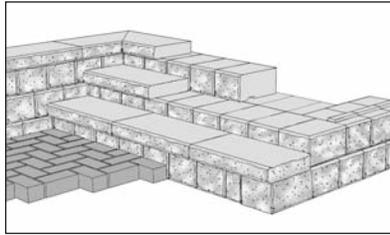
We recommend using stone treads, such as limestone, bluestone or granite, to complement the wall with an attractive seamless look. Set with an acrylic-based mortar or with **SRW Adhesive** as instructed in **Section 7 - Capping the Wall**. Position the treads to provide a 1" overhang. Allow the adhesive to cure at least 24 hours before opening the stairs to traffic. **Important: When coping units are used for treads they must be treated with a penetrating-type sealer. Promptly remove snow and ice and use sand for traction control. Avoid use of magnesium and potassium deicers, which can be harmful to concrete products.**



Tip: Consider using our Bullnose Coping paver units for treads.

Other Step Options with Pisa2 and Roman Pisa

Perpendicular – This structure is simply a wall with an inside and an outside corner, and the courses of the wall between the two corners step back at 12" per course. Install the units for the riser courses as previously explained, then finish by placing our *Universal Coping Stones* for the treads.



Outset steps – This structure is constructed in the same manner as the perpendicular steps, one course at a time. However, with this arrangement, it is

necessary to construct two inside corners, and two outside corners. To avoid a step-back, use only *Stretcher Cap* units for the side walls, making sure to adhere them with **SRW Adhesive**. Otherwise, the side walls will batter toward each other by $\frac{3}{4}$ " inch per course and each riser will be $1\frac{1}{2}$ " narrower than the course below.

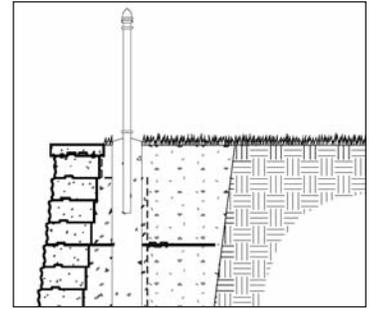
Terraced Walls

Terraced or tiered walls are often used for aesthetic reasons to suit a particular landscape design scheme. In some cases, they have been used as a means of avoiding building a wall over 4' by breaking it into two walls. While it may seem logical to do so, it does contradict sound engineering principles used in calculating factors of safety for conventional gravity wall designs. If the upper wall is within a horizontal distance of less than twice the height of the lower wall, a surcharge load will be applied to the lower wall and geogrid reinforcing may be required. In this case, the two walls model the structure of a single taller wall and engineering analysis for the wall should be sought.

Rule of Thumb: A terraced wall should be set back a distance equal to, but not less than, twice the height of the lower wall in front. For example, if the lower wall in front is $3\frac{1}{2}$ ' high, the tiered wall behind it should be built at least 7' back.

Fences/Parking Areas

Generally, building codes will determine the height at which a fence is required along the top of a wall. The Building Code (IBC/IRC '06) requires a 42" minimum railing/fence when a wall exceeds 30" exposed height in high pedestrian traffic areas. Fencing should not be anchored to the top of the wall regardless of height.

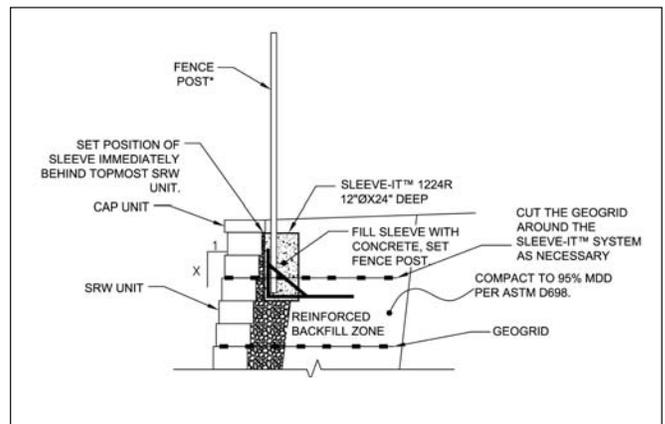


As you erect the wall, place a cardboard construction tube behind the wall and compact the soil around it. If the wall is reinforced with geogrid, cut holes in the layers of grid that surround the tube. Once the wall has been brought to its finished elevation, position the fence post in the tube and set it using standard procedures by filling the tube with concrete. The Sleeve-It™ 1224R is a fence post footing device that allows railings to be installed directly adjacent to the wall face. Simply insert the Sleeve-It unit during wall construction, then backfill and compact around it as wall is completed. This product ensures the railing will act independently from the wall system when under a load. Sleeve-It is designed for fence and pedestrian rail applications. The system is not appropriate for fences with privacy screens or vehicular guard

Rule of Thumb: Place posts and guard rails a minimum distance of 3' behind the back of the wall units.

Railings/Guards

If the wall is going to support a parking area, it will be necessary to install guard rails along the top. Guard rails are installed in a similar manner to fence posts. Follow the customary procedures recommended for the particular type being used. For vehicular barriers a minimum 3.3' offset from the wall block is required.



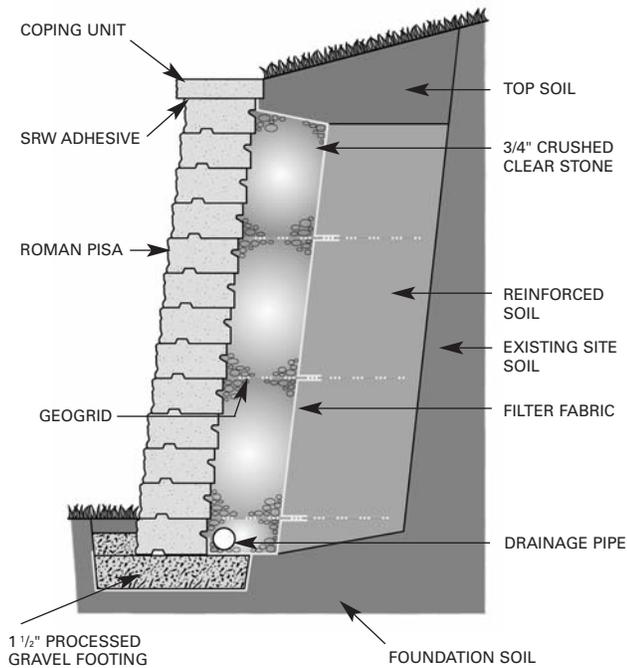
Sleeve-It™ Post Anchor System

GEOGRID-REINFORCED MSE STRUCTURES

A MSE retaining wall system combines the beauty and strength of a segmental retaining wall system with geosynthetic soil reinforcement techniques to create taller, more cost efficient walls as compared to traditional retaining wall structures.

Geogrids are used to stabilize a retaining wall structure by reinforcing the soil behind the wall, thereby increasing the mass of the entire structure. The mechanically stabilized wall resists loads, surcharges, and poor soil conditions. A geogrid-reinforced segmental retaining wall is an alternative to conventional poured in-place gravity or cantilevered retaining walls used in many civil engineering structures. This reduces the load carrying requirements of the facing elements, thus decreasing the cost of the wall's construction. The result is a savings in costs, material, and time.

Typical MSE Retaining Wall Cross Section



Geogrid Placement Procedures

Generally speaking, the grid is placed on the wall units, extended back onto the compacted gravel, back-filled, and compacted. As courses of units are added and back-filled, additional layers of grid are placed at appropriate heights. The number of layers and length of geogrid depend on several conditions, including the type of soil being retained. Poor draining soils, such as clay, require more geogrid than granular soils, which drain well.

1. Build the wall to the required height for the first layer of geogrid following the directions shown in the **Construction Section**. Be sure that the drainage and infill zone behind the units have been properly back-filled with 3/4" stone and soil, respectively. The fill should be compacted with soil in 3"-4" lifts to obtain a minimum 95% standard Proctor density and leveled with the top of the wall. Sweep the top of the units clean.

2. The grid shall be rolled out, cut to specified length, placed onto the wall units, and then extended back onto the compacted soil. Overlap the adjacent sections of grid by 4".



Rules of Thumb: Grid

- The grid should be unrolled in a direction perpendicular to the wall!
- Maximum spacing of grid should not exceed 2'.
- Length of geogrid is equal to 0.6 - 0.7 of the wall height for level walls with no surcharge.

3. Place the next course of SRW units, taking care that the grid sits flat and is securely between the units.

4. Pull the geogrid away from the back of the wall until it is taut and free of wrinkles.



Tip: Use pins, staples or sand bags to ensure there is no slackness prior to placement of the next layer of infill soil. Remove when covered with soil.

5. Place the next layer of infill soil on top of the geogrid by beginning near the wall fascia and spreading it back across the grid. Backfill in 3"-4" lifts, using only vibratory plate compactors within a 3' area from the back of the wall.



Rules of Thumb: Equipment

- Do not use heavy compaction equipment within 3' of the back of the wall.
- No tracked construction equipment shall be allowed to operate directly on top of the geogrid until at least 6" of fill has been placed. Rubber-tired equipment may drive on top of the geogrid at slow speeds but should exercise care not to stop suddenly or make sharp turns.

6. Place soil in the rest of the infill area in maximum lifts of 6" and compact to obtain a 95% standard Proctor density

7. Continue to place additional courses backfilling with stone and gravel as every course is laid.



Tip: To place the geotextile fabric that is used to separate the drainage stone from the infill soil between layers of grid, "pillow" it back into the infill soil.

Corners

When placing grid in corner locations, never overlap layers of grid directly on top of each other. Provide at least 3" of soil between layers for proper anchorage if both layers are placed in the same SRW elevation.

Additional Design Information

For additional information, see the design charts starting on page 37. **Ideal** offers a free wall design service. Complete the Preliminary Design Request Form on page 43 and return it to **Ideal**. You may copy the form or download it from www.idealconcreteblock.com.

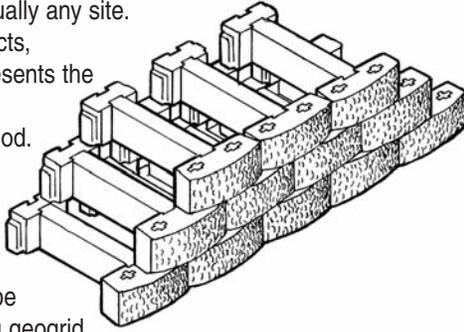
GRAVITYSTONE®

GravityStone is the next generation of segmental retaining wall systems. It combines the simplicity of easy-to-handle dry stack units with the superior earth retention capabilities of crib wall structures. Its unique and patented components interconnect to form a structural wall system that enables construction of single-cell, multiple-depth gravity structures, or MSE walls.

With the capability of modular cell or geogrid reinforced design, **GravityStone** offers designers and builders a choice of wall systems to fit virtually any site.

In "cut" wall projects, **GravityStone** presents the most economical construction method. Excavation is minimized, less equipment is required, and higher walls can be built without using geogrid.

Compared to typical crib wall systems, **GravityStone** components are significantly lighter in weight which results in a labor savings as much as 20%! In "fill" wall applications, where circumstances are more suitable for earth stabilization, **GravityStone** also offers advantages over conventional segmental wall systems by reducing the amount of geogrid by as much as 50%! And unlike conventional segmental wall systems, **GravityStone** can be used to construct substantial, free-standing, double-sided walls!

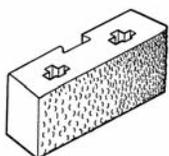


GETTING STARTED

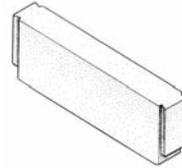
Installation of **GravityStone** is quick and easy. Adequate planning is essential to executing a fast, smooth, and efficient installation. Familiarity with the **GravityStone** products offers the installer many options for optimizing efficiencies and costs of constructing retaining walls. This section provides a working explanation of the fundamental construction procedures that will help to ensure the dependable performance and economic value of **GravityStone** retaining walls. While specialized installation details are shown in the **Details Section** on page 21, please consult the **GravityStone Contractor's Manual** for complete information when using **GravityStone** under the most demanding loading conditions.

COMPONENTS

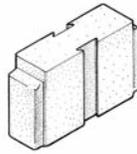
The **GravityStone** system is comprised of three basic units: *Face*, *Trunk* and *Anchor/Junction*. The patented system is light in weight, easy to handle, and forms a strong wall with the use of "GridLock" interlocking couplings.



Face: The standard unit for all cell configurations. It is available in a straight split-face and a tumbled surface finish.
 18" w x 8" h x 6" d • 1 sf/pc
 Split-face 59 lb/pc • Tumbled 56 lb/pc
 Batter: 3/4" per foot in set-back position



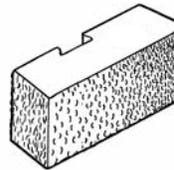
Trunk: Connects the *Face* and *Anchor/Junction* to complete the structural assembly for each cell.
 23 5/8" l x 8" h x 3 5/8" w • 55 lb/pc



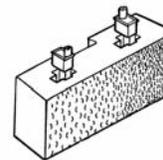
Anchor/Junction: Connects to the *Trunk* and creates passive resistance to prevent the cell from moving outward. It also provides the connection for additional cells in multi-cell structures. The *Anchor/Junctions* can be used to connect to *Face*

units as a **Mini-Cell** or **Double-Sided Mini-Cell** assembly.
 11 5/8" l x 8" h x 4 5/8" w • 30 lb/pc

The following components complete the **GravityStone** system:



Corner Unit: This unit is used to construct outside corners.
 15" l x 8" h x 6" d • 52 lb/pc

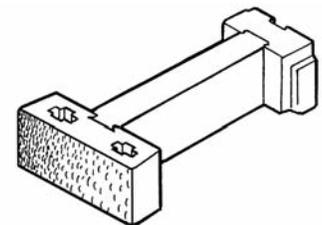


Plugs: Connect the *Face* units in one course to the *Face* units in the next course. The patented design allows them to be reversed to achieve a vertical or battered wall with a 5/8" setback per course or 1" per foot of wall height (4.5 degree batter).

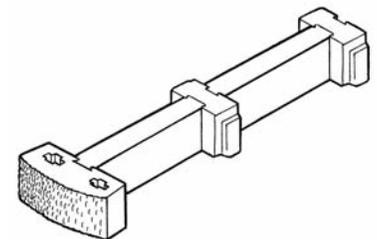
GRAVITYSTONE CELLULAR ASSEMBLY

The units comprising the **GravityStone** system assemble into various cellular configurations to create a large, stable wall mass. The assembly is created by interlocking the "GridLock" couplings molded into each unit. The three primary assemblies are:

Single-Cell: Consists of a *Face* unit, a *Trunk* unit, and a *Anchor/Junction* unit. The effective overall dimensions are:
 18" w x 8" h x 32" d
 Effective depth = 32"



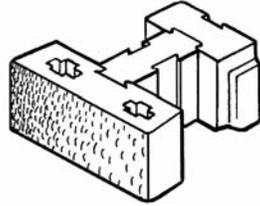
Multi-Cell: Consists of a *Face* unit, multiple (2 or more) *Trunk* units, and multiple *Anchor/Junction* units. The effective overall dimensions are:
 18" w x 8" h x varying depths shown below:



2 cell effective depth = 58"
3 cell effective depth = 84"
4 cell effective depth = 110" **For each additional cell add 26"**

Note: Although some illustrations show a curved face unit, only the straight face units are available.

Mini-Cell: Consists of a *Face* unit, and two *Anchor/Junction* units. The effective overall dimensions are: 18" w x 8" h x 21" d



CHOICE OF SYSTEMS

GravityStone can be classified into two types of wall systems:

- **Modular:** Where only **GravityStone's** concrete elements are used. May be comprised of single and/or multi-cell assemblies.
- **MSE:** Where the use of geogrid is incorporated.

DESIGN SELECTION - "The Product Fit to the Site"

Both **GravityStone** systems are suitable for any retaining wall application and can even be combined on the same wall or project. To determine the best solution and most cost-effective system for a project, a thorough analysis should be conducted by a qualified engineer.

