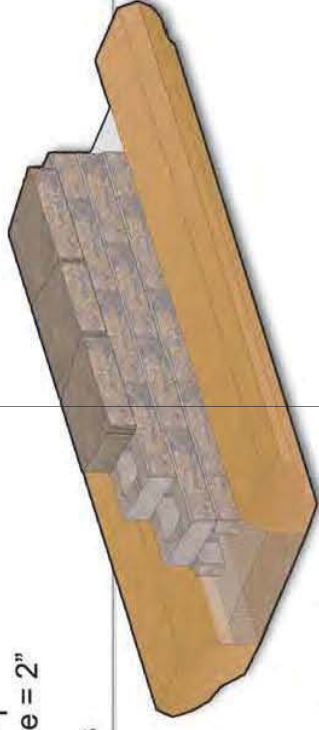
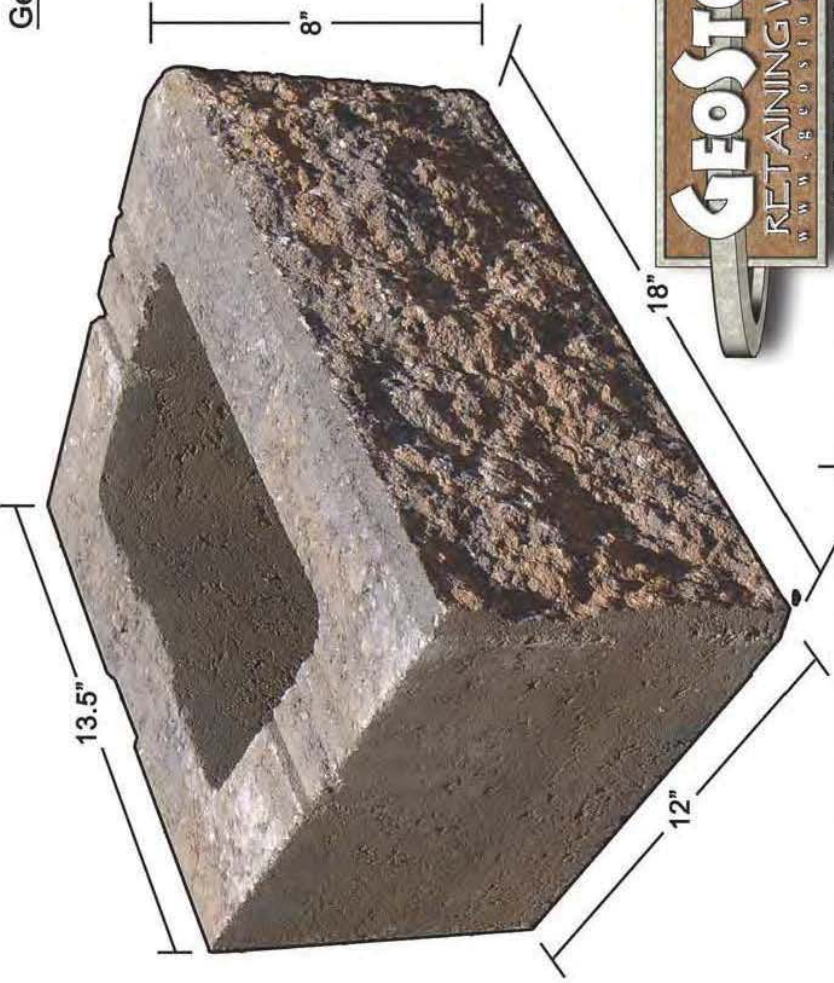


GeoStone Standard (8" x 18" x 12")

1. Each block = 1 sq ft of wall face
-Wall: 100' L x 5' H (500 sq ft) = 500 Blocks
2. Each core = 1/2 cubic ft of core fill
3. Setback (batter)
- Bevel top of split face = 0.35" / course or 2.5°
- First groove = 1"
- Second groove = 2"
4. Radius = 4.5"
5. Weight = 75 lbs

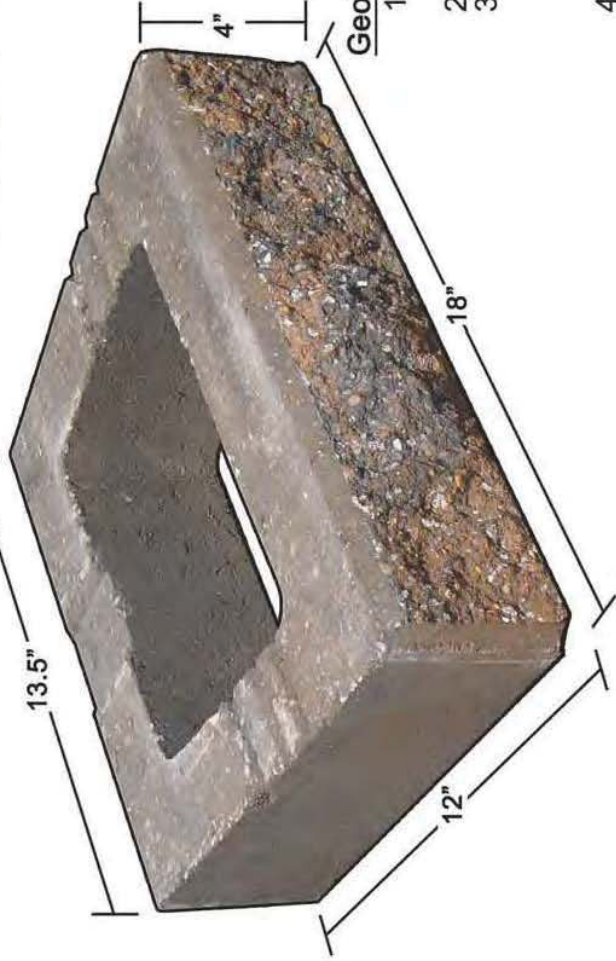


Base Leveling Pad (Footing):

- Use Compacted Crushed Stone - Preferably 8910
- Footing should be no less than 6" deep
- Footing Trench should be 2x Length of Block (face to tail)
- Depth of embedment of block will depend on wall height, surcharge, soil conditions, and slope.



SPECS PAGE

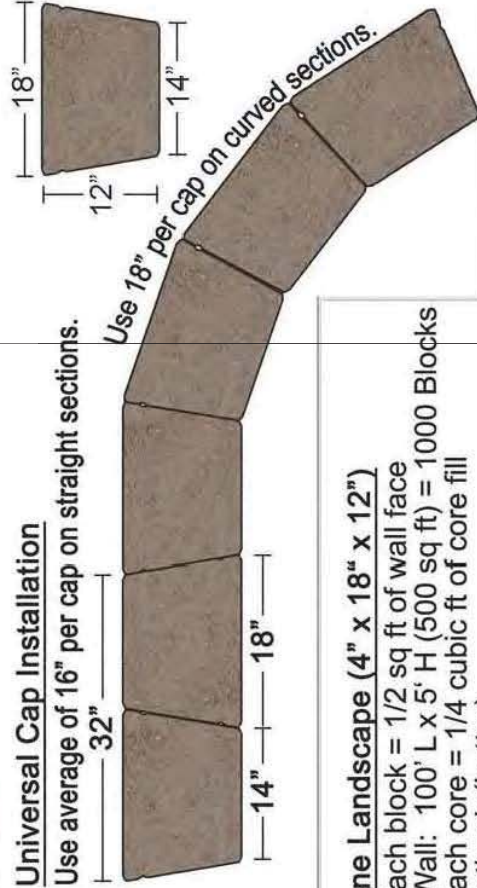


GeoStone Landscape (4" x 18" x 12")

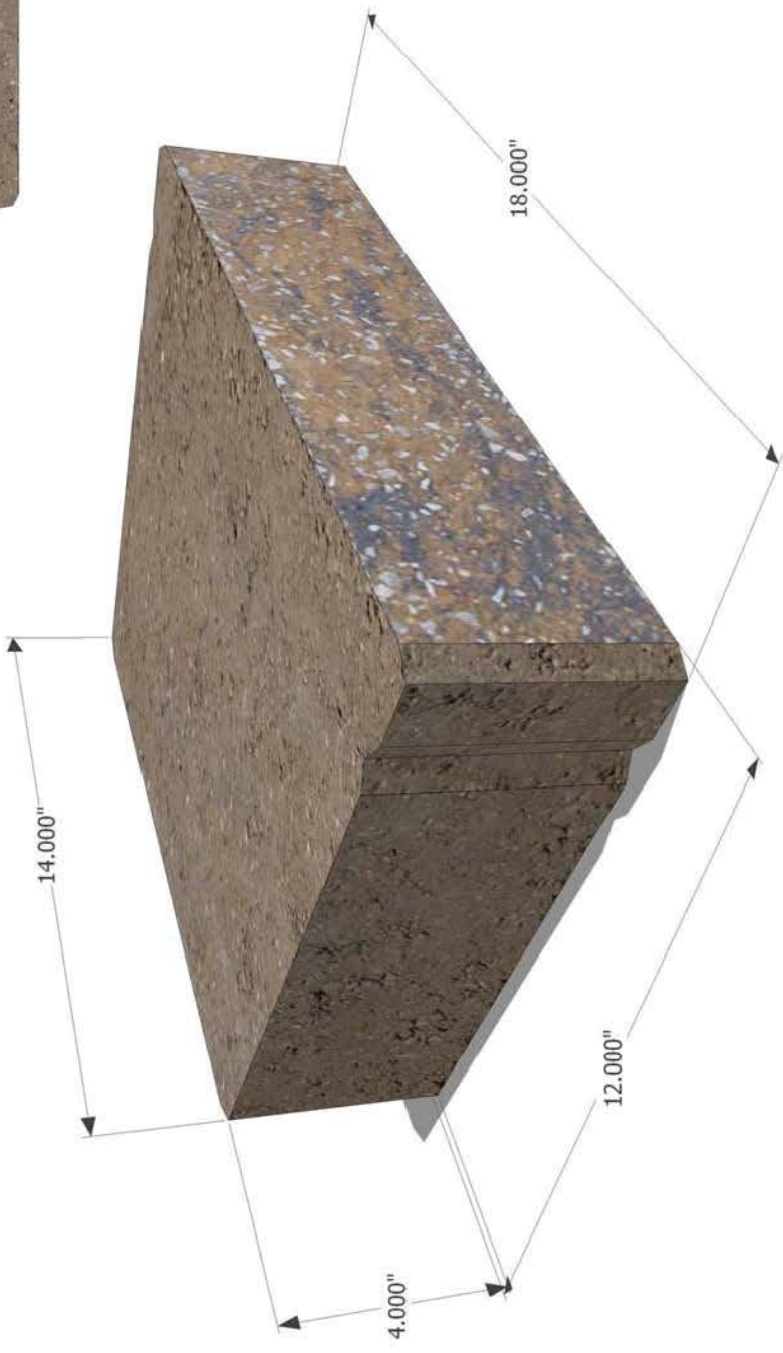
1. Each block = 1/2 sq ft of wall face
-Wall: 100' L x 5' H (500 sq ft) = 1000 Blocks
2. Each core = 1/4 cubic ft of core fill
3. Setback (batter)
- Bevel top of split face = 0.35" / course or 5°
- First groove = 1"
- Second groove = 2"
4. Radius = 4.5"
5. Weight = 36 lbs

Universal Cap Installation

Use average of 16" per cap on straight sections.



Use 18" per cap on curved sections.



DRAWN BY
 DA
DESCRIPTION
 Hardscape Rendering

PROJECT NO.
 245.170
PROJECT
 Project Name

ISSUE
 08.08.08
RE-ISSUE
 08.09.08

CLIENT
 Client Name
 12345 Main Street
 Boulder, CO 00000
 Tel: 000.000.0000

Geostone Hardscape
 11221 Hwy 280 East
 Westover, AL 35185
 205-678-9969
 www.geostone.com



<http://www.geostone.com/>

Standard Specifications

CONCRETE SEGMENTAL RETAINING WALL

Section 02830

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of furnishing and constructing a Mechanically Stabilized Earth (MSE) segmental retaining wall system having high molecular weight, high tenacity polyester geogrids positively connected to Segmental Concrete Facing Units. Work shall be done in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions shown on the plans.
- B. Related Sections
 - Section 02200 - Site Preparation
 - Section 02300 - Earthwork

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - C1372 - Standard Specification for Segmental Retaining Wall Units
 - C140-91 - Method of Sampling and Testing Concrete Masonry Units
 - C150-94 - Specification for Portland Cement
 - C33-93 - Specification for Concrete Aggregates
 - C595/C595M - Specification for Blended Hydraulic Cement
 - C90-93 - Specification for Load-bearing Concrete Masonry Units
 - D422 - Gradation of Soils
 - D424 - Atterburg Limit of Soils
 - D698 - Test method for Laboratory Compaction Characteristics of Soil Using Standard Effort

 - D5262 - Test Method for Evaluating the Unconfined Tension Creep Behavior of Geosynthetics
 - D4355 - Test Method for Deterioration of Geotextiles from Exposures to Ultraviolet Light and Moisture
 - D4595 – Test Method for Tensile Properties of Geotextiles by the Wide Strip Method

- B. Geosynthetic Research Institute (GRI)
 - GG1 – Standard Test Method for Geogrid Rib Tensile Strength
 - GG4 - Standard Practice for Determination of Long Term Design Strength of Geosynthetic Reinforcements
 - GG5 – Standard Test Method for Determination of Geogrid Pullout

- C. National Concrete Masonry Association (NCMA)
 - NCMA Design Manual for Segmental Retaining Walls, Second Edition
 - NCMASRWU-1 - Determination of Connection Strength between Geosynthetics and Segmental Concrete Units
 - NCMASRWU-2 - Determination of Connection Strength between Segmental Concrete Units

1.03 DEFINITIONS

- A. GeoStone Segmental Concrete Facing Unit - A Segmental Concrete Facing Unit, machine made from Portland cement, water, and mineral aggregates.
- B. GeoStone Geogrid - a structural element formed by a regular network of integrally connected tensile elements that allows interlocking with surrounding soil, rock, or earth and functions primarily as reinforcement.
- C. GeoStone Connector - a polyester resin connection method used to positively connect the Geosynthetic Reinforcement to the Segmental Concrete Units. Connector is not necessary but used as an additional connection method when required.
- D. Unit Fill - free-draining, coarse granular soil which is placed within, between and behind the Segmental Concrete Units
- E. Reinforced Backfill – compacted structural fill which is placed within the reinforced zone soil volume as outlined on the plans

1.04 SUBMITTALS

- A. Product Data – Manufacturer’s materials specifications, installation instructions, and general recommendations
- B. Design Data – Engineering plans prepared by a professional engineer registered in the State of the project location. The engineering designs, techniques and material evaluations shall be in accordance with parts 2 and 3 of this specification

1.05 QUALITY ASSURANCE

- A. Construction – Contractor performing work in this section shall have a minimum of 2 years experience and have constructed at least 50,000 square feet of segmental concrete retaining walls on projects of like scope. When requested, evidence of experience, noting project, owner, and design professional shall be furnished to the owner or owner’s agent.
- B. Testing – An independent testing lab shall be required to test the select fill material to determine suitability of material for the project and shall conduct compaction tests

for each layer of fill material at the rate of at least 1 test per 1000 square feet per lift.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. GeoStone Segmental Concrete Units – Contractor shall inspect materials upon delivery to ensure that the specified type, grade, color and texture has been received and shall prevent excessive mud, wet concrete, epoxy, or other deleterious materials from coming into contact with and affixing to retaining wall materials.
- B. GeoStone Polymeric Materials – Contractor shall inspect materials upon delivery to ensure that the specified type and grade has been received and shall store materials in such a manner as to prevent degradation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The GeoStone Segmental Concrete Facing Unit shall be manufactured by an approved GeoStone Licensee and/or an approved manufacturer of the GeoStone Retaining Wall Units.
- B. The GeoStone Geogrid shall be manufactured by an approved manufacturer of the GeoStone Retaining Wall Systems' Geosynthetic Reinforcement.

2.02 MATERIALS

- A. GeoStone Segmental Concrete Facing Units – Hollow load-bearing units conforming to ASTM C-90, normal weight, Type II with a minimum compressive strength of 4000 psi, a maximum absorption rate of 8% by weight and a minimum face shell thickness of 2 inches. The GeoStone Segmental Concrete Facing Units shall conform to NCMA TEK 2-4A, Section 3.1.
 - 1. Color of the retaining wall units shall be _____
 - 2. Finish of the retaining wall units shall be straight geometry split face.
- C. GeoStone Structural Geogrids – Geosynthetic reinforcements consisting of high tenacity, high molecular weight, low carboxyl end group polyester yarns, woven into a stable interlocking grid and then coated with polyvinyl chloride to provide protection from harmful UV rays. The type, strength and placement location of the GeoStone Geogrids shall be shown on the engineering plans. The design properties of the GeoStone Geogrids shall be determined according to the procedures outlined in this specification.
- D. GeoStone Connector – Polyester resin with silica inclusions

2.03 ACCESSORIES

- A. Geotextile – 6oz. per square yard polypropylene non-woven geotextile, AASHTO M288, Class 2, produced by Evergreen Technologies, Inc. or equal as approved by GeoStone Retaining Wall Systems, Inc.
- B. Adhesive – As recommended by GeoStone Retaining Wall Systems, Inc.

2.04 BASE LEVELING PAD MATERIAL

- A. Materials shall consist of compacted sand, gravel or crushed rock or leveling concrete (non-reinforced) as shown on the construction drawings. The leveling pad shall be a minimum of 6 inches thick. The leveling concrete shall be a minimum of 4 inches thick with 2 inches of compacted soil for a total thickness of 6 inches.

2.05 BACKFILL MATERIALS

- A. Unit Fill (Core Fill) – Free draining, coarse-grained soil that is placed within the empty cores of the Segmental Concrete Facing Units.
 - a. 100 to 75 percent passing a 1-in. sieve
 - b. 50 to 75 percent passing a $\frac{3}{4}$ -in. sieve
 - c. 0 to 60 percent passing a No. 4 sieve
 - d. 0 to 50 percent passing a No. 40 sieve
 - e. 0 to 5 percent passing a No. 200 sieve
- B. Drainage Fill – Free draining, coarse-grained soil which is placed behind the Segmental Concrete Facing Unit.
 - a. 100 to 75 percent passing a 1-in. sieve
 - b. 50 to 75 percent passing a $\frac{3}{4}$ -in. sieve
 - c. 0 to 60 percent passing a No. 4 sieve
 - d. 0 to 50 percent passing a No. 40 sieve
 - e. 0 to 5 percent passing a No. 200 sieve
- C. Reinforced Backfill – Granular fill with a Ph range of 2 to 12 and graded as follows:
 - a. 100 to 75 percent passing a 2-in. sieve
 - b. 100 to 75 percent passing a $\frac{3}{4}$ -in. sieve
 - c. 100 to 20 percent passing a No. 4 sieve
 - d. 0 to 60 percent passing a No. 40 sieve
 - e. 0 to 35 percent passing a No. 200 sieve

PART 3 CONSTRUCTION

3.01 QUALIFICATION

- A. Contractor and site supervisor shall have proven qualified experience to complete the installation of the segmental retaining wall system.

3.02 EXCAVATION

- A. Contractor shall excavate to the lines and grades shown on the construction drawings. Architect/Engineer will inspect the excavation and approve prior to placement of leveling pad or fill soils.
- B. Contractor shall take precautions to minimize over excavation. Over-excavated areas shall be filled with compacted infill material as directed by the Architect/Engineer.
- C. Excavation of unsuitable soils and replacement with approved compacted material shall be performed as directed by the geotechnical engineer.
- D. General Contractor shall verify location of existing structures and utilities prior to excavation.

3.03 FOUNDATION PREPARATION

- A. Foundation trench shall be excavated to the dimensions indicated on the construction Drawings.
- B. The reinforced zone and the leveling pad foundation soil shall be examined by an engineer to ensure proper bearing strength.
- C. Soils not meeting required strength shall be removed and replaced with proper materials as approved by the Engineer.
- D. Foundation materials shall be compacted to a minimum of 95 percent Standard Proctor Dry Density in accordance with ASTM D698 before placing the leveling pad.

3.04 LEVELING PAD

- A. Leveling pad materials shall be placed as shown on the construction drawings with a Minimum thickness of 6 inches.
- B. Leveling pad material shall be compacted to provide a dense, level surface on which to place the first course of units.
- C. The leveling pad shall be level both horizontally and front to back to ensure the first course of units and subsequent courses, are level as well as to ensure complete contact of the retaining wall units with the base.

3.05 UNIT INSTALLATION

- A. The first course of segmental units shall be placed on the base leveling pad and leveled side to side and front to back and unit-to-unit.
- B. All units shall be laid snugly together and parallel to the straight or curved line of the wall face.

- C. A string line can be used to align a straight wall, or flex pipes can be used to establish a smooth convex or concave curved wall.
- D. The GeoStone Segmental Concrete Units shall be swept clean of all debris before installing the next course of units and/or placing the geogrid materials

3.06 STRUCTURAL GEOSYNTHETIC REINFORCEMENT INSTALLATION

- A. GeoStone geogrids shall be oriented with the highest strength axis perpendicular to the wall alignment.
- B. GeoStone geogrids shall be placed at the elevation and to the extent shown on the engineering plans or as directed by the Architect/Engineer.
- C. GeoStone geogrids shall be laid horizontally on compacted backfill. Place the next course of segmental concrete units over the geosynthetic reinforcement. The geosynthetic reinforcement shall be pulled taut, and anchored prior to backfill placement on the geosynthetic reinforcement.
- D. Tracked construction equipment shall not be operated directly on the geosynthetic reinforcement. A minimum fill thickness of 6 inches is required prior to operation of tracked vehicles over the geosynthetic reinforcement.

3.07 DRAINAGE FILL AND UNIT FILL

- A. Unit Fill and Drainage Fill, placed 12 inches behind the wall, shall consist of a free draining, coarse-grained soil meeting the requirements of Section 2.05
- B. Unit Fill and Drainage Fill shall be placed in all of the unit voids and behind the wall every one or two courses or before placing the geogrid materials.

3.08 BACKFILL

- A. The reinforced backfill material shall be placed in maximum lifts of 8 inches and shall be compacted to a minimum of 95 percent Standard Proctor Dry Density in accordance with ASTM D698.
- B. Only hand-operated compaction equipment shall be used within 3 feet of the tail of the GeoStone Segmental Concrete Facing Unit.
- C. The backfill shall be smooth and level so that the geogrid lays flat.

3.09 CAP INSTALLATION

- A. Cap units shall be glued to underlying units with an approved adhesive.
- B. A string line or flex pipes shall be used to align caps

3.10 TOLERANCES

- A. Variation from batter indicated: Plus or minus 1/8 in. per ft. maximum.

END OF SECTION

FREQUENTLY ASKED QUESTIONS

Is there a formula for calculating the amount of rock needed for building a wall with Geostone? I am building a wall 32' long by 40" high.

The method for figuring is as follows:

Length x width x height = cubic ft of rock

$32' \times 3' \times 3.33' = 319.68$ cu. Ft. (which of course can be converted to tons if necessary @ 125 lbs per cu. Ft.) Density of rock may vary by size and region. Check with your local rock supplier.

The cores of the blocks contain:

GeoStone Standard 8"x18"x12" = $\frac{1}{2}$ cubic ft.

- $32' \times 3.33' = 107$ blocks x $\frac{1}{2}$ cubic ft = 53.5 cubic ft.

GeoStone Landscape 4"x18"x12" = $\frac{1}{4}$ cubic ft.

- $(32' \times 3.33')^2 = 214$ blocks x $\frac{1}{4}$ cubic ft = 53.5 cubic ft

Your leveling pad should be a minimum of 6" deep x 18" wide x 32' long = 24 cubic ft.

$24 + 53.5 + 319.68 = 397.18$ cubic ft x 125 lbs per cubic ft = 49647.5 lbs / 2000 = 24.82 Tons

What does wall batter mean?

It is preferred that a segmental wall be constructed with a slope, set back or batter to the back rather than vertical. Each course of block will be set back a certain distance from the course below it. Batter can also be referred to as "setback".



- Two GeoStone Landscape Blocks on 5 degree batter.

How is this batter accomplished in a GeoStone wall?

The batter is accomplished by recessing or placing each course of blocks an equal amount of space behind the course below.

How much batter can be built into a GeoStone wall?

The GeoStone wall has much more flexibility in its batter since pens or lips do not restrict it. A GeoStone wall can be vertical or with as much as a 2" batter per course.

How is a consistent batter maintained during construction?

A bevel is located on the front of the block at the top of the face. This bevel provides a 0.35" batter if the course of block above is set to the back of the bevel. On the Landscape Block, this equates to a 5 degree batter, or a 2.5 degree batter on the Standard Block. Three grooves are cast into the upper side of the GeoStone module which can also be used to maintain consistency in batter. When building a straight wall, it is recommended that a string line be used.

Since the GeoStone module does not use pins or a lip, how does it get its connection strength?

The GeoStone module has a large open core (1/2 sq. ft in the Standard and 1/4 sq. ft in the Landscape block). This core is filled with #67 rock (1" top size) creating what we call [Rock Interlock](#). This form of connection has been tested in labs as well as real world situations and time and again proves to be one of the most powerful forms of connection available.

Has the GeoStone module been tested for its block to block sheer strength and the block to geogrid pull out strength?

Yes, the GeoStone module has been tested at Bathurst & Clarabut GeoTechnical in Ontario, Canada, SGI & GeoSyntec in Atlanta, and TRI Environmental in Texas, using a number of different geogrids available in the market. These [test results](#) are used to aid engineers when designing our walls for real world use.

Is this test data available and how may it be obtained?

You can view the test results by visiting this webpage: <http://geostone.com/techpage1.htm> .

Is design software available for designing GeoStone Segmental Retaining Walls?

Yes, We have designed templates that contain GeoStone information that are used in conjunction with the NCMA SRWall version 2.1 and higher. The NCMA software is the approved standard for the industry. It can also be downloaded visiting the following webpage: <http://geostone.com/techpageGSsoftware.htm> .

How is GeoStone block made?

The GeoStone module is manufactured in concrete block plants using a mold that casts two or more blocks together face to face. A splitter breaks the modules apart creating an individually unique split surface on each block, which is very attractive as a wall face. This process is known as "Hardsplit".

What are the dimensions of the GeoStone module?

STANDARD BLOCK: The face of the module is 18" wide. They are 8" high and 12" deep. This is equivalent to 1 square foot of wall face. The sides taper back to 13 1/4" wide in the back.

LANDSCAPE BLOCK: The face of the module is 18" wide. They are 4" high and 12" deep. This is equivalent to 1/2 square foot of wall face. The sides taper back to 13.5" wide in the back.

This taper in the module allows for the turning of a radius in the wall construction.

How tight a radius can be turned using GeoStone module?

4 1/2 feet. Wall heights and batter needs to be considered if designing a tight radius.

What is really different or significant about the GeoStone block?

Flexibility and simplicity of construction. Construction of a GeoStone wall employs the same basic techniques required in construction of most segmental walls. The foundation, leveling pad construction using proper embedment, compacting of #67 rock in the drain zone, proper placement of the reinforcing geogrid and compaction of the soils in the reinforcing zone are all requirements of building a segmental retaining wall. "Soils" in the reinforced zone are critical. We recommend an all rock reinforced zone when feasible. In the instance of on site soils, we recommend soil of a gravel nature with a friction angle of no less than 28 degrees. As with all soil backfills, we recommend that a geotechnical engineer be consulted and the wall be designed and stamped by a professional engineer familiar with the construction of segmental retaining walls.

The prior procedures with regard to engineers and soil testing refer to walls with severe loading, slopes, and/or significant heights (5' or higher).

The design of the GeoStone module allows for construction of all radius turns and inside and outside 90-degree corners while maintaining the desired wall batter. The flexibility gained when not limited by alignment pins and lips is refreshing and welcomed by installers. It is also appreciated by owners when reflected in the beauty of the finished wall. Installers appreciate the well balanced, easy to handle Standard 70 to 75 lb module or Landscape 36 to 40 lb module which is very stable when placed in the wall and core filled with #67 stone.

Can GeoStone be made in different colors?

This depends upon the nearest GeoStone manufacturer to your job. All block plants manufacturing GeoStone make basic concrete gray. Some block plants have extensive color capabilities including variegated colors. Check with your local GeoStone manufacturer or with GeoStone Retaining Walls Systems Inc. As an option, stains can be made to match any color and applied to a gray wall.

May I install a GeoStone wall myself or should I hire an Installer?

An experienced installer is always recommended especially if the wall is 4 feet or higher where reinforcing becomes necessary. Installation manuals are available to provide guidelines for building a GeoStone wall. Before undertaking the building of a wall yourself, be sure you have sufficient information about the procedure.

How can I find an experienced GeoStone wall installer?

The closest GeoStone manufacturer or dealer can connect you with an experienced installer in your area.

http://geostone.com/Retaining_Wall_Dealers.htm

Can a GeoStone wall be used when you have a slope behind the wall?

Yes, placing a slope, driveway or building behind a wall is referred to as placing a surcharge or load on the wall. A maximum of a 2 to 1 slope can be placed behind a wall. Parking lots, driveways, buildings of all sizes even swimming pools can all be behind a retaining wall. The key to having a successful wall is making sure the wall is designed to meet the pressures (loading) that will be on the wall.

Can GeoStone be used as retaining walls in lakes, rivers and on the coast?

Yes, we have a large number of seawalls (as they are commonly referred to as) that have been built in all different kinds of water applications. GeoStone has taken placed a great deal of emphasis on seawalls and their importance to waterfront property. Truth be known, seawalls are our passion. The following article was written about seawalls and has seen national publication in magazines as well as international recognition via the web in universities in both China and India.

http://geostone.com/seawalls_understanding.htm

What compressive strength is acceptable for segmental retaining wall blocks?

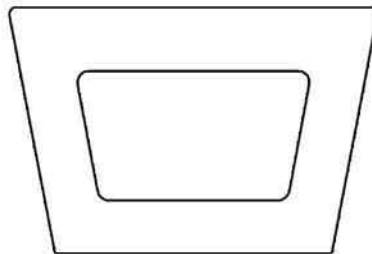
NCMA and ASTM require that the blocks obtain a minimum of 3000 psi. Compressive strength tests, done on a regular basis, on the GeoStone module have always exceeded 4000 psi.

INDUSTRY TERMS & DEFINITIONS

1. **Base:** The first course of block, usually laid on a gravel footing.
2. **Batter:** A backward and upward slope of the face of a wall.
3. **Concave Radius:** Referring to the inside of a curve.
4. **Connection Strength:** Measures the amount of pressure it takes to separate a block system from its geogrid reinforcement.
5. **Convex Radius:** Referring to the outside of a curve.
6. **Drainage Zone:** The zone immediately behind the block filled with free draining materials.
7. **Embedment:** The block that is buried below finished grade. This is done to lock in the toe of the wall.
8. **Hardscape:** The part of a building's grounds consisting of structures, such as patios, retaining walls, and walkways, made with hard materials.
9. **Hardsplit:** A procedure in which two or more blocks are made faces adjoined. After the block has dried and cured, the blocks are split at the face producing a unique, textured finish.
10. **Inside Corner:** See Concave.
11. **Leveling Pad:** An area that is used to create a level surface for the first course of block. Usually a fine crushed stone such as #8910 is placed and compacted to refusal. A 6 inch pad is usually adequate.
12. **Outside Corner:** See Convex.
13. **Plate Tamp:** A mechanical device that is used to vibrate and compact the leveling pad and backfill. On larger commercial walls, a larger device would be recommended.
14. **Reinforced Zone:** The area behind the block that contains the geogrids.
15. **Reinforcement:** Typically referring to the geogrids in SRW applications which tie the block into the back fill creating a giant mass resistant to forward pressures created by what is being retained.
16. **Retained Zone:** The area behind the reinforced zone that is being supported. Usually the reason for having a retaining wall.
17. **Set-back:** See Batter.
18. **Sheer:** Measures the amount of friction between two courses of blocks utilizing the block system's patented form of connection.
19. **Split-faced:** A textured face using the Hardsplit technique.
20. **SRW:** Segmental Retaining Wall.



COMPRESSIVE STRENGTH TESTING



Q O R E

Property Sciences

CONCRETE MASONRY UNIT TESTS ASTM C90 & ASTM C140 SPECIFICATIONS

Client:	Geostone	Job Number:	11930
Project:	Segmented Retaining Wall	Received:	11/20/2008
Type masonry unit:	Segmented Retaining Wall	Weight:	Medium Weight
Nominal Size	Width (in): Coupons Cut	Height (in):	Coupons Cut
Type aggregate:	Expanded shale, clay or slag	Length (in):	Coupons Cut

SAMPLE WEIGHTS

SAMPLE NUMBER	RECEIVED WEIGHT, #	SATURATED WEIGHT, #	SUSPENDED WEIGHT, #	OVEN DRY WEIGHT, #
1	11.95	12.75	6.75	11.55
2	11.60	12.45	6.65	11.30
3	11.50	12.35	6.55	11.15
AVERAGE	11.68	12.52	6.65	11.33

SAMPLE DIMENSIONS AND PERCENT SOLIDS

SAMPLE NUMBER	LENGTH, INCHES	WIDTH, INCHES	HEIGHT, INCHES	PERCENT SOLIDS
1	11.031	2.648	5.476	103.89%
2	10.9735	2.6045	5.5565	101.14%
3	11.076	2.564	5.639	100.32%
AVERAGE	11.027	2.605	5.557	101.78%

RESULTS [CMU Meet or Exceed Specification for Dimensions](#)

RESPECTFULLY SUBMITTED



Q O R E

Property Sciences

CONCRETE MASONRY UNIT TESTS ASTM C90 & ASTM C140 SPECIFICATIONS

Client:	Geostone	Job Number:	11930
Project:	Segmented Retaining Wall	Received:	11/20/2008
Type masonry unit:	Segmented Retaining Wall	Weight:	Medium Weight
Nominal Size	Width (in): Coupons Cut	Height (in):	Coupons Cut
Type aggregate:	Expanded shale, clay or slag	Length (in):	Coupons Cut

SAMPLE AREA AND VOLUME

SAMPLE NUMBER	NET AREA, SQ. INCH.	GROSS AREA SQ INCH.	NET VOLUME CUBIC FEET	GROSS VOLUME, CUBIC FEET
1	17.2619	29.2088	0.0961538	0.0925536
2	14.94092	28.5805	0.0929487	0.0919025
3	16.36600	28.3933	0.0929487	0.0926562
AVERAGE	16.18961	28.7275	0.0940171	0.0923708

SAMPLE ABSORPTION AND DRY DENSITY

SAMPLE NUMBER	ABSORPTION, LBS/CF	ABSORPTION, PERCENT	MOISTURE PERCENT	DRY DENSITY, LBS/CF
1	12.5	10.4	33.3	120.1
2	12.4	10.2	26.1	121.6
3	12.9	10.8	29.2	120.0
AVERAGE	12.6	10.4	29.5	120.6

REQUIREMENTS

ABSORPTION, LBS/CF 15	DRY DENSITY, LBS/CF FROM 105 TO LESS THAN 125 PCF
-----------------------------	--

RESULTS **CMU Meet or Exceed Specification for Density**
CMU Meet or Exceed Specification for Absorption

RESPECTFULLY SUBMITTED



Q O R E

Property Sciences

CONCRETE MASONRY UNIT TESTS ASTM C90 & ASTM C140 SPECIFICATIONS

Client:	Geostone	Job Number:	11930			
Project:	Segmented Retaining Wall	Received:	11/20/2008			
Type masonry unit:	Segmented Retaining Wall	Weight:	Medium Weight			
Nominal Size	Width (in):	Coupons Cut	Height (in):	Coupons Cut	Length (in):	Coupons Cut
Type aggregate:	Expanded shale, clay or slag					

EQUIVALENT THICKNESS

SAMPLE NUMBER	EQUIVALENT THICKNESS, IN.
1	2.75
2	2.63
3	2.57
AVERAGE	2.65

COMPRESSIVE STRENGTH NET AND GROSS AREA

SAMPLE NUMBER	COMPRESSIVE LOAD, LBS.	COMPRESSIVE STRENGTH, PSI		
		NET AREA	REQUIREMENT	GROSS AREA
1	85,630	4,960	2,500	2,930
2	79,245	5,300	2,500	2,770
3	85,025	5,200	2,500	2,990
AVERAGE	83,300	5,150	3,000	2,900

RESULTS *CMU meets or exceeds compressive strength.*

RESPECTFULLY SUBMITTED



Q O R E

Property Sciences

CONCRETE MASONRY UNIT TESTS ASTM C90 & ASTM C140 SPECIFICATIONS

Client:	Geostone	Job Number:	11930			
Project:	Segmented Retaining Wall	Received:	11/20/2008			
Type masonry unit:	Segmented Retaining Wall	Weight:	Medium Weight			
Nominal Size	Width (in):	Coupons Cut	Height (in):	Coupons Cut	Length (in):	Coupons Cut
Type aggregate:	Expanded shale, clay or slag					

MINIMUM FACE SHELL THICKNESS

SAMPLE NUMBER	FACE SHELL THICKNESS REQUIRED, INCHES	ACTUAL FACE SHELL THICKNESS, INCHES
1	-	N/A
2	-	N/A
3	-	N/A
AVERAGE =		N/A

MINIMUM WEBB THICKNESS

SAMPLE NUMBER	WEBB THICKNESS REQUIRED, INCHES	ACTUAL WEBB THICKNESS, INCHES
1	-	N/A
2	-	N/A
3	-	N/A
AVERAGE =		N/A

MINIMUM EQUIVALENT WEBB THICKNESS

SAMPLE NUMBER	EQUIVALENT WEBB REQUIRED, IN/LSF	ACTUAL EQUIVALENT WEBB, IN/LSF
1	-	N/A
2	-	N/A
3	-	N/A
AVERAGE =		N/A

RESULTS

RESPECTFULLY SUBMITTED





**SEGMENTAL RETAINING WALL UNITS
ASTM C-1372**

PROJECT NAME: Geostone (Misc. CMU Testing)

JOB NO. : 10958

CLIENT NAME: Geostone Retaining Wall

DATE: 2-20-2004

SAMPLE I.D. : 12 in. S/F 1/2 High Retaining Wall Unit

DATE RECEIVED: 1-17-2004

SAMPLE #	COMPRESSIVE STRENGTH (psi)
1	3967
2	4509
3	5042
Average	4506

Coupons were saw cut from the face shells of 3 retaining wall units and were cut to a height to thickness ratio of 2:1, length to thickness ratio of 4:1.

