

KEYSTONE HARDSCAPES WALL SYSTEM

ST. LOUIS COUNTY MASTERPLAN

REGAL STONE PRO/

REGAL STONE PRO ROCK FACE 3 pc WALLS
SOIL REINFORCED ZONE

STL County Approved Master Plan Numbers

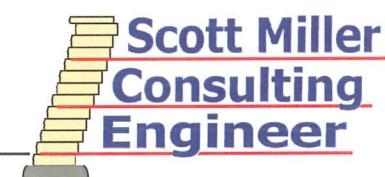
Index of Drawings

Sheet 1	Title and Index
Sheet 2	Applications and Design Information
Sheet 3, 4	Specifications
Sheet 5, 6, 7, 8	Typical Details
Sheet 9, 10	Standard Design – Horizontal Backfill
Sheet 11	Standard Design – Sloping Backfill
Sheet 12	Standard Design – Tiered Wall

Single tier wall up to 6' high w/ level soil backfill	728-18-17
Single tier wall up to 6' high w/ level soil backfill and 120 psf surcharge	728-18-18
Single tier wall up to 6' high, 3:1 max slope w/sloping soil backfill	728-18-19
Two tier wall, each tier up to 4' high w/ level soil backfill	728-18-20



P.O. Box 94529 North Little Rock, AR 72190
Tel: 501.374.3546 Fax: 501.374.3547 E-mail: segwalls@gmail.com



PAVESTONE
2720 EAST OUTER ROAD
SCOTT CITY, MISSOURI 63780
573-332-8312



COVER SHEET
Sheet 1 of 12
Date: May 1, 2018

APPLICATION

The Keystone Hardscapes Retaining Wall system is a reinforced soil structure combining an architecturally attractive concrete facing block with geogrid reinforcement. The geogrid reinforcement interlocks with the Keystone Hardscapes Regal Stone Pro/Regal Stone Pro Rock Face 3 pc block units and fill soil to create a stable gravity retaining wall. Design of these reinforced soil structures uses well established guidelines that are readily available. The following specifications and details provide a design to incorporate geogrid reinforcement into the soil for the purposes of constructing retaining walls. Consult Pavestone for additional details regarding design, appearance and aesthetic considerations.

STANDARD DESIGN PROCEDURE

The following design tables established for the construction of soil reinforced walls are based upon generally accepted soil parameters in the St. Louis County, Missouri area. An engineer shall review the site conditions and the soil present at the proposed location of the soil reinforced walls to determine if the actual conditions match the assumed parameters. All soil parameters assumed in the design of the following tables are well drained, long-term strength conditions. High plastic silts and clays should be avoided without specific design modification recommendations from an engineer. Frost heave and settlement need to be addressed if warranted by conditions. Consult an engineer if the walls are constantly in contact with water, i.e. near or at rivers, lakes and ponds.

Four typical geometric cases were selected for these tables. The first case is a typical retaining wall with horizontal backfill, the second case is with a 120 psf surcharge, the third case is a 3:1 sloping backfill, and the fourth case is a tiered wall. Global stability has not been checked. The following is a summary of the design parameters used and the minimum factors of safety which the tables are based on.

SOIL PROPERTIES:

	Friction Angle (degrees)	Unit Weight (lbs/cf)	Cohesion (lbs/sf)
Wall Fill	28	120	0
Retained Backfill	28	120	0
Foundation Soil	28	120	0

Friction Angle – degrees
Unit weight – lbs per cf
Cohesion – lbs per sf

MINIMUM FACTORS OF SAFETY (CALCULATED)