The following is a comparison of their basic advantages:

Modular - If the site has a "cut" embankment, Modular construction generally is the most cost efficient. With well-draining type soils, walls as high as 8' can be built using the **Single-Cell** assembly, or up to 15' with **Multi-Cell** construction. Modular construction also gives you the option of building the wall vertically, with a batter, or using an inclined base with a vertical plug alignment to create a straight wall column. This feature is helpful for sites that require a high wall within limited space constraints.

MSE - If the site is a "fill" embankment where a considerable quantity of additional backfill is necessary, MSE walls are generally the most cost effective because lower quality soils are permissible. Because **GravityStone** structures are larger than conventional segmental retaining walls, the amount of geogrid required may be reduced by as much as 50%! Walls, with little or no surcharge, can be built as high as 15' by using geogrid in conjunction with a **Mini-Cell** construction assembly (*Face-Anchor/Junction-Anchor/Junction*). For taller walls, or those subject to surcharge and back slopes, the **Single-Cell** assembly (*Face-Trunk-Anchor/Junction*), combined with geogrid, is best.

CONSTRUCTION

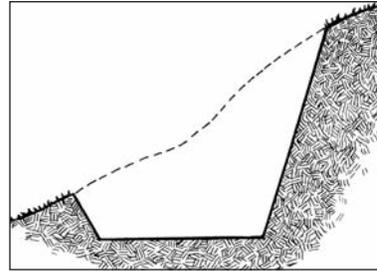
Please review the **General Conditions** and **Planning** sections on page 8 for an overview on project design guidelines and preparation for segmental retaining walls.

1. Excavating

Staking out the wall - Start by staking out the location of your wall. Excavate the area to the lines and grades shown on the approved plans. The wall location is especially important on outside (convex) curves where the step-back of the units will

decrease the radius of the curve as the wall goes higher. See the section on **Curved Walls** for more information. If your project is a "cut" wall, allow approximately 12" of working space behind the wall. Take precautions not to over-excavate and always maintain safe slopes parameters per OSHA requirements. Also, carefully consider the effect construction will have on nearby structures and parking areas. Make sure not to undermine or encroach upon the foundation supporting these structures in any way.

Trench - Once you have staked out the location of your wall, excavate a trench at least 14" deep. Dig deep enough for a 6"



thick gravel base and to embed the first row of units below finished grade. The width (front to back) of the base depends on the assembly chosen. Dig wide enough to accommodate the number of cells required,

plus an additional 6" in front and 6" in back. For **Single-Cell** walls, the width for excavation is 44"; each additional cell requires an additional 26".

Note: If the height of your wall above finished grade is less than 4', use a 4" thick gravel base and bury the first course only 4" below finished grade. If your wall is greater than 8' high, you will need to bury your first course an additional 1" for every course of units over 8' high so it will necessary to excavate deeper. For example, a 10' high wall will require a 17" deep trench to accommodate a 6" base and 11" of units below grade. It will also be necessary to embed the first course deeper when the area in front of the wall slopes down.

If the wall is to step-up into a slope at different levels, start at the lowest point and excavate each rise in elevation in 8" increments. If the wall has multiple step-ups, be sure to allow for the 5/8" step-back that occurs in every course for each 8" increase in height.

The soil at the bottom of the trench must be firm and stable. Remove all loam, grass, roots and large rocks. If necessary, continue to excavate until you reach granular type soil such as GP, GW, SP, or SW soil types for optimum stress distribution and drainage. Using a plate compactor, tamp the bottom of the trench until it is level and firmly packed. Next place filter fabric over the bottom and sides of the trench. Extend enough fabric up the back side to completely cover the embankment in order to prevent soil from washing into the crushed stone. Overlap sections of fabric by at least 12".



Rule of Thumb:

Foundation soil shall be compacted to at least 95% Standard Proctor density.

2. Installing and Compacting the Base

The material for the base, or footing as it is sometimes called, should be well-draining gravel consisting of coarse granular

material. We recommend 1 1/2" processed gravel or crusher run. **Note:** In some cases, the engineer may specify the use of 3/4" stone as a blanket drain.

Fill the trench with about 3" of gravel, then level and compact it thoroughly with the plate compactor. When the gravel has been thoroughly compacted, add the next layer. Add and compact enough gravel until the base is 6" thick and the top 8" below finished grade. As noted earlier, the thickness and elevation of the base will be deeper for walls over 6' high.



Tip: To facilitate the compaction process, wet but do not saturate the material with water.



Rule of Thumb:

The base shall be compacted to at least 95% Standard Proctor Density.



Tip: For long walls with minimal elevation changes, you might consider using Flowable Fill to construct the base instead of compacted gravel.



Rule of Thumb:

Foundation soils with a low bearing capacity, areas with the water table close to the foundation, or submersed foundations require different designs and stabilization techniques with products such as Turfstone.

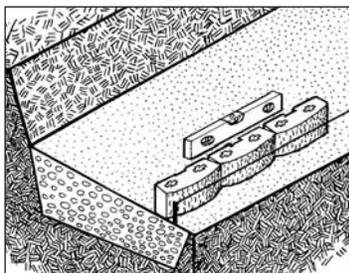
3. Installing the First Course

The first course of units is the most important and takes the longest time to install. Once you have positioned and leveled the units in this row, you will be able to place subsequent courses quickly and easily.



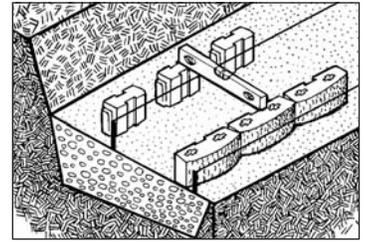
Tip: To make leveling easier, spread and compact up to 1/2" of coarse concrete sand on top of the compacted base material.

Face Units - Snap a chalk line on the base or drive stakes and pull a string line to mark the location of the front of the wall. Start by placing the *Face* units directly on the base along the chalk or string line. Use a carpenter's level to align and level each unit from side to side and a torpedo level from front to back. Lay the units side by side along the length of the footing, carefully following the desired alignment of the wall. Adjust the spacing between units for curved sections as needed. If your wall steps up, begin at the lowest level of the excavation. If your wall has 90° corners, it is best to start from a corner. See the **Details Section** for more

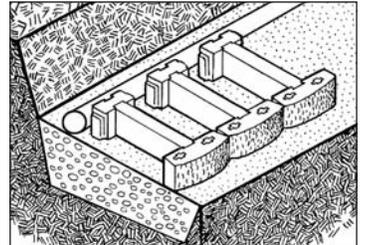


information on building corners. You can also start next to a fixed structure such as the foundation of a house.

Anchors - Use a three-foot level with an offset mark to position the anchors at the appropriate distance behind the faces. For Single-Cell assemblies, the distance is about 22" behind the *Faces*. A string line may also be used to assist in the proper placement. Verify that the *Anchor/Junction* units are level from side to side and from front to back as you proceed.



Trunks - Now slide a *Trunk* unit into a *Face* and *Anchor/Junction* by engaging the "GridLock" couplings. You now have a **Single-Cell** assembly of **GravityStone**. Continue this procedure for the entire course. Verify that the cells are level and positioned properly.



Tip: Once the *Trunk* unit is started into the *Face* and *Anchor/Junctions*, slightly lift and adjust the *Anchor/Junctions* to ease the placement of the *Trunk*.

Inserting Alignment Plugs

The alignment *Plugs* are reversible. When placed in the forward position, the wall will lay up vertical. When the *Plugs* are set to the back, the wall will batter back 5/8" for each course.



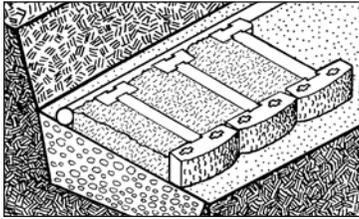
Tip: Walls are stronger when a batter is used although curved walls are easier to build in a vertical alignment.

Insert the alignment *Plugs* into the holes in the desired position. Two *Plugs* are required for each unit. Ensure that the flange on the alignment plug seats into the recessed void on top of the *Face* unit.

Drainage Pipe & Drainage Stone - After the first course has been installed, place perforated pipe, with the holes facing **down**, on the base behind the units along the entire length of the wall and several feet beyond. The pipe should be sloped at each end to allow gravity to flow any collected water beyond the wall. Some brands are sold already covered with a geotextile sock; otherwise wrap the pipe in filter fabric.

Filling the Cells

Unless otherwise instructed by an engineer, fill the cells with a #57 or #67 graded stone. Use a tamping rod to consolidate the stone in the cells. Tamp the stone level to the top of the units,



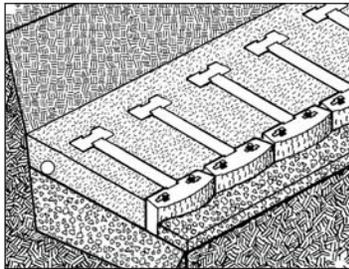
being careful not to move the units in any way. Be sure to verify the cells are level and positioned properly.



Rule of Thumb:

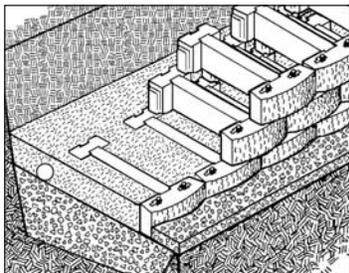
Never stack more than two layers of **Single-Cells** before placing and compacting the fill.

Next, fill and compact the trench on the front side of the units by using the same 1 1/2" processed gravel you used for the base and then back-fill behind the cells with #57 or #67 graded stone. Sweep the tops of the *Face*, *Trunk* and *Anchor/Junctions* clean of excess gravel. **Note:** If your wall requires a **Multi-Cell** assembly or geogrid reinforcement, review the instructions under the appropriate section that follows at this time.



4. Laying the Wall

Second Course - Place the second course of *Face* units onto the first course taking care to engage the alignment *Plugs*. Position the units in a “running bond” pattern by staggering them so the joints occur over the middle of the unit below. Align the units to achieve a uniform appearance. Then place the *Anchor/Junctions* on top of the *Anchor/Junctions* in the course below, straddling them for the length of the wall. Slide the *Trunk* unit into the *Face* and the *Anchor/Junctions*. Remember to slightly lift and adjust the *Anchor/Junction* units to help the *Trunk* slide in smoothly.



Tip: Occasionally, it may be necessary to shim some units to maintain level coursing. Small pieces of plastic, asphalt shingles or galvanized wall ties work well for this purpose.

Successive Courses - As you lay successive courses, you will need to cut some units in half to maintain the bond. If the wall is constructed with a batter, it will be necessary to cut some units in sections of wall between two corners. To maintain the integrity of the *Plug* holes, remove pieces of equal size from each end of the *Face* units. While a perfect “running bond” is not necessary, always maintain some stagger to the joints. Trim the face of the units as needed using a 3lb hammer and mason’s chisel or brick-set. **ALWAYS EXERCISE CAUTION AND WEAR SAFETY GLASSES AND A NIOSH APPROVED RESPIRATOR!**

Insert the alignment *Plugs* into the *Face* units in the proper position. Proceed with filling the cell assemblies with stone as previously noted. Backfill with #57 or #67 graded stone, and if necessary, place and compact soil behind the wall.



Tip: Double check for alignment (*Plug* position and orientation) and level, from front-to-back and from side to side, prior to filling.

Subsequent Courses - Repeat this procedure for the remaining courses until you have reached the desired height of your wall.



Tip: Always select block from several pallets as you are installing to distribute the color uniformly.



Rule of Thumb:

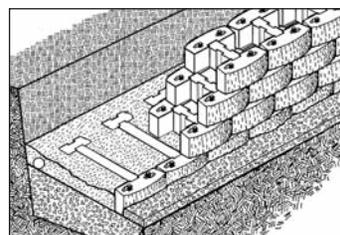
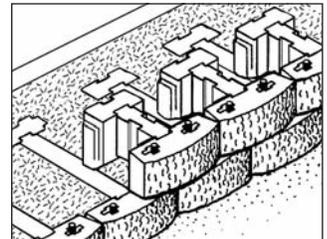
Use only hand-operated compaction equipment within 3' from the back of the wall.



Rule of Thumb:

The completed wall shall be within +/- 1.25", measured over a 10' distance, in either a horizontal or vertical direction compared to the design line and grade control.

Mini-Cell: In some instances, the last three courses can be constructed by using a **Mini-Cell** arrangement instead of the standard **Single-Cell** assembly. Unless otherwise designed by a qualified engineer, this applies only to walls without a slope or surcharge.

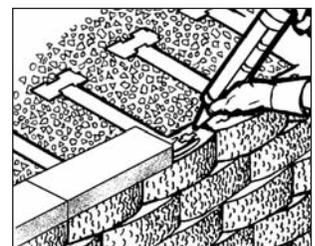


Double-Sided Mini-Cell: For projects where the back of the wall is exposed above grade, build a **Double-Sided Mini-Cell** configuration for an attractive finish on both sides of the wall by placing 2 **Face Units** back-to-back

connected with an **Anchor Junction**.

5. Capping the Wall

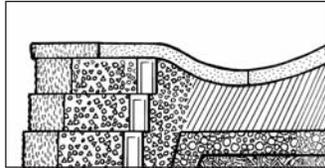
Finish the wall with our *Universal Coping Stone*. Position the units flush to the front, or with a slight overhang. Secure them to the wall with our **SRW Adhesive** by applying several 3/8" beads to the top surface of the *Face* and *Trunk* units. It’s best to do only 3 or 4



units at a time to prevent the sealant from skinning over. When setting the coping units, apply firm pressure to secure them in place. Allow 24 hours or so for complete curing.

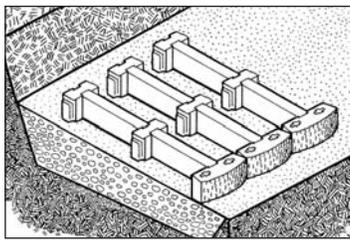
6. Finish Grading

To complete the project, fold the filter fabric over the drainage zone of $\frac{3}{4}$ " stone at the mid level of the next to last row and add a layer of low permeability soil to minimize water infiltration. Finish the grading so that water does not pond behind the wall. If necessary, construct a small drainage swale to collect and channel the water away, or grade the surface to direct water over the top and down the face of the wall. If landscaping is included in your contract, complete the project by placing topsoil for sod or plants.



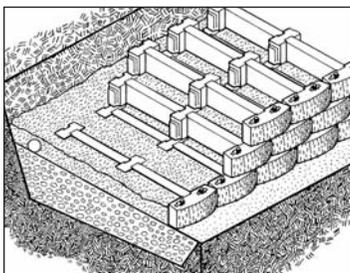
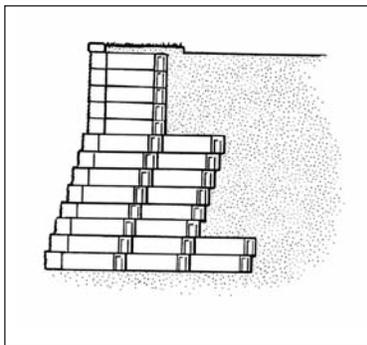
MULTI-CELL ASSEMBLY

For walls that will experience an increased load due to height, surcharge, or backslope, a larger structure consisting of additional cells with *Trunks* and *Anchor/Junctions* may be required. An engineer will determine the amount of cells and



number of courses that will be required. This method is especially advantageous when weather conditions affect ability to place and compact the soil for conventional segmental wall systems using geogrid.

A multi-cell structure typically is wider at the bottom courses and narrows as the wall grows in height. For example, a 12' high wall could be constructed using three cells deep for the first 2 courses, two cells deep for the next 5 courses, and one cell deep for the next 9 courses.



To install the additional *Trunk* and *Anchor/Junction* units, simply repeat the steps described above. After the first cell has been assembled, place another row of *Anchor/Junctions* about 22" behind the ones in front. Then slide the *Trunks*

in between them to complete the second cell assembly. Remember that all additional cells will need to be filled with gravel and compacted.