Note: Minimum average compressive strength of 3 units is 3000 psi with no individual unit less than 2500 psi.

Note: Compressive strength does meet or exceed limits for ASTM C-1372.

Respectfully Submitted,



SEGMENTAL RETAINING WALL UNITS
ASTM C-1372

PROJECT NAME: Geostone (Misc. CMU Testing)

JOB NO. : 10958

CLIENT NAME: Geostone Retaining Wall

SAMPLE I.D. : 12 in. S/F 1/2 High Retaining Wall Unit

DATE: 03-02-2004

SAMPLE #	COMPRESSIVE STRENGTH
1	3967
2	4509
3	5042
Average	4506

Coupons were saw cut from the face shells of 3 retaining wall units and were cut to a height to thickness ratio of 2:1, length to thickness ratio of 4:1. Note: Minimum average compressive strength of 3 units is 3000 psi with no individual unit less than 2500 psi.

Average Absorption	6.0%	7.8 lb/ft ³
--------------------	------	------------------------

Note: Maximum average absorption for 3 normal weight units is 13 lb/ft³.

SAMPLE #	DRY DENSITY lb/ft ³
1	129.04
2	130.89
3	130.12
Average	130.02

Note: Average Oven-Dry Density for 3 normal weight units is 125 lb/ft³ or more.

Note: Compressive strength does meet or exceed limits for ASTM C 1372. Absorption and Density do meet or exceed limits for ASTM C 1372.

Respectfully Submitted,



**SEGMENTAL RETAINING WALL UNITS
ASTM C-1372**

PROJECT NAME: Geostone (Misc. CMU Testing)

JOB NO. : 10958

CLIENT NAME: Geostone Retaining Wall

DATE: 2-20-2004

SAMPLE I.D. : 12 in. S/F 1/2 High Retaining Wall Unit

DATE RECEIVED: 1-17-2004

SAMPLE #	COMPRESSIVE STRENGTH (psi)
1	3967
2	4509
3	5042
Average	4506

***Coupons were saw cut from the face shells of 3 retaining wall units
and were cut to a height to thickness ratio of 2:1, length to thickness ratio of 4:1.***

***Note: Minimum average compressive strength of 3 units is 3000 psi
with no individual unit less than 2500 psi.***

Note: Compressive strength does meet or exceed limits for ASTM C-1372.

Respectfully Submitted,



SEGMENTAL RETAINING WALL UNITS
ASTM C-1372

PROJECT NAME: Geostone (Misc. CMU Testing)

JOB NO. : 10958

CLIENT NAME: Geostone Retaining Wall

SAMPLE I.D. : 12 in. S/F 1/2 High Retaining Wall Unit

DATE: 03-02-2004

SAMPLE #	COMPRESSIVE STRENGTH
1	3967
2	4509
3	<u>5042</u>
Average	4506

Coupons were saw cut from the face shells of 3 retaining wall units and were cut to a height to thickness ratio of 2:1, length to thickness ratio of 4:1. Note: Minimum average compressive strength of 3 units is 3000 psi with no individual unit less than 2500 psi.

Average Absorption	6.0%	7.8 lb/ft ³
--------------------	------	------------------------

Note: Maximum average absorption for 3 normal weight units is 13 lb/ft³.

SAMPLE #	DRY DENSITY lb/ft ³
1	129.04
2	130.89
3	<u>130.12</u>
Average	130.02

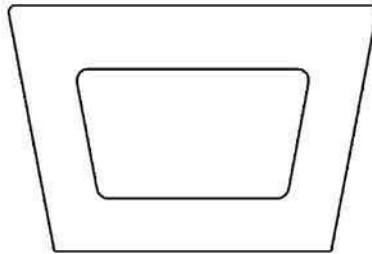
Note: Average Oven-Dry Density for 3 normal weight units is 125 lb/ft³ or more.

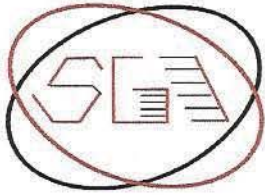
Note: Compressive strength does meet or exceed limits for ASTM C 1372. Absorption and Density do meet or exceed limits for ASTM C 1372.

Respectfully Submitted,



CONNECTION STRENGTH TESTING





SGI TESTING SERVICES

A GEORGIA LIMITED LIABILITY COMPANY

23 February 2004

Mr. David Agee
Geostone Retaining Wall Systems, Inc.
P.O. Box 325
Westover, AL 35185

Subject: Laboratory Test Results Transmittal
Connection Strength Testing
Synteen SF55 Geogrid/Geostone 4-in. Thick Blocks

Dear Mr. Agee,

SGI Testing Services, LLC (SGI_{sm}) is pleased to present the attached test results for the above-mentioned testing program. The note section below addresses sample preparation, sample disposal and a disclosure statement.

SGI_{sm} appreciates the opportunity to provide laboratory testing services to Geostone Retaining Wall Systems, Inc. Should you have any questions regarding the attached document(s), or if you require additional information, please do not hesitate to contact the undersigned.

Sincerely,



Zehong Yuan, Ph.D., P.E.
Chief Technical Officer

Attachments

Notes:

- (1) Unless otherwise noted in the test results the sample(s)/specimen(s) were prepared in accordance with the applicable test standards or generally accepted sampling procedures.
- (2) Contaminated/chemical samples and all related laboratory generated waste (i.e., test liquids, PPE, absorbents, etc.) will be returned to the client or designated representative(s), at the client's cost, within 60 days following the completion of the testing program, unless special arrangements for proper disposal are made with SGI_{sm}.
- (3) Materials that are not contaminated will be discarded after test specimens and archived specimens are obtained. Archived specimens will be discarded 60 days after the samples are received at the laboratory, unless long-term storage arrangements are specifically made with the laboratory.
- (4) The reported results apply only to the materials and test conditions used in the laboratory testing program. The results do not necessarily apply to other materials or test conditions. The test results should not be used in engineering analysis unless the test conditions model the anticipated field conditions. The testing was performed in accordance with general engineering testing standards and requirements. The reported results are submitted for the exclusive use of the client to whom they are addressed.

SGI1053

MAIL TO: SGI TESTING SERVICES, LLC

P.O. Box 2427
LILBURN, GEORGIA 30048-2427

WEB SITE: WWW.INTERACTIONSSPECIALISTS.COM

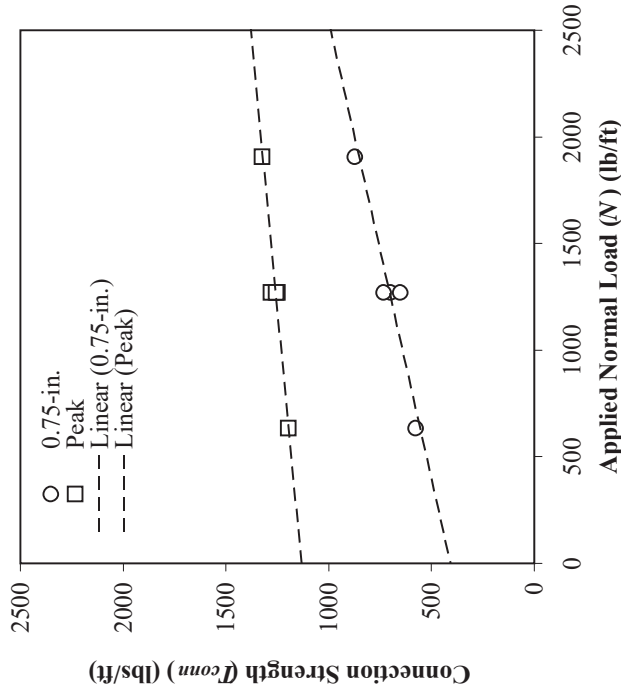
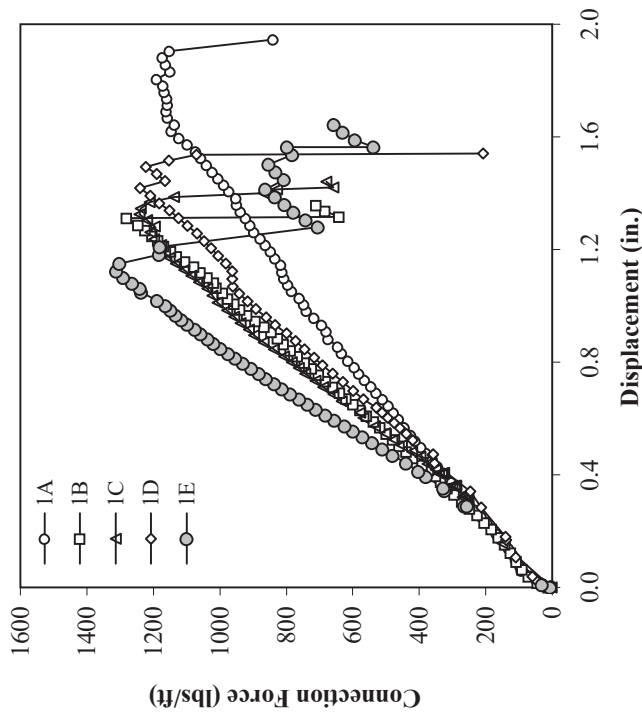
FACILITY LOCATION

4405 INTERNATIONAL BOULEVARD
SUITE B-117
NORCROSS, GEORGIA 30093

PHONE: 770.931.8222 FAX: 770.931.8240

**GEOSTONE RETAINING WALL SYSTEMS, INC.
CONNECTION STRENGTH TESTING (ASTM D 6638)**

TEST SERIES NO. 1: Synteen SF20/20 Geogrid in machine direction within Geostone 4" thick block units with compacted AASHTO #57 soil



Test No.	Test Specimen Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
IA	34.5	4.4	636	15	5.0	575	1197	$T_{0.75-in.} = 410 + (N) \tan (13^\circ)$
IB	34.5	8.8	1272	30	10.0	698	1280	$T_{peak} = 1135 + (N) \tan (6^\circ)$
IC	34.5	8.8	1272	30	10.0	732	1248	
ID	34.5	8.8	1272	30	10.0	651	1253	
IE	34.5	13.3	1908	45	15.0	872	1322	

NOTES:

Dimensions of Geostone Block Unit: 17.75 in. wide by 12 in. long and 4 in. high.
 Weight of a full-size Geostone Block: 37.5 lbs.
 Average Unit Weight of Facing (Block and Gravel): 127.2 pcf
 Failure Mode of Geogrid: abrasion and rupture of the geogrid in each test.



SGI TESTING SERVICES, LLC

DATE TESTED: 25 to 26 July 2003

FIGURE NO. C-1

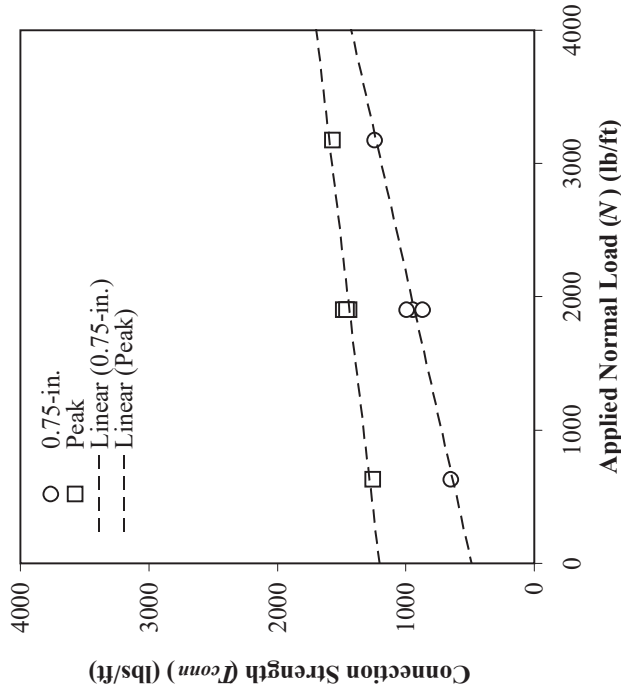
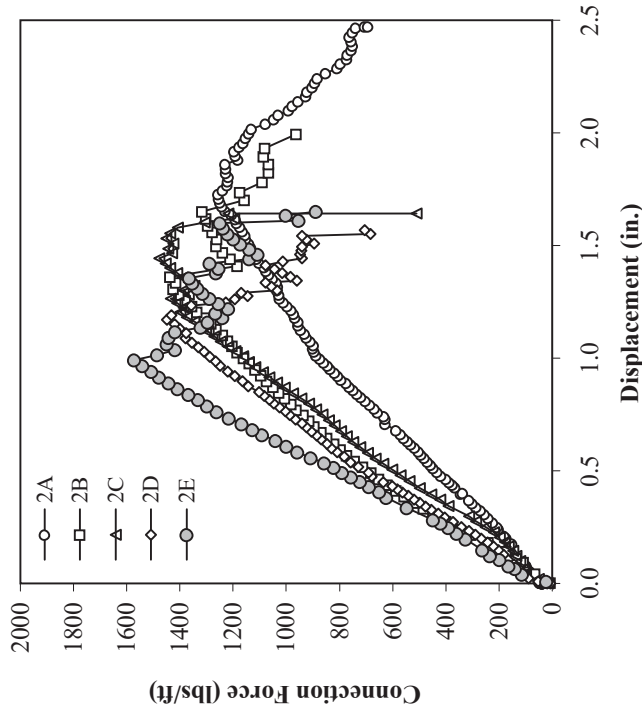
PROJECT NO. SGII053

DOCUMENT NO. SGI1053.07

FILE NO.

**GEOSTONE RETAINING WALL SYSTEMS, INC.
CONNECTION STRENGTH TESTING (ASTM D 6638)**

TEST SERIES NO. 2: Synteen SF35 Geogrid in machine direction within Geostone 4" thick block units with compacted AASHTO #57 soil



Test No.	Test Specimen Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
2A	35.3	4.4	636	15	5.0	645	1257	$T_{0.75-in.} = 490 + (N) \tan (13^\circ)$ $T_{peak} = 1205 + (N) \tan (7^\circ)$
2B	35.3	13.3	1908	45	15.0	941	1438	
2C	35.3	13.3	1908	45	15.0	865	1485	
2D	35.3	13.3	1908	45	15.0	991	1459	
2E	35.3	22.1	3180	75	25.0	1241	1571	

NOTES:

Dimensions of Geostone Block Unit: 17.75 in. wide by 12 in. long and 4 in. high.
Weight of a full-size Geostone Block: 37.5 lbs.
Average Unit Weight of Facing (Block and Gravel): 127.2 pcf
Failure Mode of Geogrid: abrasion and rupture of the geogrid ribs in each test.



SGI TESTING SERVICES, LLC

DATE TESTED: 27 to 28 July 2003

FIGURE NO. C-2

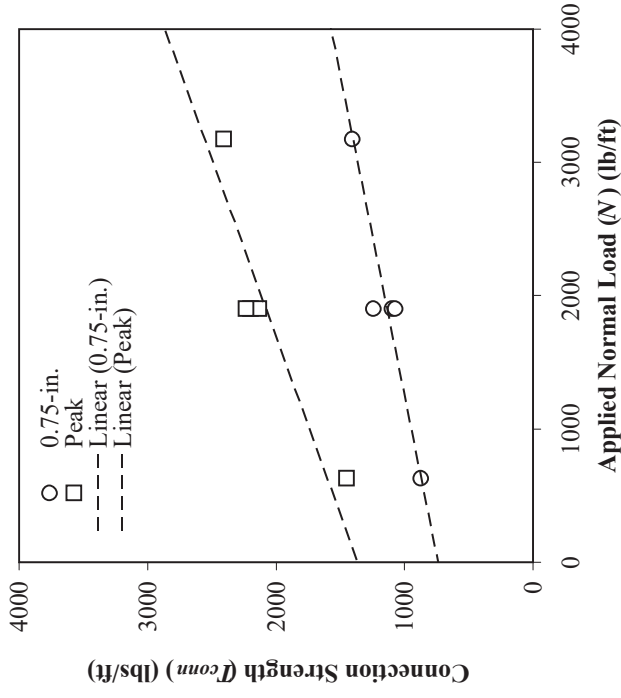
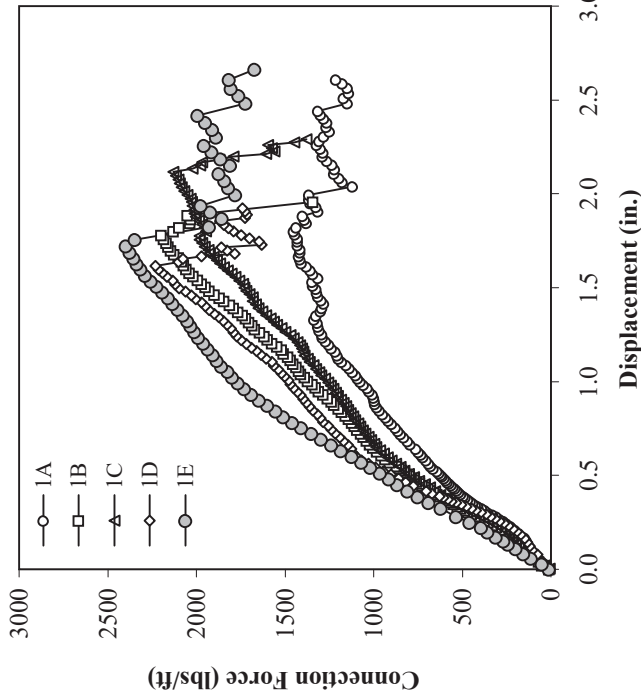
PROJECT NO. SGII053

DOCUMENT NO. SGI1053.07

FILE NO.

GEOSTONE RETAINING WALL SYSTEMS, INC. CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 1: Synteen SF55 Geogrid in machine direction within Geostone 4" thick block units with compacted AASHTO #57 sto



Test No.	Test Specimen Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
1A	35.3	4.4	636	15	5.0	874	1450	$T_{0.75-in.} = 740 + (N) \tan (12^\circ)$ $T_{peak} = 1365 + (N) \tan (21^\circ)$
1B	35.3	13.3	1908	45	15.0	1098	2198	
1C	35.3	13.3	1908	45	15.0	1069	2131	
1D	35.3	13.3	1908	45	15.0	1243	2230	
1E	35.3	22.1	3180	75	25.0	1403	2404	

NOTES:

Dimensions of Geostone Block Unit: 17.75 in. wide by 12 in. long and 4 in. high.
 Weight of a full-size Geostone Block: 37.5 lbs.
 Average Unit Weight of Facing (Block and Gravel): 127.2 pcf
 Failure Mode: pullout of the geogrid in Test 1A. Abrasion and rupture of the geogrid ribs in 1B through 1E.

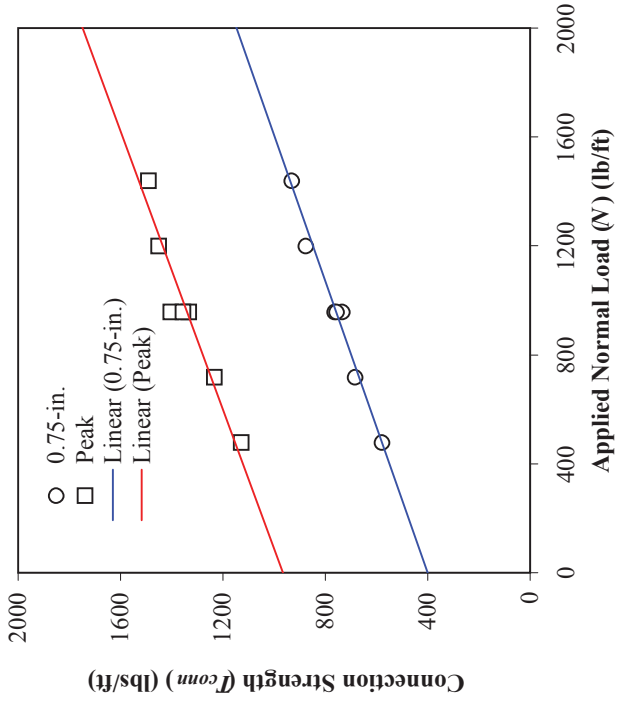
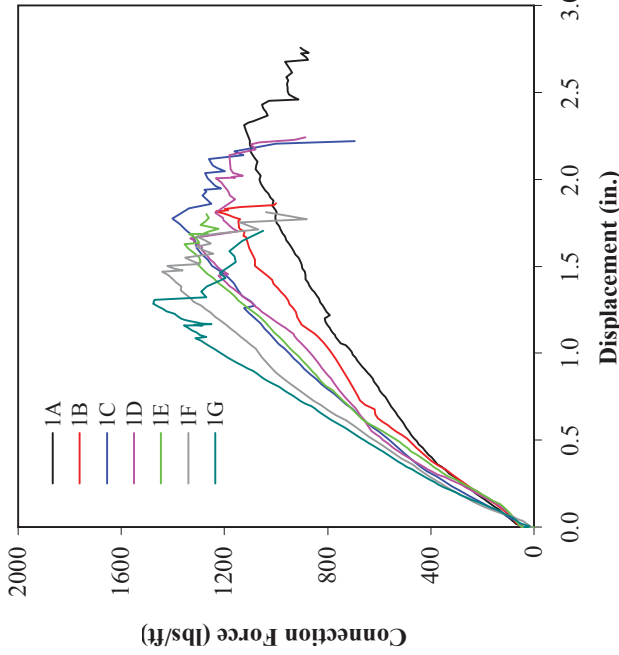
DATE TESTED: 17 to 18 February 2004
 FIGURE NO. C-1
 PROJECT NO. SGI1053
 DOCUMENT NO. SGI1053.07
 FILE NO.



SGI TESTING SERVICES, LLC

GEOSTONE RETAINING WALL SYSTEMS, INC. CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 1: Syntec SF20 geogrid in machine direction between two courses of Geostone blocks (8" thick) with compacted AASHTO #57 stone within block apertures and space between blocks



Test No.	Geogrid Specimen Nominal Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Wall Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
1A	34.0	3.3	480	6	4.0	578	1128	$T_{0.75-in.} = 400 + (N) \tan (20^\circ)$
1B	34.0	5.0	720	9	6.0	682	1232	
1C	34.0	6.7	960	12	8.0	763	1403	
1D	34.0	6.7	960	12	8.0	733	1332	$T_{peak} = 965 + (N) \tan (21^\circ)$
1E	34.0	6.7	960	12	8.0	756	1356	
1F	34.0	8.3	1200	15	10.0	875	1450	
1G	34.0	10.0	1440	18	12.0	930	1489	

NOTES:

- Dimensions of Block: 18 in. wide by 12 in. long and 8 in. high.
- Weight of Full-Size Block: 70 lbs
- Unit Weight of Facing (Block & Gravel): 120 pcf
- Failure Mode of Geogrid: Abrasion and rupture of geogrid ribs in each test.

DATE REPORTED: 3/20/2008

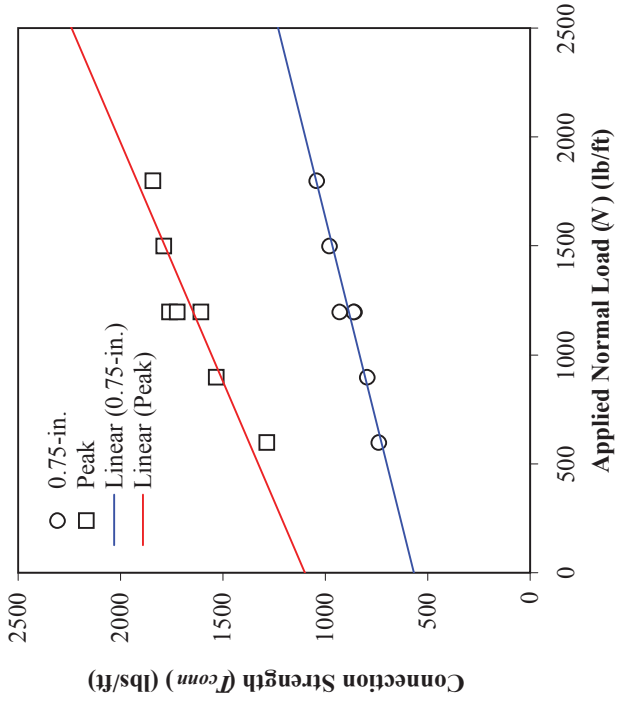
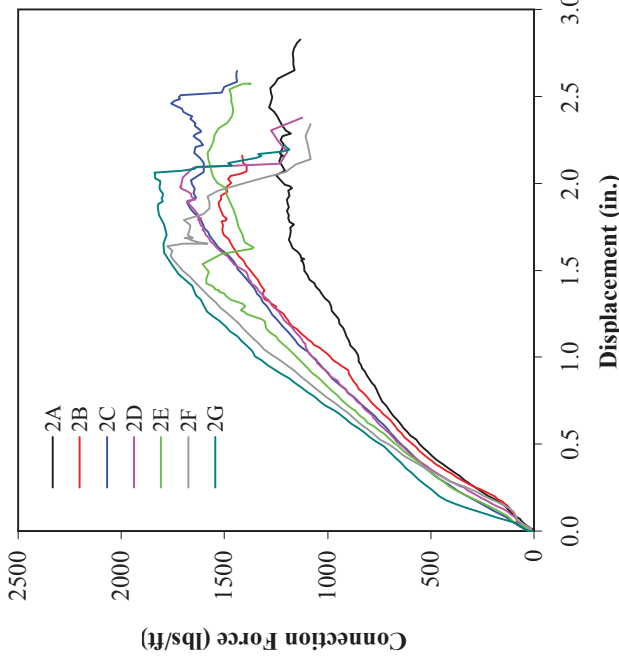


SGI TESTING SERVICES, LLC

FIGURE NO. C-1
PROJECT NO. SGI8014
DOCUMENT NO.
FILE NO.

GEOSTONE RETAINING WALL SYSTEMS, INC. CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 2: Synten SF35 geogrid in machine direction between two courses of Geostone blocks (8" thick) with compacted AASHTO #57 stone within block apertures and space between blocks



Test No.	Geogrid Specimen Nominal Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Wall Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
2A	34.0	4.2	600	8	5.0	737	1284	$T_{0.75-in.} = 565 + (N) \tan (15 ^\circ)$ $T_{peak} = 1100 + (N) \tan (24 ^\circ)$
2B	34.0	6.3	900	11	7.5	793	1530	
2C	34.0	8.3	1200	15	10.0	857	1760	
2D	34.0	8.3	1200	15	10.0	861	1721	
2E	34.0	8.3	1200	15	10.0	929	1607	
2F	34.0	10.4	1500	19	12.5	980	1786	
2G	34.0	12.5	1800	23	15.0	1042	1840	

NOTES:

- Dimensions of Block: 18 in. wide by 12 in. long and 8 in. high.
- Weight of Full-Size Block: 70 lbs
- Unit Weight of Facing (Block & Gravel): 120 pcf
- Failure Mode of Geogrid: Abrasion and rupture of geogrid ribs in each test.

DATE REPORTED: 3/20/2008



SGI TESTING SERVICES, LLC

FIGURE NO. C-2

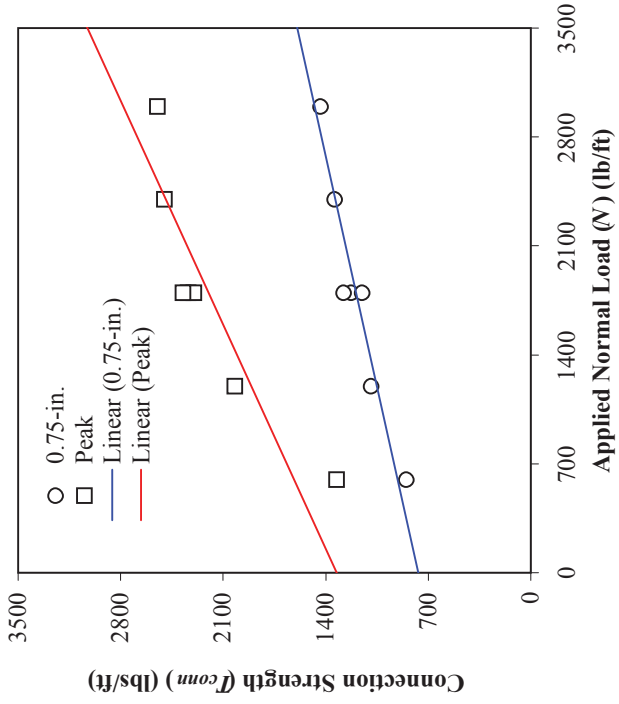
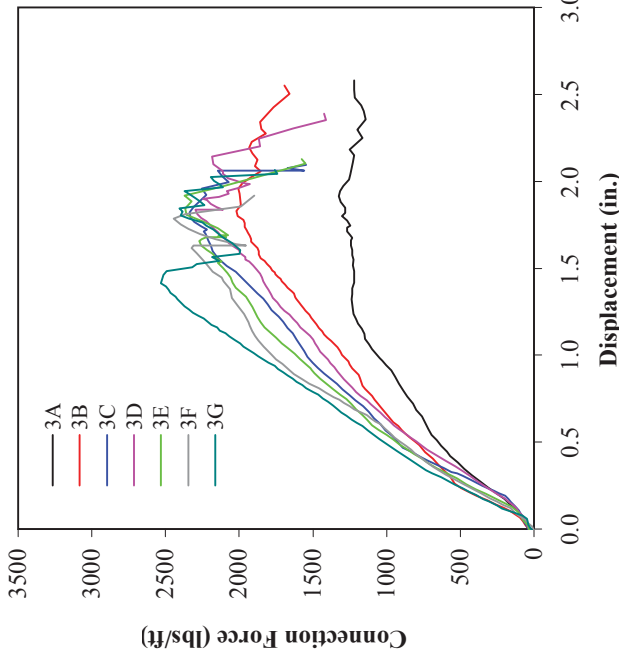
PROJECT NO. SGI8014

DOCUMENT NO.

FILE NO.

GEOSTONE RETAINING WALL SYSTEMS, INC. CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 3: Syntex SF55 geogrid in machine direction between two courses of Geostone blocks (8" thick) with compacted AASHTO #57 stone within block apertures and space between blocks



Test No.	Geogrid Specimen Nominal Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Wall Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
3A	34.0	4.2	600	8	5.0	846	1326	$T_{0.75-in.} = 765 + (N) \tan (13 ^\circ)$ $T_{peak} = 1325 + (N) \tan (26 ^\circ)$
3B	34.0	8.3	1200	15	10.0	1086	2020	
3C	34.0	12.5	1800	23	15.0	1224	2336	
3D	34.0	12.5	1800	23	15.0	1150	2297	
3E	34.0	12.5	1800	23	15.0	1278	2373	
3F	34.0	16.7	2400	30	20.0	1335	2498	
3G	34.0	20.8	3000	38	25.0	1431	2546	

NOTES:

- Dimensions of Block: 18 in. wide by 12 in. long and 8 in. high.
- Weight of Full-Size Block: 70 lbs
- Unit Weight of Facing (Block & Gravel): 120 pcf
- Failure Mode of Geogrid: Abrasion and rupture of geogrid ribs in each test.

DATE REPORTED: 3/20/2008

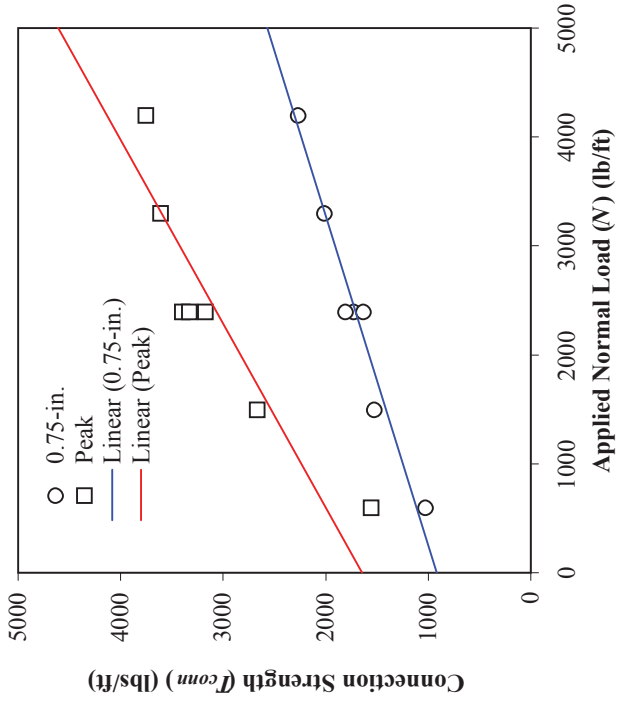
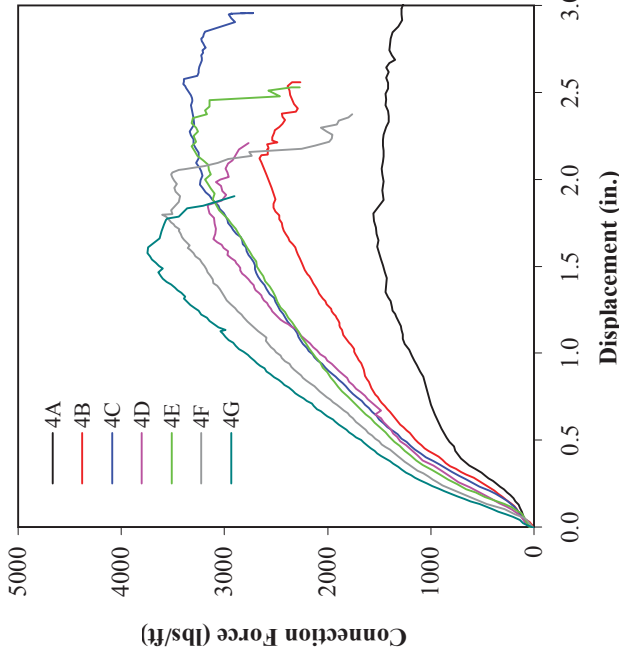


SGI TESTING SERVICES, LLC

FIGURE NO. C-3
PROJECT NO. SGI8014
DOCUMENT NO.
FILE NO.

GEOSTONE RETAINING WALL SYSTEMS, INC. CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 4: Syntec SF80 geogrid in machine direction between two courses of Geostone blocks (8" thick) with compacted AASHTO #57 stone within block apertures and space between blocks



Test No.	Geogrid Specimen Nominal Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Wall Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
4A	34.0	4.2	600	8	5.0	1022	1557	$T_{0.75-in.} = 920 + (N) \tan (18^\circ)$ $T_{peak} = 1645 + (N) \tan (31^\circ)$
4B	34.0	10.4	1500	19	12.5	1521	2663	
4C	34.0	16.7	2400	30	20.0	1724	3397	
4D	34.0	16.7	2400	30	20.0	1632	3172	
4E	34.0	16.7	2400	30	20.0	1803	3328	
4F	34.0	22.9	3300	41	27.5	2012	3607	
4G	34.0	29.2	4200	53	35.0	2265	3749	

NOTES:

- Dimensions of Block: 18 in. wide by 12 in. long and 8 in. high.
- Weight of Full-Size Block: 70 lbs
- Unit Weight of Facing (Block & Gravel): 120 pcf
- Failure Mode of Geogrid: Abrasion and rupture of geogrid ribs in each test.

DATE REPORTED: 3/20/2008



SGI TESTING SERVICES, LLC

FIGURE NO. C-4

PROJECT NO. SGI8014

DOCUMENT NO.

FILE NO.



StrataGrid SG150

Cross-Machine Direction

Geogrid Type: StrataGrid SG150
Segmental Unit: GeoStone Landscape

Segmental Unit Connection Strength Data

Test Facility: SGI Testing
Test Date: May 2009

Laboratory Test Data

Normal Load (lb/ft)	Peak Connection (lb/ft)	3/4" Connection (lb/ft)
200	618	370
450	865	419
700	919	428
700	970	453
700	1027	518
950	1059	542
1200	1089	567

Segmental Unit: GeoStone Landscape

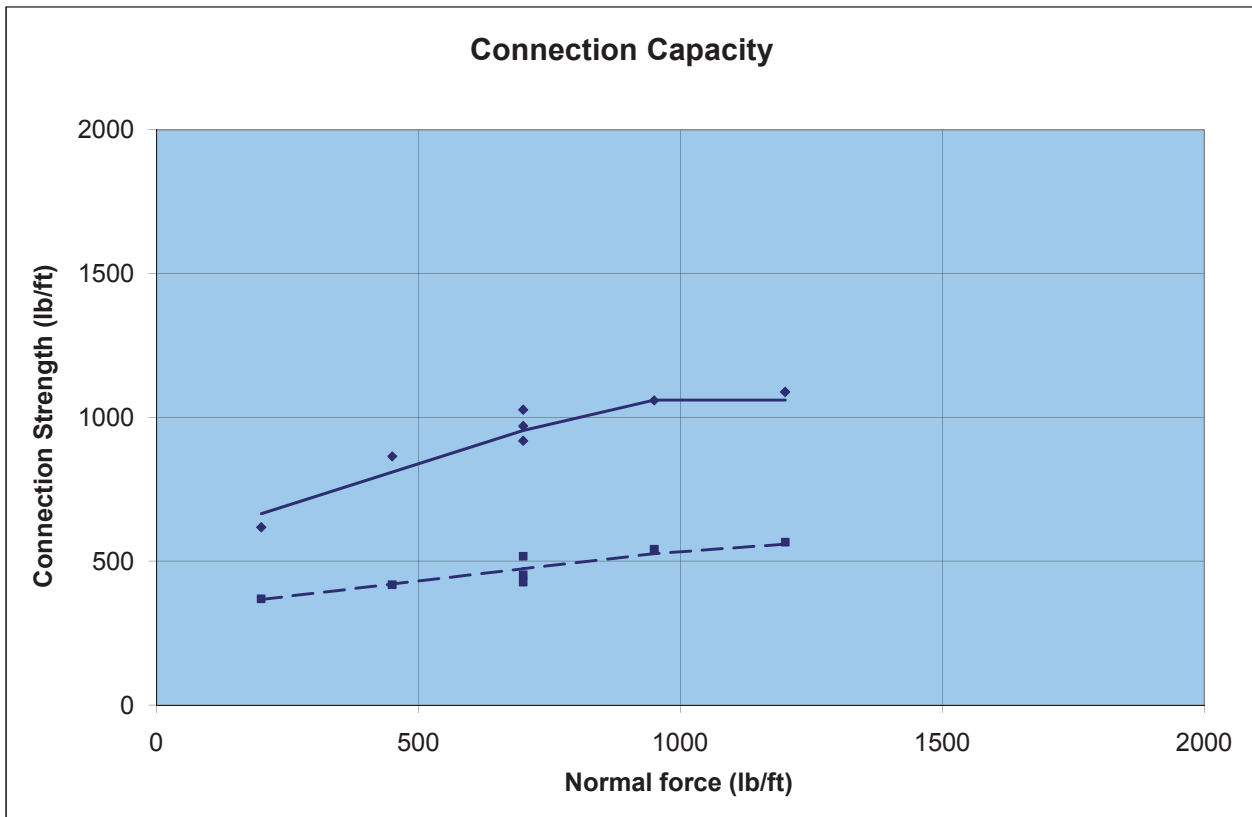
Height (in.)	4
Width (in.)	12
Length (in.)	18
Weight (infilled) (lbs.)	110
Center of Gravity (in.)	6

Segmental Unit Interface Shear Data

	Ultimate State	Serviceability State
Block to Block		
Minimum (lb/ft)	N/A	N/A
Friction Angle (deg)	N/A	N/A
Maximum (lb/ft)	N/A	N/A

At Geogrid Level		
Minimum (lb/ft)	N/A	N/A
Friction Angle (deg)	N/A	N/A
Maximum (lb/ft)	N/A	N/A

	Ultimate State	Serviceability State
Geogrid Connection		
Minimum (lb/ft)	550	325
Friction Angle (deg)	30	12
Maximum (lb/ft)	1060	560



StrataGrid SG200



STRATA
SYSTEMS, INC.