Reinforcement Pullout = 1.5

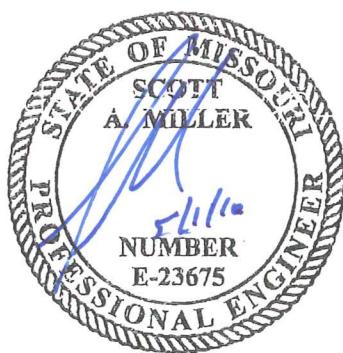
Reinforcement Rupture = 1.5

External Sliding = 1.5

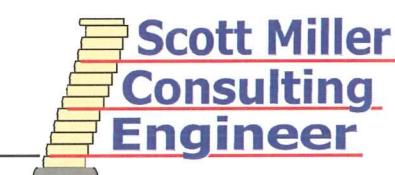
Overspinning = 2.0

Overall for Unknowns = 1.5

Bearing Capacity = 1500 psf unless accompanied by certified
Geotechnical Engineering Report



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APPLICATION
Sheet 2 of 12
Date: May 1, 2018

Section 32 32 23

KEYSTONE HARDSCAPES REGAL STONE PRO/REGAL STONE PRO ROCK FACE 3 PC RETAINING WALL SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Work includes furnishing and installing concrete segmental retaining all units to the lines and grades designated on the construction drawings and as specified herein.

B. Related Sections

1. Section – Geosynthetic Wall Reinforcement
2. Section – Backfill
3. Section – Drainage Fill
4. Section – Landscaping Turf
5. Section – Drain Tile

1.02 REFERENCES

A. American Society of Testing and Materials

1. ASTM C1372-16; Standard Specification for Segmental Retaining Wall Units.
2. ASTM C1262-10; Standard Test Method Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units.
3. ASTM C698-91; Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb Rammer and 12.0-inch Drop (Standard Proctor).
4. ASTM D448-12; Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
5. ASTM C140-12; Standard Test Methods of Sampling and Testing Concrete Masonry Units.
6. ASTM D2922-05; Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
7. ASTM D1556-15; Standard Test Method for Density of Soil in Place by the Sand Cone Method.
8. ASTM D2488-12; Standard Practice for Description and Identification of Soils, Visual-Manual Procedure (USCS: Unified Soil Classification System).

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01300:

1. Manufacturer's literature: Materials description
2. Samples
 - a. Furnish one (1) unit in the color and face pattern specified if requested by the Architect. If approved, unit may be used in the finished work.
 - b. 12.0 inches square or larger piece of geosynthetic reinforcement specified.
3. Test reports from an independent laboratory stating moisture absorption and compressive strength properties of the concrete wall units meet the project specifications when tested in accordance with ASTM C140-12. Sections 6, 8 and 9.

1.04 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall check the materials upon delivery to assure that proper material has been received.

- B. Deliver and handle materials in such manner as to prevent damage. Store above ground on wood pallets or blocking. Removed damaged or otherwise unsuitable material, when so determined, from the site.
 1. Faces of the concrete wall units shall be substantially free of chips, cracks and stains.
 2. The Contractor shall prevent excessive mud, wet cement, epoxy and like material, which may affix themselves, from coming in contact with the material.

1.05 EXTRA MATERIALS

- A. Furnish Owner with three (3) replacement units identical to those installed on the Project.

1.06 DEFINITIONS

- A. Geosynthetic reinforcement Mirafi 3XT is a material specifically fabricated for use as a soil reinforcement.
- B. Concrete retaining wall units are as detailed on the drawings and are specified under Section 02276; Regal Stone Pro/Regal Stone Pro Rock face 3 pc Retaining Walls Units.
- C. Drainage aggregate is a material used around and directly behind the concrete wall units.
- D. Backfill is the soil which is used as fill behind the drainage aggregate, and within the reinforced soil mass if applicable.
- E. Foundation soil is the soil mass supporting the leveling pad and reinforced zone of the retaining wall system.