DETAILS

Curves

GravityStone is designed so that the *Plugs* that align the blocks are placed on the "quarter spot". This minimizes the difficulty of maintaining plug alignment when building curving walls. Block placement for curves should be started at the central tangent and worked towards the free end. Start at the central tangent of the smallest radius on walls with multiple curves.



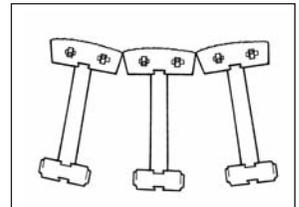
Tip: Elimination of *Anchor/Junctions* units and/or *Trunk* units facilitates placement on curves and corners.

Layout

To layout a curved wall, start by determining the mid point of the curve you wish to build. From that point, measure a distance no less than 6' away from the wall to locate the center of a circle. If constructing a concave (inside) wall, the center point of the circle will be in front of the wall. Drive a stake and attach a string. The length of the string should be equal to the length of the radius of the circle. Use the string to strike an arc along the soil to mark the proper location of the base. If building a convex (outside) wall, locate the circle behind the wall and follow the same steps.

Concave (Inside) Walls

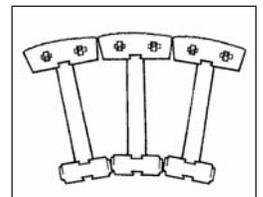
Stacking the Block - When using a batter the radius will grow wider the higher the wall is built. To minimize this effect the height of the wall should be equal to, or greater than, the radius of the wall. Stacking the block with a zero setback maintains the radius and helps to eliminate troubles in constructing radius walls. However, if there is batter in the main wall then it should be continued in the concave wall section.



The Anchor - Concave walls cause the *Anchor/Junctions* to spread apart in a fan shape. In some circumstances, this may result in a lack of support for the next course of *Anchors*. If this occurs simply place other *Anchor/Junctions* at the location where the next course of *Anchor/Junctions* will rest.

Convex (Outside) Walls

Unless building the wall without a batter, the radius will tighten by 1" with every 1 foot increase in height. For walls less than 6' high, increase the length of the radius used to mark the first course by 1" for every foot less than 6'.



For a 6' high wall, the bottom radius should be 6'5".
 For a 5' high wall, the bottom radius should be 6'4".
 For a 4' high wall, the bottom radius should be 6'3".
 For a 3' high wall, the bottom radius should be 6'2".
 For a 2' high wall, the bottom radius should be 6'1".
 For a 1' high wall, the bottom radius should be 6'.

For walls greater than 6' high, the radius should be equal to, or greater than, the height of the wall. Making a slight gap between the units on the first course can also ease the effects of tightening of wall. Additionally, using the plugs in a zero set back will help eliminate any difficulty in creating a curved wall. However, remember to always maintain the batter that is being used in the main wall sections.

Outside Corners

90° Corner Unit - When incorporating corners, it is best to start the wall in the corner and build out. Follow these simple steps to construct corners with a 90° *Corner* unit.

1. Mark the location of the corner with a stake and use string lines to indicate the line of the intersecting walls. When digging the trench, allow extra space at the corner location.

2. Once the gravel base has been placed and compacted to the desired elevation, mark the exact location of the corner. Use a builder's square to ensure an accurate 90° angle, or lay it out using the 3-4-5 triangle method.



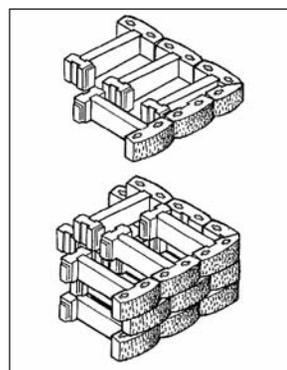
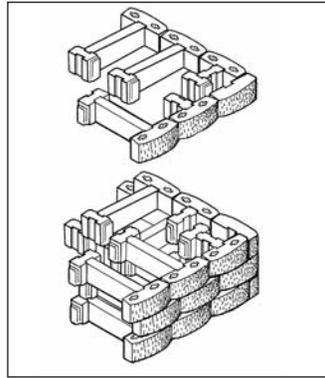
Tip: Snap a chalk line directly on the gravel footing as a guide to align the wall.

3. Position a *Corner* unit on the base exactly where the intersecting lines meet in the corner. Then place **GravityStone Face** units on each side of it. Using a level, align and plumb the units. Install *Anchor/Junctions* to create a crossing pattern. Continue the wall on each side using *Face* units following the directions shown in **GravityStone Section 3 - Installing the First Course**. However, do not insert a *Plug* in the closest hole of the unit sitting adjacent to the shortest face of the corner.

4. For the second course, position a *Corner* unit, in the alternate direction, onto the *Corner* and *Face* unit in place below. Place *Face* units on each side, following the directions shown in **GravityStone Section 4 - Laying the Wall**, once again leaving out a *Plug* in the hole closest to the short face of the corner.

5. Continue this procedure for each course, alternating the *Corner* units 90° every course to maintain the running bond pattern. Use a *Universal Coping Stone* as a cap to finish the corner.

Mitered Corner Unit - A corner unit can also be created by mitering a **GravityStone Face** unit at a 45° angle. You will need to miter both half and full-size units. At the end of one wall, use a half-length mitered unit. At the end of the intersecting wall, use a

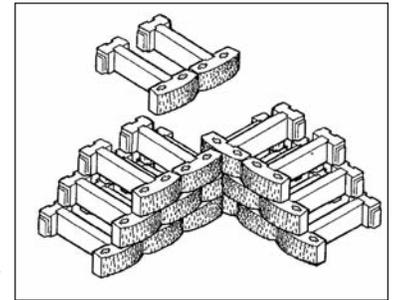


full-length mitered unit. Align the wall ends by abutting the mitered ends. Alternate the half and full length units, from one side to the other, as the corner is built. Apply **SRW Adhesive** to the *Face* unit, which has no *Trunk* or *Anchor/Junctions*. Fill the units with drainage stone as the corner section is built.

Inside Corners

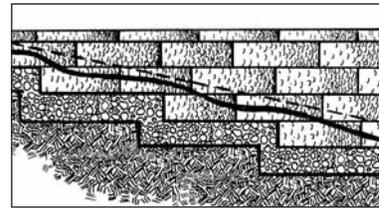
To stack this properly, you must overlap the ends of the wall sections. The minimum overlap at the top course is 9". When building a vertical wall the overlap will be constant. However, if you are building a wall with a batter, the wall will step-back 1" for each vertical foot of wall.

Therefore, the overlap in the 1st course must be increased to maintain the minimum 9" overlap in the top course. For example, a 10' high wall will require an additional overlap of 10" in the first course for a total overlap of 19".



Step-Ups

When building along the direction of a slope, the wall must be stepped in increments of 8". Do not attempt to slant the wall to the angle of the slope. When building a long wall with a batter, it



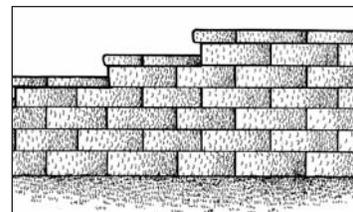
will be necessary to gradually adjust the alignment of the base course. Remember that the wall will step-back 1" for every foot in height of grade change.

Ending the Wall

There are several ways to end a wall along a slope. One is to turn the units into the grade, burying at least one complete unit along the incline.



Another choice is to place a *Corner* unit at the end of every course that steps down to expose the split face at the end of the wall. Split a *Universal Coping Stone* into the appropriate corner piece and position it onto the units to attain a 1" overhang. Be sure to secure them with **SRW Adhesive**.



Stairs

A stairway built into a **GravityStone** wall adds form and function. For efficient installation, we recommend you build the stairs independently of the side walls. You will also need to build a corner on each side of the stairs where you wish to incorporate them into the main wall. When using the *Face* units for risers,

you will need to lay out the stair opening in multiples of 18". You can also construct the risers using **Stonewall** units, which would require laying out the stair opening in 12" increments.

Start with the corners and build them as you normally would. To avoid the automatic step-back as you construct the side walls, set the *Plugs forward* to create a vertical rise. Otherwise, you will need to cut the riser and coping units to fit the space created by the step-back developed in the side walls.

Once the side walls have been erected, you can start the stairs at the front or set them in from the corners. How high you lift your foot and how much room you have to put it down is known as the "rise over run". The height of the first riser should measure from the top of the tread to the finished grade. For a 12" run, use 2 *Face* units, placed back to back, for the stair riser or use 1 **Stonewall** unit. If using **Stonewall**, follow the installation instructions under **Stair Construction** on page 14. If using the **GravityStone Faces**, put a few dabs of **SRW Adhesive** on the back of them to form a 12" deep module.

The depth of the excavation will depend on the height of the rise. Install and compact a 6" gravel base as the footing. Place a row of double module *Face* units onto the base across the width of the stair opening, and level them front to back and side to side.

Construct the next riser assembly by placing and compacting another 6" thick gravel footing behind the first course of units. Position another row of *Face* units onto the base directly behind the units in front. Finish as noted above. Install successive risers in the same manner for the number of stairs needed.

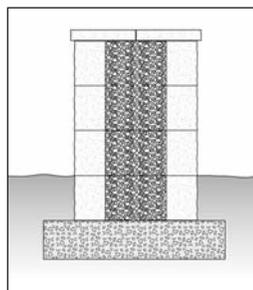
Treads

We recommend using a rock-faced stone, such as limestone, bluestone or granite for treads to complement the wall with an attractive seamless look. Set with an acrylic-based mortar or with **SRW Adhesive** as instructed in **Section 7 - Capping the Wall**. Position the treads to provide a 1" overhang. Allow the adhesive to cure at least 24 hours before opening the stairs to traffic.

Important: When coping units are used for stair treads, they must be treated with a penetrating-type sealer. Promptly remove snow and ice and use sand for traction control. Avoid use of magnesium and potassium deicers, which can be harmful to concrete products.

FREE-STANDING WALLS

There is no other system on the market today that can construct free-standing, double sided walls as substantial as GravityStone. Barrier walls, perimeter walls and even sound barrier walls can be constructed safely using the G/S Face-Anchor-Face (22" w) system or the Face-Trunk-Face (33" w) system.



Tip: For curved sections of wall, do not connect the opposite *Face* units. Instead, lock the *Trunk* or *Anchor/Junctions* into only one of the *Face* units; if necessary, shorten them to fit. The friction and weight of the gravel will hold them securely.

It is important to build free standing walls on a solid foundation. Granular soils provide the best bearing capacity needed for walls over 4' high. If the subgrade soil is clay, the exposed height

should be limited to 4 feet or less. On granular soils, the maximum exposed height for Mini Cell (Face-Anchor-Face) is 6' and 8' high for Single Cell (Face-Trunk-Face). Consult a qualified engineer for higher walls.

Since the walls rely on the internal mass of the wall for stability, they must be built plumb on well-leveled, compacted foundations. Although free standing walls are not subject to overturning from the pressure of earth behind the wall, they must be able to withstand forces created by wind. In order to develop adequate resistance to sliding caused by high winds, at least one 8" course must be buried below grade. For double-sided Mini Cell (*Face-Anchor/Junctions-Face*) configurations, remove enough soil to construct a base at least 12" thick by 34" wide. For Single Cell Double Walls (*Face-Trunk-Face*) the dimensions of the gravel base should be 16" thick by 44" wide.

Step the foundation in 8" increments to accommodate grade changes. Do not slant the wall along a slope. Place the *Face* units into position then connect them with either the *Anchor/Junctions* or *Trunk* units. Sweep top of units, add shear plugs, and proceed with the next course until the desired wall height is achieved. The cells must be completely filled with 1 1/2" processed gravel or crusher run as the wall is built to provide structural stability and resistance to overturning loads. Lay no more than three courses before adding the gravel into the core of the wall. Finish the wall by securing the coping with our SRW Adhesive.

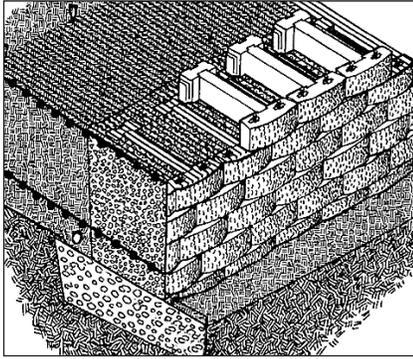
GRAVITYSTONE WITH GEOGRID REINFORCEMENT

For walls that will experience increased loads due to height, surcharge, or backslope, additional reinforcement techniques may be required. One method is to use geogrid to reinforce the earth behind the wall. The number of layers, their positioning, and length, as well the strength of the geogrid material, are all variables that require evaluation and calculation. When using geogrid, the design must be prepared by a qualified professional engineer.

Installation

Place the geogrid over the top of the **GravityStone** units and position it as close to the front of the unit's face as possible. Cut out the material so that it does not go over the plugs. Extend the grid back onto the compacted gravel. Additional gravel is then placed on top of the grid and is compacted.

As courses of units are added and back-filled, additional layers of grid are placed at appropriate heights.



The number of layers and length of geogrid depend on several conditions, including the type of soil being

retained. Poor draining soils such as clay require more geogrid than granular soils which drain well. Typically, grid should be placed every 2 or 3 courses and should extend back a distance about equal to three-quarters the height of the wall. Your engineer will be able to specify to number of layers of grid that will be required and how far back the grid should extend.

Note: Some designs may require a drainage chimney, made of $\frac{3}{4}$ " crushed stone, that extends vertically immediately behind the reinforced soil and geogrid area to collect and drain water off in order to prevent it from saturating the reinforced infill soil area.

For more information, see the **Geogrid Placement Procedures** section on page 16 or consult the design charts at the end of this manual.

ESTIMATING

Begin by measuring the length and total height of the wall. The height should include the number of courses buried below finished grade. Coping units should be calculated separately. If the wall changes in height or direction, or has curves, you should consider each change as a wall segment and estimate the amount of wall units by segment. It will be necessary to count the number of corners and, if included in the wall, the amount of PISA Lites™ and PISA Sounds.™

There are several ways to determine the amount of SRW units that are needed for a project.

Pisa2 and Roman Pisa - Total Area Method

1. Determine the height and length of each wall segment. Do not include the coping units in the height.
2. Multiply the total height of each segment by its length to find the area.
3. Add the areas of the segments to determine the total face area (square footage) of the wall.
4. Multiply the total area by the number of pieces shown.

- **Running Bond Pattern - Pisa2 or Roman Pisa:**

Multiply the total square feet by 3

- **Roman Pisa Ashlar #1**

- Stretchers 164 pcs/100sf of wall
- Jumbos 56 pcs/100sf of wall
- Halves 110 pcs/100sf of wall
- Stretcher Caps* Multiply wall length by .85

- **Roman Pisa Ashlar #2**

- Stretchers 164 pcs/100sf of wall
- Jumbos 56 pcs/100sf of wall
- Halves 110 pcs/100sf of wall
- Stretcher Caps* Multiply wall length by .85

- **Roman Pisa Ashlar #3**

- Stretchers 160 pcs/100sf of wall
- Jumbos 80 pcs/100sf of wall
- Halves 42 pcs/100sf of wall
- Stretcher Caps* Multiply wall length by .8

- **Roman Pisa Ashlar #4**

- Stretchers 168 pcs/100sf of wall
- Jumbos 60 pcs/100sf of wall
- Halves 30 pcs/100sf of wall
- Stretcher Caps* Multiply wall length by .95

** Important: Deduct the number of Stretcher Cap units from the total number of Stretchers.*

5. Refer to the Estimating Components section to determine the quantity of corners and coping units.

Stonewall - Total Area Method

1. Determine the height and length of each wall segment. Do not include the coping units in the height.
2. Multiply the total height of each segment by its length to find the area.
3. Add the areas of the segments to determine the total face area (square footage) of the wall.
4. Multiply the total area by 1.5 to determine the number of **Stonewall** units.

5. Refer to the Estimating Components section to determine the quantity of corners and coping units.

Fat Face

1. Determine the total square foot area of each wall segment.
2. The number of units equals the square footage of the wall.

GravityStone - Total Area Method

Because **GravityStone** walls may be comprised of more than one type of cell assembly, use the chart shown to calculate the number of units.