380 Dahlonega Road, Suite 200, Cumming, GA 30040
(800) 680-7750 • (770) 888-6688 • Fax: (770) 888-6680
E-mail: strata@geogrid.com
www.geogrid.com

Geogrid Type: StrataGrid SG200
Segmental Unit: GeoStone Standard

Segmental Unit Connection Strength Data

Test Facility: SGI Testing
Test Date: May 2009

Laboratory Test Data

Normal Load (lb/ft)	3/4"	
	Peak Connection (lb/ft)	Connection (lb/ft)
400	1020	665
900	1476	812
1400	1631	1023
1400	1801	984
1400	1685	952
1900	1884	1187
2400	2055	1269

Segmental Unit **GeoStone Standard**

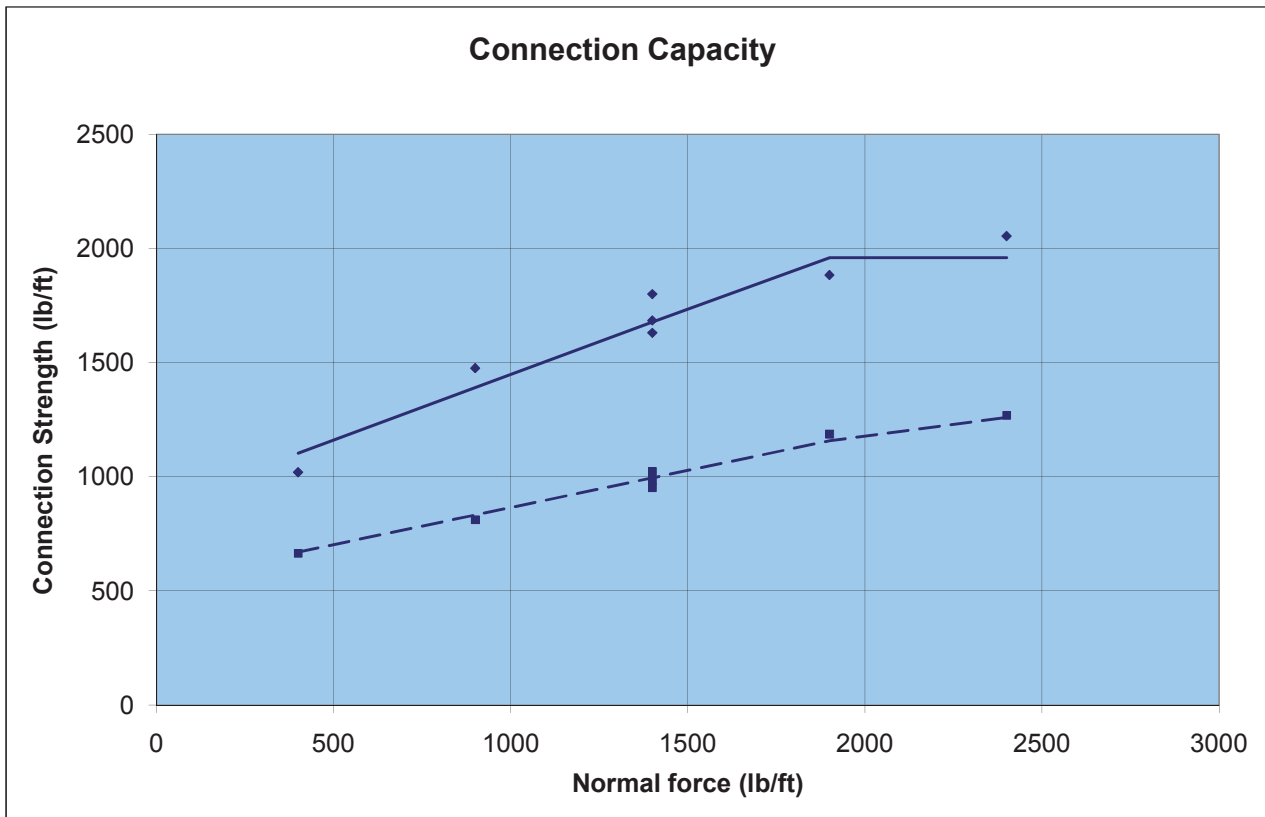
Height (in.)	8
Width (in.)	12
Length (in.)	18
Weight (infilled) (lbs.)	120
Center of Gravity (in.)	6

Segmental Unit Interface Shear Data

	Ultimate State	Serviceability State
Block to Block		
Minimum (lb/ft)	N/A	N/A
Friction Angle (deg)	N/A	N/A
Maximum (lb/ft)	N/A	N/A

	Ultimate State	Serviceability State
At Geogrid Level		
Minimum (lb/ft)	N/A	N/A
Friction Angle (deg)	N/A	N/A
Maximum (lb/ft)	N/A	N/A

	Ultimate State	Serviceability State
Geogrid Connection		
Minimum (lb/ft)	873	540
Friction Angle (deg)	29.9	18
Maximum (lb/ft)	1960	1260



StrataGrid SG350



STRATA
SYSTEMS, INC.

380 Dahlonega Road, Suite 200, Cumming, GA 30040
(800) 680-7750 • (770) 888-6688 • Fax: (770) 888-6680
E-mail: strata@geogrid.com
www.geogrid.com

Geogrid Type: StrataGrid SG350
Segmental Unit: GeoStone Standard

Segmental Unit Connection Strength Data

Test Facility: SGI Testing
Test Date: May 2009

Laboratory Test Data

Normal Load (lb/ft)	Peak Connection (lb/ft)	3/4" Connection (lb/ft)
600	1220	964
1300	1791	1070
2000	2216	1172
2000	2223	1366
2000	2308	1248
2750	2294	1515
3500	2499	1616

Segmental Unit **GeoStone Standard**

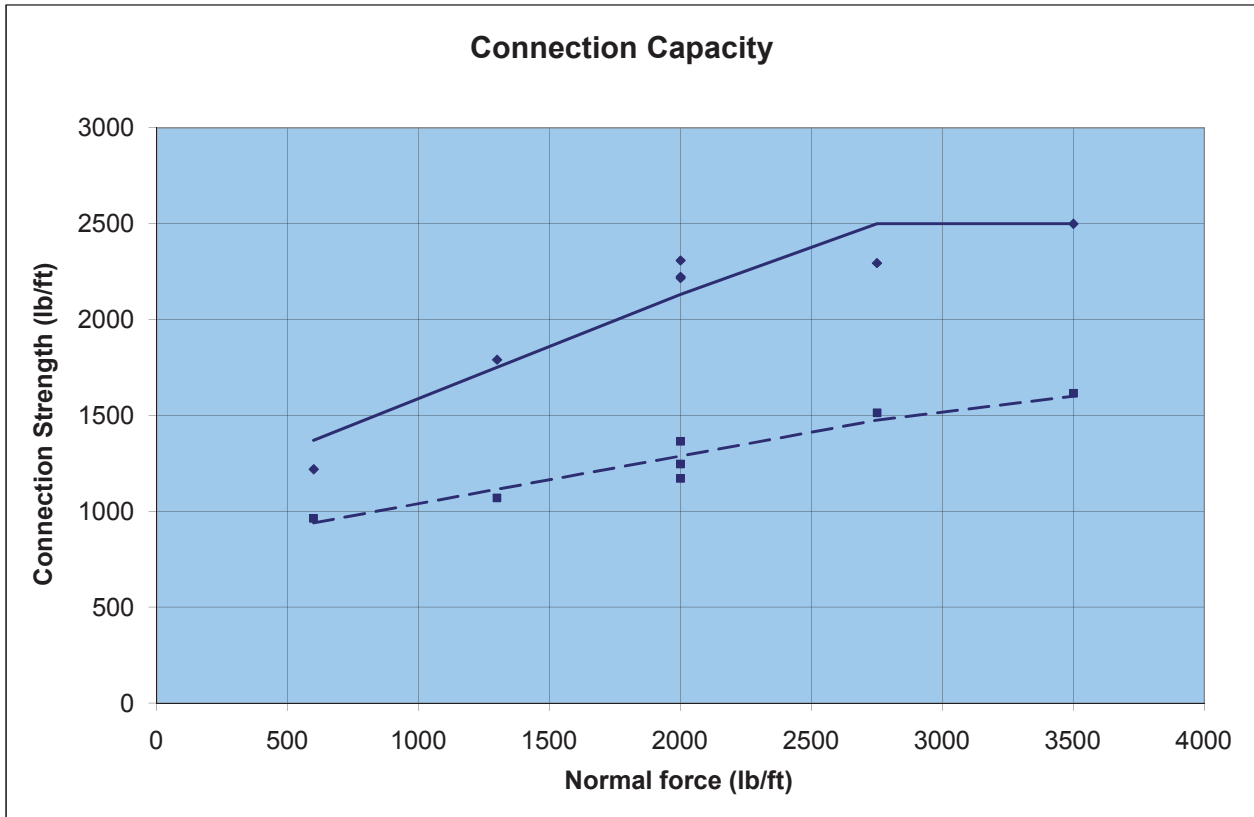
Height (in.)	8
Width (in.)	12
Length (in.)	18
Weight (infilled) (lbs.)	120
Center of Gravity (in.)	6

Segmental Unit Interface Shear Data

	Ultimate State	Serviceability State
Block to Block		
Minimum (lb/ft)	N/A	N/A
Friction Angle (deg)	N/A	N/A
Maximum (lb/ft)	N/A	N/A

	Ultimate State	Serviceability State
At Geogrid Level		
Minimum (lb/ft)	N/A	N/A
Friction Angle (deg)	N/A	N/A
Maximum (lb/ft)	N/A	N/A

	Ultimate State	Serviceability State
Geogrid Connection		
Minimum (lb/ft)	1045	790
Friction Angle (deg)	28.5	14
Maximum (lb/ft)	2500	1600



StrataGrid SG550



STRATA
SYSTEMS, INC.

380 Dahlonega Road, Suite 200, Cumming, GA 30040
(800) 680-7750 • (770) 888-6688 • Fax: (770) 888-6680
E-mail: strata@geogrid.com
www.geogrid.com

Geogrid Type: StrataGrid SG550
Segmental Unit: GeoStone Standard

Segmental Unit Connection Strength Data

Test Facility: SGI Testing
Test Date: May 2009

Laboratory Test Data

Normal Load (lb/ft)	Peak Connection (lb/ft)	3/4" Connection (lb/ft)
600	1304	1058
1500	2323	1633
2500	3038	1704
2500	3385	1918
2500	3119	1993
3500	3540	2074
4500	3817	2287

Segmental Unit **GeoStone Standard**

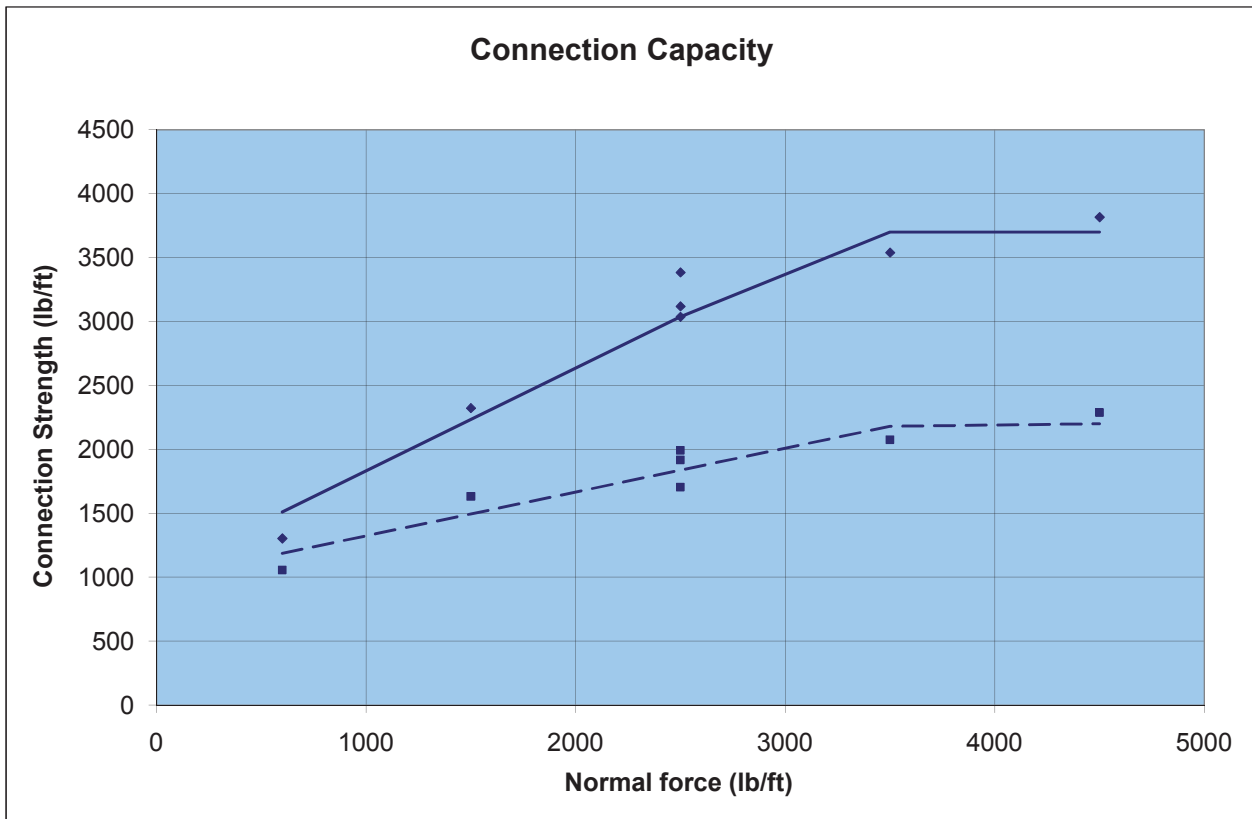
Height (in.)	8
Width (in.)	12
Length (in.)	18
Weight (infilled) (lbs.)	120
Center of Gravity (in.)	6

Segmental Unit Interface Shear Data

	Ultimate State	Serviceability State
Block to Block		
Minimum (lb/ft)	N/A	N/A
Friction Angle (deg)	N/A	N/A
Maximum (lb/ft)	N/A	N/A

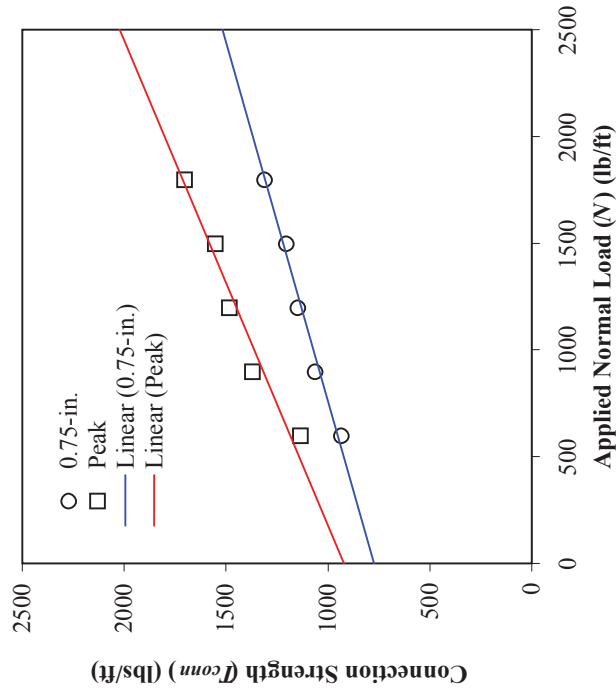
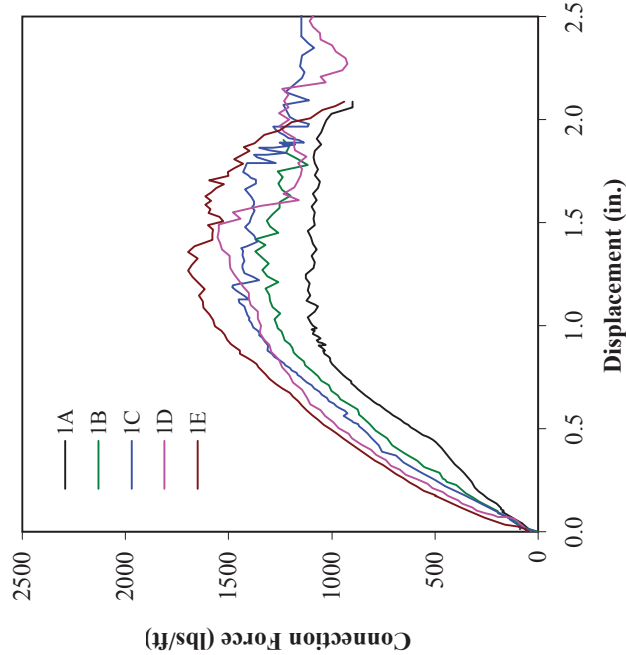
At Geogrid Level		
Minimum (lb/ft)	N/A	N/A
Friction Angle (deg)	N/A	N/A
Maximum (lb/ft)	N/A	N/A

	Ultimate State	Serviceability State
Geogrid Connection		
Minimum (lb/ft)	1028	981
Friction Angle (deg)	38.8	18.9
Maximum (lb/ft)	3700	2200



GEOSTAR TECHNOLOGIES, LLC CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 1: Optima HP200 geogrid in machine direction between two courses of GeoStone Standard blocks (8" Thick) with compacted AASHTO #57 stone within block apertures and space between blocks



Test No.	Geogrid Specimen Nominal Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Wall Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
1A	32.0	4.2	600	8	5.0	932	1134	$T_{0.75-in.} = 775$ $T_{peak} = 920$
1B	32.0	6.3	900	11	7.5	1062	1370	
1C	32.0	8.3	1200	15	10.0	1148	1483	
1D	32.0	10.4	1500	19	12.5	1202	1553	
1E	32.0	12.5	1800	23	15.0	1308	1703	

NOTES:

- Dimensions of Block: 18 in. wide by 12 in. long and 8 in. high.
- Weight of Full-Size Block: 70 lbs
- Unit Weight of Facing (Block and Gravel): 120 pcf
- Failure Mode: Abrasion and rupture of geogrid ribs in each test.

DATE REPORTED: 4/23/2009

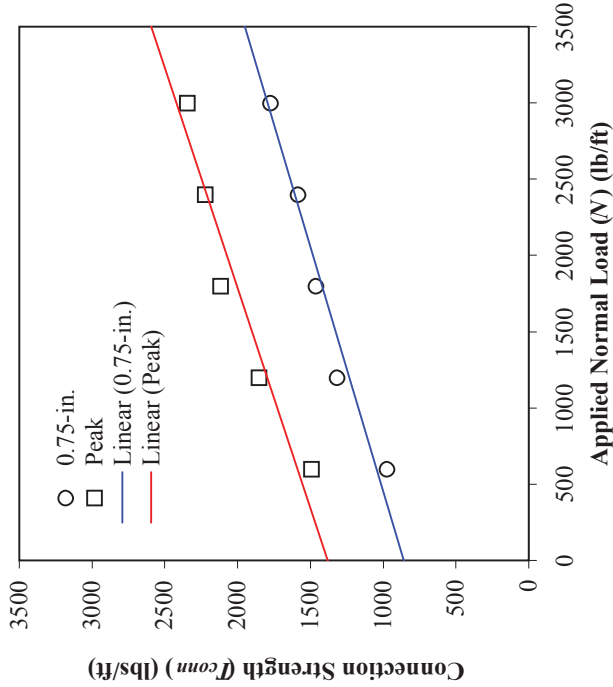
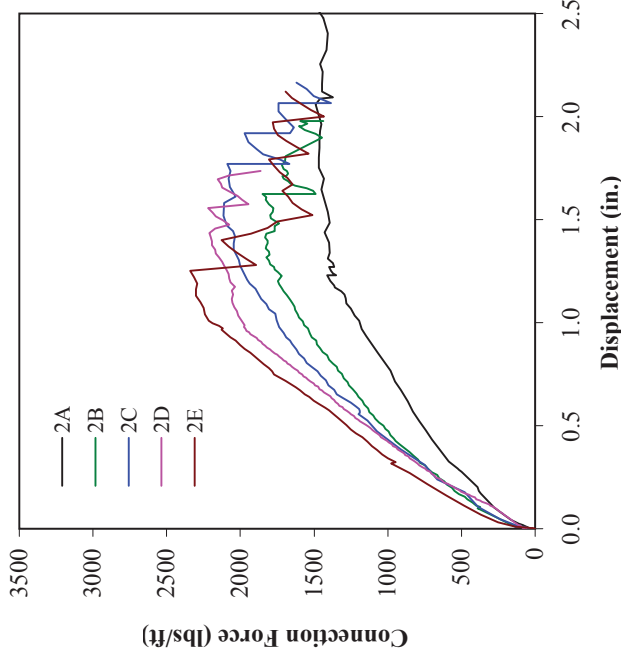


FIGURE NO. C-1
PROJECT NO. SGI9011
DOCUMENT NO.
FILE NO.

SGI TESTING SERVICES, LLC

GEOSTAR TECHNOLOGIES, LLC CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 2: Optima HP300 geogrid in machine direction between two courses of GeoStone Standard blocks (8" Thick) with compacted AASHTO #57 stone within block apertures and space between blocks



Test No.	Geogrid Specimen Nominal Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Wall Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
2A	32.0	4.2	600	8	5.0	971	1491	$T_{0.75-in.} = 860$
2B	32.0	8.3	1200	15	10.0	1313	1851	$(N) \tan (17^\circ)$
2C	32.0	12.5	1800	23	15.0	1462	2114	
2D	32.0	16.7	2400	30	20.0	1585	2220	$T_{peak} = 1380$
2E	32.0	20.8	3000	38	25.0	1772	2346	$(N) \tan (19^\circ)$

NOTES:
 Dimensions of Block: 18 in. wide by 12 in. long and 8 in. high.
 Weight of Full-Size Block: 70 lbs
 Unit Weight of Facing (Block and Gravel): 120 pcf
 Failure Mode: Abrasion and rupture of geogrid ribs in each test.

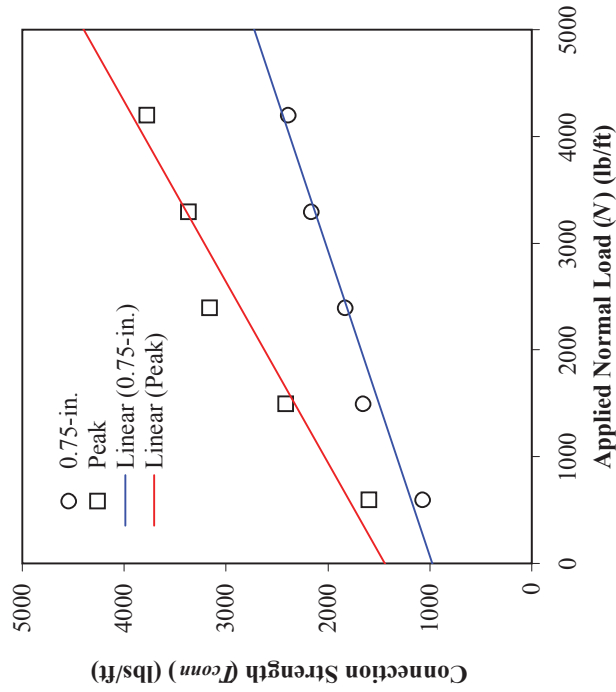
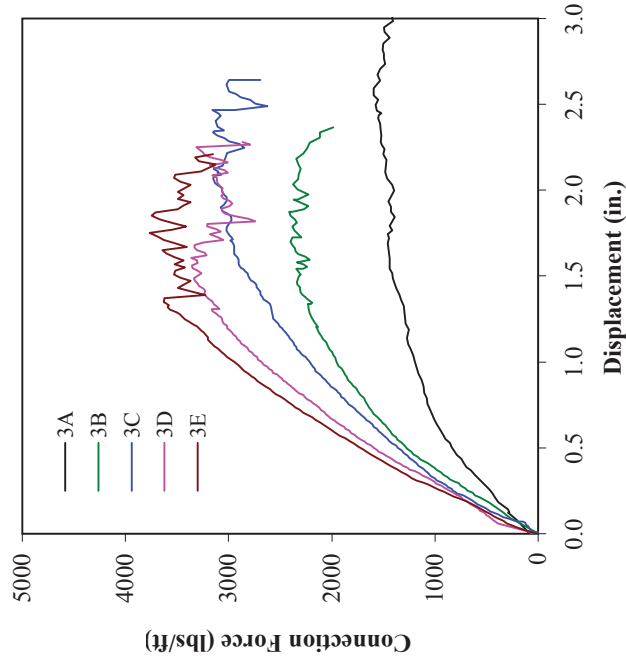
DATE REPORTED: 4/23/2009
 FIGURE NO. C-2
 PROJECT NO. SGI9011
 DOCUMENT NO.
 FILE NO.



SGI TESTING SERVICES, LLC

GEOSTAR TECHNOLOGIES, LLC CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 3: Optima HP500 geogrid in machine direction between two courses of GeoStone Standard blocks (8" Thick) with compacted AASHTO #57 stone within block apertures and space between blocks



Test No.	Geogrid Specimen Nominal Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Wall Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
3A	32.0	4.2	600	8	5.0	1066	1593	
3B	32.0	10.4	1500	19	12.5	1652	2412	$T_{0.75-in.} = 980$
3C	32.0	16.7	2400	30	20.0	1827	3159	$(N) \tan (19^\circ)$
3D	32.0	22.9	3300	41	27.5	2159	3365	$T_{peak} = 1445$
3E	32.0	29.2	4200	53	35.0	2385	3776	$(N) \tan (31^\circ)$

NOTES:
 Dimensions of Block:
 Weight of Full-Size Block:
 Unit Weight of Facing (Block and Gravel):
 Failure Mode:

18 in. wide by 12 in. long and 8 in. high.
 70 lbs
 120 pcf
 Abrasion and rupture of geogrid ribs in each test.

DATE REPORTED: 4/23/2009

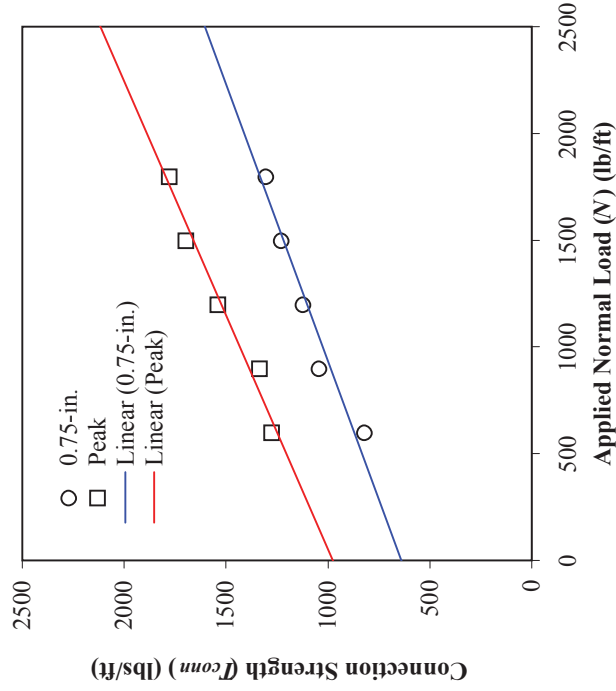
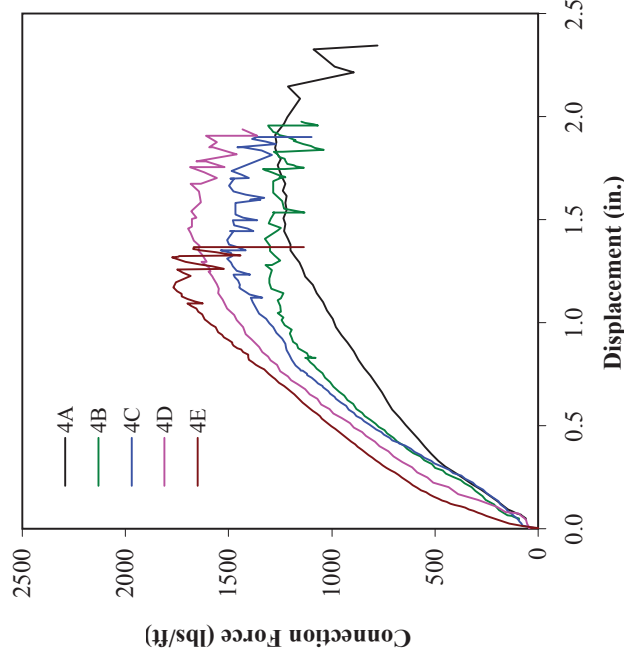
FIGURE NO. C-3
 PROJECT NO. SGI9011
 DOCUMENT NO.
 FILE NO.



SGI TESTING SERVICES, LLC

GEOSTAR TECHNOLOGIES, LLC CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 4: Optima HP200 geogrid in machine direction between two courses of GeoStone Landscape blocks (4" Thick) with compacted AASHTO #57 stone within block apertures and space between blocks



Test No.	Geogrid Specimen Nominal Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Wall Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
4A	32.0	4.2	600	15	5.0	819	1275	$T_{0.75-in.} = 640 (N) \tan (21^\circ)$ $T_{peak} = 975 (N) \tan (25^\circ)$
4B	32.0	6.3	900	23	7.5	1044	1333	
4C	32.0	8.3	1200	30	10.0	1120	1538	
4D	32.0	10.4	1500	38	12.5	1229	1696	
4E	32.0	12.5	1800	45	15.0	1305	1779	

NOTES:

- Dimensions of Block: 18 in. wide by 12 in. long and 4 in. high.
- Weight of Full-Size Block: 36 lbs
- Unit Weight of Facing (Block and Gravel): 120 pcf
- Failure Mode: Abrasion and rupture of geogrid ribs in each test.

DATE REPORTED: 4/23/2009

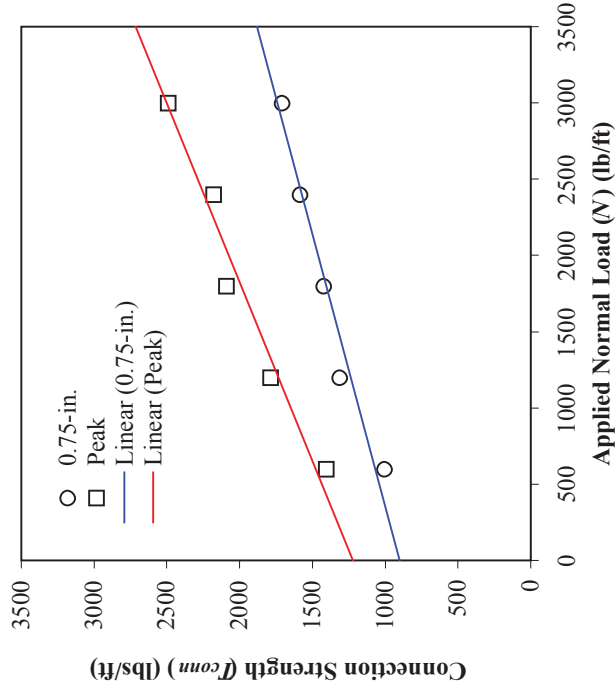
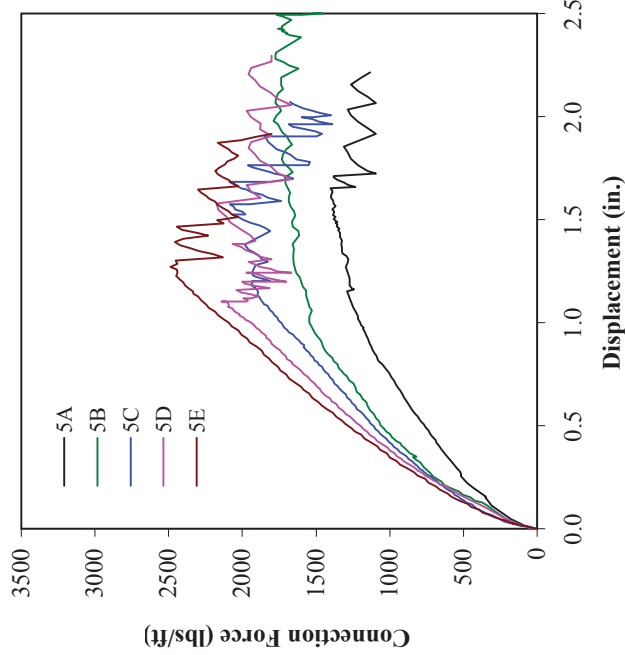


SGI TESTING SERVICES, LLC

FIGURE NO. C-4
PROJECT NO. SGI9011
DOCUMENT NO.
FILE NO.

GEOSTAR TECHNOLOGIES, LLC CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 5: Optima HP300 geogrid in machine direction between two courses of GeoStone Landscape blocks (4" Thick) with compacted AASHTO #57 stone within block apertures and space between blocks



Test No.	Geogrid Specimen Nominal Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Wall Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
5A	32.0	4.2	600	15	5.0	1002	1404	$T_{0.75-in.} = 900$
5B	32.0	8.3	1200	30	10.0	1310	1787	$(N) \tan (16^\circ)$
5C	32.0	12.5	1800	45	15.0	1420	2088	
5D	32.0	16.7	2400	60	20.0	1583	2177	$T_{peak} = 1220$
5E	32.0	20.8	3000	75	25.0	1706	2490	$(N) \tan (23^\circ)$

NOTES:

- Dimensions of Block: 18 in. wide by 12 in. long and 4 in. high.
- Weight of Full-Size Block: 36 lbs
- Unit Weight of Facing (Block and Gravel): 120 pcf
- Failure Mode: Abrasion and rupture of geogrid ribs in each test.

DATE REPORTED: 4/23/2009

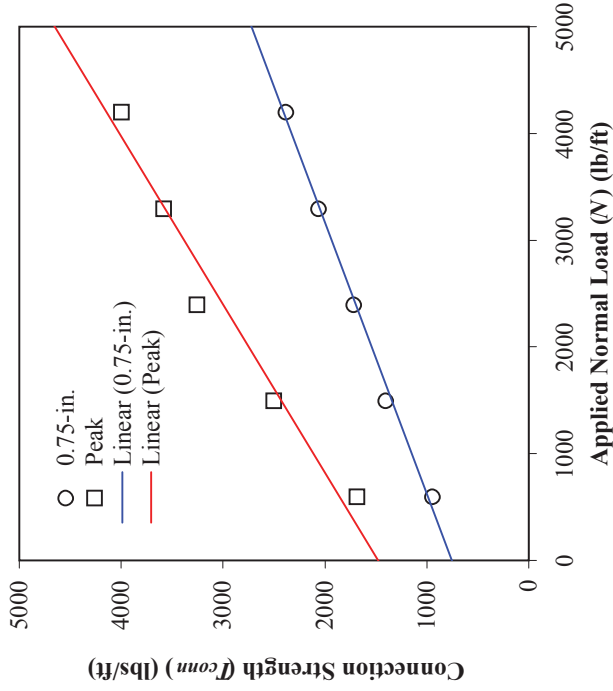
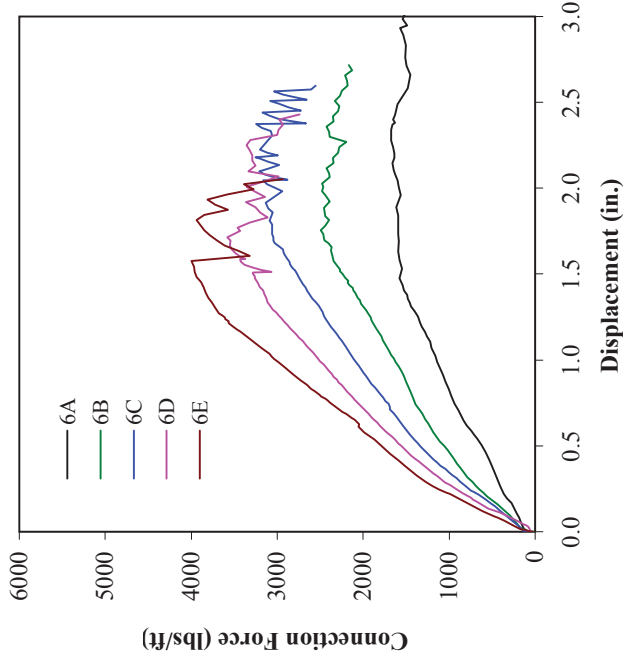


SGI TESTING SERVICES, LLC

FIGURE NO. C-5
PROJECT NO. SGI9011
DOCUMENT NO.
FILE NO.

GEOSTAR TECHNOLOGIES, LLC
CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 6: Optima HP500 geogrid in machine direction between two courses of GeoStone Landscape blocks (4" Thick) with compacted AASHTO #57 stone within block apertures and space between blocks



Test No.	Geogrid Specimen Nominal Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Wall Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
6A	32.0	4.2	600	15	5.0	943	1682	$T_{0.75-in.} = 755 (N) \tan (21^\circ)$ $T_{peak} = 1480 (N) \tan (32^\circ)$
6B	32.0	10.4	1500	38	12.5	1398	2502	
6C	32.0	16.7	2400	60	20.0	1716	3252	
6D	32.0	22.9	3300	83	27.5	2063	3583	
6E	32.0	29.2	4200	105	35.0	2382	3997	

NOTES:
 Dimensions of Block: 18 in. wide by 12 in. long and 4 in. high.
 Weight of Full-Size Block: 36 lbs
 Unit Weight of Facing (Block and Gravel): 120 pcf
 Failure Mode: Abrasion and rupture of geogrid ribs in each test.

DATE REPORTED: 4/23/2009

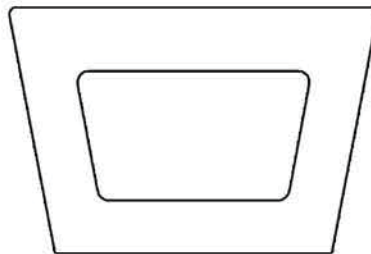


SGI TESTING SERVICES, LLC

FIGURE NO. C-6
 PROJECT NO. SGI9011
 DOCUMENT NO.
 FILE NO.

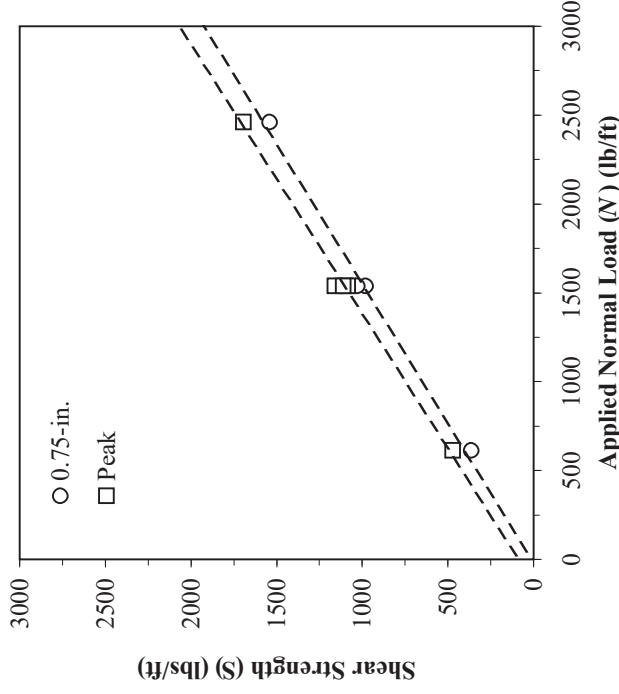
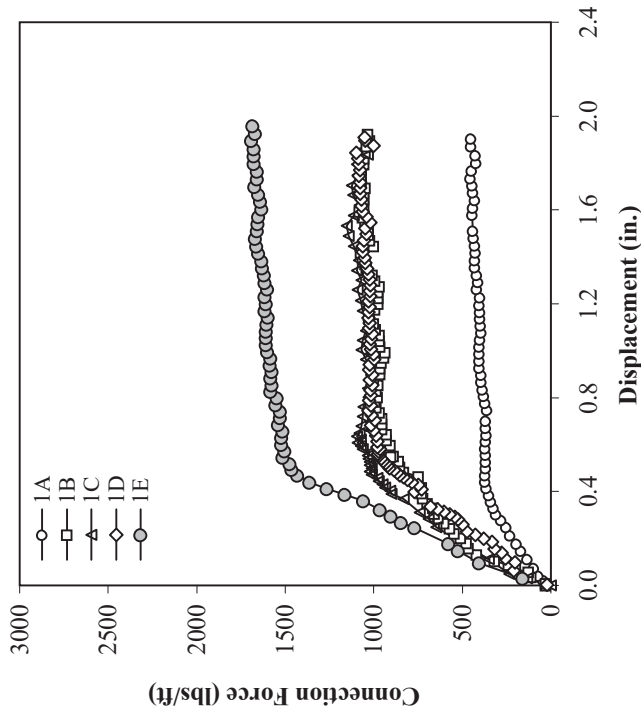


BLOCK SHEAR TESTING



**GEOSTONE RETAINING WALL SYSTEMS, INC.
BLOCK SHEAR TESTING (NCMA TEST METHOD SRWU-2)**

TEST SERIES NO. 1: Geostone 4" thick block unit/Geostone 4" thick block units with compacted AASHTO #57 stone (grave)



Test No.	Test Specimen Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Shear Strength Equations (S)
IA	17.8	4.3	616	8	5.0	361	470	$S_{0.75-in.} = 10 + (N) \tan (33^\circ)$ $S_{I'_{peak}} = 85 + (N) \tan (33^\circ)$
IB	17.8	10.7	1540	19	12.5	979	1082	
IC	17.8	10.7	1540	19	12.5	1059	1157	
ID	17.8	10.7	1540	19	12.5	1028	1108	
IE	17.8	17.1	2464	30	20.0	1539	1691	

Note:

Dimensions of Geostone Block Unit: 17.75 in. wide by 12 in. long and 4 in. high.
Weight of a Full-Size Geostone Block: 37.5 lbs.
Average Unit Weight of Facing (Block and Gravel): 123.2 pcf

DATE TESTED: 27 May 2004

FIGURE NO. C-1

PROJECT NO. SGI1053

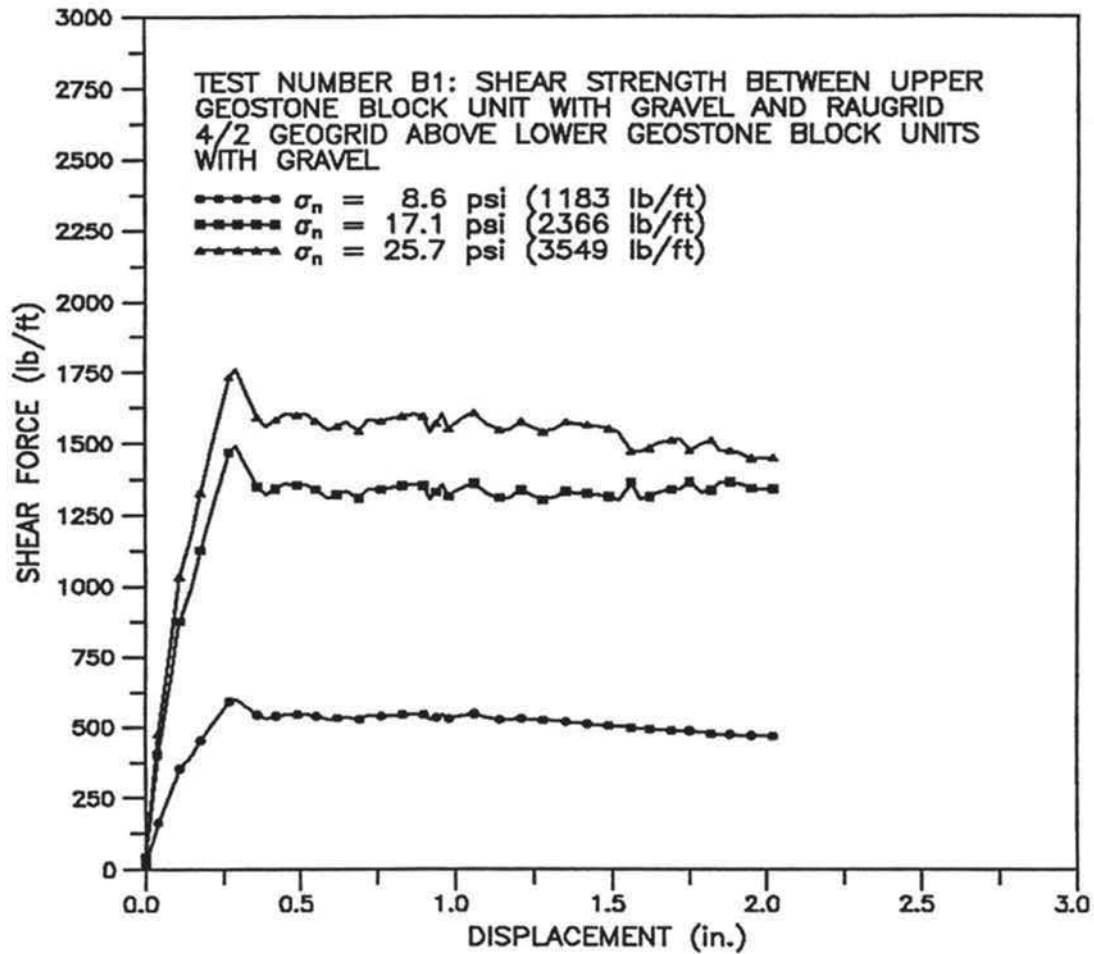
DOCUMENT NO.

FILE NO.



SGI TESTING SERVICES, LLC

GEOSTONE RETAINING WALL SYSTEMS, INC.
BLOCK SHEAR TESTING



DATE TESTED: 28 TO 31 JANUARY 2000

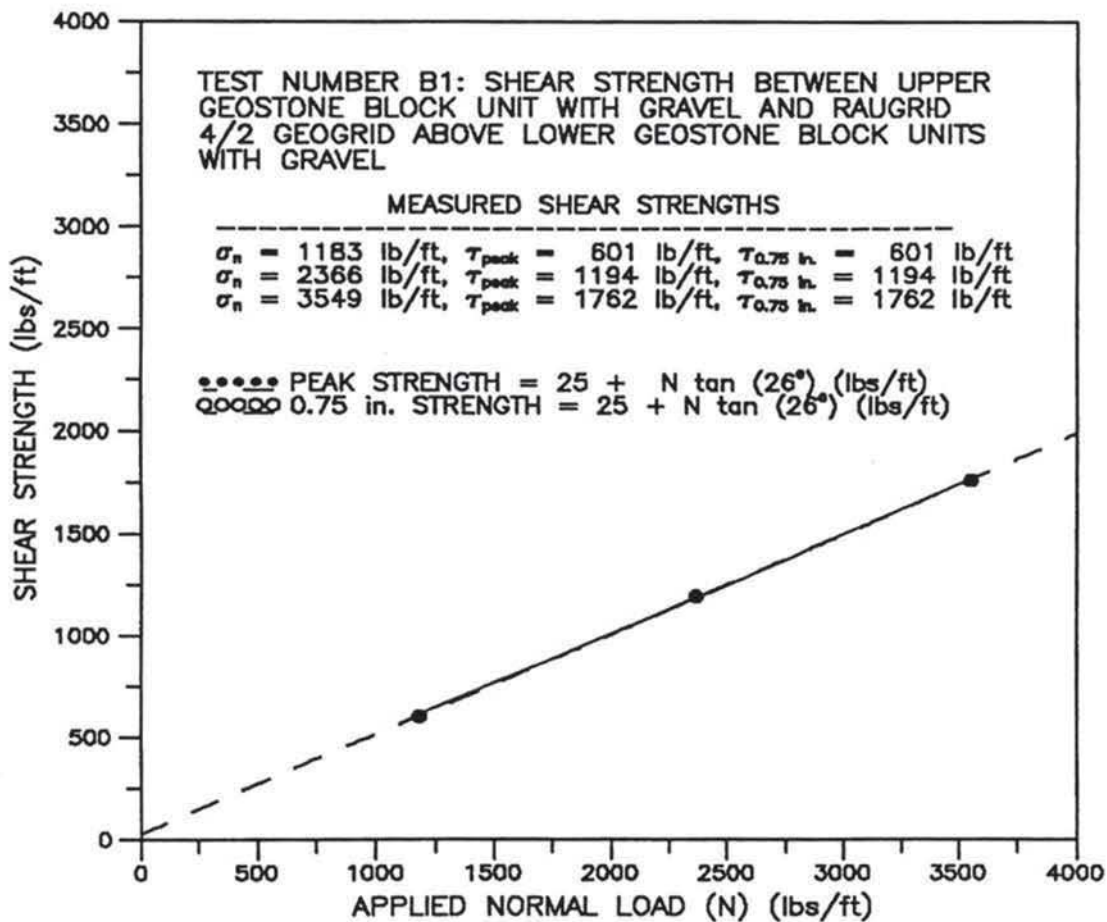


GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	C-1
PROJECT NO.	GLI1137
DOCUMENT NO.	SGI00003
FILE NO.	

GEOSTONE RETAINING WALL SYSTEMS, INC.
BLOCK SHEAR TESTING



DATE TESTED: 28 TO 31 JANUARY 2000

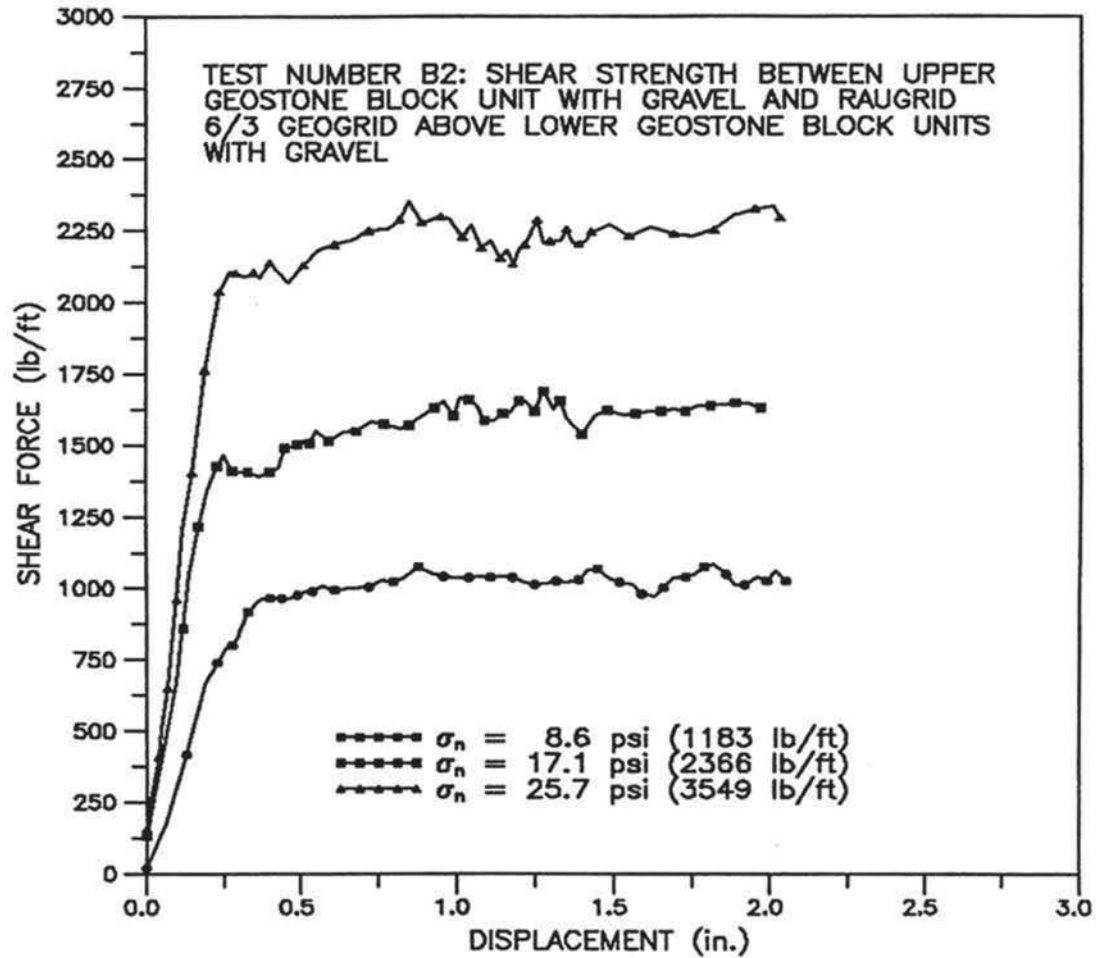


GeoSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	C-2
PROJECT NO.	GLI1137
DOCUMENT NO.	SGI00003
FILE NO.	

GEOSTONE RETAINING WALL SYSTEMS, INC.
BLOCK SHEAR TESTING



DATE TESTED: 30 TO 31 MARCH 2000

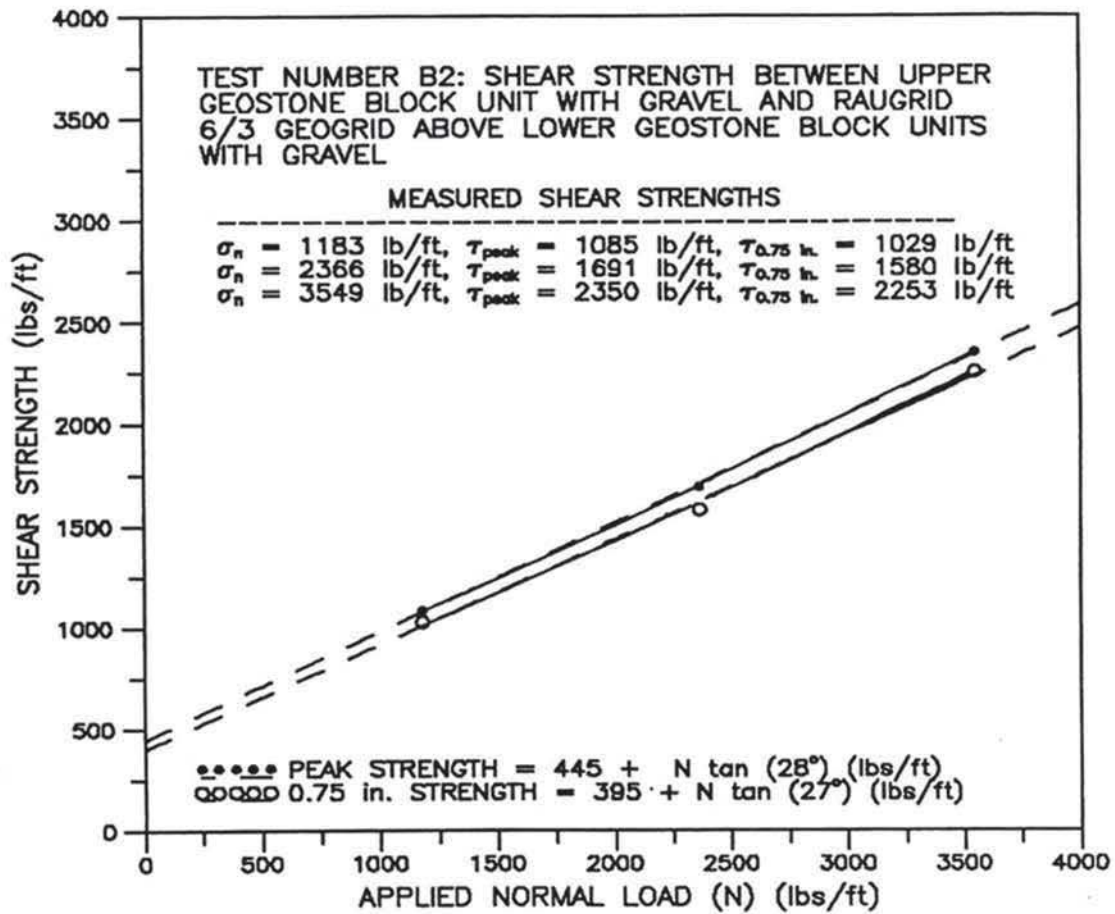


GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	C-3
PROJECT NO.	GLI1137
DOCUMENT NO.	SGI00003
FILE NO.	

GEOSTONE RETAINING WALL SYSTEMS, INC. BLOCK SHEAR TESTING



DATE TESTED: 30 TO 31 MARCH 2000



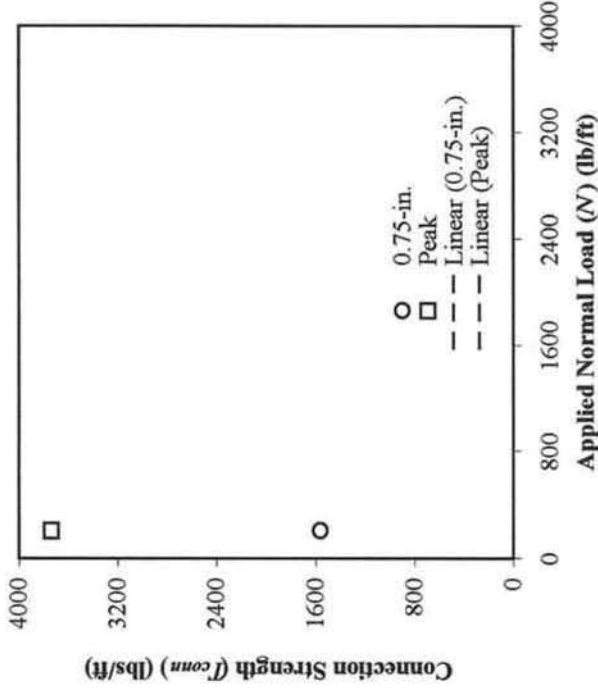
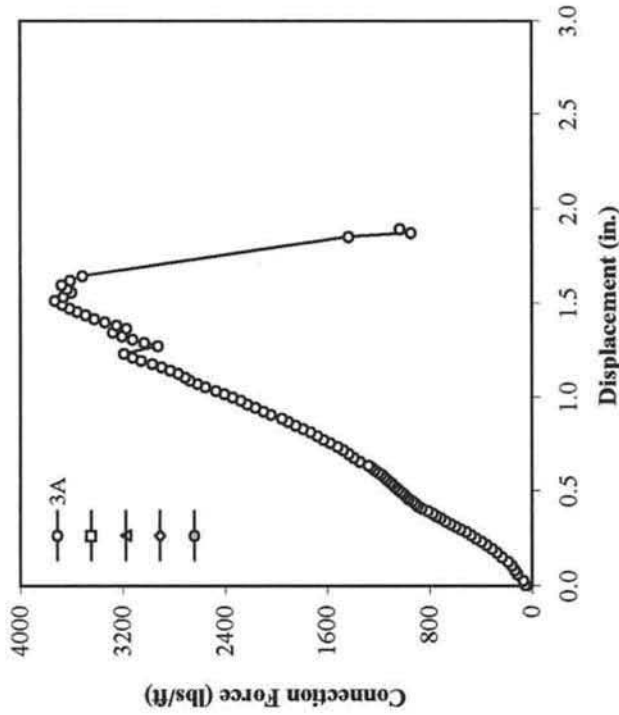
GeoSynTec CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	C-4
PROJECT NO.	GLI1137
DOCUMENT NO.	SGI00003
FILE NO.	

**GEOSTONE RETAINING WALL SYSTEMS, INC.
CONNECTION STRENGTH TESTING (ASTM D 6638)**

TEST SERIES NO. 3: Synteen SF80 Geogrid in Machine Direction within Geostone Block Units with Gravel Bonded with Approximately 0.2 gal/ft of Epoxy-Sand Mix and Cured for 48 hours



Test No.	Test Specimen Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
3A	35.5	1.5	210	3	1.8	1562	3737	$T'_{0.75-in.} = ##### + (N) \tan (##\theta)$ $T'_{peak} = ##### + (N) \tan (##\theta)$

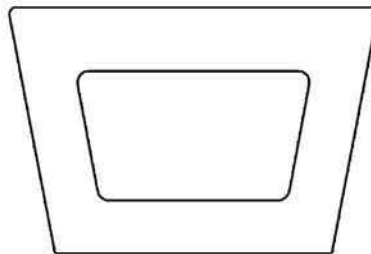
Note:
Dimensions of Geostone Block: 17.5 in. wide by 12 in. long and 8 in. high.
Weight of a Full-Size Geostone Block with Gravel: 114.2 lbs.

DATE TESTED: 16 to 18 November 2001
FIGURE NO. C-3
PROJECT NO. SGI1053
DOCUMENT NO.
FILE NO.





POSITIVE CONNECTION TESTING





The GeoStone Rock-Interlock connection is an open core system, that utilizes angular crushed stone in the cores to lock the blocks together. The friction of this connection is among the most powerful in the industry. The way a wall's power is measured is through a series of tests that measure the amount of force it would take to separate the blocks from the geogrids. These tests are called "Pullout" or "Connection Strength" tests. The GeoStone connection strength testing has resulted in some of the highest results in the industry.

What if the geogrid could not be pulled out of the wall? This would result in 100% connection strength. The only limitation would be the strength of the geogrid itself. There is no form of geogrid connection that is more powerful.

GeoStone's GeoLock is a mass inside the core of the block that is permanently attached to the geogrid, rock, and the block itself?



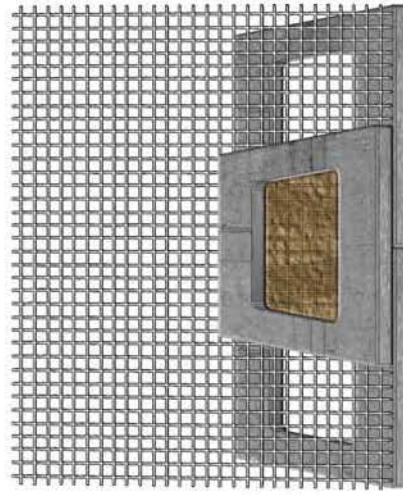
Procedure: Mix a polyester resin with sand to the consistency of pancake batter and add the catalyst. Pour the catalyzed mixture into the open core of the module onto the exposed geogrid and rock. The module is then filled with rock. Apply this positive connection application at each geogrid level in the wall or as directed by the wall design. When the resin hardens it bonds rock, grid, and block into an indestructible mass that will not allow the grid to pull out of the wall. The polyester resin is totally compatible with the PVC coating on the geogrid. Since the connection strength is now 100% or equal to that of the grid strength, there is no stronger result in the entire SRW industry.

To see an actual installation visit us at:

http://geostone.com/Landscape_Installation_PosCon.htm



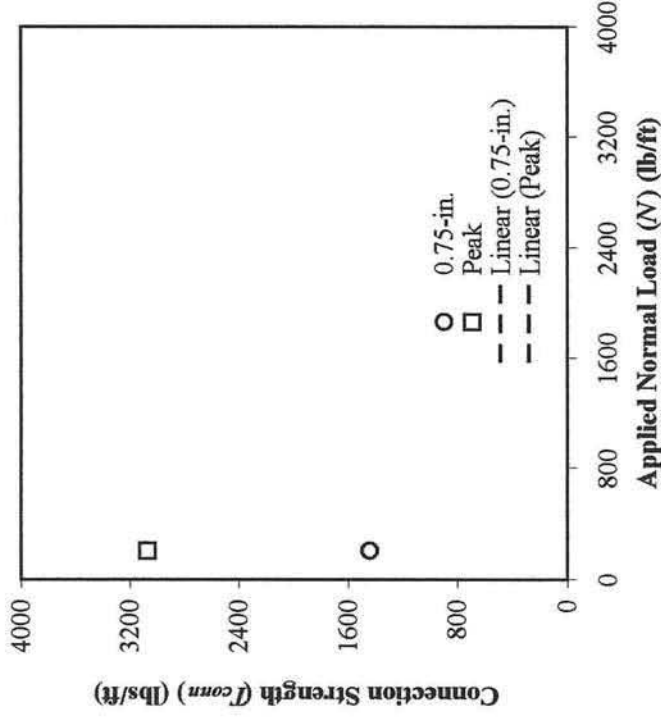
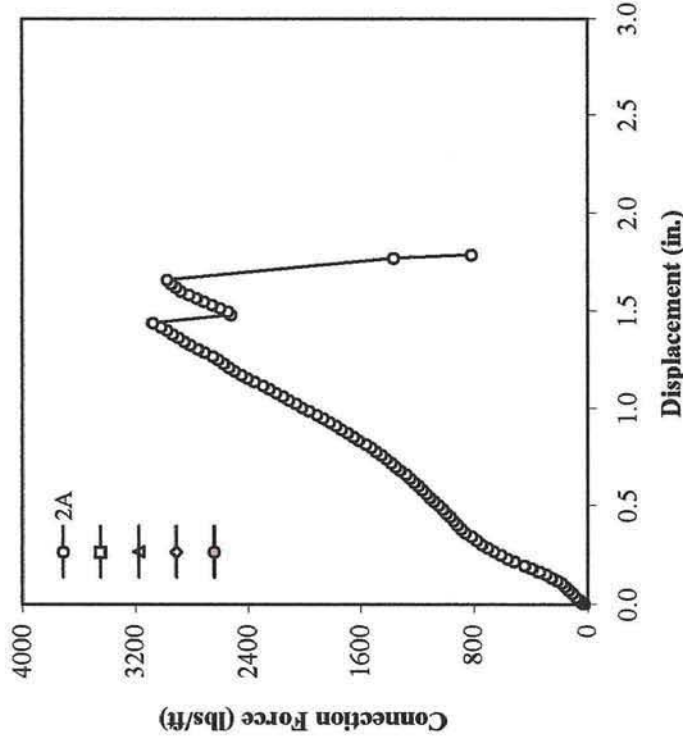
Attention: GeoStone's ultimate positive connection procedure is not necessary with all applications. This is an added measure used in only the most extreme installations.



Courses above and below geogrid layer are permanently locked together with the core fill and geogrid. The illustrations above show where these connections take place both within the wall and within the blocks. The cores of the top block overlap the two blocks below it. As the polyester resin is poured into the cell, it will bond to all three blocks and conform to their shape. This creates a connection that cannot be surpassed in strength.

GEOSTONE RETAINING WALL SYSTEMS, INC. CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 2: Syntec SF55 Geogrid in Machine Direction within Geostone Block Units with Gravel Bonded with Approximately 0.2 gal/ft of Epoxy-Sand Mix and Cured for 72 hours



Test No.	Test Specimen Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
2A	35.0	1.5	210	3	1.8	1441	3073	$T'_{0.75-in.} = ##### + (N) \tan (\#\#\#)$ $T'_{peak} = ##### + (N) \tan (\#\#\#)$

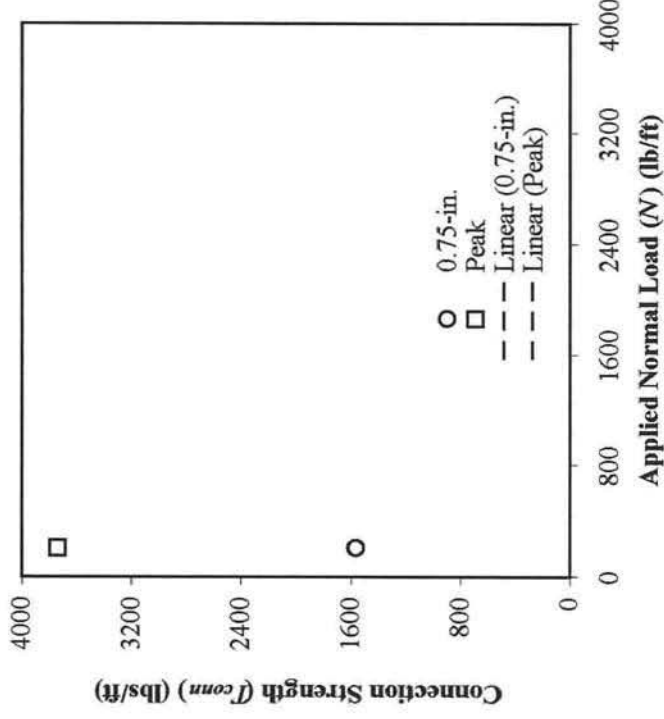
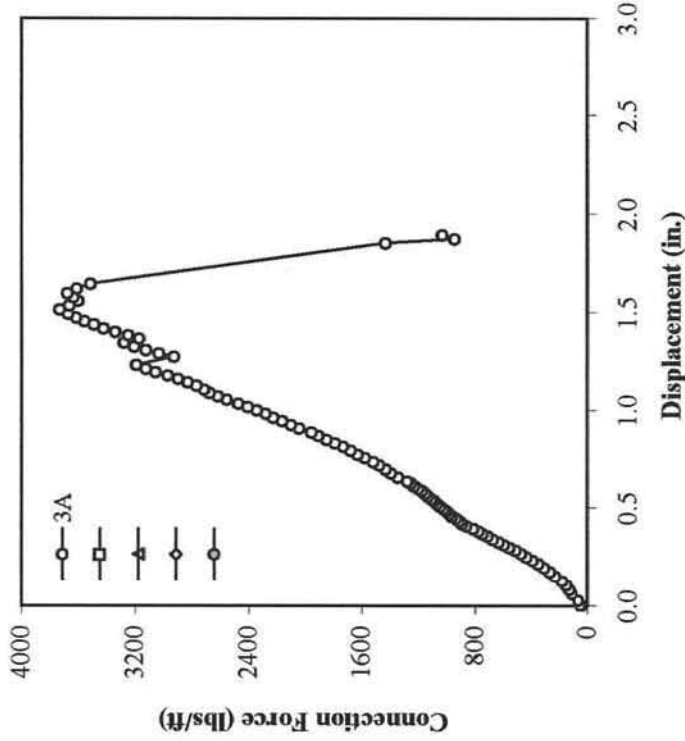
Note:
Dimensions of Geostone Block: 17.5 in. wide by 12 in. long and 8 in. high.
Weight of a Full-Size Geostone Block with Gravel: 114.2 lbs.

DATE TESTED: 14 to 18 July 2001
FIGURE NO. C-2
PROJECT NO. SGI1053
DOCUMENT NO.
FILE NO.



GEOSTONE RETAINING WALL SYSTEMS, INC. CONNECTION STRENGTH TESTING (ASTM D 6638)

TEST SERIES NO. 3: Synceen SF80 Geogrid in Machine Direction within Geostone Block Units with Gravel Bonded with Approximately 0.2 gal/ft of Epoxy-Sand Mix and Cured for 48 hours



Test No.	Test Specimen Width (in.)	Test Normal Stress (psi)	Equivalent Normal Load (lb/ft)	Approx. No. of Blocks	Approx. Height (ft)	0.75-in. Strength (lb/ft)	Peak Strength (lb/ft)	Connection Strength Equations (T_{conn})
3A	35.5	1.5	210	3	1.8	1562	3737	$T'_{0.75-in.} = ##### + (N) \tan (##^\circ)$ $T'_{peak} = ##### + (N) \tan (##^\circ)$

Note:
Dimensions of Geostone Block: 17.5 in. wide by 12 in. long and 8 in. high.
Weight of a Full-Size Geostone Block with Gravel: 114.2 lbs.

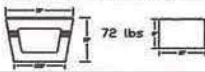




GEOSTONE
www.geostone.com

GEOSTONE RETAINING WALLS ARE MADE TO ADJUST FOR DIFFERENT HEIGHTS AND SITUATIONS. REINFORCEMENT IS SOMETIMES REQUIRED. PLEASE REFER TO www.geostone.com FOR GENERAL REINFORCING PROCEDURES AND GUIDELINES. ALSO PLEASE NOTE THAT A LOT OF MUNICIPALITIES WILL REQUIRE THAT RETAINING WALLS OVER 4 FEET IN HEIGHT BE DESIGNED AND STAMPED BY A PROFESSIONAL ENGINEER. PLEASE CHECK WITH YOUR LOCAL MUNICIPALITY PRIOR TO ANY CONSTRUCTION.