1. Determine the height and length of each wall segment. Do not include the coping units in the height.
2. Calculate the area of each segment.
3. Determine the amount of square footage for each type of cell assembly used in the segment.
4. Using the chart below, calculate the amount of **Face, Trunk** and/or **Anchor** units of each assembly by multiplying the quantity shown for each unit by the square footage.

NO. OF UNIT COMPONENTS PER 1 SF FOR GRAVITYSTONE			
CELL TYPE	FACE	TRUNK	ANCHOR
Mini-Cell	1	---	2
Single-Cell	1	1	1
Double-Cell	1	2	2
Triple-Cell	1	3	3

5. Add the amounts to determine the total number of **Face, Trunk,** and/or **Anchor** units.
6. Refer to the Estimating Components section to determine the quantity of corners and coping units.

Olde Boston Wall - Total Area Method

1. Determine the total square foot area of each wall segment.
2. Calculate the number of units using one of the following formulas:
 - For 8" wide walls placed in 4" x 12" running bond pattern multiply the total area by 3.1.
 - For 12" wide walls placed in a 4" x 8" pattern multiply the total area by 4.6.
3. **Olde Boston Wall** units are used for corners and coping and are included in the above calculation.

Ancestral WallStone - Total Area Method

1. Determine the total square foot area of each wall segment.
2. Multiply the total area by 1.2 for 3" high and .6 for 6" high to determine the number of **sets**.
3. **Ancestral** units are used for corners.

Ancestral Coping

1. Calculate the total length of the wall by measuring each wall segment.
2. Divide the total length by 2.16 to determine the number of **pairs**.

Estimating Components

Corners

1. Count the number of corners in the wall as well as the number of courses. Be sure to include corners at stairs.
 2. Order one *Corner* unit for each course.
- **Pisa2 Corners** come as *Right* and *Left* handed units and are alternated every course. *Stretcher Cap* units are placed adjacent to **Pisa2 Corners**. Order an equal amount of *Stretcher Caps* to *Corner* units.
 - **Roman Pisa Corners** are reversible. *Stretcher Cap* units are placed adjacent to **Roman Pisa Corners**. Order an equal amount of *Stretcher Caps* to *Corner* units.
 - **Stonewall** and **Fat Face Corners** are reversible and alternated every other course.

Step-downs

Corner units are also used to terminate a row of block where the wall steps down.

- For **Pisa2** walls, order the proper *Right* or *Left* Hand units. When facing the wall, if the step-down is to the right, order *Right*-handed units; if to the left, order *Left*-handed units.
- For **Roman Pisa**, **Stonewall** and **Fat Face**, order 1 *Corner* unit for every course that steps down and reverse orientation as necessary.

Half Units

Half units are used to maintain a running bond or complete an ashlar **Roman Pisa** pattern.

- **Pisa2** and **Roman Pisa** systems include manufactured *Half* units.
- **Stonewall** half units may be cut from full size units or ordered as *Corner* units, which double as half units.
- **Fat Face** half units are created by field-cutting full-size units.

Coping Units

To calculate the number of pieces needed, use one of the following:

- **Ancestral Coping Sets:** Multiply the length by .46
- **Roman Pisa Coping:** Multiply the length by .75
- **Universal Coping Stone:** Multiply the length by .75
- **Pisa2** and **Roman Pisa Stretcher Caps:** Multiply the length by 1.5
- **Stonewall Caps:** Multiply the length by 1
- **ReversaCap:** Multiply the length by 1.6

SRW Adhesive

- **10 oz tube:** 14lf @ $\frac{3}{8}$ " bead or 10 sf of wall area for Roman Pisa Ashlar patterns
- **29 oz tube:** 40lf @ $\frac{3}{8}$ " bead or 30 sf of wall area for Roman Pisa Ashlar patterns

Geogrid

Geo-grid quantities will vary significantly depending on the soil. Consult an engineer for a site-specific geo-grid design. For estimating purposes, one of the Grid estimating charts can be used.

1. Select the appropriate chart that best represents the type of slope and/or surcharge for the site.
2. For each wall segment, calculate the grid length and number of layers for the type and strengths of grid indicated.
3. Add the quantities of geo-grid by type/strength to determine the amount of geo-grid required.

Preliminary Design Service

Ideal is pleased to offer a FREE Preliminary Design Service to our customers. Ask your Ideal Authorized Dealer for a SRW Preliminary Design Request form (or copy the form from page 43 or download it from www.IdealConcreteBlock.com). Complete the information and fax/send it to the number/address shown on the form. Based on information submitted, a professional engineer will review your project at NO cost and provide a quantity take-off of blocks and grid strength(s), length and placement. Allow 48 to 72 hours for this service.

Processed Gravel/Crusher Run - For a Base 6" thick x 100 lf

- **Ancestral Wallstone:** 4-5 tons for 20" wide base
- **Stonewall or Fat Face:** 6-7 tons for 24" wide base
- **Pisa2/Roman Pisa:** 6-7 tons for 24" wide base
- **GravityStone:**
 - **Mini-Cell:** 8-9 tons for 24" wide base
 - **Single-Cell:** 11-12 tons for 44" wide base
 - **Double-Cell:** 17-18 tons for 70" wide base
 - **Triple-Cell:** 23 tons for 96" wide base

Unit Fill - per 100 sf of wall

- **Stonewall:** 2 1/2 tons $\frac{3}{4}$ " stone
- **Fat Face:** 2 1/2 tons $\frac{3}{4}$ " stone
- **GravityStone:**
 - **Mini-Cell:** 4 tons #57 or #67 graded stone
 - **Single-Cell:** 8 tons #57 or #67 graded stone
 - **Double-Cell:** 16 tons #57 or #67 graded stone
 - **Triple-Cell:** 24 tons #57 or #67 graded stone

Drainage Stone (behind wall) - per 100 sf of wall

- **Stonewall or Fat Face:** 5 tons of $\frac{3}{4}$ " stone
- **Pisa2/Roman Pisa:** 5 tons of $\frac{3}{4}$ " stone

Amounts are based on the approximate weights of:

- 1 1/2" processed gravel/crusher run - 115 lb/cu ft
- $\frac{3}{4}$ " crushed stone - 100 lb/cu ft
- #57 and #67 graded stone - 105 lb/cu ft

Estimating Chart Method

Another way to estimate the number of units is to use the charts on the following pages as guides. Refer to the charts to determine the number of units needed for each wall segment and total the amounts. Remember to allow a few extra units for cutting and waste.

ESTIMATING CHARTS

STONEWALL - Number of Units								
HEIGHT & COURSE		LENGTH						
		5'	10'	15'	20'	30'	40'	50'
8"	1st	5	10	15	20	30	40	50
16"	2nd	10	20	30	40	60	80	100
24"	3rd	15	30	45	60	90	120	150
32"	4th	20	40	60	80	120	160	200
40"	5th	25	50	75	100	150	200	250
48"	6th	30	60	90	120	180	240	300

Shaded row indicates the buried course

PISA2 & ROMAN PISA SYSTEM COMPONENTS			
TYPE	SIZE	PCS/SF	APPROX. WEIGHT
Stretcher	6" h x 8" w x 12" d	3	43 lb/pc
Half	6" h x 4" w x 12" d	6	22 lb/pc
Corner - Right & Left	6" h x 8" w x 12" d	N/A	46 lb/pc
Stretcher Cap	6" h x 8" w x 12" d	3	43 lb/pc
Roman Pisa Jumbo	6" h x 12" w x 8" d	2	51 lb/pc
ReversaCap	3" h x 7/8" w x 12" d	1.6 pcs/lf	22.5 lb/pc
Universal Coping	3 5/8" h x 16" w x 13" d	1.33 lf/pc	57 lb/pc
Roman Pisa Coping	3 5/8" h x 16" w x 13" d	1.33 lf/pc	57 lb/pc

PISA2 & ROMAN PISA - Number of Units (Using Stretchers Only)								
HEIGHT & COURSE		LENGTH						
		5'	10'	15'	20'	30'	40'	50'
6"	1st	8	15	23	30	45	60	75
12"	2nd	15	30	45	60	90	120	150
18"	3rd	23	45	60	90	135	180	225
24"	4th	30	60	90	120	180	240	300
30"	5th	38	75	113	150	225	300	375
36"	6th	45	90	135	180	270	360	450
42"	7th	53	105	158	210	315	420	525
48"	8th	60	120	180	240	360	480	600

Shaded row indicates the buried course

ROMAN PISA PATTERNS - Number of Units (per 100 sf)			
TYPE	STRETCHER	HALF	JUMBO
Ashlar Pattern #1	164*	110	56
Ashlar Pattern #2	164*	110	56
Ashlar Pattern #3	160**	42	80
Ashlar Pattern #4	168***	30	60
Stretcher & Half - 2:1 Ratio	240	120	---
Stretcher & Half - 4:1 Ratio	265	66	---

*Includes 9 Stretcher Cap units for every 10' of closure row. **Includes 8 Stretcher Cap units for every 10' of closure row. ***Includes 11 Stretcher Cap units for every 10' of closure row.

OLDE BOSTON WALL - Number of Units							
		WALL LENGTH					
		4" x 8" faces - running bond			4" x 12" faces - running bond		
Wall Height	Courses	10 ft	20 ft	30 ft	10 ft	20 ft	30 ft
8"	2	30	60	90	20	40	60
12"	3	45	90	135	30	60	90
16"	4	60	120	180	40	80	120
20"	5	75	150	225	50	100	150
24"	6	90	180	270	60	120	180

Height includes first course of wall units buried below grade • Maximum wall height is 2'

OLDE BOSTON - Number of Units for Pillars, Pilasters and Posts								
20" x 20"			24" x 24"			32" x 32"		
Height	Courses	Units	Height	Courses	Units	Height	Courses	Units
24"	6	24	24"	6	36	24"	6	48
28"	7	28	28"	7	42	28"	7	56
32"	8	32	32"	8	48	32"	8	64
36"	9	36	36"	9	54	36"	9	72
40"	10	40	40"	10	60	40"	10	80
Non-shaded area heights are suitable for all pillars, pilasters and posts. Shaded area heights are suitable only for attached pillars and pilasters.						44"	11	88
						48"	12	96

Height includes the first two courses of wall units buried below grade

3" and 6" High ANCESTRAL WALL - Number of Sets								
WALL HEIGHT	3" High Ancestral WallStone				6" High Ancestral WallStone			
	LENGTH				LENGTH			
	5'	10'	20'	30'	5'	10'	20'	30'
6"	3	6	12	18	2	3	6	9
9"	5	9	18	27	--	--	--	--
12"	6	12	24	36	3	6	12	18
15"	8	15	30	45	--	--	--	--
18"	9	18	36	54	5	9	18	27
21"	11	21	42	63	--	--	--	--
24"	12	24	48	72	6	12	24	36
27"	14	27	54	81	--	--	--	--
30"	15	30	60	90	8	15	30	45
33"	17	33	66	99	--	--	--	--
36"	18	36	72	108	9	18	36	54

Height includes a course of wall units buried below grade • Number of sets may be rounded to full sets of 3 units - 16"/14" • 14"/12" • 12"/10"

Coverage: 3" high = 1.2 sets/sf • 6" high = .6 sets/sf

Maximum height as a Garden/Retaining wall should not exceed 30" including buried course.

Shaded rows indicate quantities when used as a free-standing wall set on and adhered to a TurfStone base.

3" and 6" high ANCESTRAL WALL - Combination						
RATIO of SETS		SF of COMBO	SF EACH SET/100SF		NO. of SETS/100SF	
3" High	6" High		3" High	6" High	3" High	6" High
1 set	1 set	2.49	33	67	40 sets	40 sets
2 sets	1 set	3.32	50	50	60 sets	30 sets
3 sets	1 set	4.15	60	40	72 sets	24 sets
3 sets	2 sets	5.81	43	57	52 sets	34 sets
1 set	2 sets	4.15	20	80	24 sets	48 sets
1 set	3 sets	5.81	14	86	17 sets	52 sets
2 sets	3 sets	6.64	25	75	30 sets	45 sets

Number of sets may be rounded up to full sets of 3 units.

CAPS & COPING - Number of Units							
STYLE	LENGTH						
	5'	10'	15'	20'	30'	40'	50'
Pisa StretcherCap	8	15	23	30	45	60	75
ReversaCap	8	16	24	32	48	64	80
Universal Coping	3.75	7.5	11.25	15	22.5	30	37.5
Roman Pisa Coping	3.75	7.5	11.25	15	22.5	30	37.5
Stonewall Cap	5	10	15	20	30	40	50
Ancestral Coping	3 pr	5 pr	7 pr	10 pr	15 pr	20 pr	25 pr

GRAVITYSTONE COMPONENT PER CELL ASSEMBLY - Number of Units (per course)							
TYPE	UNIT	LENGTH					
		15'	30'	50'	75'	100'	150'
MINI-CELL	FACE	10	20	34	50	67	100
	ANCHOR	20	40	68	100	134	200
SINGLE-CELL	FACE	10	20	34	50	67	100
	TRUNK	10	20	34	50	67	100
	ANCHOR	10	20	34	50	67	100
DOUBLE-CELL	FACE	10	20	34	50	67	100
	TRUNK	20	40	68	100	134	200
	ANCHOR	20	40	68	100	134	200
ADDITIONAL CELLS	TRUNK	10	20	34	50	67	100
	ANCHOR	10	20	34	50	67	100

GRAVITYSTONE PILLARS - ESTIMATING CHARTS

21" x 21" GravityStone Pillar									
Height and No. of Courses		Total Units Required			# Courses below grade	Gravel Base			No. of Turfstone
		Corners	Face Units	Anchor/Junction		Depth	Width	Length	
24"	3	12	-	-	1/2	9"	33"	33"	3 pcs.
32"	4	16	-	-	1	9"	33"	33"	
40"	5	20	-	-	1	9"	33"	33"	

21" x 30" GravityStone Pillar									
Height and No. of Courses		Total Units Required			# Courses below grade	Gravel Base			No. of Turfstone
		Corners	Face Units	Anchor/Junction		Depth	Width	Length	
24"	3	12	3	3	1/2	9"	33"	33"	4 pcs.
32"	4	16	4	4	1	9"	33"	33"	
40"	5	20	5	5	1	9"	33"	33"	
48"	6	24	6	6	1	9"	33"	33"	

30" x 30" GravityStone Pillar									
Height and No. of Courses		Total Units Required			# Courses below grade	Gravel Base			No. of Turfstone
		Corners	Face Units	Anchor/Junction		Depth	Width	Length	
24"	3	12	6	6	1/2	9"	42"	42"	4 pcs.
32"	4	16	8	8	1	9"	42"	42"	
40"	5	20	10	10	1	9"	42"	42"	
48"	6	24	12	12	1	9"	42"	42"	
						Concrete Footing			N/A
56"	7	28	14	14	1 1/2	13"	42"	42"	

30" x 39" GravityStone Pillar									
Height and No. of Courses		Total Units Required			# Courses below grade	Gravel Base			No. of Turfstone
		Corners	Face Units	Anchor/Junction		Depth	Width	Length	
24"	3	12	9	12	1/2	9"	42"	51"	5 pcs.
32"	4	16	12	16	1	9"	42"	51"	
40"	5	20	13	20	1	9"	42"	51"	
48"	6	24	18	24	1	9"	42"	51"	
						Concrete Footing			N/A
56"	7	28	21	28	1 1/2	13"	42"	51"	
64"	8	32	24	32	1 1/2	15"	42"	51"	

39" x 39" GravityStone Pillar									
Height and No. of Courses		Total Units Required			# Courses below grade	Gravel Base			No. of Turfstone
		Corners	Face Units	Anchor/Junction		Depth	Width	Length	
24"	3	12	9	12	1/2	9"	51"	51"	6 pcs.
32"	4	16	12	16	1	9"	51"	51"	
40"	5	20	13	20	1	9"	51"	51"	
48"	6	24	18	24	1	9"	51"	51"	
						Concrete Footing			N/A
56"	7	28	28	56	1 1/2	13"	51"	51"	
64"	8	32	32	64	1 1/2	15"	51"	51"	

Note: Height of pillar is measured from the top of the gravel base footing.