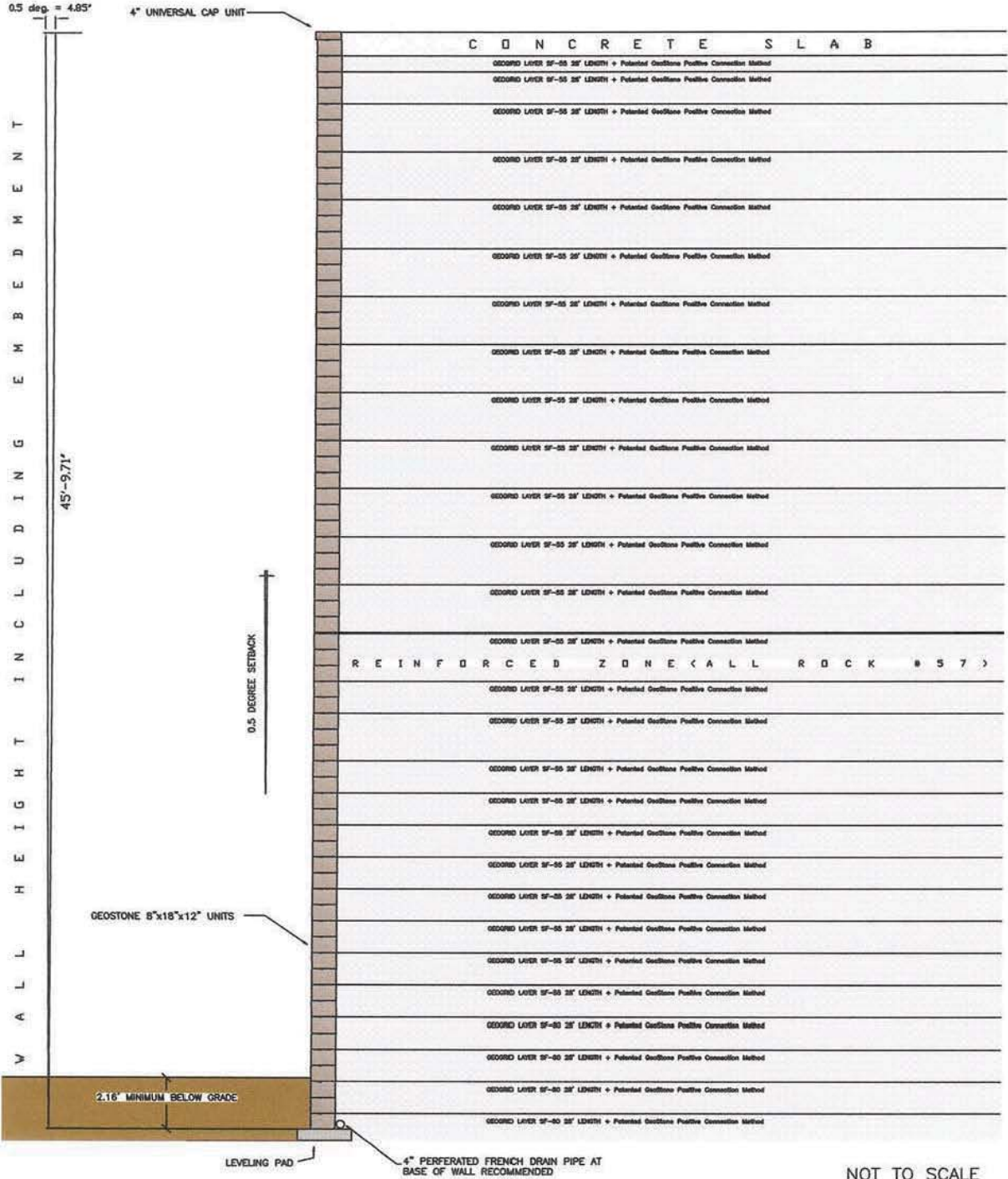
GEOSTONE STANDARD BLOCK



72 lbs

WWW.GEOSTONE.COM

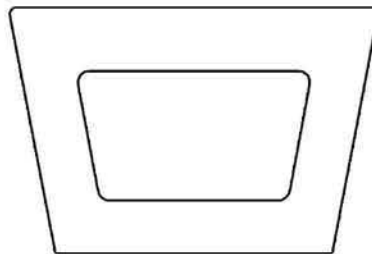
GeoStone Retaining Wall Systems, Inc.
P.O. Box 325
Westover, AL 35185
205-678-9969
www.geostone.com



NOT TO SCALE
GEOSTONE RETAINING WALL PROFILE



VARIOUS WALL DESIGNS



GeoStone Retaining Walls
 Various Wall Profile
 Westover, AL 35185
 Tel: 205-678-9969
 Toll Free: 877-GEO-9900
 http://geostone.com



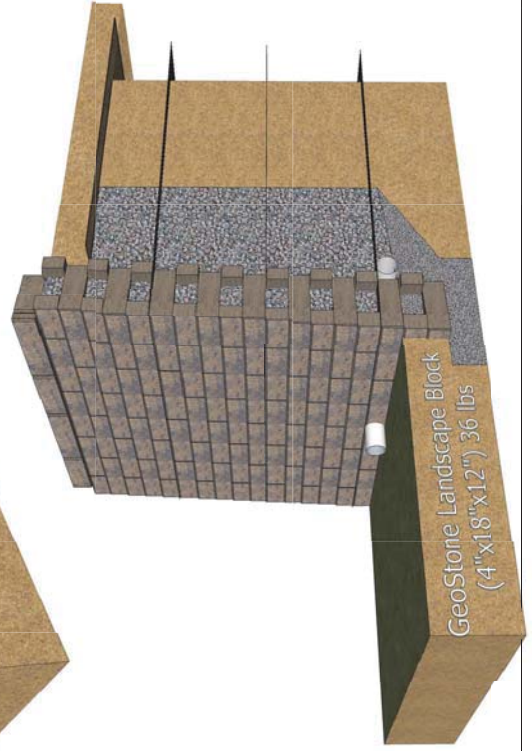
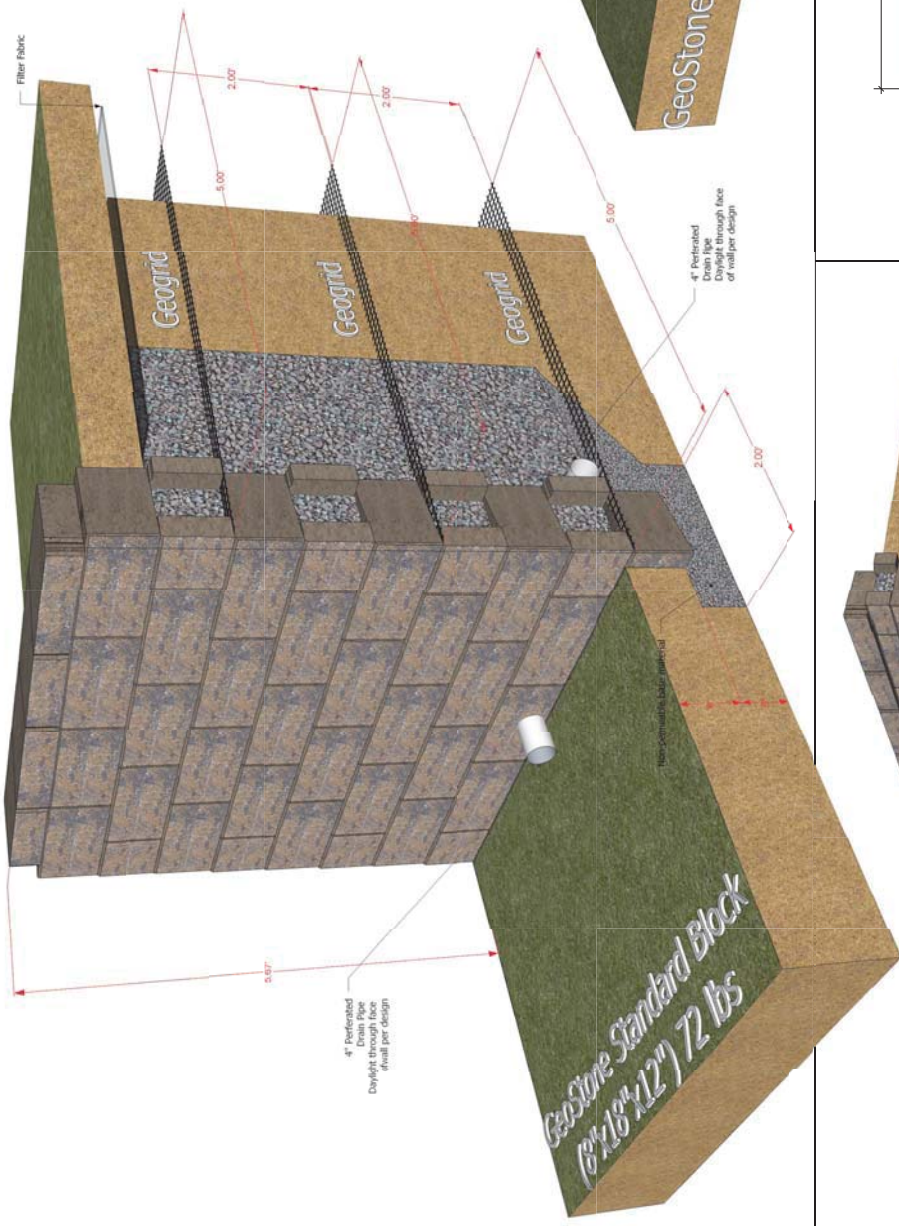
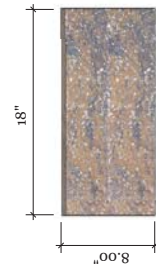
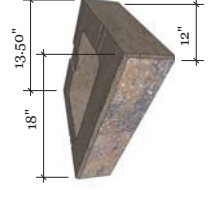
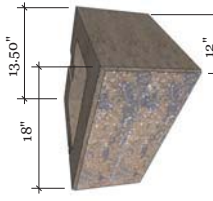
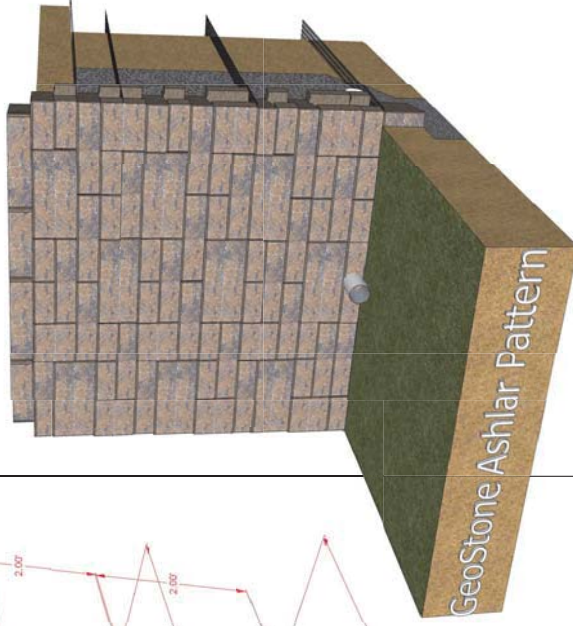
Various Wall Profile
 Product Used:
 GeoStone Landscape Block
 -Autumblend Color shown
 GeoStone Standard Block
 -8"x18"x12" - 72 lbs
 -Autumblend Color Shown

DRAWN BY
 DJA

ISSUE
 09.04.12

RE-ISSUE
 00.00.00 (0)

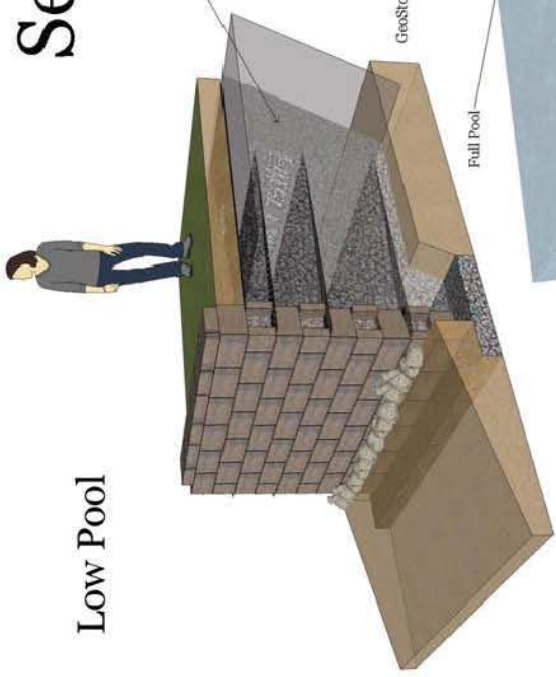
DESCRIPTION
 The walls in this drawing are for illustration purposes only and were designed according to industry standards and procedures. Certain surcharge, etc. will affect the overall design of the wall. It is recommended that all drawings be verified by a professional engineer before applying to actual situations.



GeoStone Retaining Walls
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Seawalls

Low Pool



Full Pool



Soil Cap for vegetation

Finishing Cap

GeoStone Block

Full Pool

Filter Fabric

Seawall Wall Profile
 Product Used:
 GeoStone Retaining Block
 Stone
 - Autumn Blend Color shown

DRAWN BY
 DAA

ISSUE
 09.04.12

RE-ISSUE
 06.00.00(0)

DESCRIPTION
 The walls in this drawing are for illustration purposes only and were designed according to industry standards and procedures. Certain details are not shown. If the walls are to be used in a project, the overall design of the wall. It is recommended that all drawings be verified by a professional engineer before applying to actual situations.



Rock Backfill Flooded

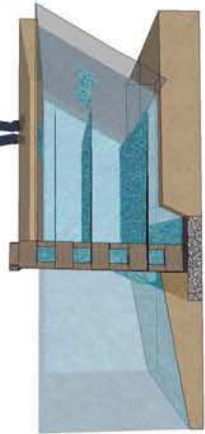
Geogrid Layers

Crushed stone footing - No Fines

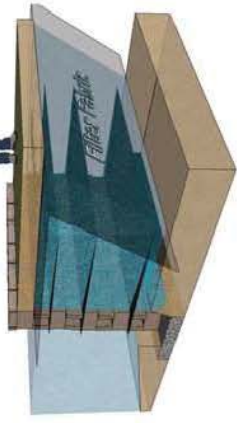
Rip Rap / Dam Stone

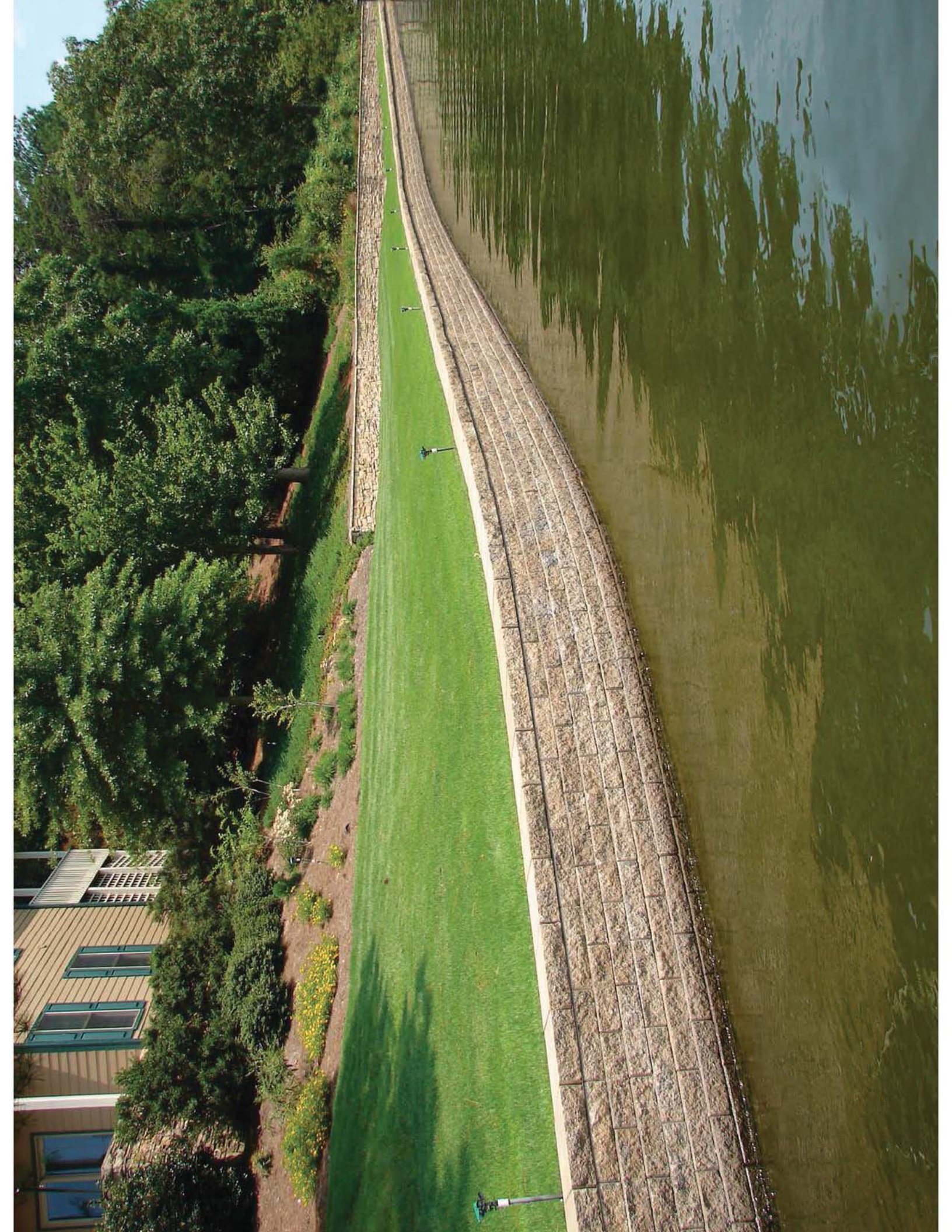
Lake Bed

Side View

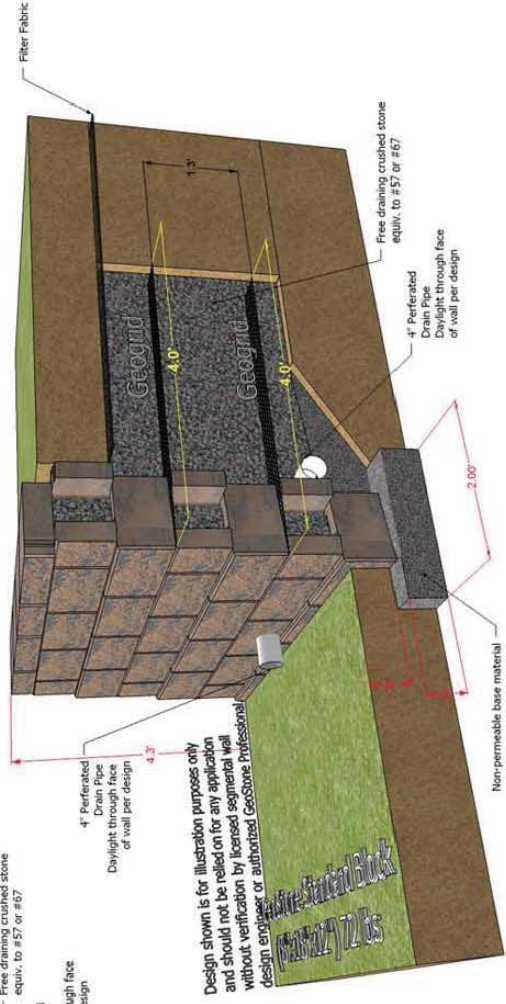
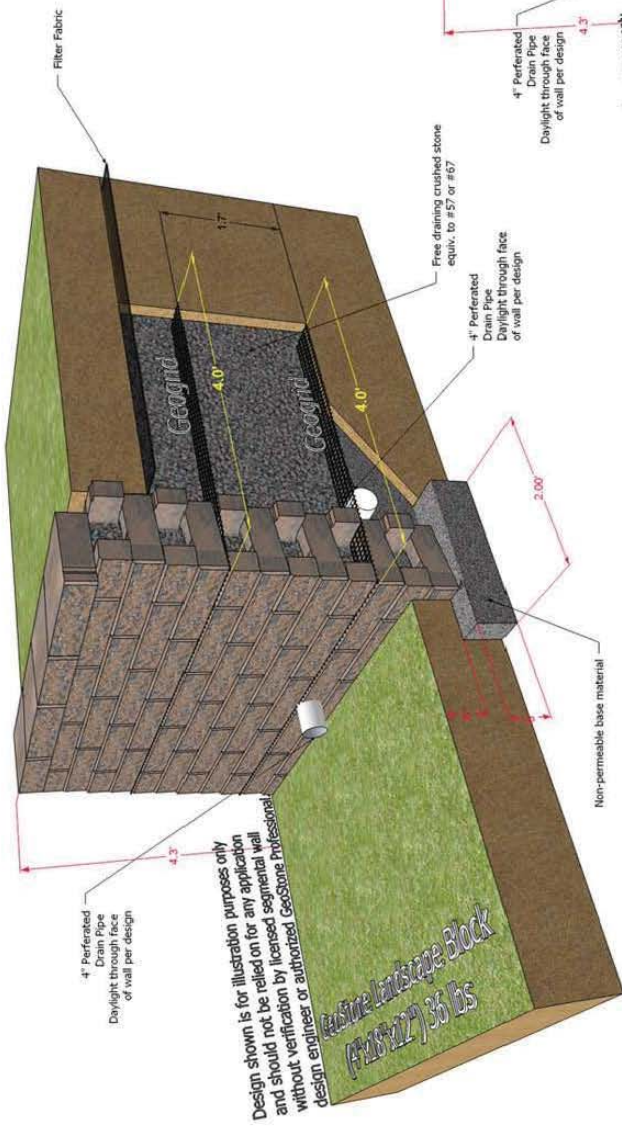
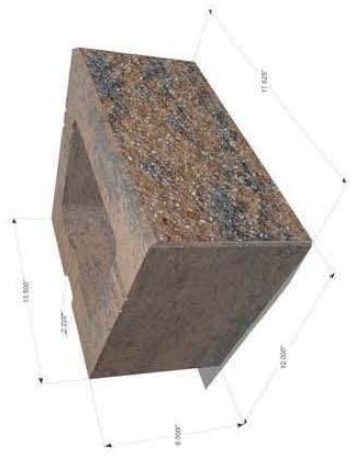
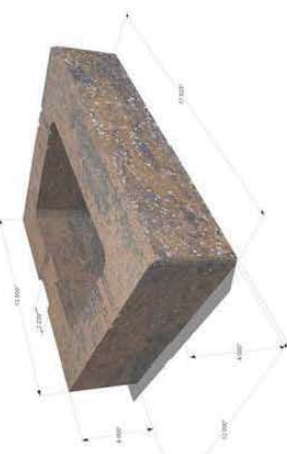


Back Iso





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Geostone Hardscape
 1122 Hwy 280 East
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CLIENT
 Client Name
 1245 Main Street
 Boulder, CO 00000
 Tel: 000.000.0000

ISSUE
 08.08.08
 RE-ISSUE
 08.09.08

PROJECT NO.
 245170
 PROJECT
 RE-ISSUE

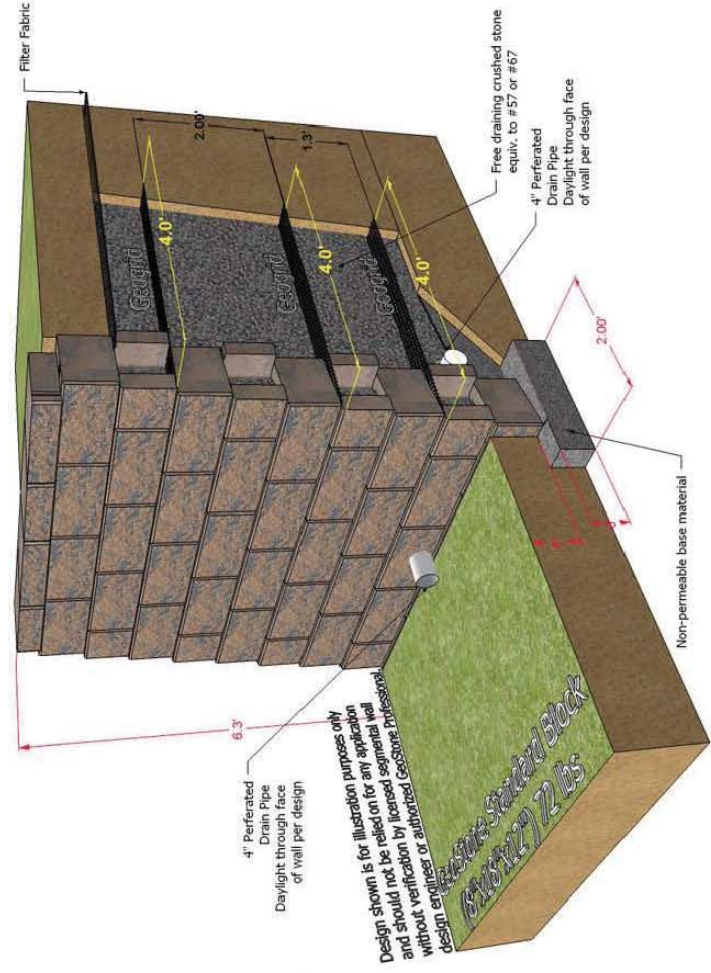
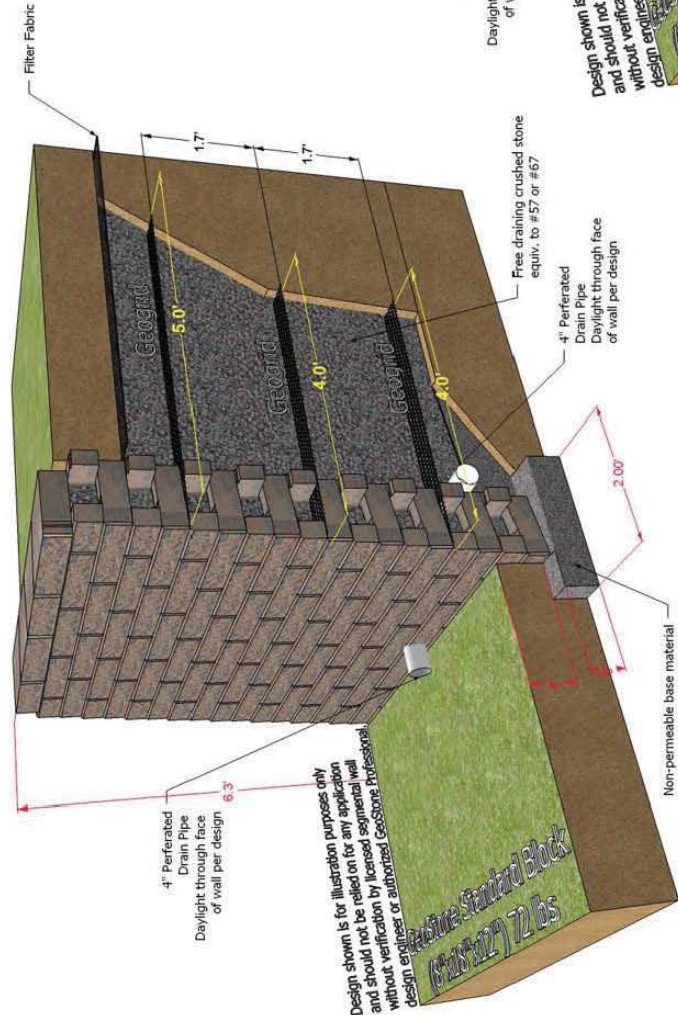
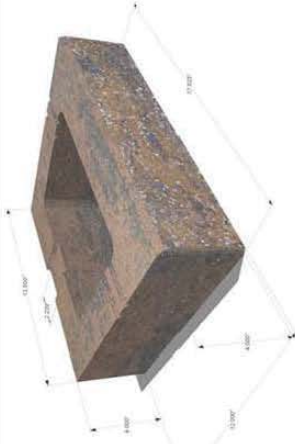
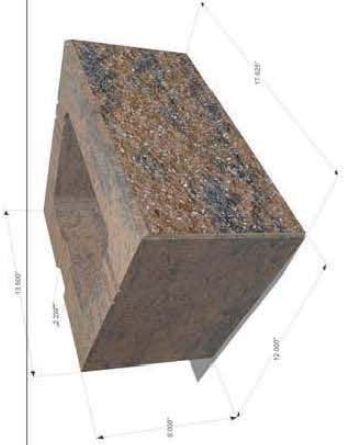
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 D/A
 DESCRIPTION
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 08.09.08

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 Project Name
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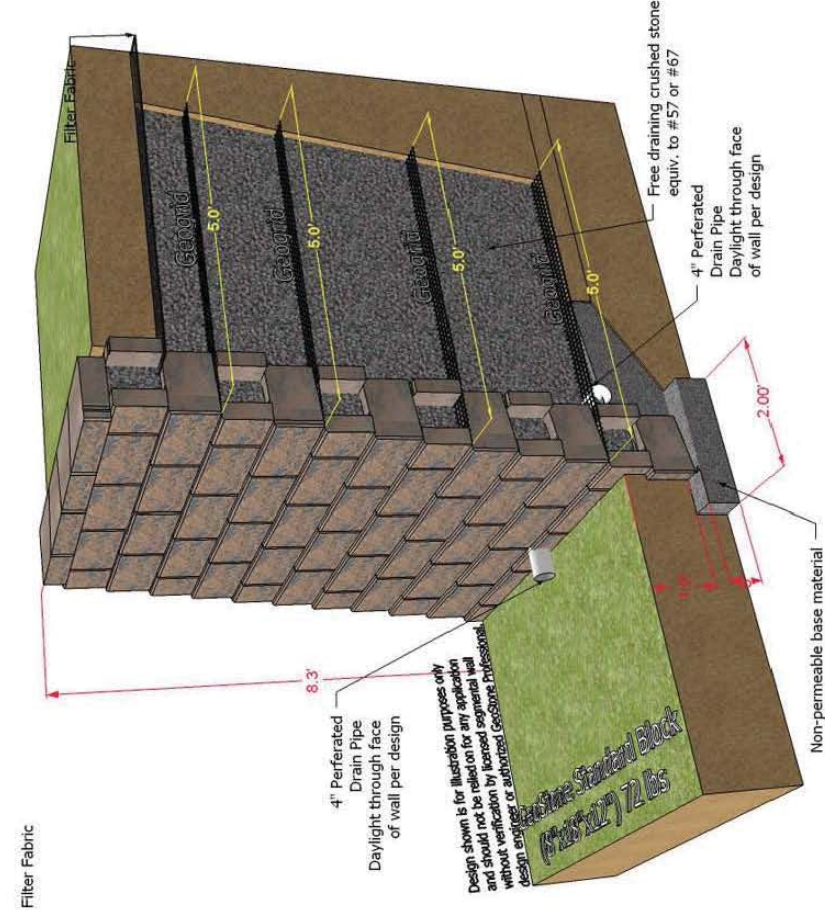
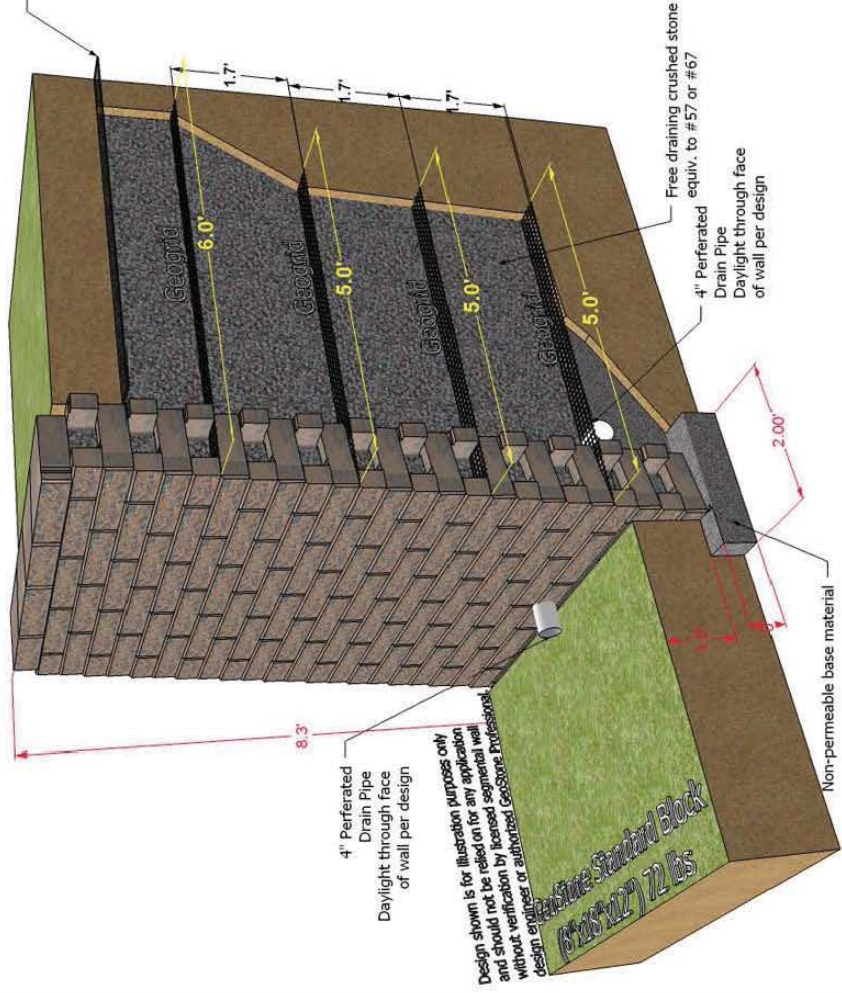
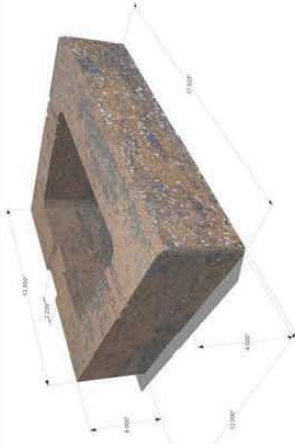
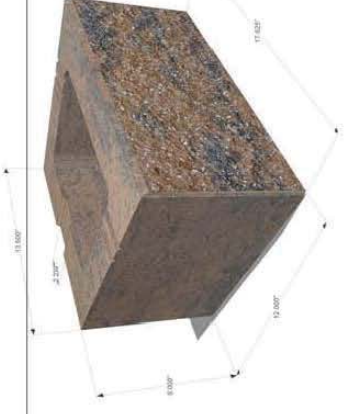
PROJECT NO.
 245.170

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DESCRIPTION
 Landscape Rendering

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PROJECT NO.
 245.170

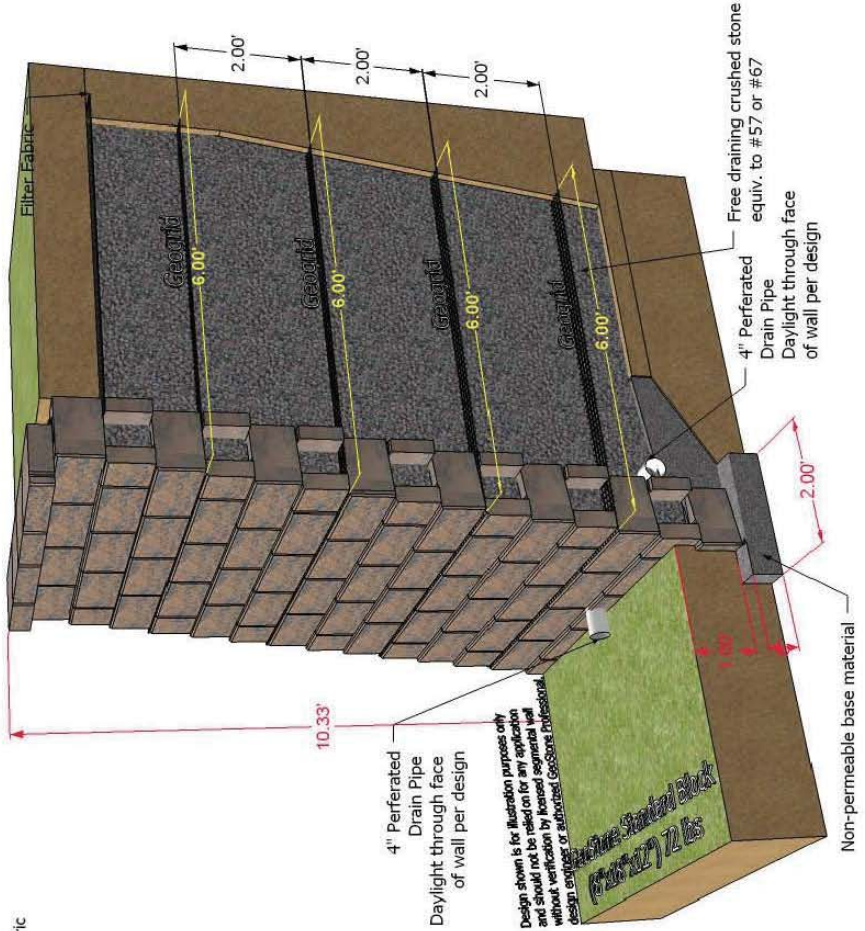
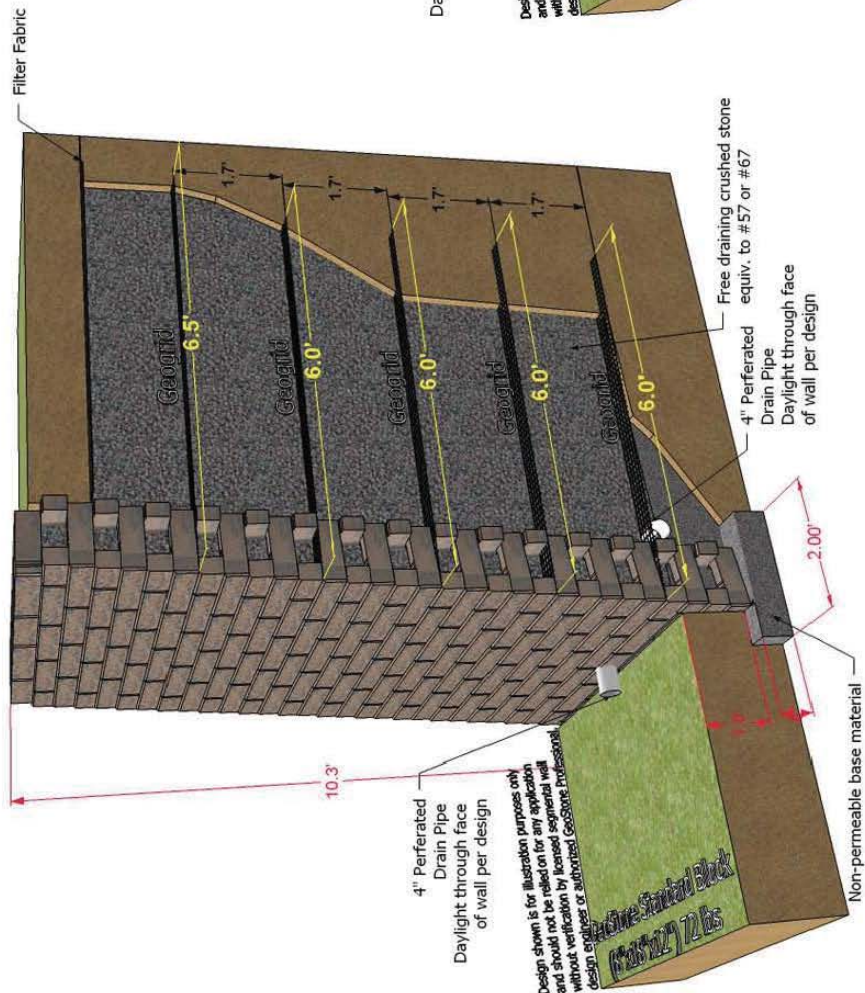
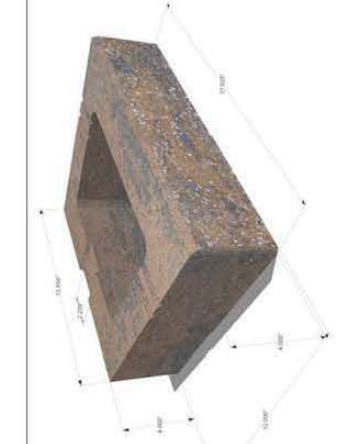
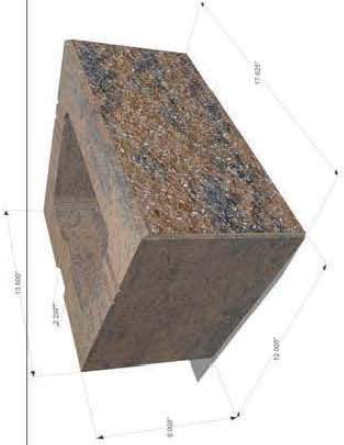
ISSUE
 08.08.08

DESIGNER
 RE-ISSUE
 08.09.08

PROJECT NAME
 Geostone Hardscape

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DESCRIPTION
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PROJECT
 RE-ISSUE
 08.09.08

PROJECT NO.
 245.170

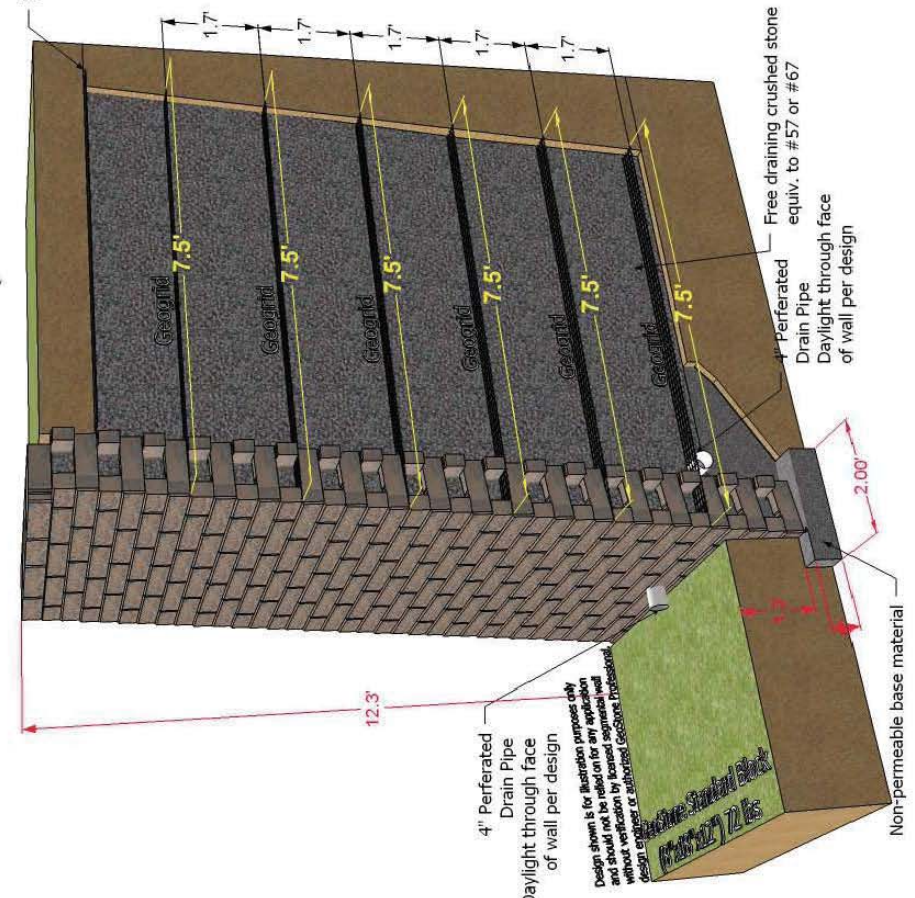
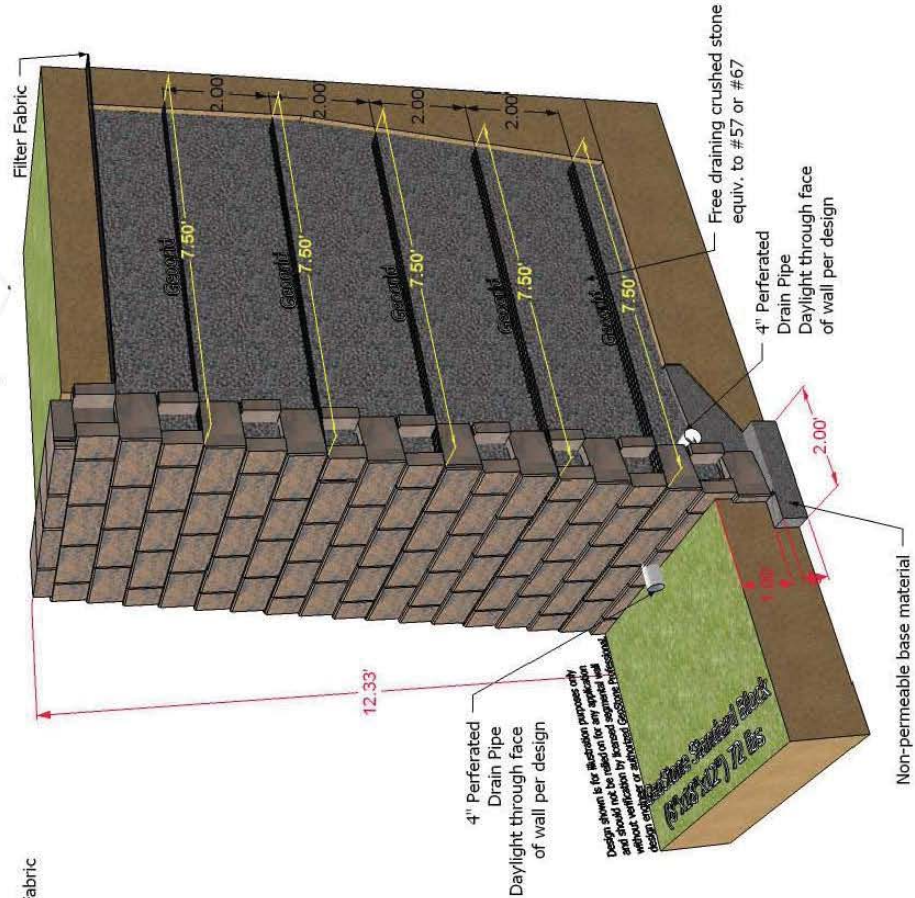
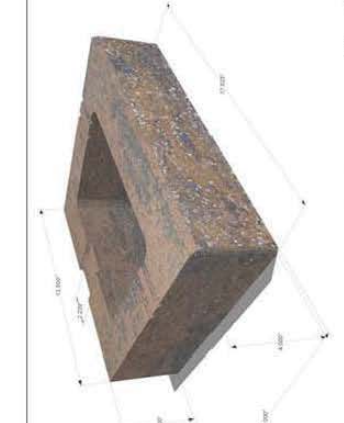
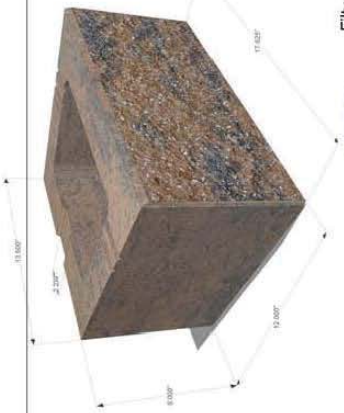
ISSUE
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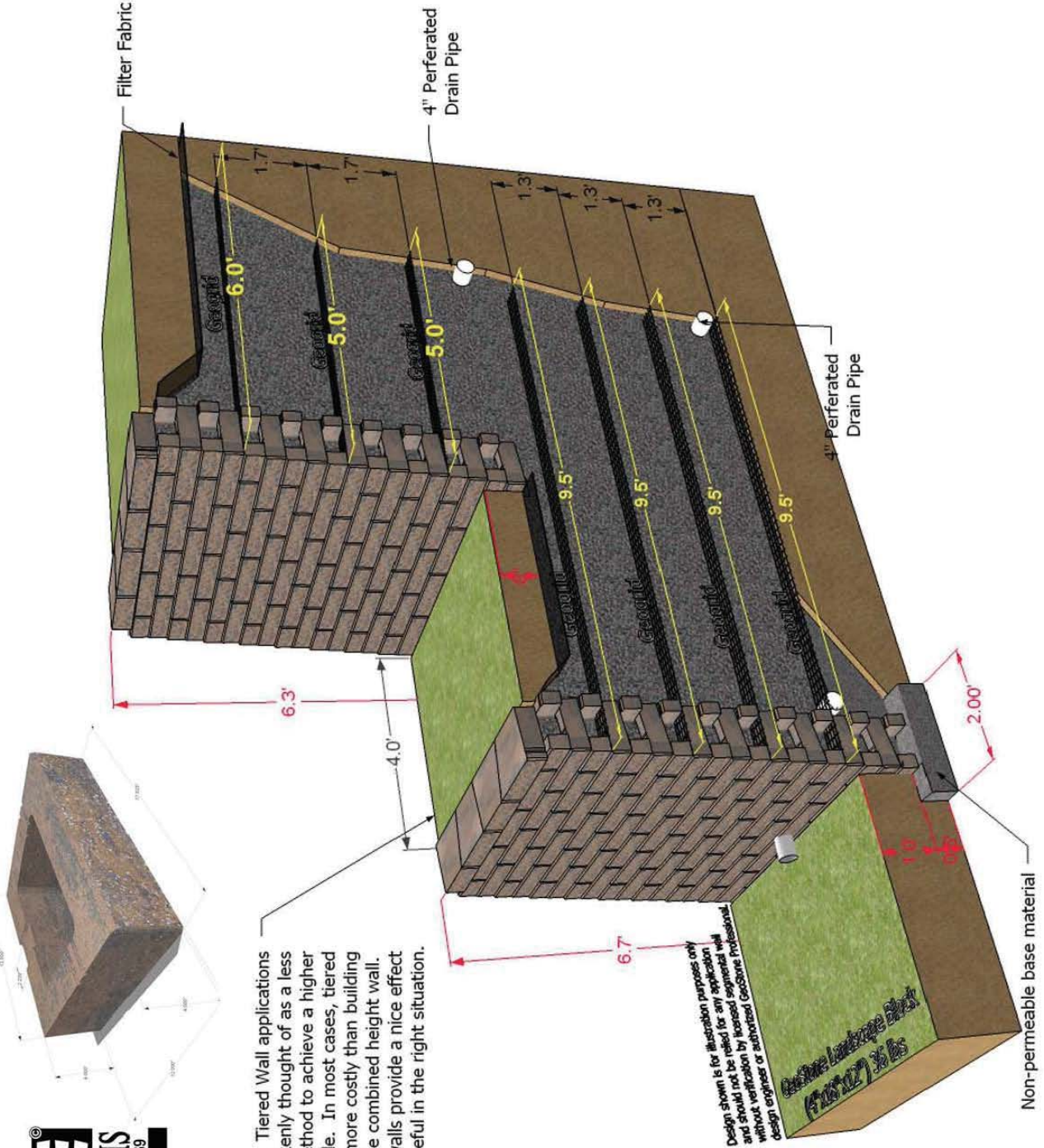
PROJECT Name
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 08.09.08

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DESCRIPTION
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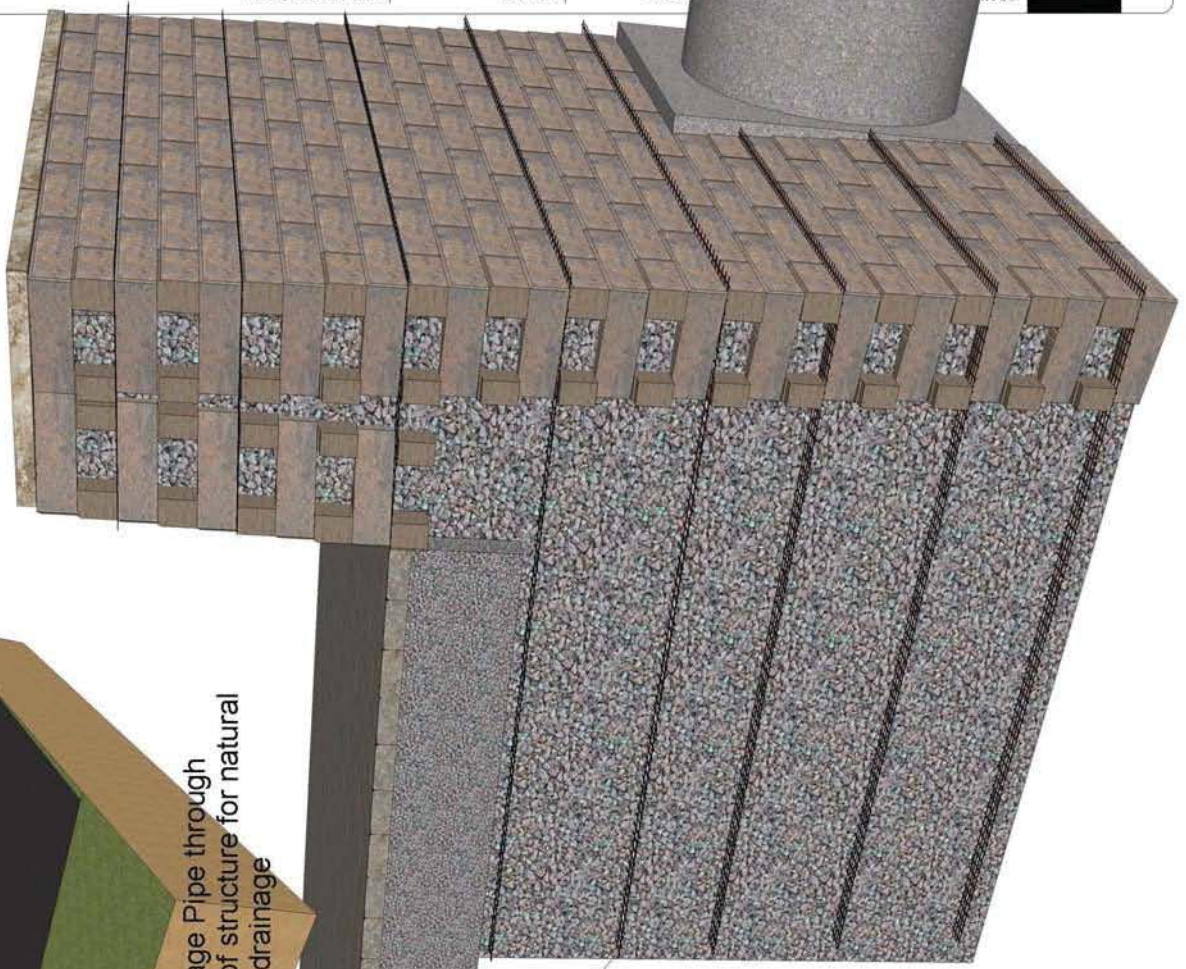
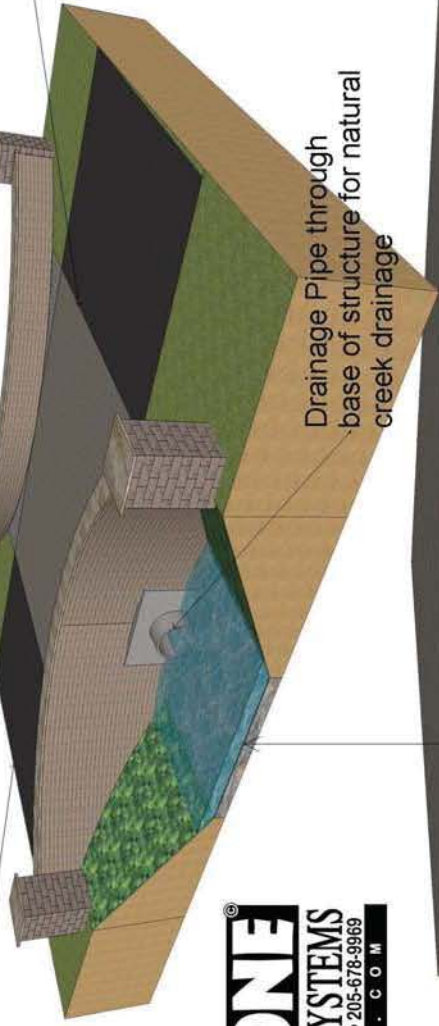


Tiered Wall applications are mistakenly thought of as a less expensive method to achieve a higher finished grade. In most cases, tiered walls are more costly than building a single combined height wall. Tiered walls provide a nice effect and can be useful in the right situation.

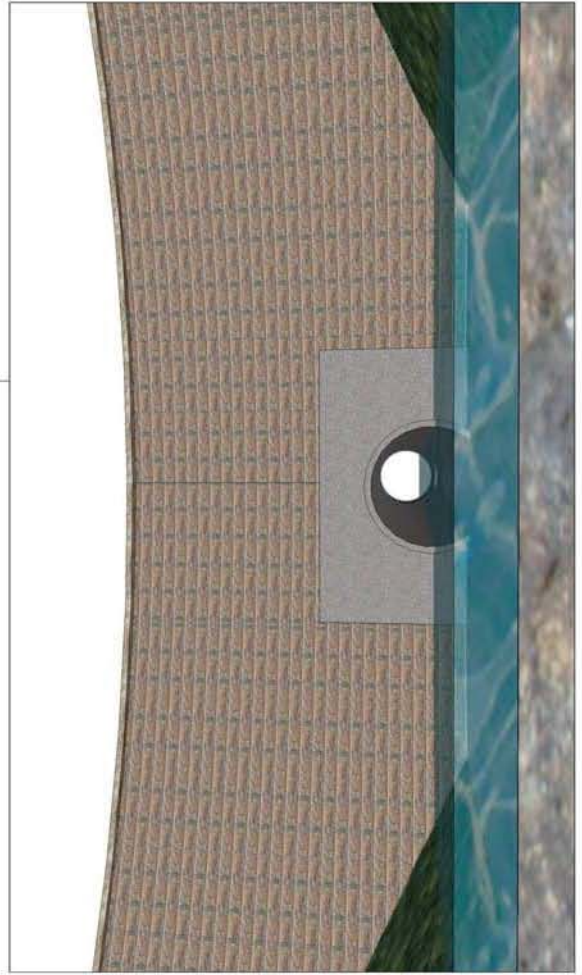


Commercial Drive

Columns Ending Parapet Walls



Geogrid Layers



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Bridge Walls

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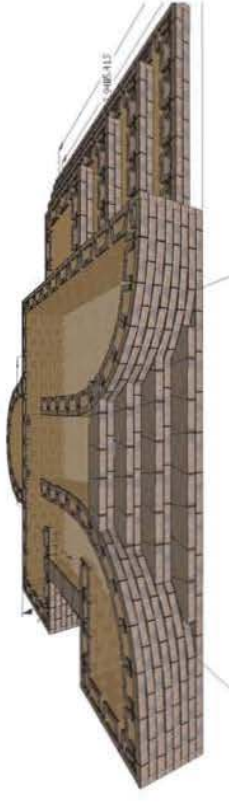
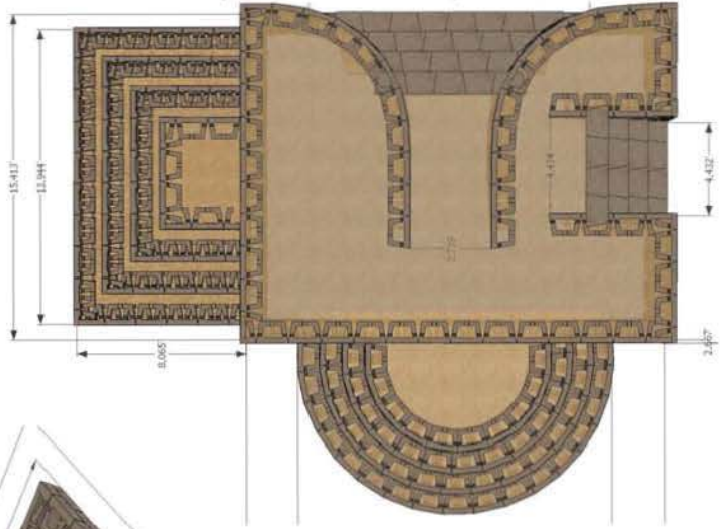
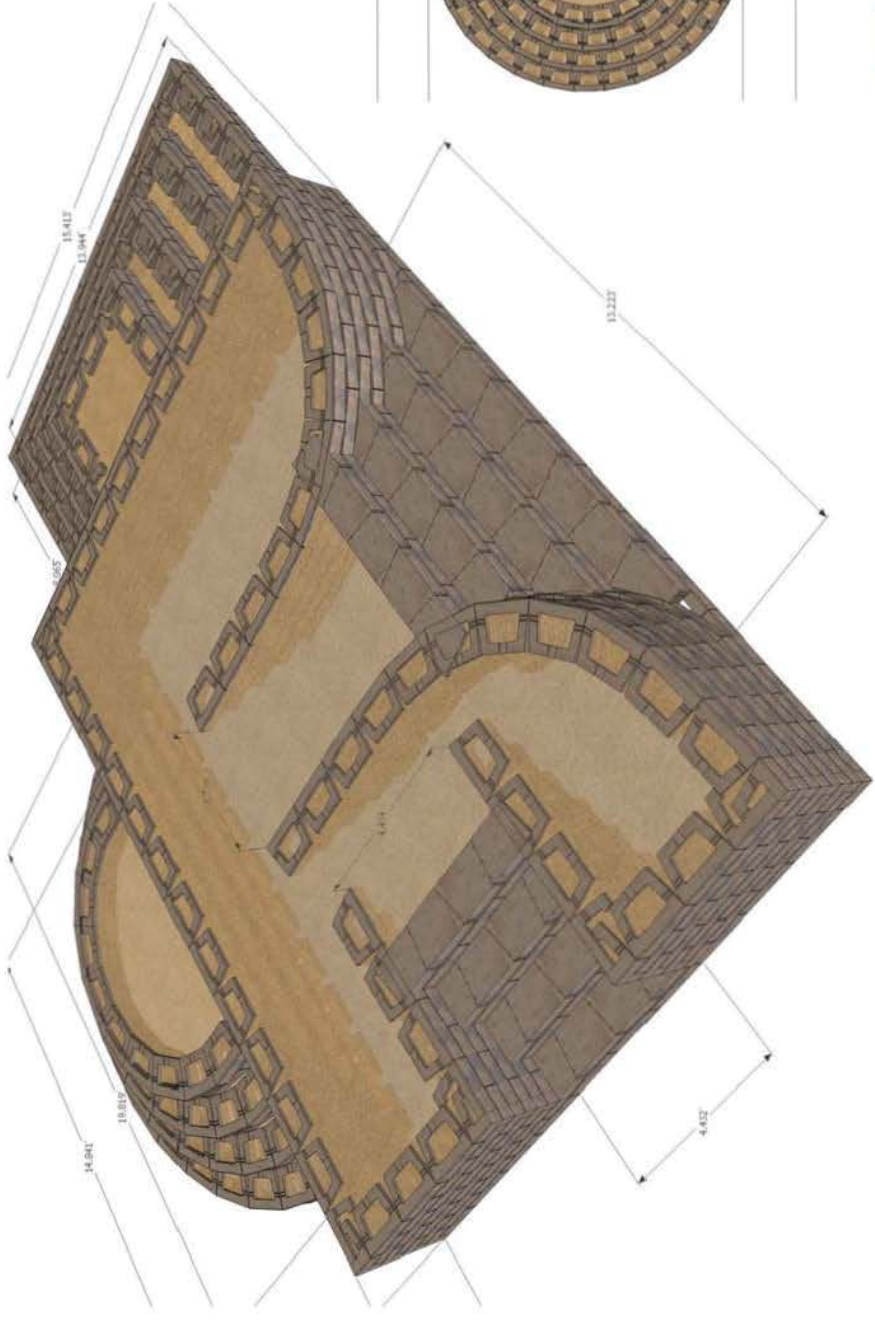
Stairs



Various Stair Applications
 Product Used:
 Geostone Retaining Block
 "A" 18" x 24" x 8" for
 - Autumn Blend Color shown

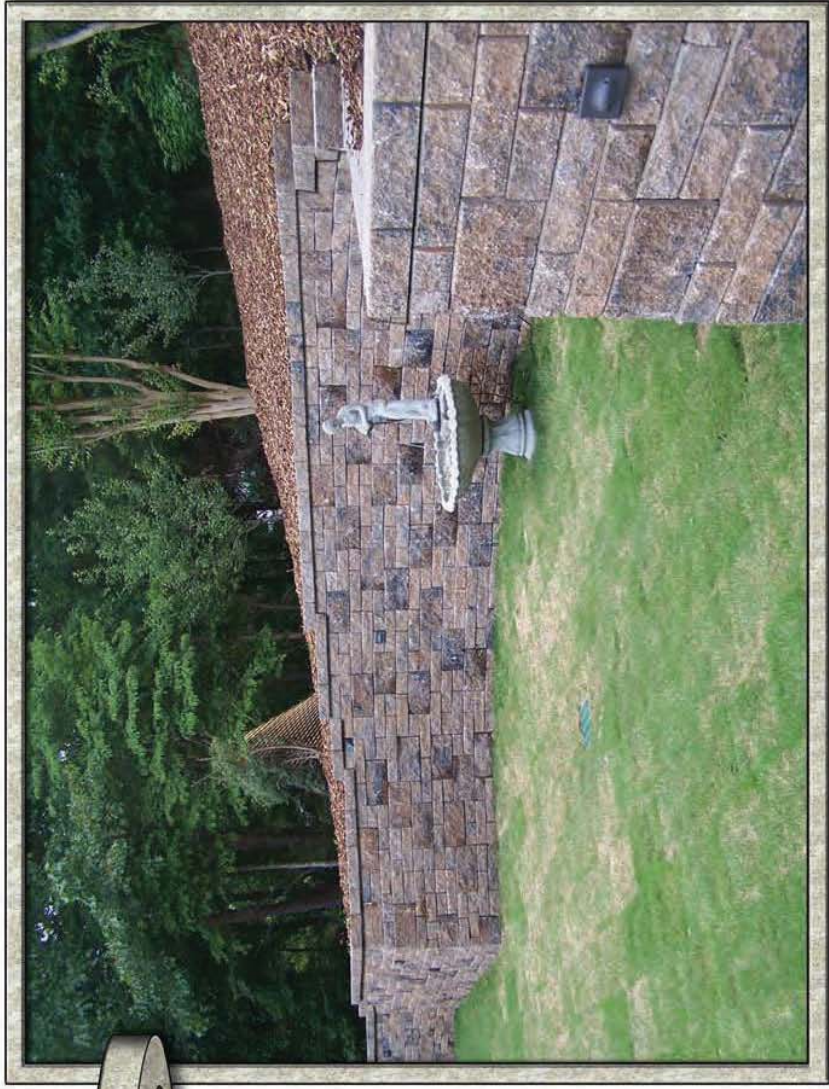
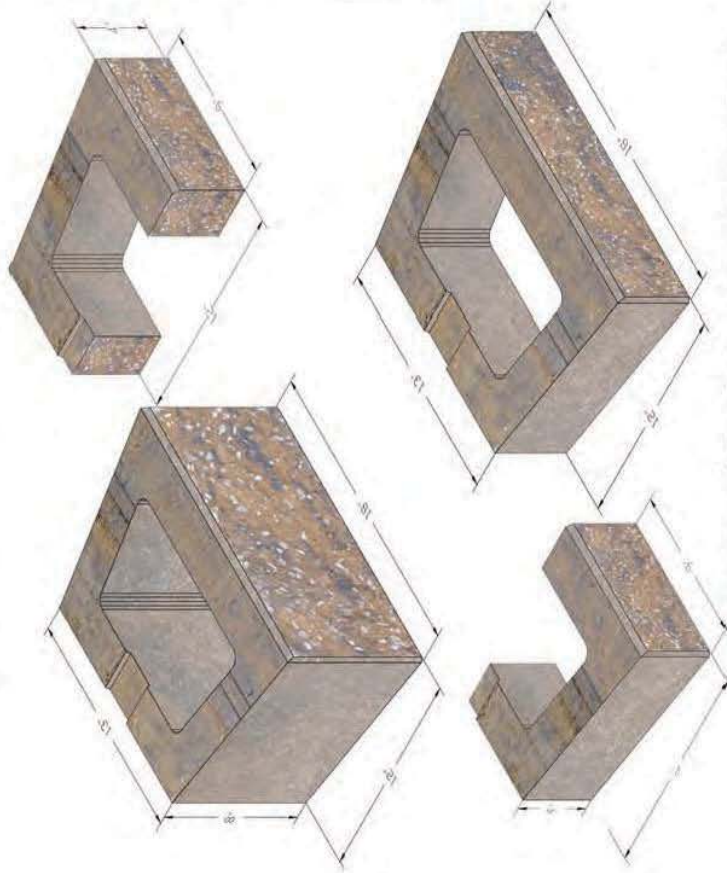
DRAWN BY
 JMA
ISSUE
 09.04.12
RE-ISSUE
 08.03.00(0)

DESCRIPTION
 This wall in this drawing are for illustration purposes only and were designed according to industry standards and procedures. Certain standards and procedures, such as drainage, etc. will affect the overall design of the wall. It is recommended that all drawings be verified by a professional engineer before applying to actual situations.



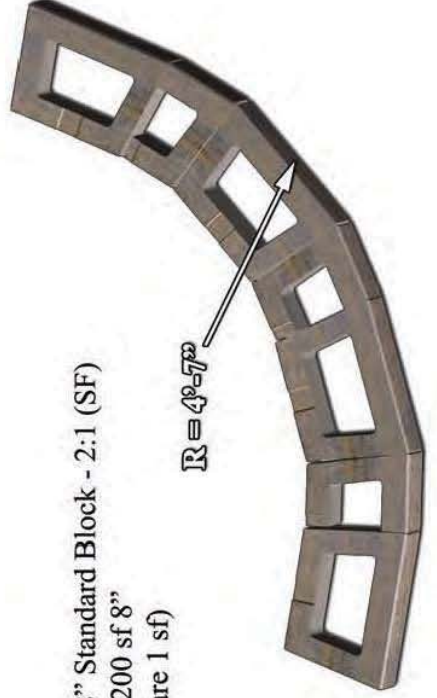


Multi-Piece Pattern



The GeoStone Retaining Wall System's open core design allows for maximum flexibility in all sorts of applications. The latest testament to this is a multiple piece pattern procedure. By cutting the 4" block in half, a random configuration can be created that utilizes both the 8" & 4" blocks. This configuration will break the horizontal lines in the wall. This is a very simple technique that can add so much to the look of your project.

Ratio of 4" Landscape Block to 8" Standard Block - 2:1 (SF)
 Ex: 600 sf of wall = 400 sf 4" + 200 sf 8"
 (4" blocks are 1/2 sf - 8" blocks are 1 sf)

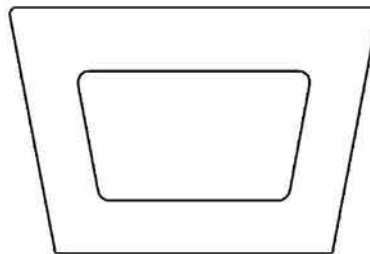








CORNERS & RADII



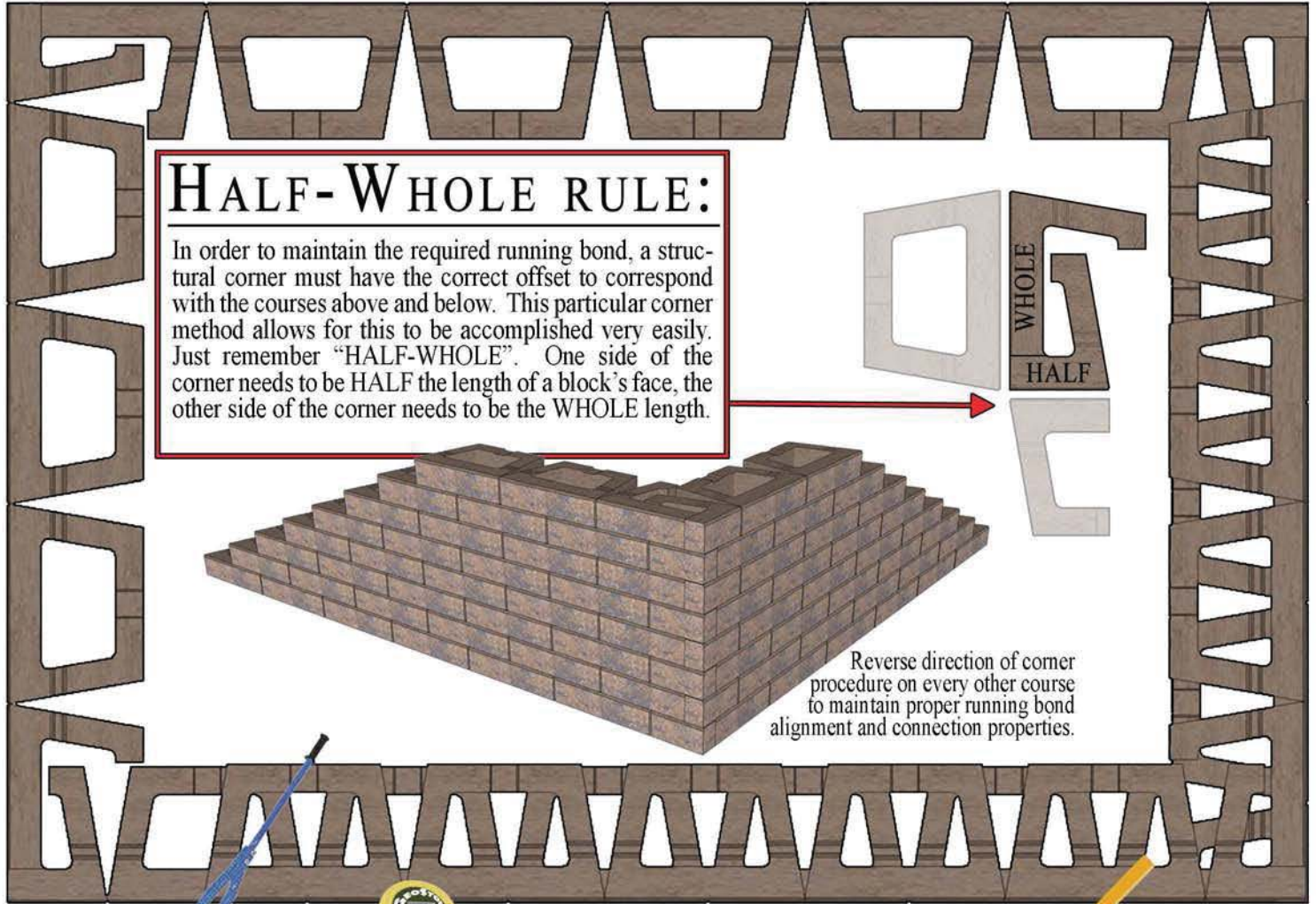
GEOSTONE OPEN CORE CORNER

AT GEOSTONE, WE PRIDE OURSELVES ON COMING UP WITH NEW AND BETTER WAYS OF DOING THINGS. THE OPEN CORE CORNER IS A PERFECT EXAMPLE OF THIS. PRIOR TO THE OPEN CORE CORNER, WALL INSTALLERS HAD TWO OPTIONS, MAKE A CORNER (MITER JOINT) OR USE A CORNER BLOCK.

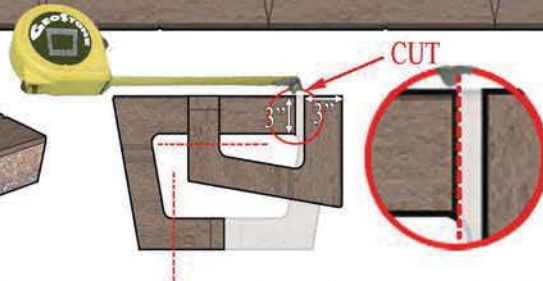
MITER CORNER: INVOLVED CUTTING BLOCKS ON A 45 DEGREE ANGLE AND FITTING THE TWO PIECES TOGETHER TO MAKE AN OUTSIDE CORNER. THIS PROCESS LEAVES AN OBVIOUS AND UNSIGHTLY VERTICAL SEAM AT THE POINT WHERE THE TWO BLOCKS MEET. OVER TIME THIS SEAM MAY BEGIN TO OPEN UP WHICH MAY OR MAY NOT POSE A STRUCTURAL PROBLEM DEPENDING ON THE SEVERITY OF THE VOID. REGARDLESS, THE WALL'S ESTHETIC VALUE HAS BEEN COMPROMISED.

CORNER BLOCK: WILL ALMOST NEVER COME FROM THE SAME RUN BECAUSE IT IS MADE WITH A DIFFERENT MOLD, MORE THAN LIKELY AT A DIFFERENT TIME, AND UNDER DIFFERENT CONDITIONS. THIS MAY PRODUCE A SIGNIFICANT COLOR VARIATION FROM THE REST OF THE WALL.

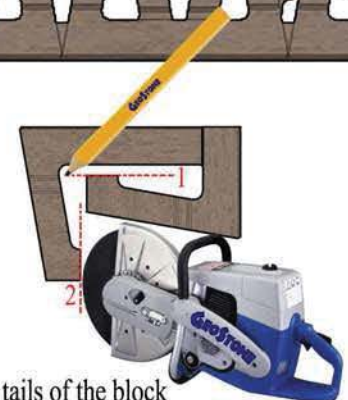
THE OPEN CORE CORNER IS A PROCEDURE THAT ALLOWS THE INSTALLER TO MAKE A STRUCTURAL CORNER FROM THE SAME BLOCK USED IN THE WALL ALLOWING FOR MATCHING CORNER THAT WILL NOT SEPARATE. INSTEAD OF A VERTICAL SEAM, YOUR CORNER WILL HAVE A "CHISELED ROCK" LOOK THAT WILL COMPLIMENT THE REST OF YOUR WALL.