GRAVITYSTONE PILLARS

Pillars add an important element to landscape design. Pillars provide form to landscapes and define property lines. At the entry to driveways, pillars make a striking gateway entrance that signifies a grand welcome home. Until recently, building pillars required the skills of a stone craftsman or mason. Now... beautiful pillars are easy to build using **GravityStone Face**, *Corner* and *Anchor/Junction* units.

1. Determine the location of the pillars. Excavate an area to accommodate the size of the footing shown in the **GravityStone Pillar Estimating Charts**. Add an additional 8" to the depths shown to accommodate the first course of **GravityStone** units, which must be buried below grade. Remove any loose soil, roots or large rocks. Compact the excavated area until firm & level. Cover the subgrade with a layer of woven geotextile fabric and wrap it up the sides of the excavation.

2. For pillars up to 48" in height, the footing is comprised of 1 1/2" processed gravel, and for added stability, a layer of *Turfstone* units (assuming the subgrade is comprised of good draining gravel). For weak soils, such as clay, or for pillars higher than 48", a reinforced concrete footing is required. Refer to the **GravityStone Pillar Estimating Charts** for the minimum thickness the footing should be.

When using processed gravel and *Turfstone*, place and compact the gravel in 3" lifts. It is important to achieve maximum compaction of the footing in order to avoid having the column lean and/or topple. Add and compact additional 3" layers of gravel to the required thickness. The final elevation for the gravel should be about 11" below grade. Complete the footing by placing a layer of *Turfstone* onto the gravel, leveling the units and filling the voids and surrounding area with gravel. (Note: It will be necessary to cut one *Turfstone* unit to fit when building 21" x 21" pillars and 21" x 30" pillars.)

3. Place and level the first course of block following the layout for the pillar you intend to build. See the **GravityStone Pillar Details** sheet for how the units should be positioned. Use a carpenter's square to ensure the corners are positioned at a 90° angle. As you place the units, glue them down to the *Turfstone* and to each other by applying 2 continuous beads of SRW Adhesive, 3/8" in diameter, to the bottom and sides of the block.

4. Before applying the adhesive, be sure to remove any dirt or dust from the side, top or bottom surfaces where adhesive will be applied. Sweep each surface clean using a soft bristle brush. Extra care should be taken with **Tumbled GravityStone** units to ensure that the surfaces are free of any residual dust from the tumbling process.

5. If the pillar will have a light, place a length of PVC pipe in the middle to act as a chase to feed the wire through.

6. Place the second course of block in a position that offsets the joints in the bottom row. Apply the adhesive to the top of the block in the first course, then immediately place the next block

on top of it, working the unit firmly into the adhesive. Do not allow the SRW adhesive to skin over before the block is placed. Adhere all of the units to each other and to the units in the course below. Align the units from the back as necessary.

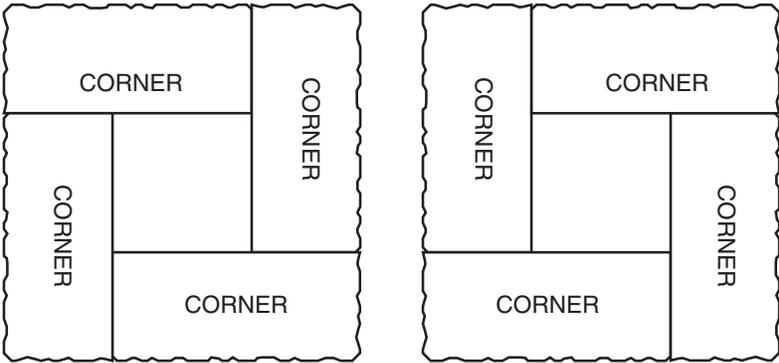
7. For pillars that include **GravityStone Face** units, insert an *Anchor/Junction* into every course. If necessary, shorten the *Anchor/Junction* by splitting off a piece in order to fit within the pillar. Provide temporary support until the cavity is filled with stone.

8. Continue to place successive courses in a similar manner until you have reached the desired height.

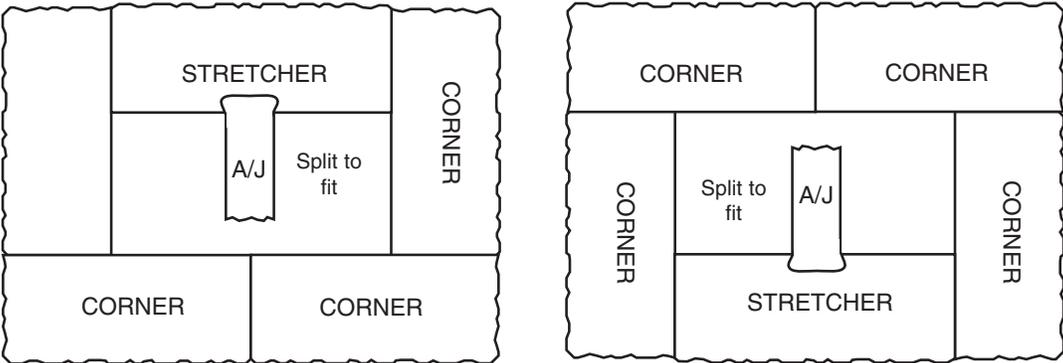
9. To stabilize the column, it must be filled with a #57 or #67 stone. Most gravel pits should have either size readily available, otherwise, use 3/4" non-graded, crushed stone. Add only enough stone to bring it up in 3"-4" lifts. Carefully rod the stone as it is being placed to ensure that it fills the inside corners and the area around the *Anchor/Junctions*. Allow the SRW adhesive to fully set before filling the pillar with stone. In warm weather, the adhesive typically develops a full cure in about 24 hours. Cool weather will require a longer set time. If it is filled within 24 hours, the column must be fully braced until the adhesive has completely set.

10. Finish by placing the cap stone, which should be secured in place with SRW adhesive. Wiring should be connected by a licensed electrician.

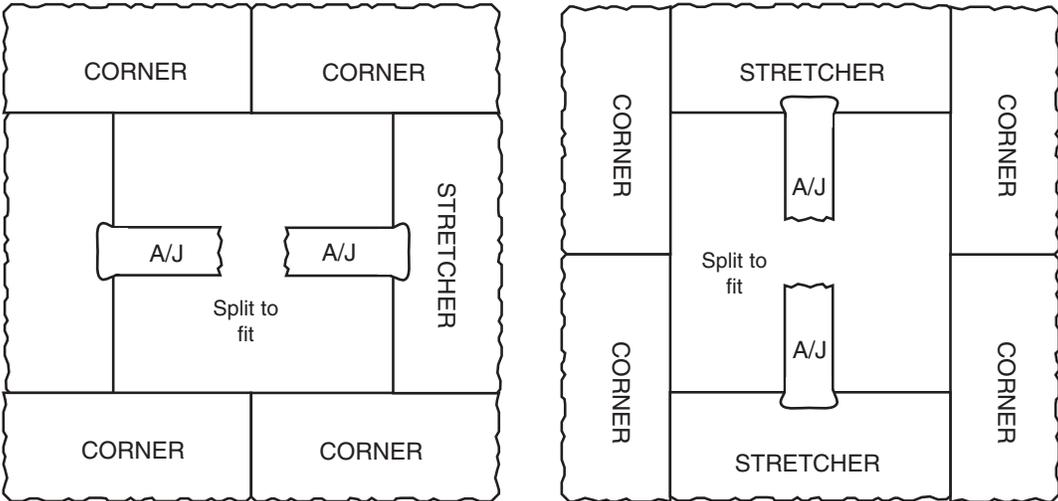
GRAVITYSTONE PILLAR DETAILS



ALTERNATING COURSES
21" X 21" PILLAR



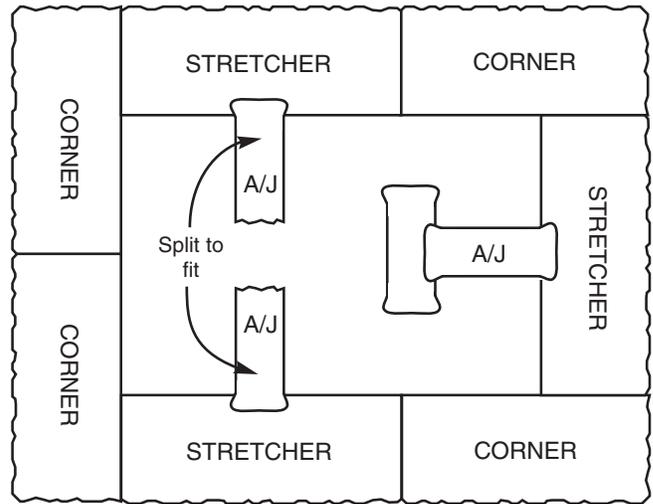
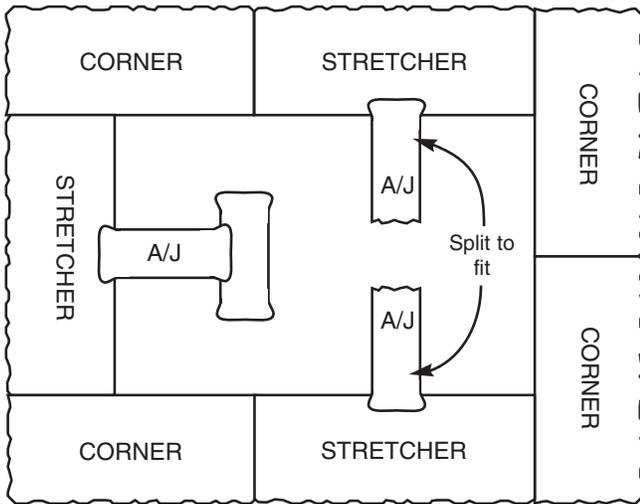
ALTERNATING COURSES
21" X 30" PILLAR



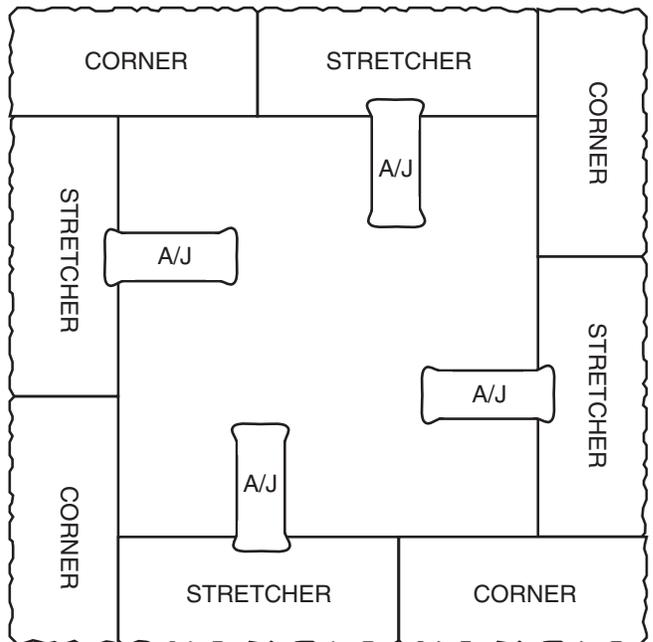
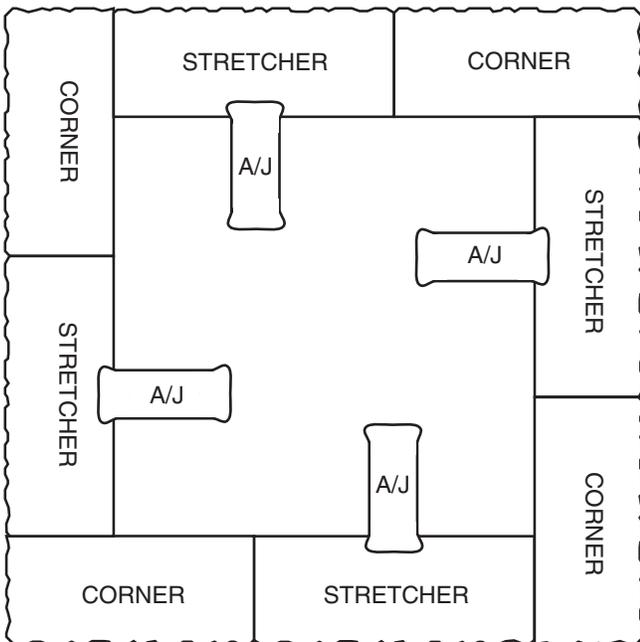
ALTERNATING COURSES
30" X 30" PILLAR

A/J = ANCHOR/JUNCTIONS

GRAVITYSTONE PILLAR DETAILS



ALTERNATING COURSES
30" X 39" PILLAR

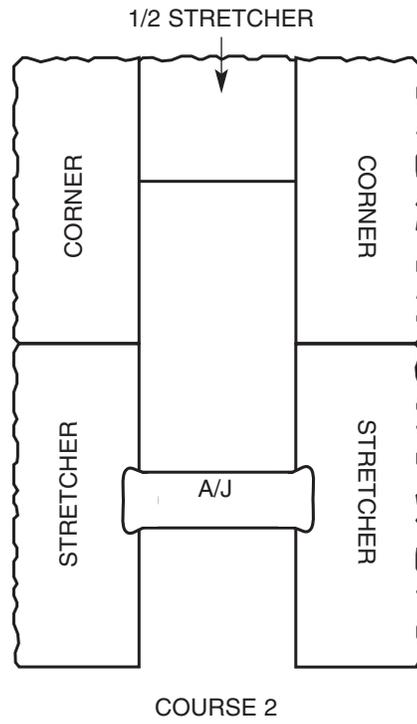
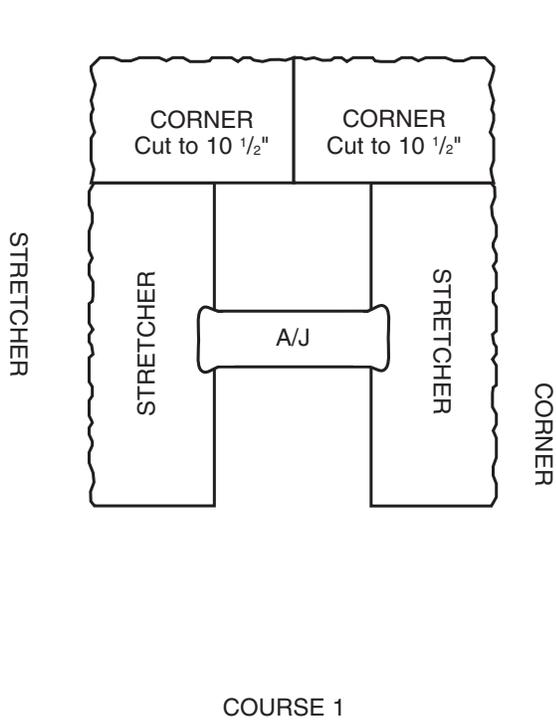


ALTERNATING COURSES
39" X 39" PILLAR

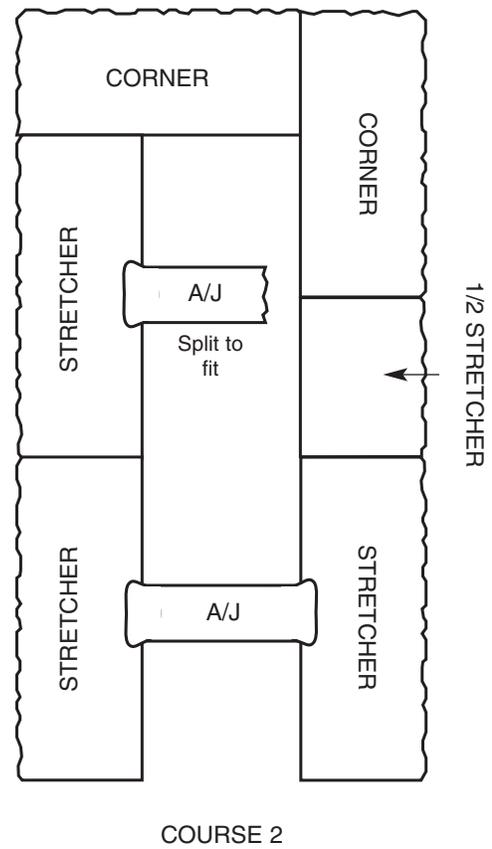
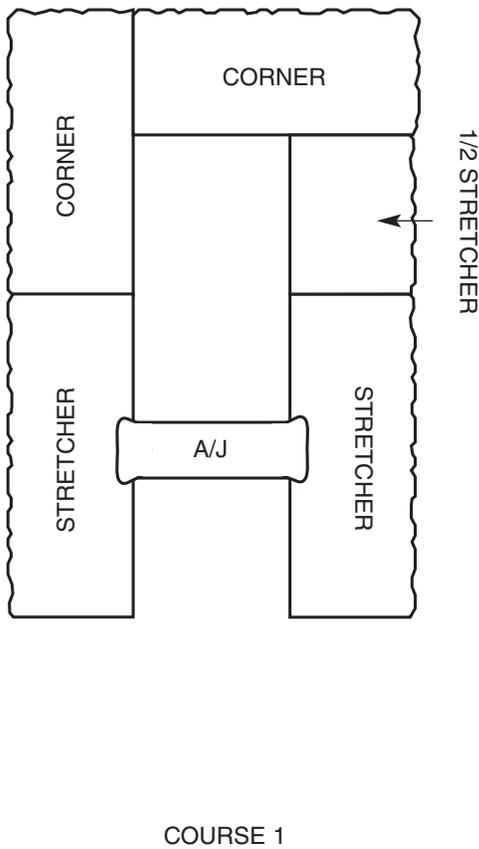
A/J = ANCHOR/JUNCTIONS

GRAVITYSTONE WALL DETAILS

DOUBLE-SIDED MINI-CELL WALL TERMINATION



VERSION 1



VERSION 2

A/J = ANCHOR/JUNCTIONS

GLOSSARY OF COMMONLY USED TERMS

Aggregate - Materials such as sand, gravel, and crushed stone. construction.