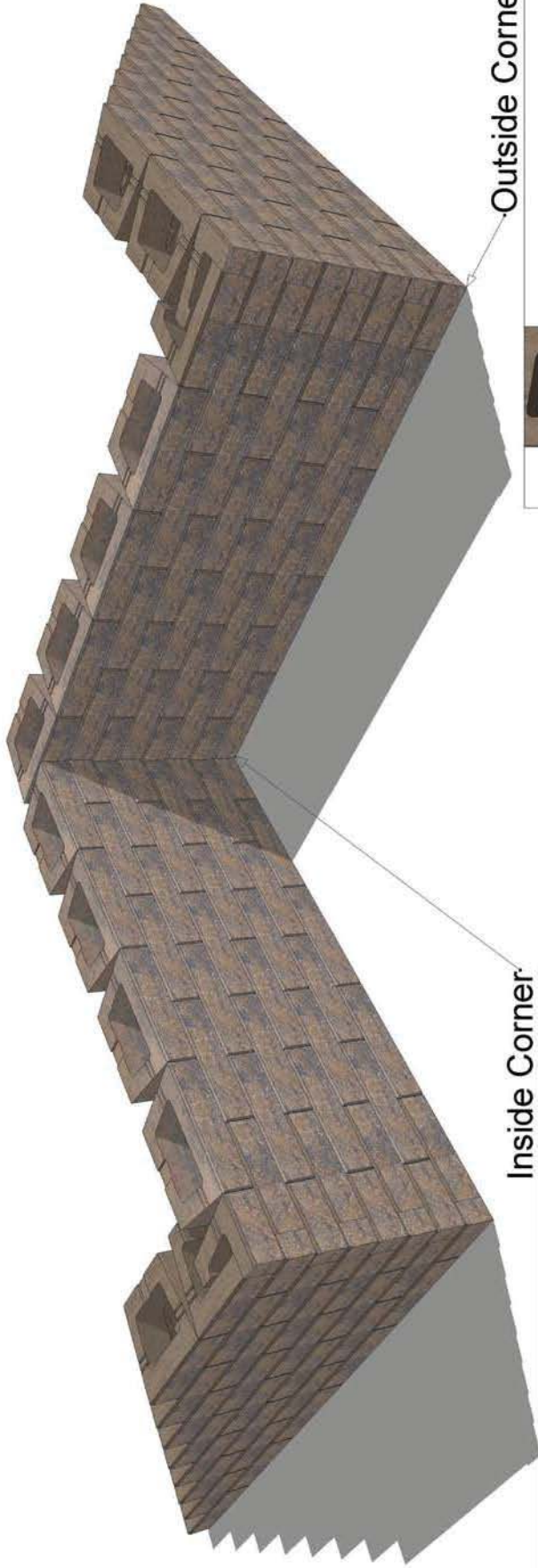
A corner takes 1.5 blocks per course to make. The first block will be Split in **HALF**. Take care to make sure this split is made at exactly the halfway point so that the other half can be used on the next course's corner. Splits are made with a block or paver splitter as shown above. Hammer and chisel cause undesired breaks.



The next block will be the **WHOLE** side. Measure all the way to the point where the inside of the core starts to make its turn. This is where a cut is necessary in order to fit snug against the machined edge of the other piece of the corner. The length of the piece to be cut off should be 3" (the same as the width of the split edge on the half block).

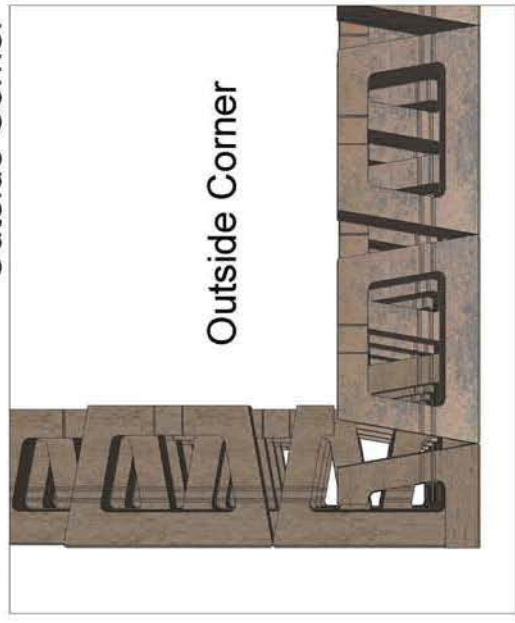


The tails of the block can either be cut or split to fit. The next block on the "**HALF**" side will determine where cut #2 will be placed. Use a liberal amount of glue in your corners for added connection. Sack Concrete can be placed in the cores with the rock as well.

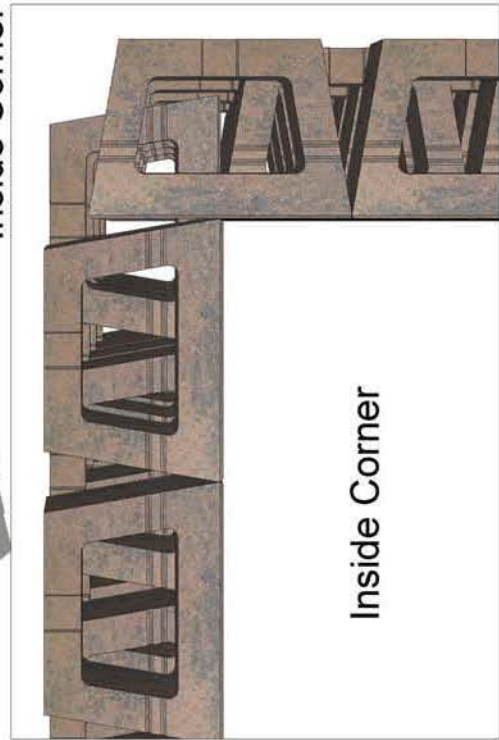


Outside Corner

Inside Corner



Outside Corner



Inside Corner

DRAWN BY
DJA
DESCRIPTION
Corners

PROJECT NO.
245.170
PROJECT
Project Name

ISSUE
05.14.14
RE-ISSUE

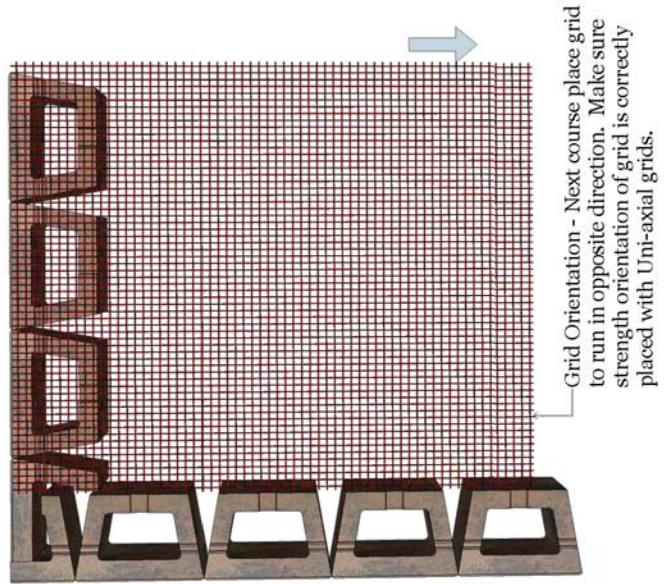
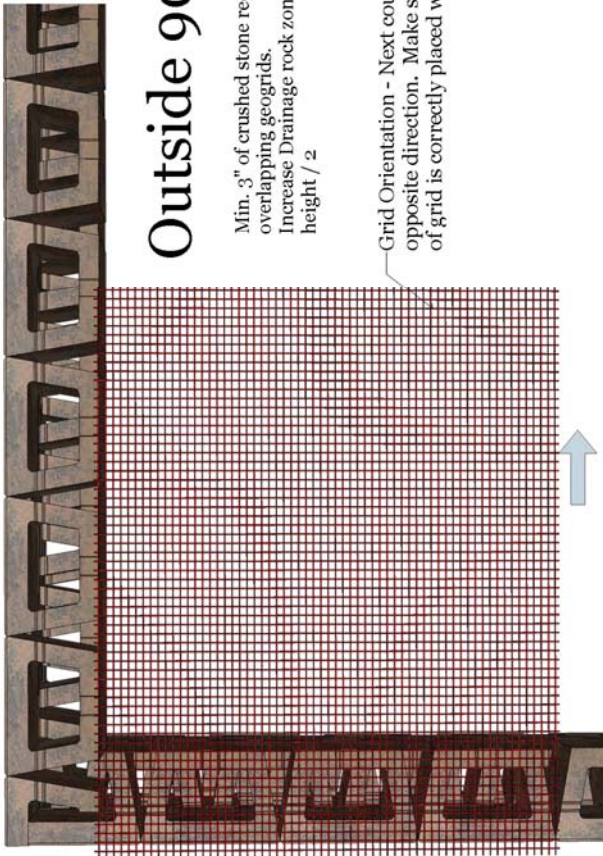
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Client Name
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Boulder, CO 80000
Tel: 000.000.0000

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Westover, AL 35185
205-678-9969
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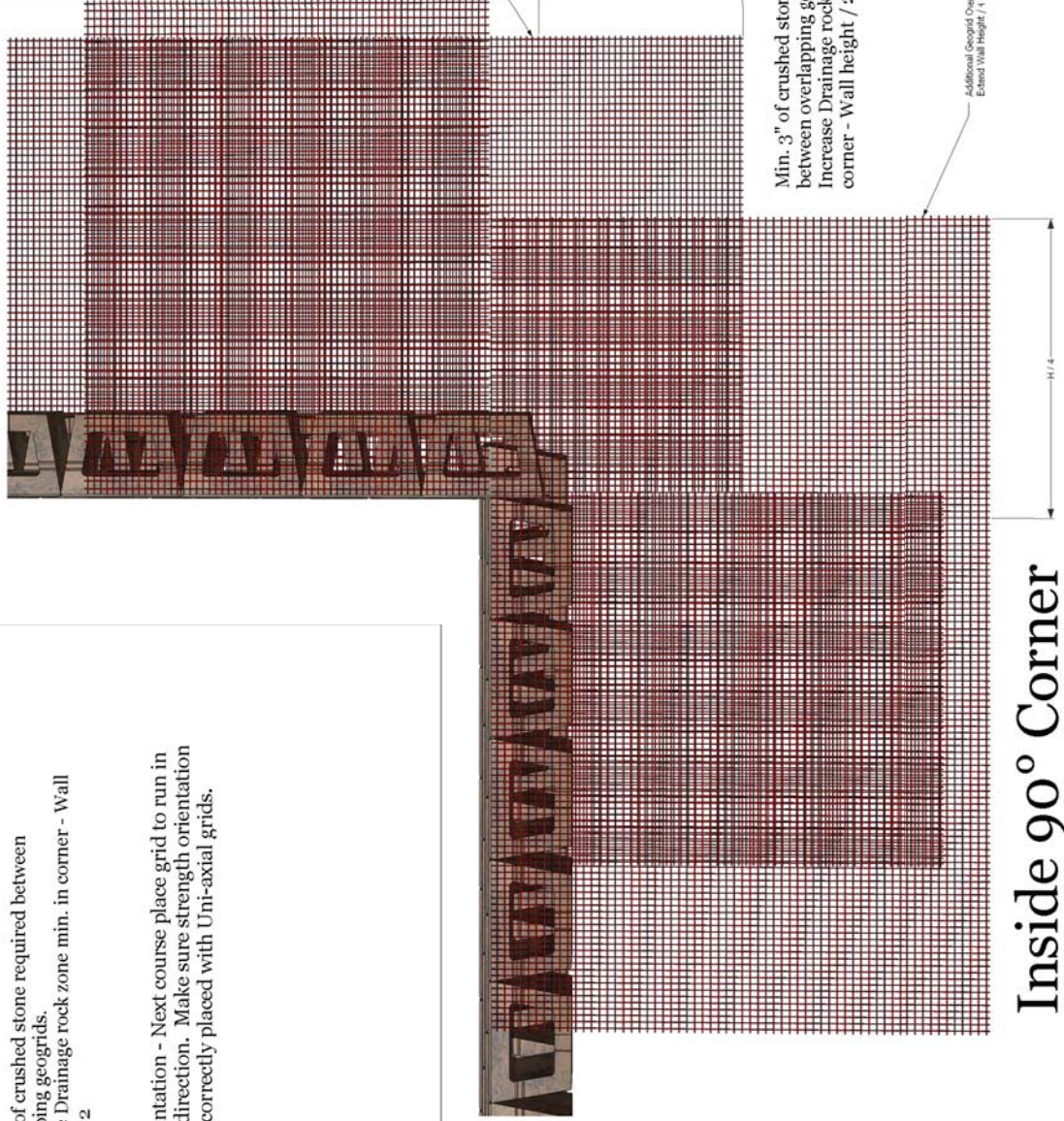
Outside 90° Corner

Min. 3" of crushed stone required between overlapping geogrids.
 Increase Drainage rock zone min. in corner - Wall height / 2

Grid Orientation - Next course place grid to run in opposite direction. Make sure strength orientation of grid is correctly placed with Uni-axial grids.



Grid Orientation - Next course place grid to run in opposite direction. Make sure strength orientation of grid is correctly placed with Uni-axial grids.



Additional Geogrid Overlap
 Extend Wall Height / 4

H / 4

Min. 3" of crushed stone required between overlapping geogrids.
 Increase Drainage rock zone min. in corner - Wall height / 2

Additional Geogrid Overlap
 Extend Wall Height / 4

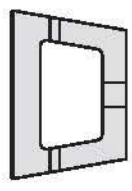
H / 4

Inside 90° Corner



General Note

GEOSTONE RETAINING WALLS ARE MADE TO ADJUST FOR DIFFERENT HEIGHTS AND SITUATIONS. REINFORCEMENT IS SOMETIMES REQUIRED. PLEASE REFER TO www.geostone.com FOR GENERAL REINFORCING PROCEDURES AND GUIDELINES. ALSO PLEASE NOTE THAT A LOT OF MUNICIPALITIES WILL REQUIRE THAT RETAINING WALLS OVER 4 FEET IN HEIGHT BE DESIGNED BY A PROFESSIONAL ENGINEER. PLEASE CHECK WITH YOUR LOCAL MUNICIPALITY PRIOR TO ANY CONSTRUCTION.



No.	Description/Part	Qty

DATE: 04/28/2016

TIME: 10:00

PROJECT NAME:

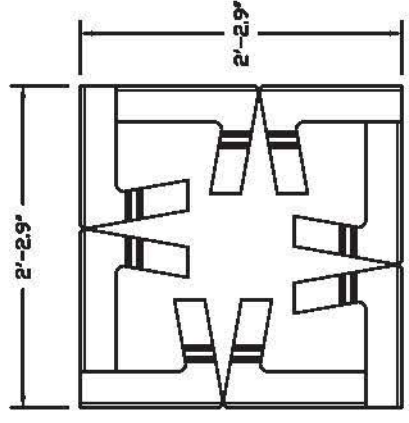
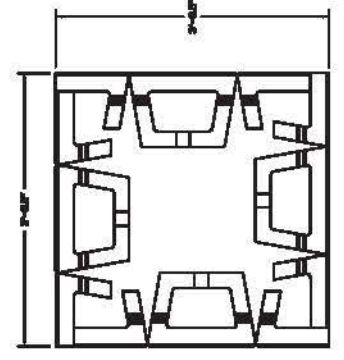
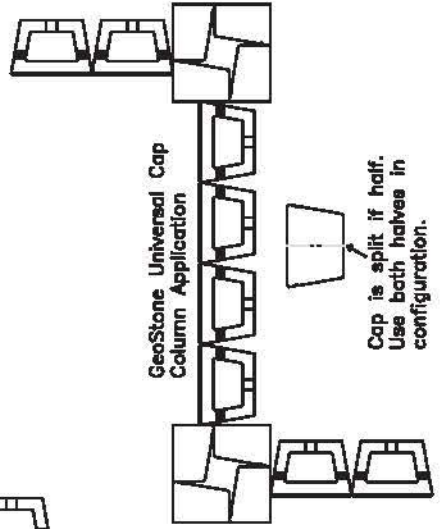
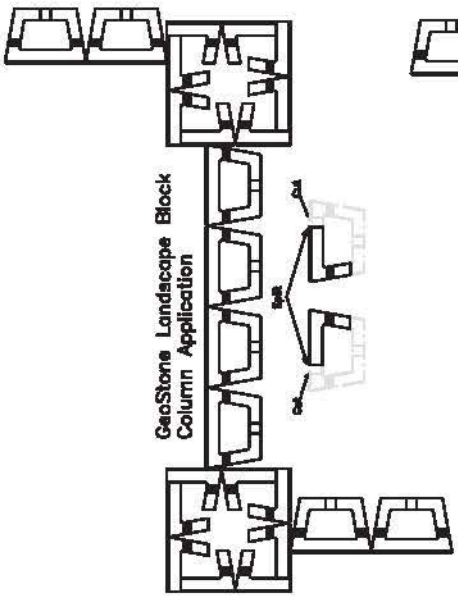
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DATE:

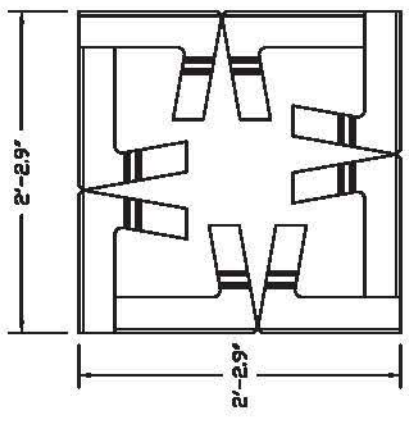
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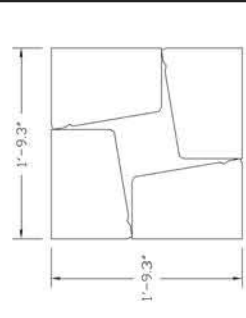
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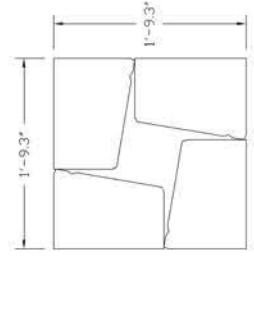
2nd course



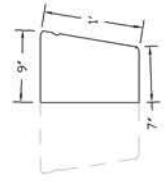
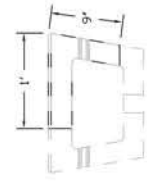
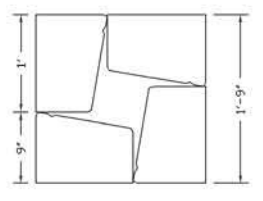
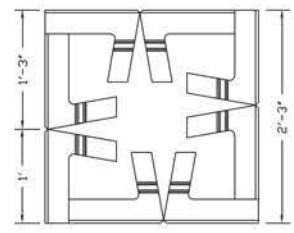
1st course



1st course



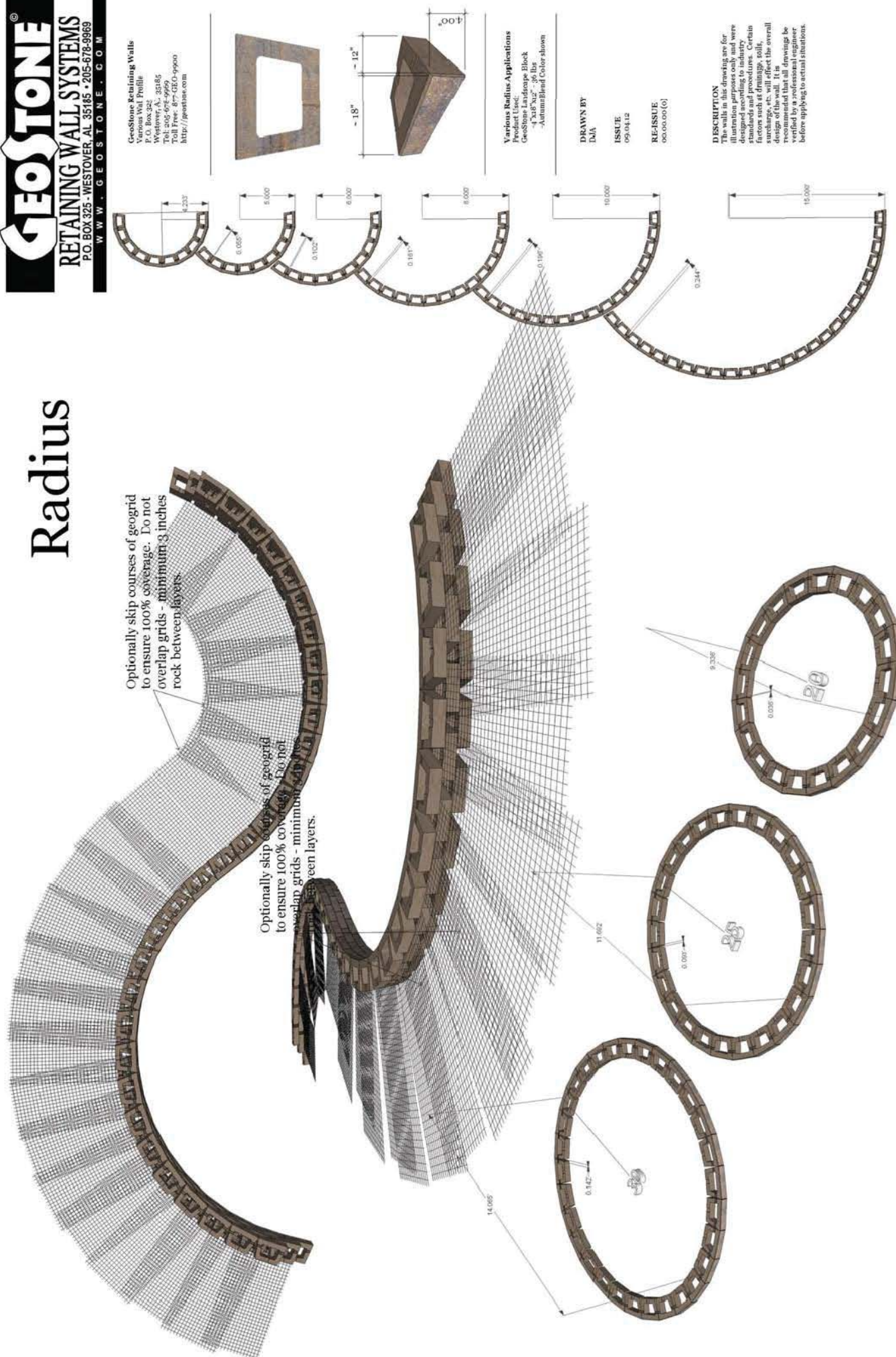
2nd course



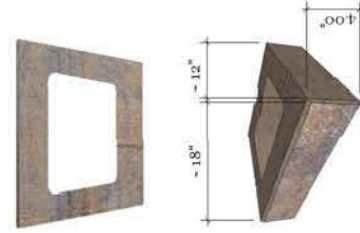
Radius

Optionally skip courses of geogrid to ensure 100% coverage. Do not overlap grids - minimum 3 inches rock between layers.

Optionally skip courses of geogrid to ensure 100% coverage. Do not overlap grids - minimum 3 inches rock between layers.



GeoStone Retaining Walls
 Various Wall Profile
 Westover, AL 35165
 Tel: 205-678-9969
 Toll Free: 877-GEO-9900
 http://geostone.com



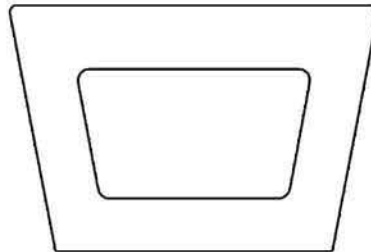
Various Radius Applications
 Product Used:
 - GeoStone Advantage Block
 - GeoStone Advantage Geogrid
 - AutumnBlend Color shown

DRAWN BY
 DAA
ISSUE
 09.04.12
RE-ISSUE
 06.00.00(0)

DESCRIPTION
 The walls in this drawing are for illustration purposes only and were designed according to industry standards and procedures. Certain features and details of the walls, such as the geogrid spacing, will affect the overall design of the wall. It is recommended that all drawings be verified by a professional engineer before applying to actual situations.



MISCELLANIOUS





GEOSTONE SUMMITUBE APPLICATION

THE WALLS IN THIS DRAWING ARE FOR ILLUSTRATION PURPOSES ONLY & WERE DESIGNED ACCORDING TO INDUSTRY STANDARD PROCEDURES. IT IS RECOMMENDED THAT THESE DRAWINGS BE VERIFIED BY AN APPROVED PROFESSIONAL ENGINEER BEFORE APPLYING TO REAL LIFE SITUATIONS.

GEOSTONE RETAINING WALLS ARE MADE TO ADJUST FOR DIFFERENT HEIGHTS AND SITUATIONS. REINFORCEMENT IS SOMETIMES REQUIRED. PLEASE REFER TO www.geostone.com FOR GENERAL REINFORCING PROCEDURES AND GUIDELINES. ALSO PLEASE NOTE THAT A LOT OF MUNICIPALITIES WILL REQUIRE THAT RETAINING WALLS OVER 4 FEET IN HEIGHT BE DESIGNED BY A PROFESSIONAL ENGINEER. PLEASE CHECK WITH YOUR LOCAL MUNICIPALITY PRIOR TO ANY CONSTRUCTION.

GEOSTONE LANDSCAPE BLOCK

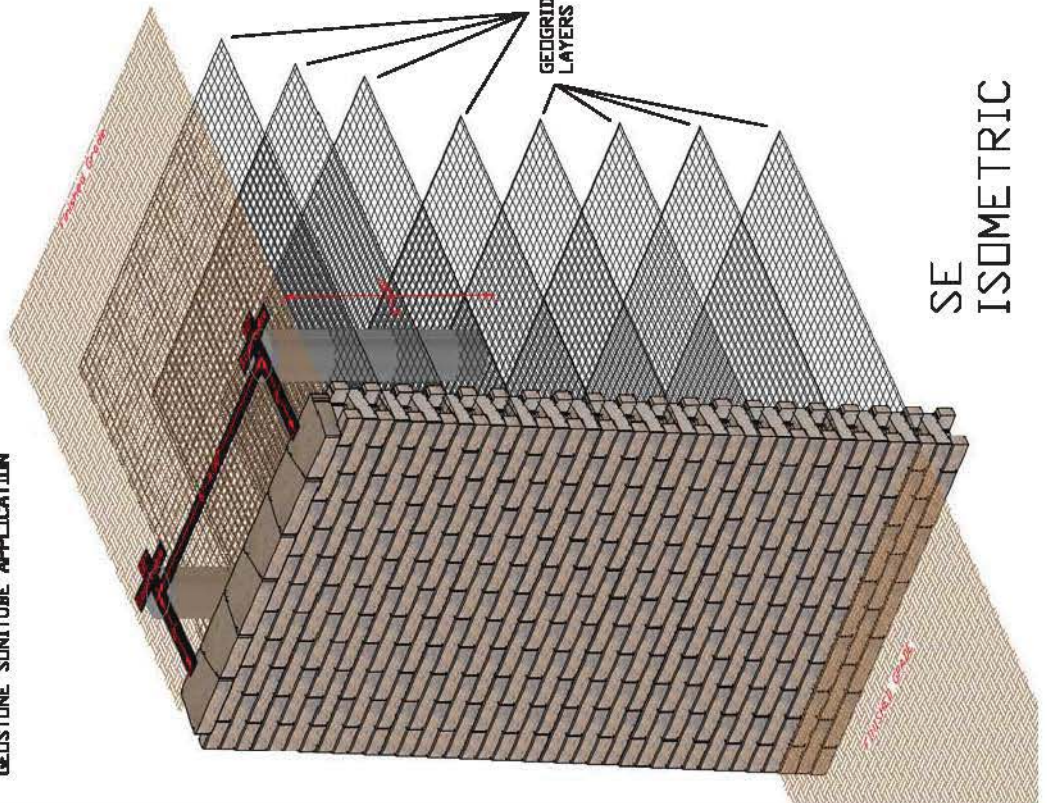
Qty.	Quantity/Area	Unit

37.5 LBS

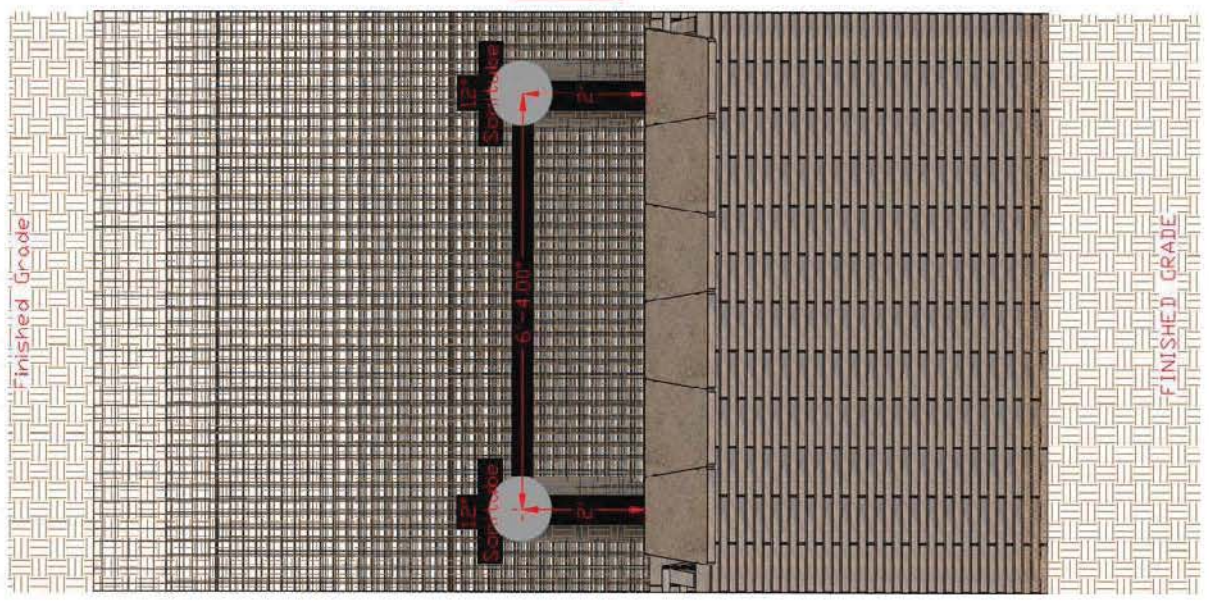
Per Box of 40 Blocks

Per Box of 40 Blocks

DATE	6/1/11	NO.	#
BY	S/July/2008	REV.	#
APP.	As Noted		



SE ISOMETRIC



TOP

Geostone Retaining Walls
 GEOSTONE RETAINING WALLS ARE MADE TO ADJUST FOR DIFFERENT HEIGHTS AND SITUATIONS. REINFORCEMENT IS SOMETIMES REQUIRED. PLEASE REFER TO www.geostone.com FOR GENERAL RETAINING PROCEDURES AND GUIDELINES. ALSO PLEASE NOTE THAT A LOT OF MUNICIPALITIES WILL REQUIRE THAT RETAINING WALLS OVER 4 FEET IN HEIGHT BE DESIGNED BY A PROFESSIONAL ENGINEER. PLEASE CHECK WITH YOUR LOCAL MUNICIPALITY PRIOR TO ANY CONSTRUCTION.

www.geostone.com

FOR GENERAL RETAINING PROCEDURES AND GUIDELINES. ALSO PLEASE NOTE THAT A LOT OF MUNICIPALITIES WILL REQUIRE THAT RETAINING WALLS OVER 4 FEET IN HEIGHT BE DESIGNED BY A PROFESSIONAL ENGINEER. PLEASE CHECK WITH YOUR LOCAL MUNICIPALITY PRIOR TO ANY CONSTRUCTION.

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No.	Revision/Date	Date

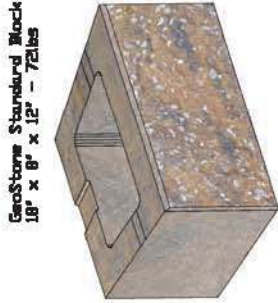
DATE OF ISSUE
 05/24/07

Page 6666
 No. 05/24/07
 Rev. As Noted

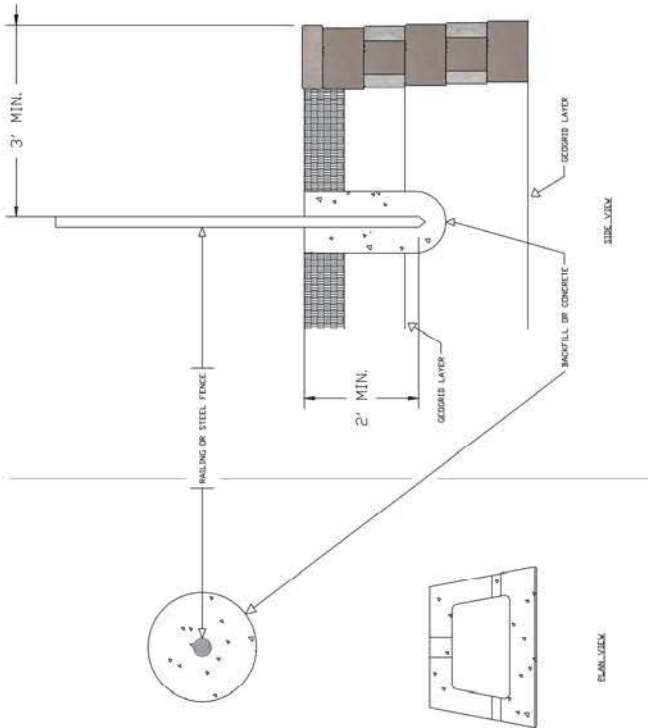
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Geostone Universal Cap
 18" x 4" x 12" - 50lbs



Geostone Standard Block
 18" x 8" x 12" - 72lbs



DETAIL

DETAIL

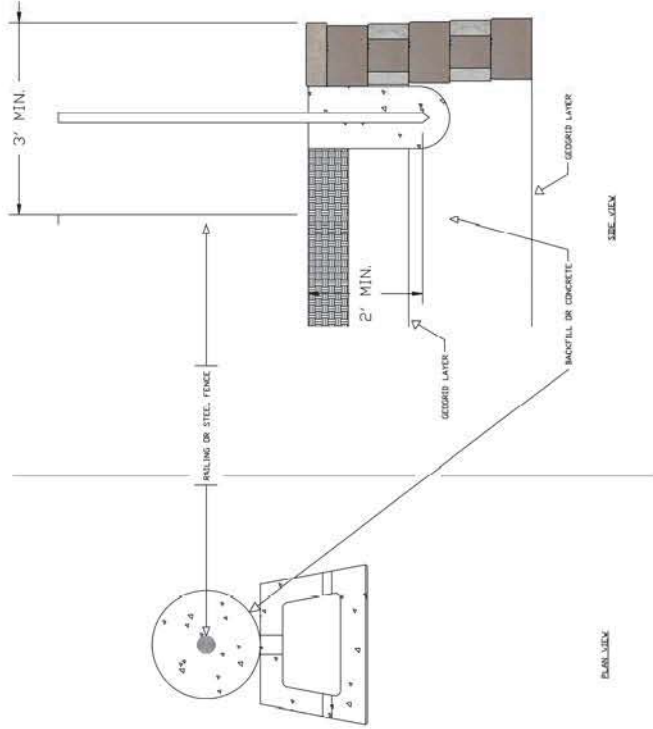


NOTE: Concrete filled tube or form to be set during wall construction, not drilled through geogrid afterwards. This method of tube filling is the recommended method of installing fences or rails set forth by the National Concrete and Masonry Association.

It may be acceptable to install fence, rails or posts in the reinforced zone if the end of the posts are sharpened and special care is taken to not pull or twist the reinforcement grid as each layer is cut and the post is placed through the grid.

The above methods allow the passive resistance of the soil to counter the required loads without seeing localized bulging or overturning of the wall's top block units.

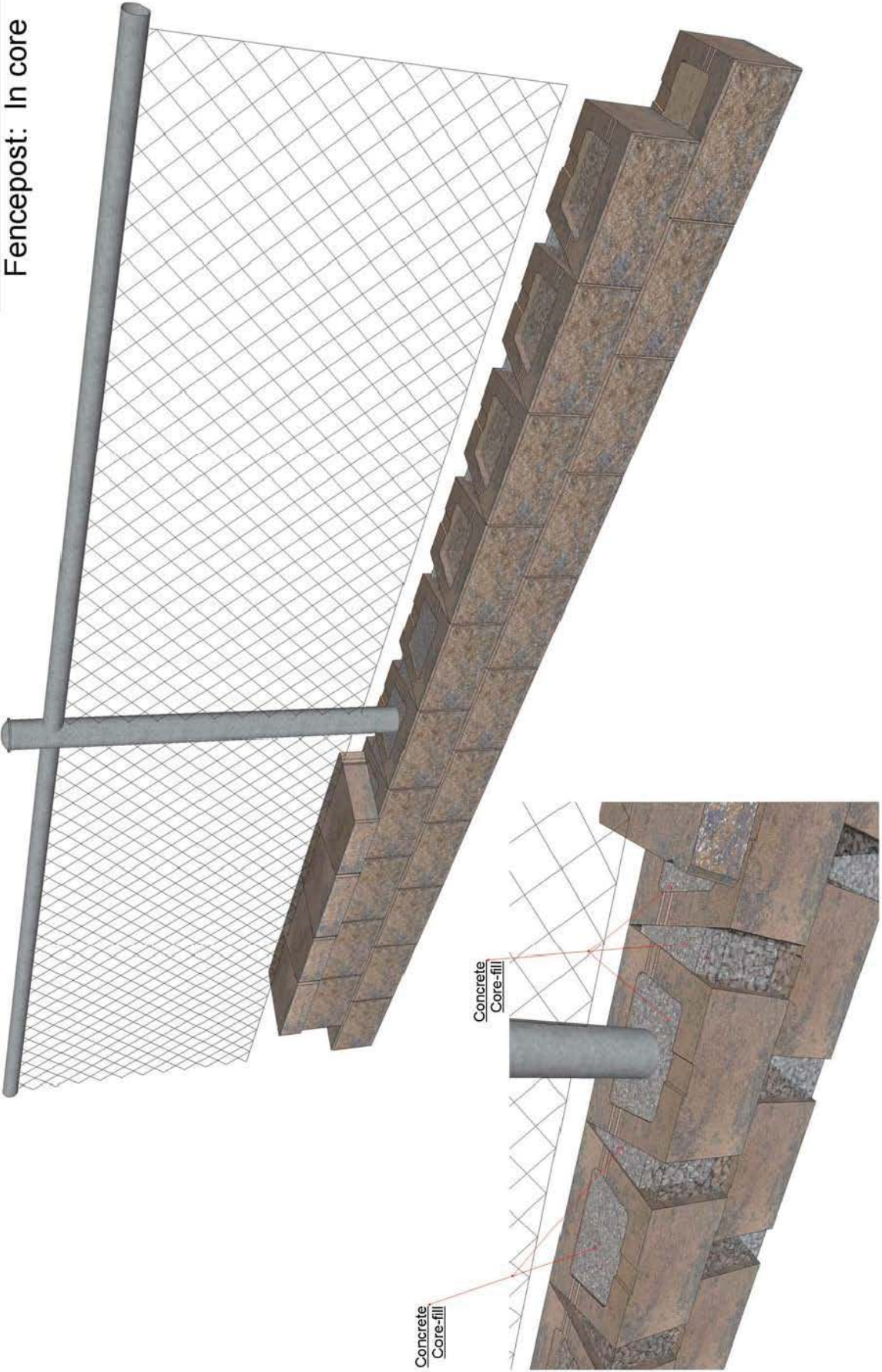
Drilling into the cap and / or blocks may result in undermining the structural integrity of the wall system and is not recommended.