Angle of Repose - The angle at which aggregate rests in a natural state.

Batter - The facing angle created by SRW unit set-back, measured from a vertical line drawn from the toe of the wall. Typical batter angles are 3° to 15° from vertical, sloping toward the infill soil.

Bearing Capacity - The load that a soil is capable of supporting without failure, significant settlement, or deformation.

Blanket Drain - A foundation pad of $\frac{3}{4}$ " stone extending behind the wall.

Chimney Drain - A vertical drain constructed at the back the of the wall infill zone in order to intercept lateral groundwater flow toward the wall. Typically it is comprised of $\frac{3}{4}$ " stone which is protected by filter fabric. Solid plastic pipe is placed at the bottom of the chimney in order to direct collected water to the drainage pipe at the base of the wall for outfall.

Compaction - The process of reducing the air voids in newly placed soils by vibration or tamping to ensure maximum density and strength in the soil.

Coping - Top course of units on a wall that provide a finished appearance and tie the wall together.

Concave Curve - A wall that curves inward like the inside radius of a circle.

Convex Curve - A wall that curves outward like the outside radius of a circle.

Cut Wall - The embankment of site soil created before the retaining wall is installed.

Density - The quantity of mass per unit volume. Dimensions are expressed as lb/cu ft.

Drainage Composite - A system, typically comprised of a dimpled plastic core with a geotextile fabric applied to prevent soil from clogging the drainage area. It is usually used to collect water behind the backfill, under the reinforced soil zone, or immediately under the SRW system.

Drainage Stone - Clean, uniform stone usually $\frac{3}{4}$ " in size that is used to fill the space behind the wall known as the drainage zone.

Drainage Zone - The space behind the wall that is filled with crushed stone to prevent water from accumulating behind the wall.

Embedment Depth - The distance the wall is buried below grade. Generally, embedment depth is expressed as the number of courses of units.

Efflorescence - A white deposit on the face of the units created by minerals carried to the surface by water.

External Stability - The summation of all forces acting on the retaining wall system. If unbalanced, a sliding, overturning, or bearing capacity type failure may occur.

Facia or Facing - The assembled modular concrete units that form the exterior face of the retaining wall.

Facia Connection Failure - A condition when the tensile load on the geogrid exceeds the strength of the geogrid/facing connection.

Fill Wall - Wall erected on a fairly level ground that will be backfilled for the purpose of changing the grade on the site.

Filter Cloth - See geotextile.

Foundation Pad - The base or footing which distributes the weight of the SRW units over the foundation soil and provides a level surface for the SRW units. Typically constructed of granular material, such as processed 1 $\frac{1}{2}$ " gravel or $\frac{3}{4}$ " crusher run, although it can consist of non-reinforced concrete or flowable fill.

Foundation Soil - The soil which supports the leveling pad and the reinforced soil zone of a soil-reinforced SRW system.

Geogrid - A synthetic material formed into a grid-like structure for use in soil reinforcement. Usually comprised of polypropylene, polyester, or polyethylene.

Geogrid/Soil Pullout Failure - A condition when the tensile load on the geogrid exceeds the strength of the soil/ geogrid connection or development strength.

Geogrid Reinforced Retaining Wall System - An earth retaining structure that incorporates synthetic materials used to reinforce the soil mass behind the structure.

Geosynthetic - A generic term used to describe synthetic or plastic materials used in soil, such as fabrics, geogrids, drainage composites and erosion control mats.

Geotextile - A textile-like material used to separate soils. Usually comprised of polypropylene or polyester, and can be woven or non-woven.

Global stability - Resistance to overall mass movement of the SRW system in a circular mode. May be a problem with tiered walls, walls with weak foundation soils, and walls with a slope at the top or bottom.

Gravity Retaining Wall System - An earth retaining structure that uses its mass to resist the movement of the soil mass behind the structure.

HDPE - High density polyethylene. Usually refers to the material used to manufacture drain pipe or geogrid.

Infill Soil - Soil located behind the SRW units and drainage zone. May be reinforced with soil reinforcement.

Interface - The top and bottom surface area of wall units in contact with other units in adjacent courses.

Internal Friction Angle - A parameter used to identify a soil's shear strength. A higher value will equate to a greater strength.

Internal Stability - The summation of all forces acting within the retaining wall system. If unbalanced, a geogrid-soil pullout, tensile overstress, internal sliding, or facing connection type failure may occur.

Leveling Pad - Same as Foundation Pad.

Long-Term Design Strength - The allowable strength in the soil reinforcement at the end of the service life of the soil-reinforced SRW. It is the maximum load that the reinforcement can carry and is taken into account in the decision process.

MSE - Mechanically stabilized earth. Soil-reinforced SRWs are considered MSE structures.

Native Soil - Soil that exists on site.

Overturning - An external stability failure mechanism of an SRW whereby lateral external forces cause the entire reinforced soil mass to rotate about the base.

Permeable - The ability of a material to pass water.

Phi Angle - The internal friction angle.

Proctor (density) - A method used to determine the compaction or density of soil materials.

PVC - Polyvinyl chloride. Usually refers to the material used to manufacture drain pipe.

Reinforced soil zone - The area of a soil-reinforced SRW which contains the soil reinforcement.

Retained soil - The soil in the embankment behind the wall that is intended to be retained.

Running Bond - A pattern created by stacking wall units so the vertical joints are offset by half a unit from the course below.

Set-back - Same as batter.

Shear Failure - A condition when the force applied to the back of a unit exceeds the connection strength or shear strength between two adjacent courses.

Side Wall - The portion of a wall that returns at an angle from the main wall. On steps, they are the walls on each side.

Sliding - An external stability failure mechanism of an SRW whereby lateral external forces cause the entire soil mass to slide forward along its base or internally along a particular layer of soil reinforcement.

Sloped Toe - A sloped grade in front of the wall.

Soil-reinforced - An SRW which uses soil reinforcement to increase the mass and stability of the structure.

SRW - The acronym for segmental retaining wall.

Surcharge - External load, usually applied at the top of an SRW. A roadway or building foundation can be a surcharge.

Subgrade Soil - The in-situ, or existing, soil found on site.

Swale - A small ditch or depression formed on top and behind the SRW system to collect water and carry it away.

Unified Soil Classification System - Used to identify similar soil types.

CL – clay, low to medium plasticity

CH – clay, medium to high plasticity

GP – gravel, poorly graded, uniform size

GW – gravel, well graded, various sizes

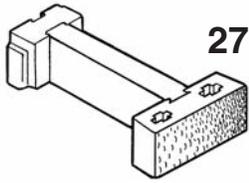
MH – silt, high plasticity

OH – decomposed organic soil, high plasticity

OL – decomposed organic soil

Pt – peat, not fully decomposed

Wall Embedment - The depth of the courses of units that are buried below grade.

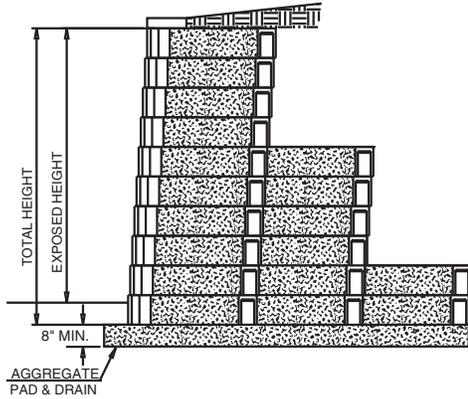


27° SINGLE/MULTI-CELL - GravityStone Modular Retaining Walls

27° SAMPLE DESIGNS FOR CONSTRUCTION ESTIMATING

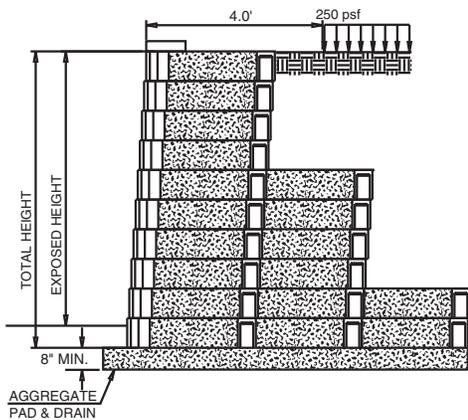
Use these charts when site soils can be conservatively represented with an angle of internal friction, $\phi \geq 27$ and a moist unit weight, $\gamma \leq 125$ pcf. This would be typical for most low plastic clays, silts, and mixtures with sand (CL, ML, SC, SM). Walls are to have a level footing pad.

WESTBLOCK Systems



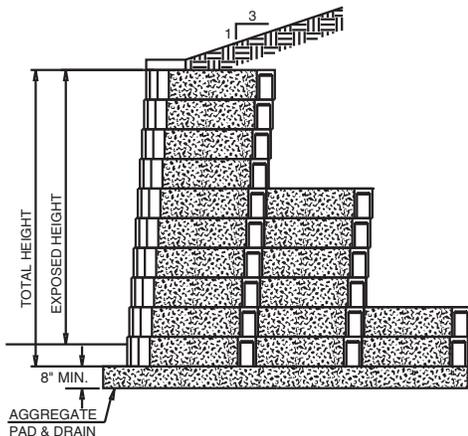
CASE 1: 27°, LEVEL TO 12H:1V BACKSLOPE

TOTAL HEIGHT (FT.)	COURSES OF UNITS	COURSE NUMBER REQUIRING						ESTIMATED		
		1 CELL	2 CELL	3 CELL	4 CELL	5 CELL	6 CELL	FACE UNIT QTY. (#/LF)	TRUNK A/J QTY. (#/LF)	UNIT FILL QTY. (CY/LF)
6.0	≤ 9	1-9						6.0	7.4	0.8
8.0	≤ 12	7-12	1-6					8.0	12.0	1.1
10.0	≤ 15	8-15	3-7	1-2				10.0	16.0	1.5
12.0	≤ 18	11-18	5-10	3-4	1-2			12.0	22.7	2.0
14.0	≤ 21	17-21	15-16	9-14	1-8			14.0	39.4	3.1
16.0	≤ 24	20-24	17-19	12-16	5-11	1-4		16.0	49.4	3.8



CASE 2: 27°, LEVEL, 250 psf SURCHARGE

TOTAL HEIGHT (FT.)	COURSES OF UNITS	COURSE NUMBER REQUIRING						ESTIMATED		
		1 CELL	2 CELL	3 CELL	4 CELL	5 CELL	6 CELL	FACE UNIT QTY. (#/LF)	TRUNK A/J QTY. (#/LF)	UNIT FILL QTY. (CY/LF)
2.7	≤ 4	1-4						2.7	2.7	0.4
4.0	≤ 6	3-6	1-2					4.0	5.4	0.6
6.0	≤ 9	7-9	1-6					6.0	10.0	1.0
8.0	≤ 12	7-12	3-6	1-2				8.0	13.4	1.3
10.0	≤ 15	13-15	11-12	1-10				10.0	24.7	2.0
12.0	≤ 18	19-18	13-15	5-12	1-4			12.0	32.7	2.6
14.0	≤ 21	20-21	17-19	14-16	1-13			14.0	46.0	3.5
16.0	≤ 24	23-24	20-22	17-19	5-16	1-4		16.0	56.7	4.3



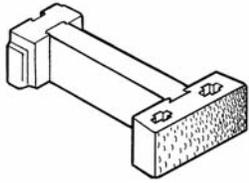
CASE 3: 27°, 3H:1V BACKSLOPE

TOTAL HEIGHT (FT.)	COURSES OF UNITS	COURSE NUMBER REQUIRING						ESTIMATED		
		1 CELL	2 CELL	3 CELL	4 CELL	5 CELL	6 CELL	FACE UNIT QTY. (#/LF)	TRUNK A/J QTY. (#/LF)	UNIT FILL QTY. (CY/LF)
6.0	≤ 9	5-9	3-4	1-2				6.0	10.0	1.1
8.0	≤ 12	11-12	9-10	1-8				8.0	20.0	1.7
10.0	≤ 15	14-15	12-13	5-11	1-4			10.0	28.7	2.4
12.0	≤ 18	17-18	13-16	9-12	5-8	1-4		12.0	38.7	3.1
14.0	≤ 21	20-21	15-19	7-14	5-6	3-4	2-1	14.0	44.0	3.6
16.0	≤ 24	23-24	21-22	18-20	15-17	11-14	1-10	16.0	71.4	5.3

Excludes blanket and chimney drains

NOTES:

- Sample designs prepared to the exact standards for modular retaining structures in the AASHTO Standard Specifications for Highways and Bridges (1996). Applicable building codes govern when they produce a more conservative design.
- Sample designs for construction cost estimating of single-height walls only. All projects should be designed by a qualified engineer using actual design conditions for the proposed site. Tiered walls require specialized design procedures.
- Sample designs have been prepared exclusively for the engineering properties of GravityStone.
- Erect wall and unit fill in maximum 8-inch lifts according to project specifications, or as directed by the engineer.

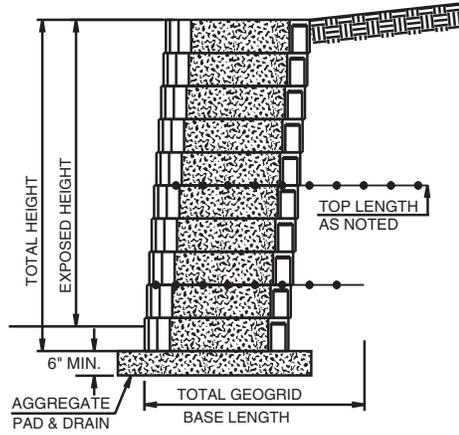


27° SINGLE-CELL - GravityStone MSE Retaining Walls

27° SAMPLE DESIGNS FOR CONSTRUCTION ESTIMATING

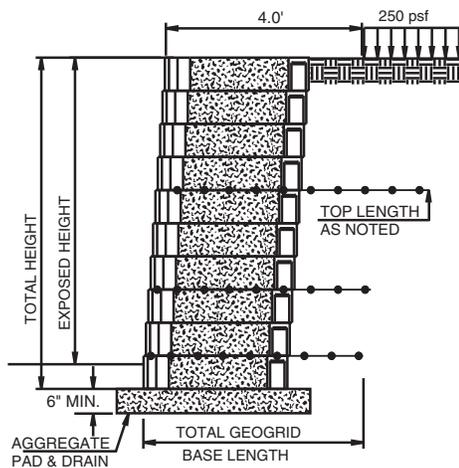
Use these charts when site soils can be conservatively represented with an angle of internal friction, $\phi \geq 27$ and a moist unit weight, $\gamma \leq 125$ pcf. This would be typical for most low plastic clays, silts, and mixtures with sand (CL, ML, SC, SM). Geogrid is to be Miragrid 8xT or unless indicated as 5xT.

WESTBLOCK Systems



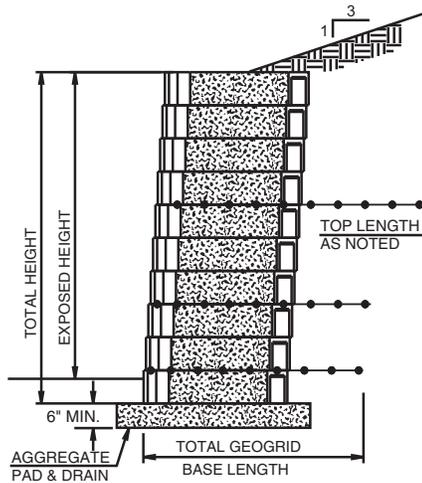
CASE 1: 27°, LEVEL TO 12H:1V BACKSLOPE

TOTAL HEIGHT (FT.)	COURSES OF UNITS	NO. OF LAYERS	GEOGRID BASE LENGTH	TOP LENGTH	GEOGRID PLACEMENT ELEVATION ON TOP OF COURSE NO.	ESTIMATED		
						GEOGRID QUANTITY (SY/LF)	UNIT FILL QUANTITY (CY/LF)	REIN.SOIL QUANTITY (CY/LF)
6.0	≤ 9	0	--	--	NONE	0.0	0.51	0.0
8.0	≤ 12	2	6.0'	6.9'	2, 5 MIRAGRID 5xT	1.5	0.65	1.2
10.0	≤ 15	2	7.0'	8.5'	4, 8	1.8	0.79	1.9
12.0	≤ 18	3	7.2'	10.2'	3, 6, 11	2.8	0.94	2.6
14.0	≤ 21	3	8.4'	11.0'	3, 7, 12	3.1	1.08	3.6
16.0	≤ 24	4	9.6'	12.4'	3, 6, 10, 15,	4.6	1.22	4.8



CASE 2: 27°, LEVEL, 250 psf SURCHARGE

TOTAL HEIGHT (FT.)	COURSES OF UNITS	NO. OF LAYERS	GEOGRID BASE LENGTH	TOP LENGTH	GEOGRID PLACEMENT ELEVATION ON TOP OF COURSE NO.	ESTIMATED		
						GEOGRID QUANTITY (SY/LF)	UNIT FILL QUANTITY (CY/LF)	REIN.SOIL QUANTITY (CY/LF)
2.7	≤ 4	0	--	--	NONE	0.0	0.28	0.0
4.0	≤ 6	1	--	6.8'	2 MIRAGRID 5xT	0.8	0.37	0.7
6.0	≤ 9	2	5.5'	7.0'	2, 4, MIRAGRID 5xT	1.4	0.51	0.9
8.0	≤ 12	2	6.2'	8.3'	3, 6,	1.6	0.65	1.3
10.0	≤ 15	2	6.3'	9.3'	3, 7,	1.8	0.79	2.2
12.0	≤ 18	3	8.0'	11.0'	3, 7, 11,	3.0	0.94	3.2
14.0	≤ 21	3	8.5'	12.6'	3, 7, 13,	3.3	1.08	4.7
16.0	≤ 24	4	9.8'	14.5'	2, 7, 11, 17	4.9	1.22	6.3



CASE 3: 27°, 3H:1V BACKSLOPE

TOTAL HEIGHT (FT.)	COURSES OF UNITS	NO. OF LAYERS	GEOGRID BASE LENGTH	TOP LENGTH	GEOGRID PLACEMENT ELEVATION ON TOP OF COURSE NO.	ESTIMATED		
						GEOGRID QUANTITY (SY/LF)	UNIT FILL QUANTITY (CY/LF)	REIN.SOIL QUANTITY (CY/LF)
4.7	≤ 7	0	--	--	NONE	0.0	0.42	0.0
6.0	≤ 9	2	5.9'	5.9'	2, 3 MIRAGRID 5xT	1.3	0.51	0.8
8.0	≤ 12	2	5.9'	7.5'	2, 4	1.5	0.65	1.3
10.0	≤ 15	2	7.5'	8.9'	2, 6	1.9	0.79	2.2
12.0	≤ 18	3	9.2'	10.4'	3, 6, 9,	3.2	0.94	3.2
14.0	≤ 21	3	10.8'	12.7'	2, 6, 12,	3.8	1.08	4.7
16.0	≤ 24	4	12.5'	14.4'	2, 5, 9, 15,	5.8	1.22	6.3

*Estimated Quantity of geogrid in square yards per linear foot of wall at that height
Excludes blanket and chimney drains
Excludes slope above top of wall*

NOTES:

- Sample designs prepared to the exact standards for soil-reinforced structures in the "Design Manual for Segmental Retaining Walls" as published by NCMA (1997). Applicable building codes govern when they produce a more conservative design.
- Sample designs for construction cost estimating of single-height walls only. All projects should be designed by a qualified engineer using actual design conditions for the proposed site. Tiered walls require specialized design procedures.
- Sample designs have been exclusively for the engineering properties of GravityStone in conjunction with MIRAGRID 8xT geogrid reinforcement, or 5xT where shown. Geogrid reinforcement lengths are measured and installed from front face of the wall, backwards.
- Sample designs require adequate drainage provisions for both reinforced wall fill and retained soil.
- Compact drainage and reinforced fill in maximum 8-inch lifts according to project specifications, or as directed by the engineer.



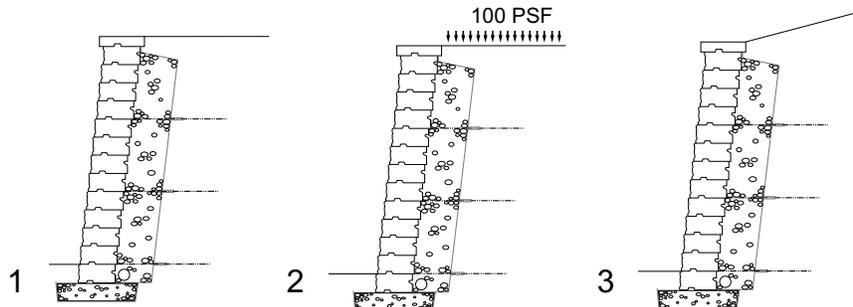
Universal Geogrid Estimating Charts

Pisa2®/Roman Pisa™

Sample designs, 27 degree friction angle soil



These charts are applicable for site soils when the friction angle is 27 degrees or higher and the moist unit weight is 120 lbs per cubic foot. That is typical for inorganic clays of low to medium plasticity. Site soils are assumed for the reinforced soil, backfill soil and foundation soil.



1 - Flat at Top and Bottom of Wall – 50 PSF surcharge (pedestrian)

Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)				
2.5'	3.0'	6	Universal	1	3 rd /4. 5'				
4.0'	4.5'	9	Universal	2	2 nd /4.0'	6 th /5.0'			
6.0'	6.5'	13	Universal	4	2 nd /4.0'	4 th /4.0'	6 th /4.5'	10 th /6.5'	

2 - Flat at Top and Bottom of Wall – 100 PSF surcharge (passenger vehicle & light trucks)

Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)				
2.5'	3.0'	6	Universal	2	2 nd /4.0'	4 th /5.5'			
4.0'	4.5'	9	Universal	3	2 nd /4.0'	4 th /4.0'	7 th /7.0'		
6.0'	6.5'	13	Universal	5	2 nd /5.0'	3 rd /5.0'	5 th /5.0'	8 th /6.0'	11 th /8.5'

3 - Flat at Bottom of Wall – 3:1 Horizontal to Vertical Slope at Top of Wall

Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)				
2.5'	3.0'	6	Universal	1	3 rd /4. 5'				
4.0'	4.5'	9	Universal	2	2 nd /4.0'	6 th /5.0'			
6.0'	6.5'	13	Universal	4	1 st /6.0'	4 th /6.0'	7 th /6.0'	10 th /7.0'	

- 1) The designs in the above table are to be used for estimating purposes only and are not intended to be used for construction.
- 2) A qualified engineer should, in all cases, perform the final as-built design predicated on the conditions specific to the site. A local registered engineer should verify all modes of failure, including global stability, before beginning construction. See your local building department for permitting requirements.
- 3) Sample designs imply there are provisions for adequate drainage for both the reinforced wall fill and the retained backfill and that the water table is at adequate depths as not to affect the structural integrity of the wall. Further, the designs assume that water runoff will be properly addressed and there are no in-ground springs behind the wall. NO provision or analysis is included for global stability.
- 4) Use these charts only when the actual soil, site geometry and surcharge conditions are conservatively represented by the conditions noted in the tables. The user is responsible for determining that the soil friction angle shown on the charts represents the soils typical to the site.
- 5) If there is a slope at the bottom front of the wall, it may be necessary to bury more courses of block than indicated.
- 6) Sample designs have been prepared exclusively for the use of SRW™ Universal geogrid. The designs should not be used for other types of geogrid and wall units other than those shown herein.
- 7) For heights in-between those shown, use the higher design.
- 8) Follow the installation instructions for the retaining wall system you are using. Geogrid must be one continuous piece from the face of the retaining wall block to the back of the reinforced soil mass – do not splice. Butt sheets together at the edges; do not overlap. Pull grid taut and free of wrinkles before placing backfill.
- 9) For walls higher than those shown, multi-tier or terraced walls, steeper slopes and surcharges greater than those shown, you should obtain preliminary design assistance by completing the **SRW Preliminary Design Form** available from your **Pavers by Ideal dealer**.



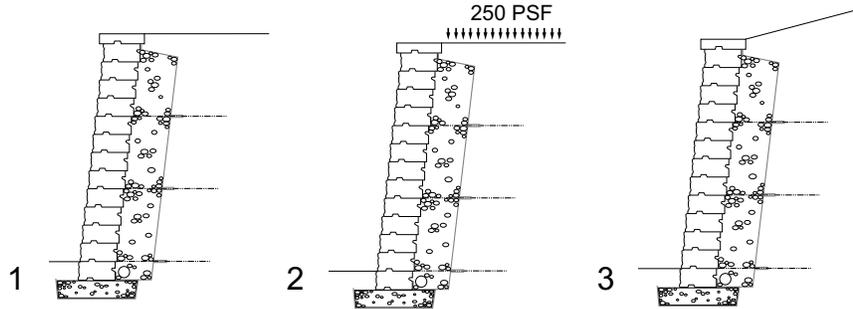
Series 3 & 5 Geogrid Estimating Charts

Pisa 2[®]/Roman Pisa[™]

Sample designs, 27 degree friction angle soil



These charts are applicable for site soils when the friction angle is 27 degrees or higher and the moist unit weight is 120 lbs per cubic foot. That is typical for inorganic clays of low to medium plasticity. Site soils are assumed for the reinforced soil, backfill soil and foundation soil.



1 - Flat at Top and Bottom of Wall - 50 PSF surcharge (pedestrian)										
Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)					
					2 nd /4.0'	5 th /4.5'				
4.0'	4.5'	9	SRW3	2	2 nd /4.0'	5 th /4.5'				
6.0'	6.5'	13	SRW3	3	2 nd /4.5'	5 th /4.5'	9 th /6.0'			
8.0'	9.0'	18	SRW3	4	2 nd /6.0'	6 th /6.0'	10 th /6.0'	14 th /7.5'		
10.0'	11.0'	22	SRW5	5	2 nd /7.5'	6 th /7.5'	10 th /7.5'	14 th /7.5'	18 th /9.0'	

2 - Flat at Top and Bottom of Wall - 250 PSF surcharge (truck traffic)										
Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)					
					2 nd /4.0'	5 th /6.0'				
4.0'	4.5'	9	SRW3	2	2 nd /4.0'	5 th /6.0'				
6.0'	6.5'	13	SRW3	3	2 nd /4.5'	4 th /4.5'	6 th /4.5'	10 th /7.5'		
8.0'	9.0'	18	SRW3	5	2 nd /6.0'	4 th /6.0'	6 th /6.0'	10 th /6.5'	15 th /9.0'	
10.0'	11.0'	22	SRW5	5	2 nd /7.5'	4 th /7.5'	7 th /7.5'	11 th /7.5'	15 th /8.0'	19 th /10.5'

3 - Flat at Bottom of Wall - 3:1 Horizontal to Vertical Slope at Top of Wall										
Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)					
					2 nd /4.0'	5 th /4.5'				
4.0'	4.5'	9	SRW3	2	2 nd /4.0'	5 th /4.5'				
6.0'	6.5'	13	SRW3	3	2 nd /5.0'	5 th /5.0'	9 th /6.5'			
8.0'	9.0'	18	SRW3	5	2 nd /6.5'	4 th /6.5'	6 th /6.5'	10 th /7.0'	14 th /8.5'	
10.0'	11.0'	22	SRW5	6	2 nd /8.5'	4 th /8.5'	6 th /8.5'	10 th /8.5'	14 th /8.5'	18 th /10.5'

- 1) The designs in the above table are to be used for estimating purposes only and are not intended to be used for construction.
- 2) A qualified engineer should, in all cases, perform the final as-built design predicated on the conditions specific to the site. A local registered engineer should verify all modes of failure, including global stability, before beginning construction. See your local building department for permitting requirements.
- 3) Sample designs imply there are provisions for adequate drainage for both the reinforced wall fill and the retained backfill and that the water table is at adequate depths as not to affect the structural integrity of the wall. Further, the designs assume that water runoff will be properly addressed and there are no in-ground springs behind the wall. NO provision or analysis is included for global stability.
- 4) Use these charts only when the actual soil, site geometry and surcharge conditions are conservatively represented by the conditions noted in the tables. The user is responsible for determining that the soil friction angle shown on the charts represents the soils typical to the site.
- 5) If there is a slope at the bottom front of the wall, it may be necessary to bury more courses of block than indicated.
- 6) Sample designs have been prepared exclusively for the use of SRW[™] 3 and 5 series geogrid. SRW[™] 5 series geogrid can be used in place of SRW[™] 3, but SRW[™] 3 CANNOT be used in place of SRW[™] 5. The designs should not be used for other types of geogrid and wall units other than those shown herein.
- 7) MINIMUM FACTORS OF SAFETY: 1.5 for internal reinforcement pullout and tensile overstress, 1.5 for external sliding, 2.0 for external overturning and bearing capacity.
- 8) For heights in-between those shown, use the higher design.
- 9) Follow the installation instructions for the retaining wall system you are using. Geogrid must be one continuous piece from the face of the retaining wall block to the back of the reinforced soil mass – do not splice. Butt sheets together at the edges; do not overlap. Pull grid taut and free of wrinkles before placing backfill.
- 10) For walls higher than those shown, multi-tier or terraced walls, steeper slopes and surcharges greater than those shown, you should obtain preliminary design assistance by completing the SRW Preliminary Design Form available from your Pavers by Ideal dealer.

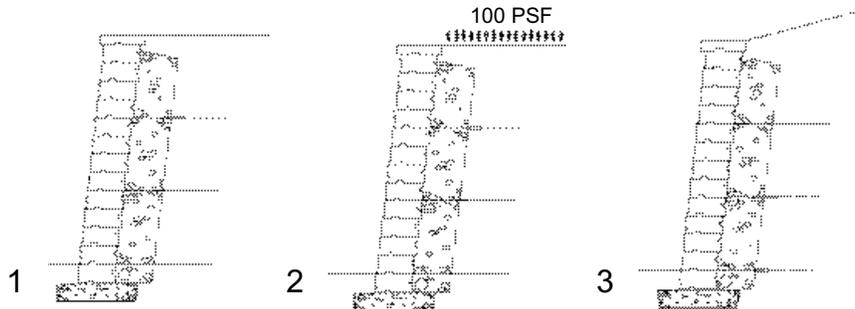


Universal Geogrid Estimating Charts Stonewall® / FatFace™



Sample designs, 27 degree friction angle soil

These charts are applicable for site soils when the friction angle is 27 degrees or higher and the moist unit weight is 120 lbs per cubic foot. That is typical for inorganic clays of low to medium plasticity. Site soils are assumed for the reinforced soil, backfill soil and foundation soil.