DETAIL

DETAIL

Fencepost: In core



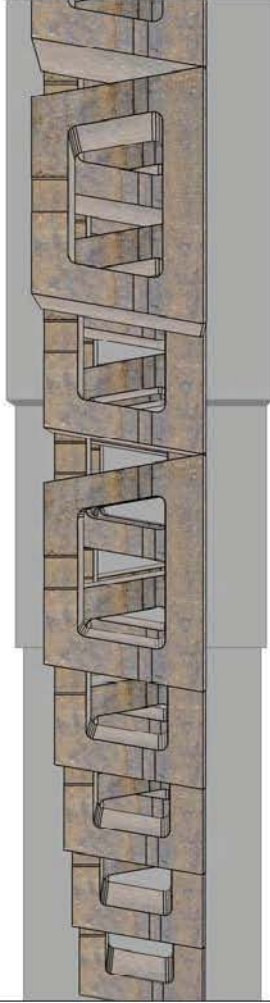
GeoStone Hardscape
 1122 Hwy 280 East
 Westover, AL 35185
 205-678-9969
 www.geostone.com

ISSUE 08.08.08
 RE-ISSUE 08.09.08

PROJECT NO. 245.170
 PROJECT Name Chainlink Fence Post

DRAWN BY DJA
 DESCRIPTION In-Core Application

Typical Step Up Detail

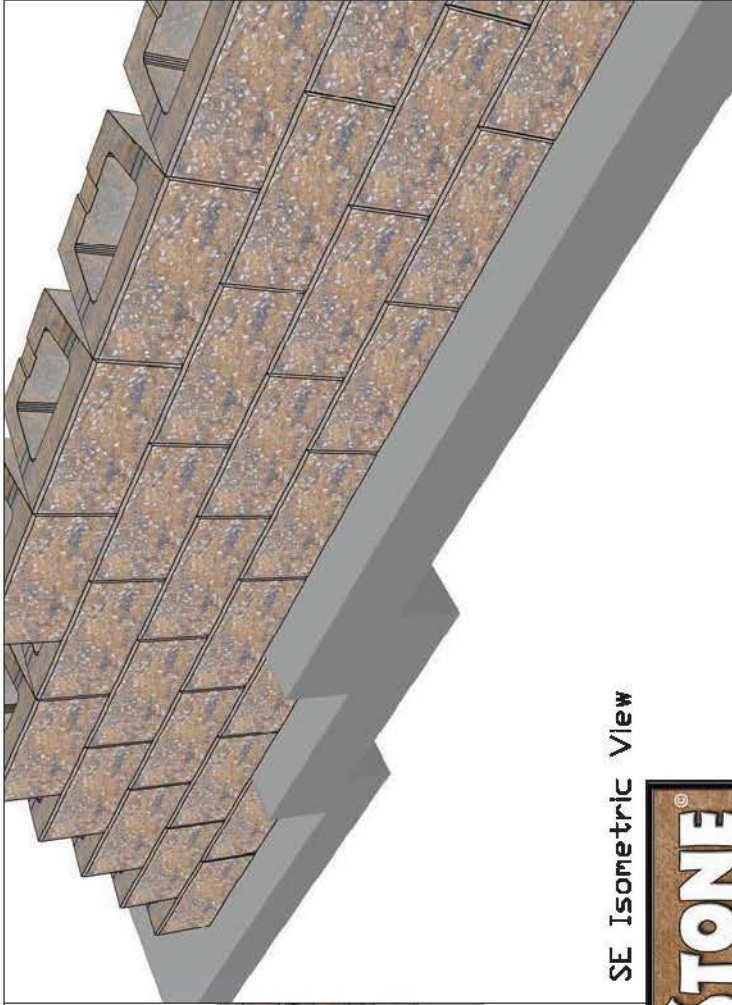


Top View

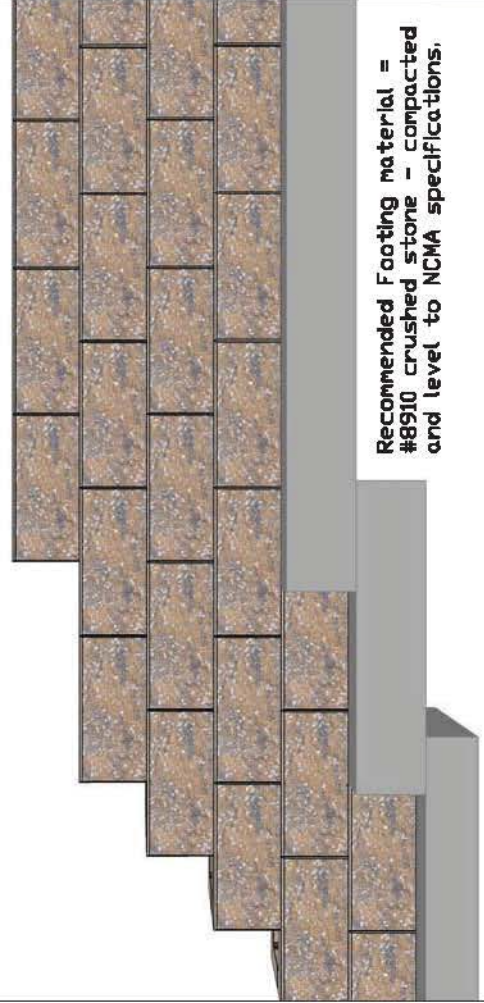
First course may follow contour of grade. Maintain required embedment. Footing to meet NCMA specifications.



SE Isometric View

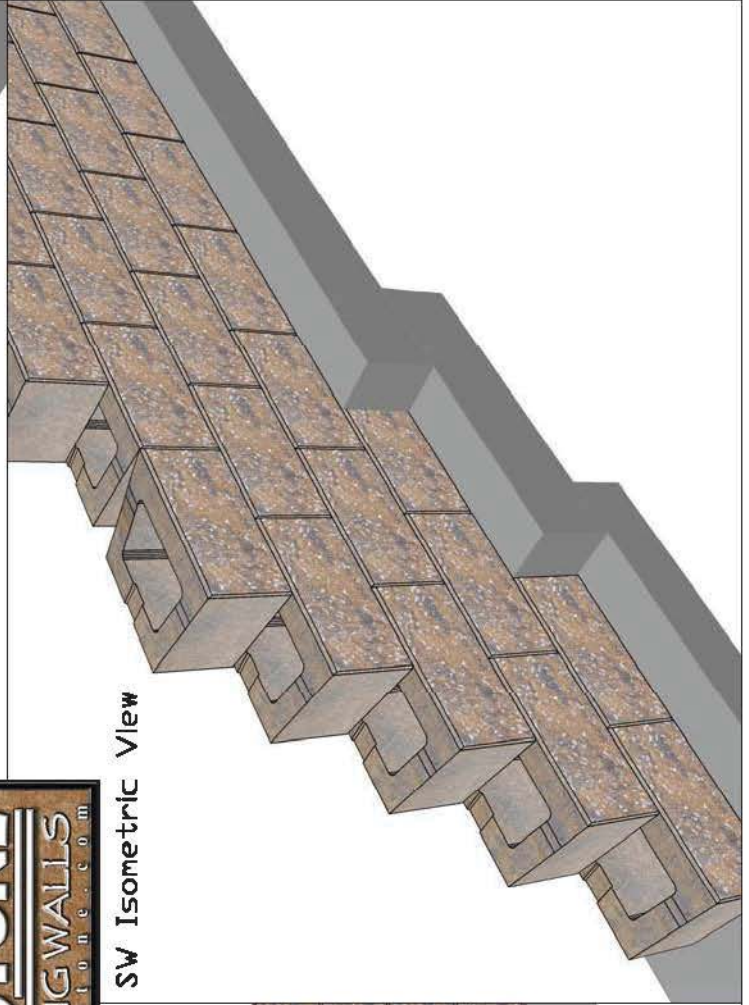


Front View



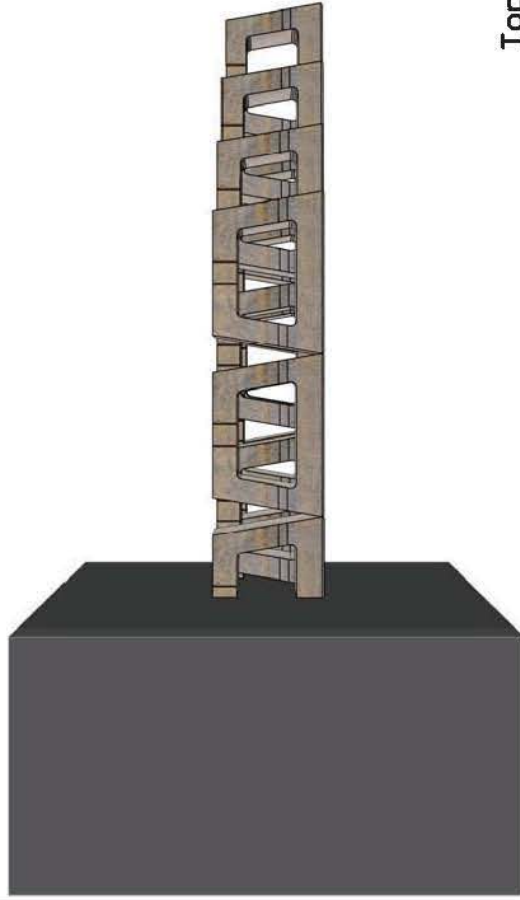
Recommended Footing material = #8910 crushed stone - compacted and level to NCMA specifications.

SW Isometric View

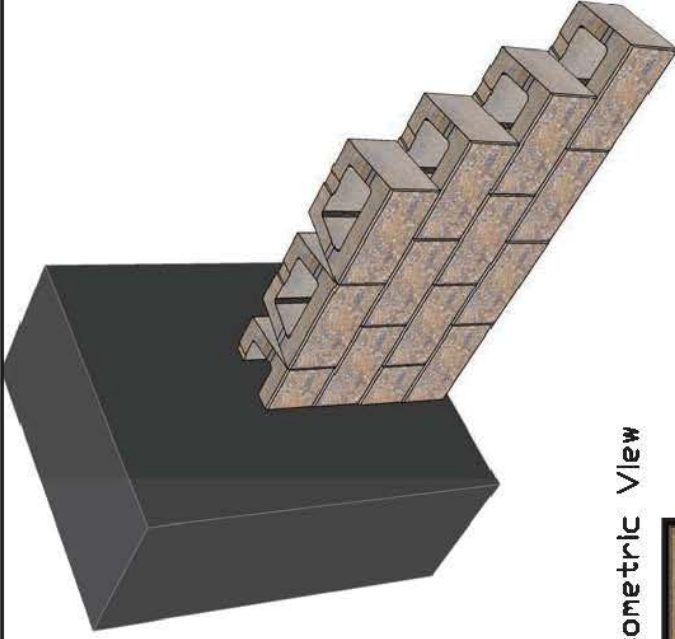


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Typical Structure Abutment



Top View

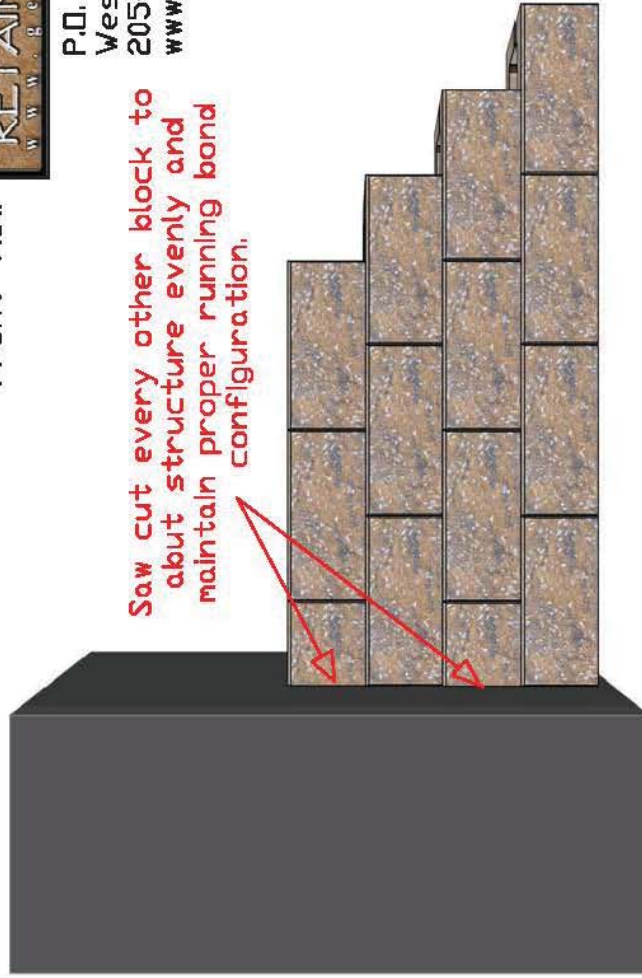


SE Isometric View



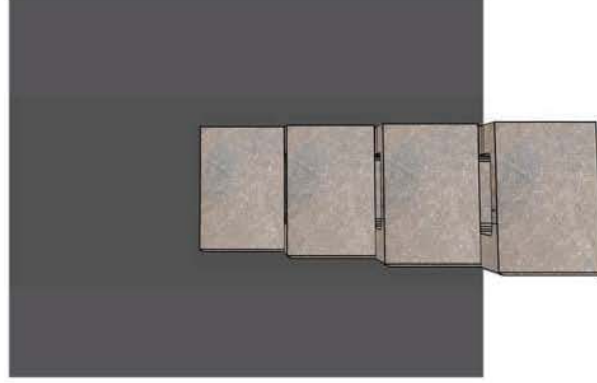
P.O. Box 325
Westover, AL 35185
205-678-9969
www.geostone.com

Front View



Saw cut every other block to about structure evenly and maintain proper running band configuration.

Side View



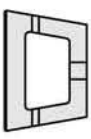
Shown Wall abutting structure. Typical wall batter maintained.

Note: Wall may be built vertical to match structure if needed. A batter can be gradually added along length of wall for added strength.

THIS DESIGN IS FOR ILLUSTRATION PURPOSES ONLY AND IS NOT INTENDED FOR USE IN ALL SITUATIONS. GEOSTONE RETAINING WALLS ARE MADE TO ADJUST FOR DIFFERENT HEIGHTS AND SITUATIONS. REINFORCEMENT IS SOMETIMES REQUIRED. PLEASE REFER TO www.geostone.com FOR GENERAL RETAINING PROCEDURES AND GUIDELINES. ALSO PLEASE NOTE THAT A LOT OF MUNICIPALITIES WILL REQUIRE THAT RETAINING WALLS OVER 4 FEET IN HEIGHT BE DESIGNED AND STAMPED BY A PROFESSIONAL ENGINEER. PLEASE CHECK WITH YOUR LOCAL MUNICIPALITY PRIOR TO ANY CONSTRUCTION. AS WITH ANY INSTALLATION, THE USE OR CONSULTATION OF A PROFESSIONAL INSTALLER IS RECOMMENDED.

General Notes

GEOSTONE RETAINING WALLS ARE MADE TO ADJUST FOR DIFFERENT HEIGHTS AND SITUATIONS. REINFORCEMENT IS SOMETIMES REQUIRED. PLEASE REFER TO www.geostone.com FOR GENERAL REINFORCING PROCEDURES AND GUIDELINES. ALSO PLEASE NOTE THAT A LOT OF MUNICIPALITIES WILL REQUIRE THAT RETAINING WALLS OVER 4 FEET IN HEIGHT BE DESIGNED AND STAMPED BY A PROFESSIONAL ENGINEER. PLEASE CHECK WITH YOUR LOCAL MUNICIPALITY PRIOR TO ANY CONSTRUCTION.

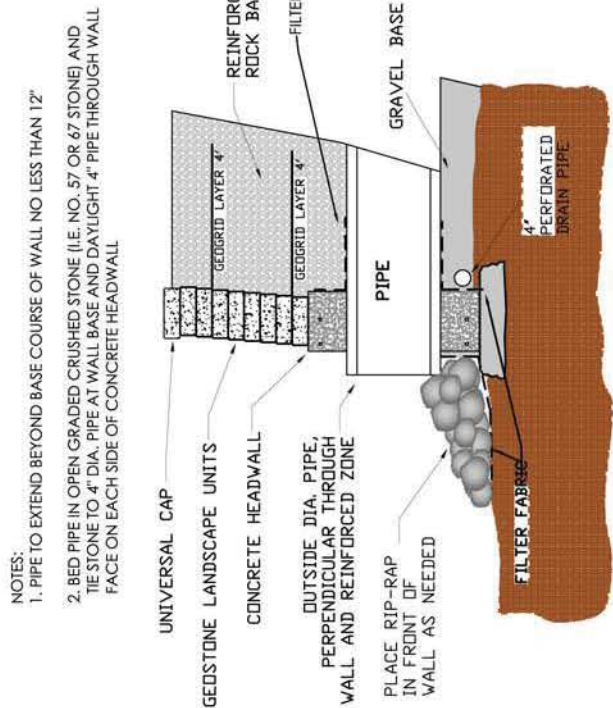
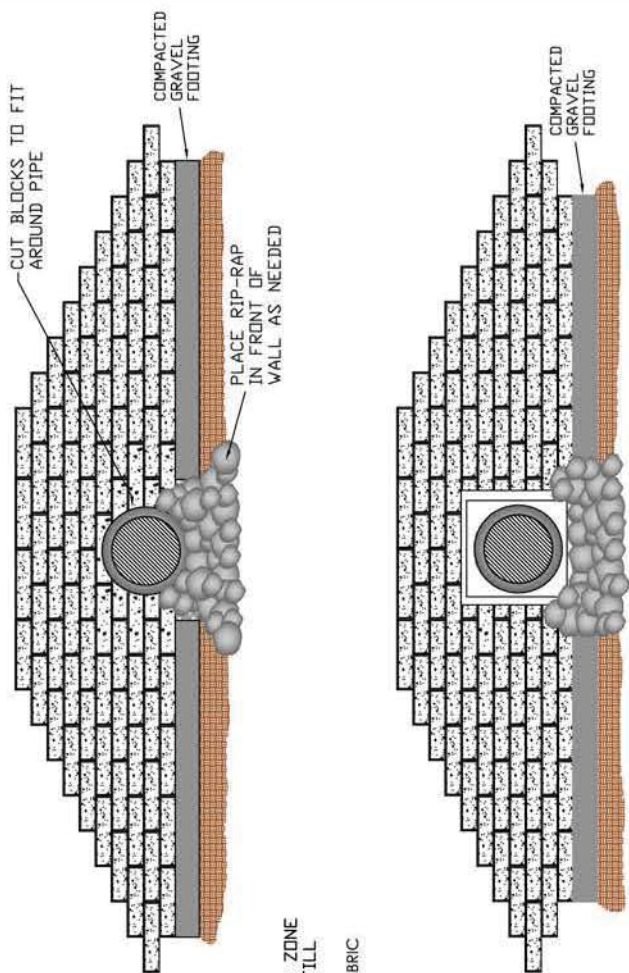


No.	Quantity/Notes	Date

Per Meter and Meter	

Per Meter and Meter	
Value	
Value	
Value	

Project	Value	Sheet
1/25/2008		00
As Noted		



NOTES:
1. PIPE TO EXTEND BEYOND BASE COURSE OF WALL NO LESS THAN 12"

2. BED PIPE IN OPEN GRADED CRUSHED STONE (I.E. NO. 57 OR 67 STONE) AND TIE STONE TO 4" DIA. PIPE AT WALL BASE AND DAYLIGHT 4" PIPE THROUGH WALL FACE ON EACH SIDE OF CONCRETE HEADWALL

**GEOSTONE LANDSCAPE BLOCK
4"x18"x12"
-CULVERT APPLICATION
(not to scale)**

{GeoStone Standard Block
8"x18"x12" could be substituted
using same techniques. Cut
block to fit.}

THE WALLS IN THIS DRAWING ARE FOR ILLUSTRATION PURPOSES ONLY & WERE DESIGNED ACCORDING TO INDUSTRY STANDARD PROCEDURES. IT IS RECOMMENDED THAT THESE DRAWINGS BE VERIFIED BY AN AUTHORIZED REPRESENTATIVE OF GEOSTONE AND/OR PROFESSIONAL ENGINEER BEFORE APPLYING TO REAL LIFE SITUATIONS.

REINFORCED RETAINING WALL

NOTE: The following is an example of a typical GeoStone installation. Not all walls require the same techniques. GeoStone recommends consulting with an Authorized GeoStone representative or professional installer before undertaking such a project. Check with your local municipality before starting any construction project for applicable regulations and permits that may be required.



Begin by digging a two foot wide trench. Excavate all loose soils and native rock until hard original ground is reached. The footing will be supporting the entire weight of the wall.



The footing depth will vary based on the the height of the wall. Rule of thumb is 1 inch of embedded block per vertical foot of wall height is required. Place four to six inches of crushed rock (#78 or #8910) in the footing and level for the wall foundation.



As preparation of the footing continues, remove all large rocks and use a vibrating plate tamp to achieve proper compaction. Get footing as smooth, level, and compacted as possible.



Run a string line for straight walls. This will help in the alignment of the first course. Use a cement trowel to smooth out base prior to setting first block.



When laying the first course, level the block front to back and side to side with a two foot carpenter's level. It is very important that the first course be placed on a compacted footing and leveled before proceeding.



It is always a good idea to shoot grades from time to time to ensure your wall is maintaining the correct level.



Align and batter each course prior to core filling with rock. Batter means setting each course back 1/4 - 1/2 inch behind the course below as seen in the picture above. On straight walls, use a string line. In curves, visually align the wall to achieve the desired appearance.



It is recommended that the cores of the block be filled with a #67 or #78 stone no less frequently than every three courses. This same stone is recommended for the backfill as well.



After core filling the block, use a rod to drive down into the cores to assure a thorough core fill. Backfill should be level to top course of block.



Compacting the backfill is very important. This provides additional resistance to pressures exerted on the wall and prevents settlement. Repeat this process after each backfill.



Sweep all rock and gravel from the tops of the blocks before laying down next course or geogrids. Any variance in height caused by rocks between courses will cause unsightly gaps. Backfill area should encompass entire proposed grid length area.



Next lay out the geogrids. Their length will depend on the wall height. Rule of thumb is no less than 75% of wall height (no shorter than 4') and no less frequent than every 2 vertical feet.



After laying out the grids, place another course of block down on top of the grids, align, then core fill and backfill. It is important that the grids be stretched tight prior to placing rock fill.

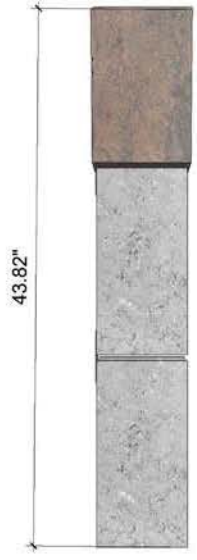


This process is repeated until the desired wall height is reached. The final course is the cap block glued down with outdoor construction adhesive.

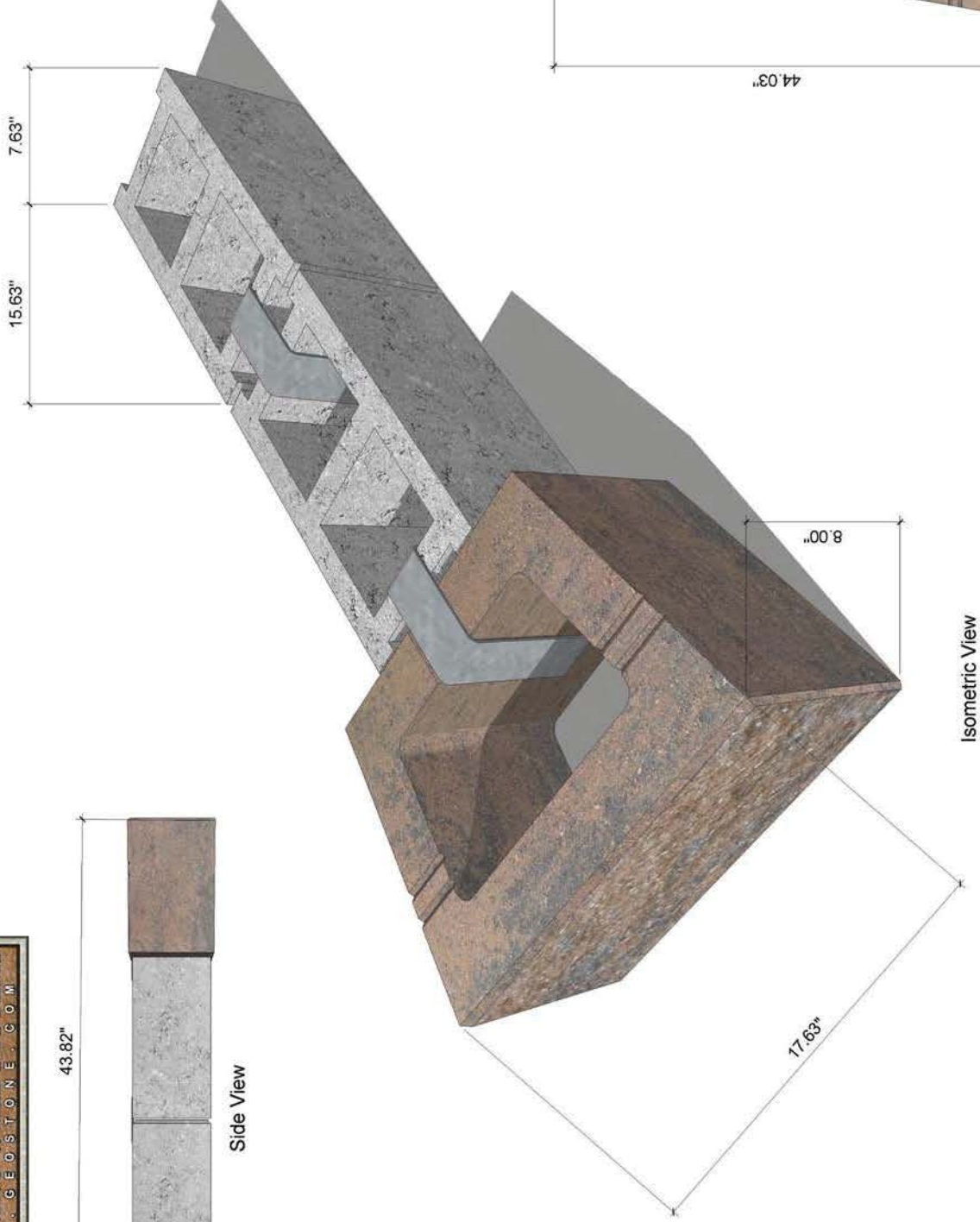




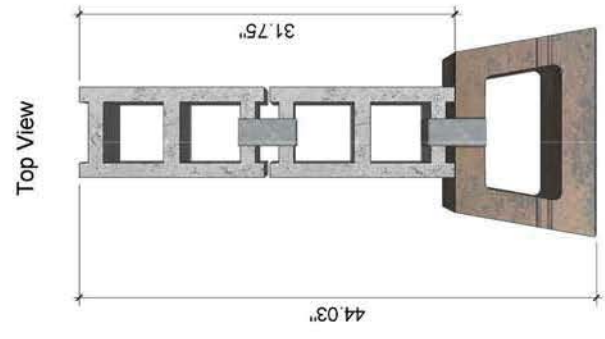
GeoStone Clip & Stretcher Application



Side View



Isometric View



Top View

DRAWN BY
DJA
Hardscape Rendering

PROJECT NO.
245.170
Project Name

ISSUE
08.08.08
RE-ISSUE
08.09.08

CLIENT
Client Name
1245 Main Street
Boulder, CO 00000
Tel: 000.000.0000

GeoStone Hardcape
11321 Hwy 280 East
Westover, AL 35185
205-678-9969
www.geostone.com

DRAWN BY
DJA
DESCRIPTION
Hardscape Rendering

PROJECT NO.
245.170
PROJECT
Courtyard

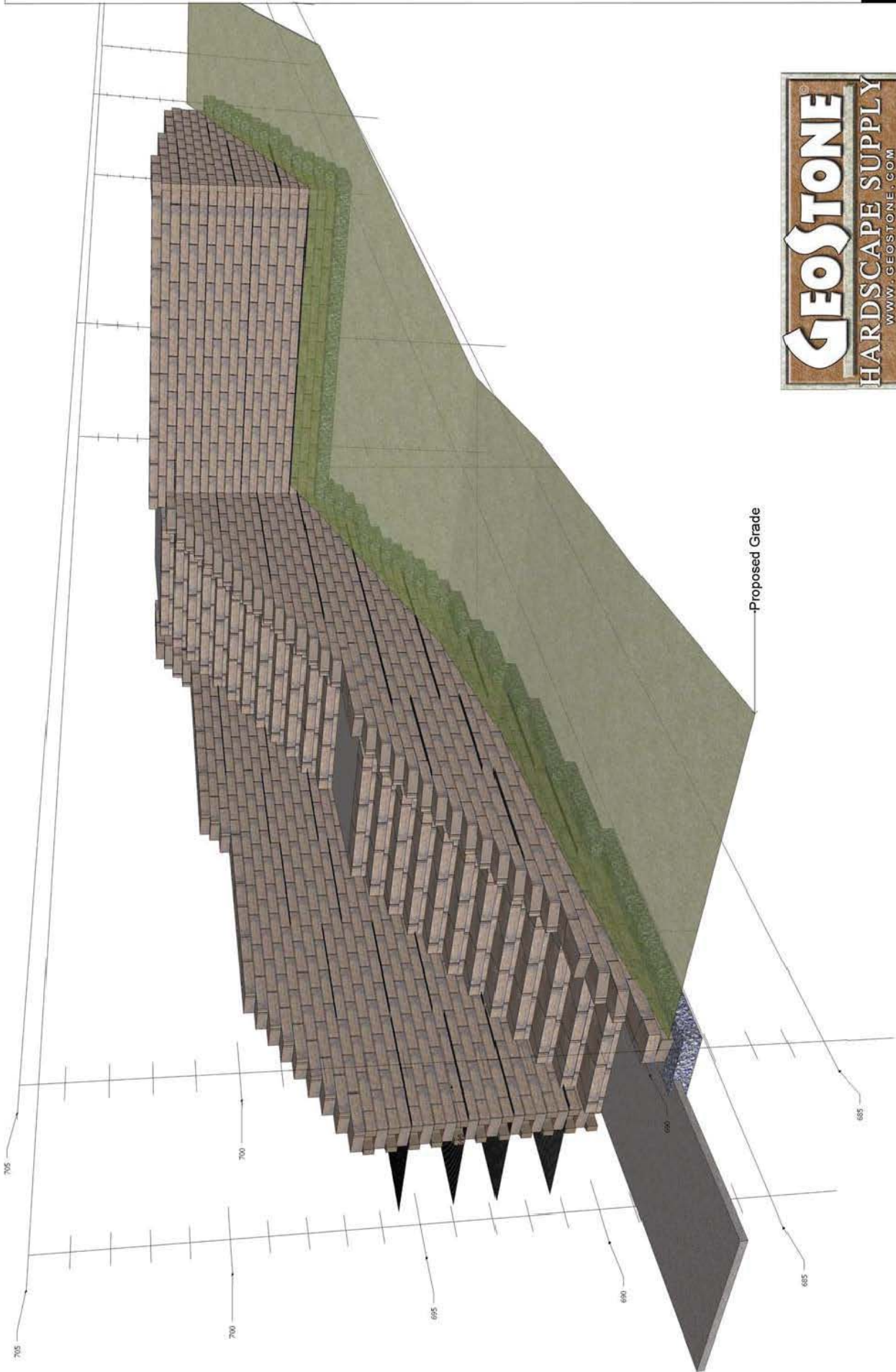
ISSUE
09.20.13

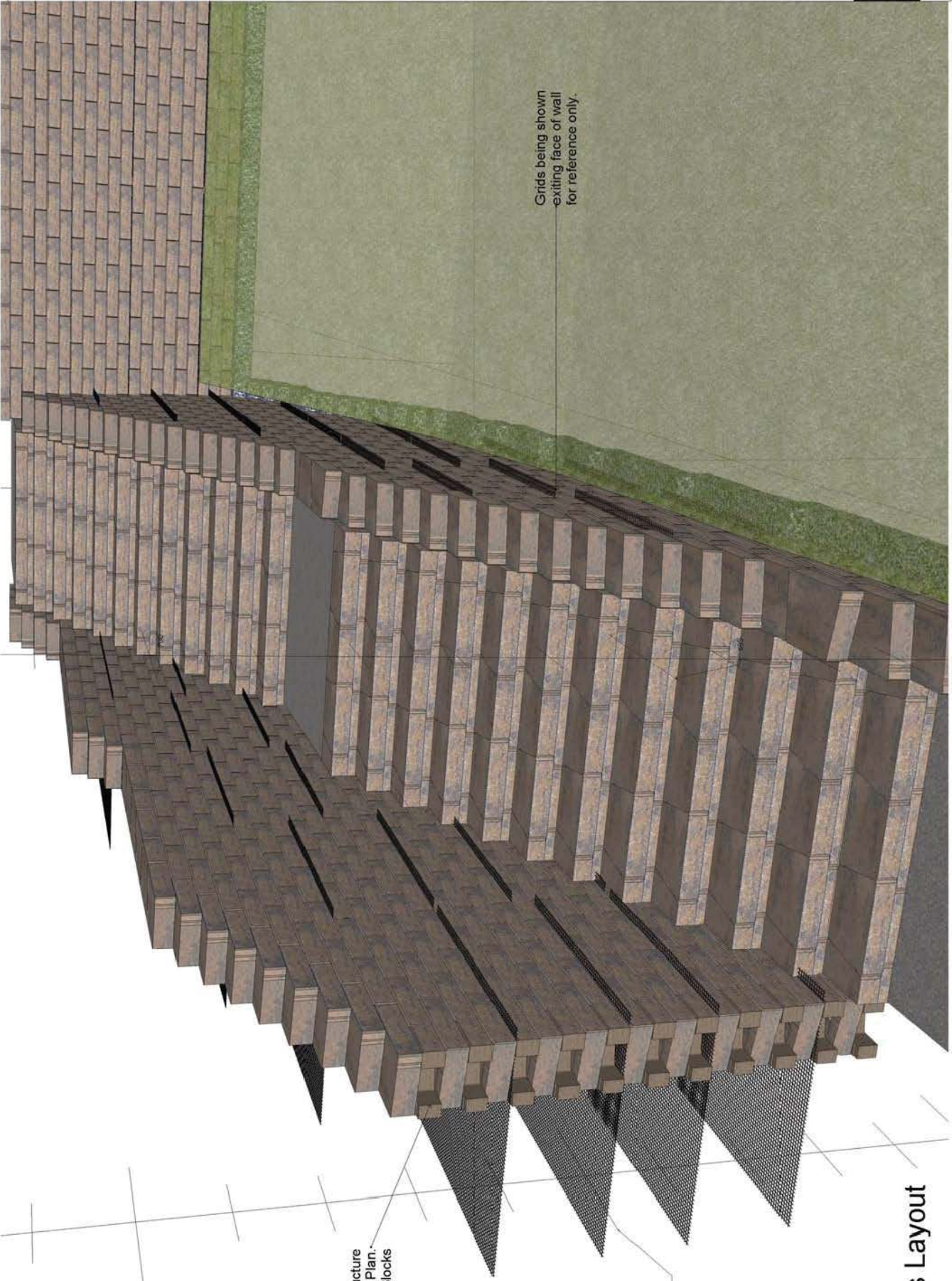
CLIENT
Southern Research
Institute
Birmingham, AL

Geostone Hardscape
11221 HWY 280 EAST
WADSWORTH, AL 35185
205-678-9969
www.geostone.com



Proposed Grade



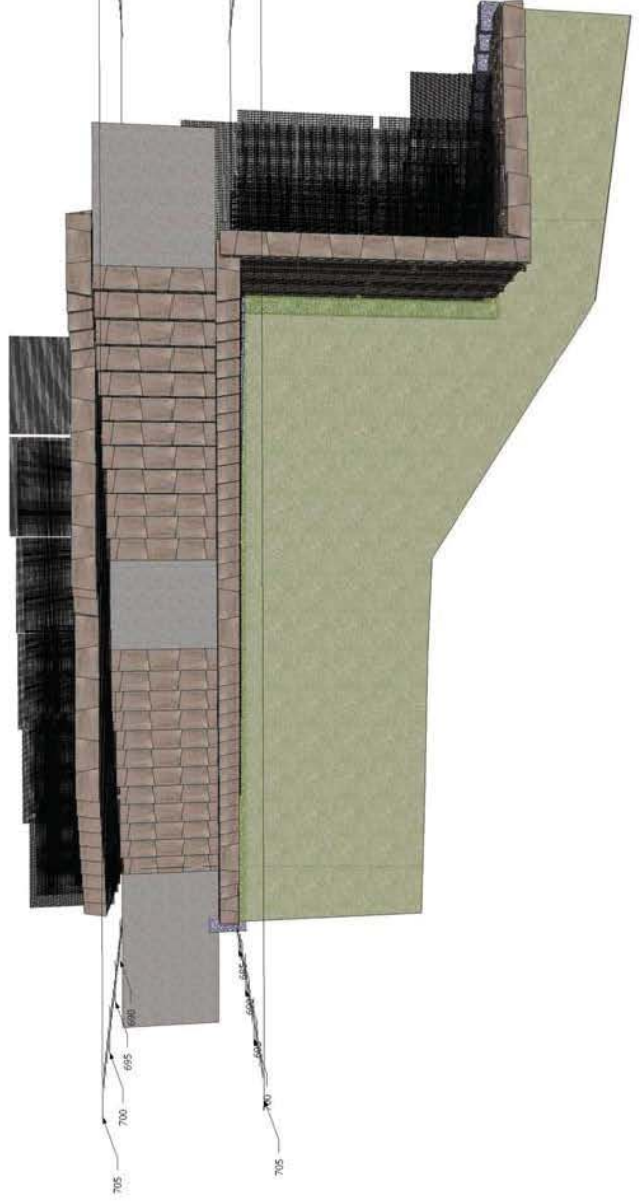


Steps Layout

Abut Structure on Plan. Core fill all Blocks

Grids being shown exiting face of wall for reference only.

Top View



Side View