1 – Flat at Top and Bottom of Wall – 50 PSF surcharge (pedestrian)

Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)				
2.5'	3.34'	5	Universal	1	2 nd /4.5'				
4.0'	4.7'	7	Universal	2	2 nd /4.0'	4 th /4.5'			
6.0'	6.7'	10	Universal	4	2 nd /4.5'	3 rd /4.5'	5 th /4.5'	7 th /6.0'	

2 – Flat at Top and Bottom of Wall – 100 PSF surcharge (passenger vehicles & light trucks)

Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)				
2.5'	3.34'	5	Universal	2	1 st /4.0'	3 rd /5.5'			
4.0'	4.7'	7	Universal	3	2 nd /4.0'	3 rd /4.0'	5 th /6.5'		
6.0'	6.7'	10	Universal	5	1 st /5.0'	2 nd /5.0'	4 th /5.0'	6 th /5.5'	8 th /8.0'

3 – Flat at Bottom of Wall – 3:1 Horizontal to Vertical Slope at Top of Wall

Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)				
2.5'	3.34'	5	Universal	1	2 nd /4.0'				
4.0'	4.7'	7	Universal	2	2 nd /4.0'	4 th /5.0'			
6.0'	6.7'	10	Universal	4	1 st /6.0'	3 rd /6.0'	5 th /6.0'	7 th /6.5'	

- 1) The designs in the above table are to be used for estimating purposes only and are not intended to be used for construction.
- 2) A qualified engineer should, in all cases, perform the final as-built design predicated on the conditions specific to the site. A local registered engineer should verify all modes of failure, including global stability, before beginning construction. See your local building department for permitting requirements.
- 3) Sample designs imply there are provisions for adequate drainage for both the reinforced wall fill and the retained backfill and that the water table is at adequate depths as not to affect the structural integrity of the wall. Further, the designs assume that water runoff will be properly addressed and there are no in-ground springs behind the wall. NO provision or analysis is included for global stability.
- 4) Use these charts only when the actual soil, site geometry and surcharge conditions are conservatively represented by the conditions noted in the tables. The user is responsible for determining that the soil friction angle shown on the charts represents the soils typical to the site.
- 5) If there is a slope at the bottom front of the wall, it may be necessary to bury more courses of block than indicated.
- 6) Sample designs have been prepared exclusively for the use of SRW™ Universal geogrid. The designs should not be used for other types of geogrid and wall units other than those shown herein.
- 7) For heights in-between those shown, use the higher design.
- 8) Follow the installation instructions for the retaining wall system you are using. Geogrid must be one continuous piece from the face of the retaining wall block to the back of the reinforced soil mass – do not splice. Butt sheets together at the edges; do not overlap. Pull grid taut and free of wrinkles before placing backfill.
- 9) For walls higher than those shown, multi-tier or terraced walls, steeper slopes and surcharges greater than those shown, you should obtain preliminary design assistance by completing the **SRW Preliminary Design Form** available from your **Pavers by Ideal Dealer**.

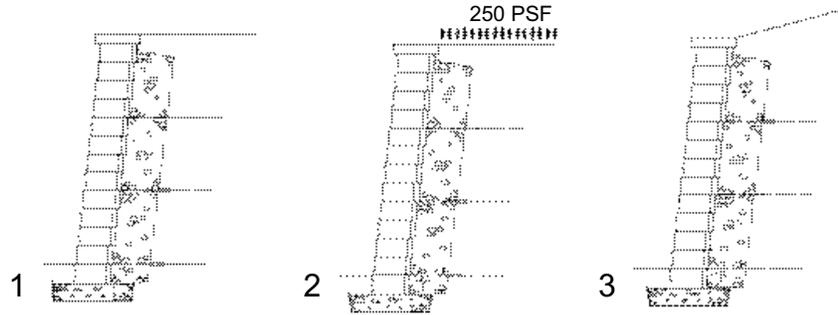


Series 3 & 5 Geogrid Estimating Charts Stonewall® / FatFace™



Sample designs, 27 degree friction angle soil

These charts are applicable for site soils when the friction angle is 27 degrees or higher and the moist unit weight is 120 lbs per cubic foot. That is typical for inorganic clays of low to medium plasticity. Site soils are assumed for the reinforced soil, backfill soil and foundation soil.



1 - Flat at Top and Bottom of Wall - 50 PSF surcharge (pedestrian)

Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)					
4.0'	4.67'	7	SRW3	2	2 nd /4.0'	5 th /5.5'				
6.0'	6.67'	10	SRW3	3	2 nd /4.5'	5 th /5.0'	8 th /6.5'			
8.0'	8.67'	13	SRW5	4	2 nd /6.0'	5 th /6.0'	8 th /6.5'	11 th /8.0'		
10.0'	11.33'	17	SRW5	6	2 nd /7.5'	4 th /7.5'	6 th /7.5'	9 th /7.5'	12 th /8.0'	15 th /10.0'

2 - Flat at Top and Bottom of Wall - 250 PSF surcharge (truck traffic)

Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)					
4.0'	4.67'	7	SRW3	2	2 nd /4.5'	5 th /7.0'				
6.0'	6.67'	10	SRW3	4	2 nd /4.5'	3 rd /4.5'	5 th /5.0'	8 th /8.5'		
8.0'	8.67'	13	SRW5	4	2 nd /6.0'	5 th /6.0'	8 th /7.0'	11 th /9.5'		
10.0'	11.33'	17	SRW5	6	2 nd /7.5'	4 th /7.5'	6 th /7.5'	9 th /7.5'	12 th /8.5'	15 th /11.5'

3 - Flat at Bottom of Wall - 3:1 Horizontal to Vertical Slope at Top of Wall

Exposed Height	Total Height	Number of Block Courses	Type of Geogrid	Number of Geogrid Layers	Block course that geogrid is placed on top of and length of geogrid. (Block course/geogrid length)					
4.0'	4.67'	7	SRW3	2	2 nd /4.0'	4 th /5.0'				
6.0'	6.67'	10	SRW3	3	2 nd /5.5'	4 th /5.5'	7 th /6.5'			
8.0'	8.67'	13	SRW5	4	2 nd /7.5'	4 th /7.5'	7 th /7.5'	10 th /8.5'		
10.0'	11.33'	17	SRW5	6	2 nd /9.5'	3 rd /9.5'	5 th /9.5'	8 th /9.5'	11 th /9.5'	14 th /11.0'

- 1) The designs in the above table are to be used for estimating purposes only and are not intended to be used for construction.
- 2) A qualified engineer should, in all cases, perform the final as-built design predicated on the conditions specific to the site. A local registered engineer should verify all modes of failure, including global stability, before beginning construction. See your local building department for permitting requirements.
- 3) Sample designs imply there are provisions for adequate drainage for both the reinforced wall fill and the retained backfill and that the water table is at adequate depths as not to affect the structural integrity of the wall. Further, the designs assume that water runoff will be properly addressed and there are no in-ground springs behind the wall. NO provision or analysis is included for global stability.
- 4) Use these charts only when the actual soil, site geometry and surcharge conditions are conservatively represented by the conditions noted in the tables. The user is responsible for determining that the soil friction angle shown on the charts represents the soils typical to the site.
- 5) If there is a slope at the bottom front of the wall, it may be necessary to bury more courses of block than indicated.
- 6) Sample designs have been prepared exclusively for the use of SRW™ 3 and 5 series geogrid. SRW™ 5 series geogrid can be used in place of SRW™ 3, but SRW™ 3 **CANNOT** be used in place of SRW™ 5. The designs should not be used for other types of geogrid and wall units other than those shown herein.
- 7) MINIMUM FACTORS OF SAFETY: 1.5 for internal reinforcement pullout and tensile overstress, 1.5 for external sliding, 2.0 for external overturning and bearing capacity.
- 8) For heights in-between those shown, use the higher design.
- 9) Follow the installation instructions for the retaining wall system you are using. Geogrid must be one continuous piece from the face of the retaining wall block to the back of the reinforced soil mass – do not splice. Butt sheets together at the edges; do not overlap. Pull grid taut and free of wrinkles before placing backfill.
- 10) For walls higher than those shown, multi-tier or terraced walls, steeper slopes and surcharges greater than those shown, you should obtain preliminary design assistance by completing the **SRW Preliminary Design Form** available from your **Pavers by Ideal dealer**.



Preliminary Design Request Form

Copy this form or download it from www.IdealConcreteBlock.com

Date _____

Customer/Project Information

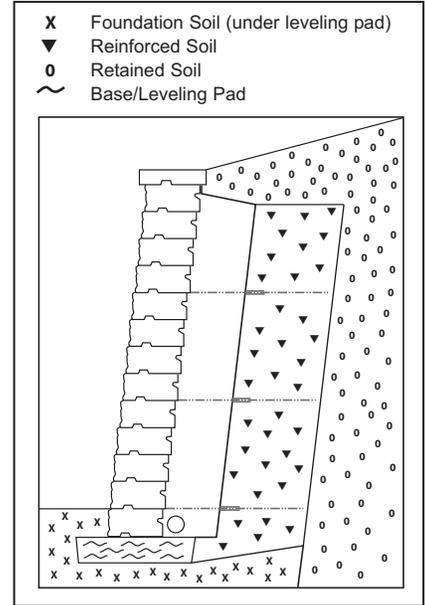
- 1) Customer Name _____ Phone _____ Fax _____
 Address _____ City _____ State _____
 Wall Contractor DIY Homeowner Arch/Engr Other _____
- 2) Project Name _____
 Address _____ City _____ State _____
 Type: Residential Commercial Municipal Other _____
- 3) Ideal Dealer _____
- 4) Engineer/Designer _____ Phone _____ Fax _____
- 5) Stamped Engineering Needed? Yes No

Wall Information

- 1) Retaining Wall Unit: Stonewall Pisa2 Roman Pisa Fat Face
- 2) Exposed Height of Wall: Feet _____ Courses _____
- 3) Total Height of Wall: Feet _____ Courses _____
- Is your retaining wall project multi-tiered or terraced? Yes No

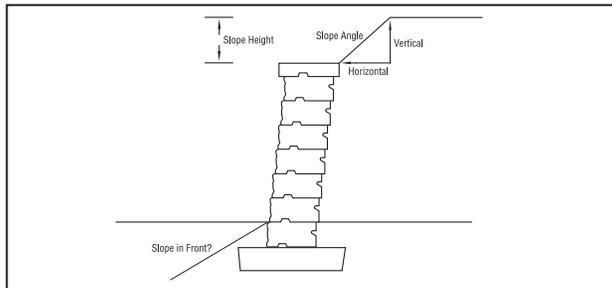
Soils Information - Is a soils report available? Yes No

- 1) Indicate Type of Soil **Soil Types: (a, b or c)**
 Reinforced Fill _____ a: Granular- sand & gravel (gritty)
 Retained Soil _____ b: Clay – plastic silts & clay (slick)
 Foundation Soil _____ c: Organic – loam & peat
- 2) Indicate Type of Base/Leveling Pad
 Sand Processed Gravel/Crusher Run Gap-graded Crushed Stone
 Other (describe) _____



Slope & Surcharge:

- 1) Indicate Type of Surcharge or Load at TOP of Wall:
 Lawn or grassy area Auto parking/Light traffic Truck parking/Highway traffic
- 2) Slope at BOTTOM/FRONT of Wall - see diagram:
 a) Is there a slope in front of the wall? No Yes: angle of slope (ex. 2 horizontal:1 vertical) Horizontal _____ Vertical _____
- 3) Slope at TOP of Wall - see diagram:
 a) Is there a slope at top of the wall? No Yes: angle of slope (ex. 2 horizontal:1 vertical) Horizontal _____ Vertical _____
 b) Is the slope height greater than 2 times the height of the wall? Yes No - indicate the slope height (ft) _____



- 4) Is internal or external water involved? YES NO

Return copies of preliminary designs by: Fax: _____ Email: _____
 Name: _____ Phone: _____
 Address: _____ City: _____ State: _____ Zip: _____

By submitting this form I acknowledge that the information to be provided is not intended to replace a site specific design performed by a professional engineer and the final determination of the suitability of the information is the user's responsibility.

Information Supplied by (please print) _____

Signature (required) _____

CONSTRUCTION OBSERVATION CHECKLIST FOR SEGMENTAL RETAINING WALLS

Site Conditions

- Soil and fill material should not be frozen
- Foundation Soil – matches or exceeds soil type and strength assumed for design
- Retained Soil – matches or exceeds soil type and properties assumed for design
- Wall heights – do not exceed design heights
- Slopes – no steeper than design
- Loading – does not exceed design

Materials

- Base Material – 1 1/2" processed gravel, 3/4" crusher run, or as specified by engineer
- Drainage Aggregate – clean, 1/2" to 3/4", angular gravel (less than 5% fines)
- Segmental Unit- approved unit and style, proper size and weight, and strength
- Shear Connectors – if pins or clips interlock units, they must be those made expressly for units
- Drainage Pipe – specified type and minimum properties, typically 4" perforated
- Geogrid – specified type (any substitutions approved by engineer)

Installation

- Trench – located according to plan, excavated and compacted to required dimensions
- Base Leveling Pad – placed to plan dimensions and compacted in 4" to 6" lifts to design thickness
- Drainage Aggregate – placed to thickness and depth shown on plans
- Drainage Collection Pipe – placed at plan location, sloped to create gravity flow of water away from wall
- Fill Placement and Compaction:
 - 6" thick lifts - 8" maximum
 - Reinforced (infill) soil compacted to 95% standard Proctor density
 - No heavy, self propelled compaction equipment within 3' (1m) of wall face
- SRW Unit Installation
 - First course below grade embedded to specific depth
 - Units level from front-to-back and side-to-side
 - Proper alignment and setback
 - Shear connection between units properly engaged per SRW manufacturer's details
 - If SRW units are cored, fill core with aggregate each course
 - Backfill with 3/4" stone for drainage after every course as wall erected
 - Curve and corner installed per SRW manufacturer's details
- Geogrid Soil Reinforcement Placement:
 - Placed horizontally at plan locations
 - Proper length (L) as shown on plans
 - Placed in proper orientation – per grid manufacturer's specs (highest strength direction perpendicular to wall face)
 - Placed continuous along the face of the wall (100% coverage)
 - Placed to front of unit and connected between units per manufacturer's details
 - Nominally tensioned to remove any slack or wrinkles prior to backfilling
 - To prevent excessive damage, tracked equipment not permitted to drive directly on grid
 - Curves and corners installed per plan details or grid manufacturer's details
- Cap/Coping Unit – adhered with specified adhesive

Construction Tolerances

While some deviation can be expected during construction every effort should be made to adjust alignment and maintain the designed batter of the wall unit used (pages 5,6 &17) as the wall is built.

- Vertical control: +/- 1.25" over a 10' distance; maximum of +/- 3"
- Horizontal Control: Straight lines: +/- 1.25" over a 10' distance; maximum of +/- 3"
- Rotation: From established wall batter: +/- 2°
- Differential Settlement: maximum of 1% of a reference length

To the best of our knowledge, the information contained in this guide is accurate. Ideal cannot assume liability whatsoever for the accuracy or completeness thereof nor do we guaranty or warrant the recommendations contained herein. A qualified engineer who is familiar with the conditions of a particular site and with the local construction practices should be consulted for guidance with design and construction recommendations. Final determination of the suitability of any information provided in this guide and its manner or use is the sole responsibility of the user.



Ideal Concrete Block Co.

45 Power Road, Westford, MA 01886

232 Lexington Street, Waltham, MA 02154

(781) 894-3200 • Westford Fax (978) 692-0817 • Waltham Fax (781) 894-8526

www.IdealConcreteBlock.com