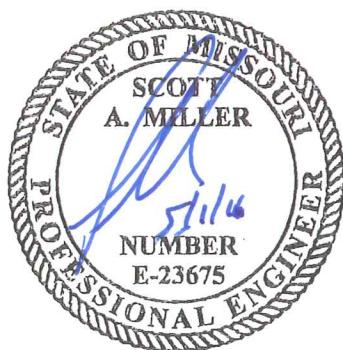
1.07 DISCREPANCIES

- A. Should discrepancies exist between the plans and specifications, the plan shall take precedence over the specifications.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete Retaining Wall Unit: "Keystone Hardscapes Regal Stone Pro/Regal Stone Pro Rock Face 3 pc Retaining Wall Units" manufactured by Pavestone L.L.C..
 1. Concrete wall units shall meet requirements of ASTM C1372-16 except the maximum water absorption shall be limited to 7.0 percent and unit height dimensions shall not vary more than +/- 1/16 inch from that specified.
 2. Color as selected by Architect from manufacturer's standard selections.
 3. Blockface: RockFace Large, RockFace Combo or Straight.
 4. The concrete units shall include an integral concrete shear connection flange/locator.
- B. Geosynthetic reinforcement: Mirafi 3XT Polyester fiber geogrid for use as soil reinforcement.
- C. Base: material shall consist of drainage aggregate, sand and gravel and/or concrete as shown on the construction drawings. A minimum of 6.0 inches of compacted base is required.
- D. Drainage aggregate: Fill between units shall consist of free-draining, crushed coarse aggregate that meets the gradation requirements of ASTM 448-12; Standard Classification for Sizes of Aggregate for Road and Bridge Construction, designation 57, 67, 6, 7 or 8.
- E. Backfill: Materials are suitable non-organic soils at a moisture content which enables compaction to the specified densities. Unsuitable soils are organic soils and those soils with the USCS classification symbol of CH, OH, MH, OL, or PT. CL soils with a Plasticity Index (PI) greater than 20 are also considered unsuitable soils.
- F. Drain tile: The drainage collection pipe shall be a perforated or slotted PVC or corrugated HDPE pipe. The pipe may be covered with a geotextile filter fabric to function as a filter.
- G. Filter Fabric: Nonwoven, needle punched Mirafi 140N fabric.



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SPECIFICATIONS
Sheet 3 of 12
Date: May 1, 2018

PART 3 EXECUTION

3.01 EXAMINATION

A. The contractor shall examine the areas and conditions under which the retaining wall is to be erected and notify the Architect or Civil Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected. The contractor shall promptly notify the wall design engineer or any site conditions which may affect wall performance or may require a reevaluation of the wall design.

3.02 EXCAVATION

A. The Contractor shall excavate to the lines and grades shown on the construction drawings. Over-excavation not approved by the owner or duly appointed owner's representative shall not be paid for and replacement with the compacted fill and/or wall system components will be required at the Contractor's expense. The Contractor shall be careful not to disturb base beyond the lines shown. The Contractor shall be responsible for the stability of the excavation and its influence on adjacent properties and structures.

3.03 FOUNDATION PREPARATION

A. Foundation soil shall be excavated as required for footing or base dimension shown on the construction drawings, or as directed by the Engineer.
B. Foundation soils shall be examined to ensure that the actual foundation soil strength meets or exceeds that required on the construction drawings. Soil not meeting the required strength shall be removed, sufficiently oversized from the front of the block and the back of the reinforcement and backfilled with suitable material.
C. Over-excavated areas shall be filled with suitable compacted backfill.

3.04 BASE COURSE PREPARATION

A. Base materials shall be placed as shown on the construction drawings with a minimum thickness of 6.0 inches.
B. Base materials shall be installed upon undisturbed soils, or foundation soils prepared in accordance with Section 3.03.
C. Material shall be compacted so as to provide a level, hard surface on which to place the first course of units.
D. Base materials shall be prepared to ensure complete contact of retaining wall unit. Gaps shall not be allowed.
E. Base materials shall be to the depths and widths shown on the plans. The Contractor may opt for using reduced depth of sand and gravel and replacement with a 1.0 to 2.0-inch concrete topping. Concrete shall be lean, unreinforced and a maximum of 2.0 inches thick. Where a reinforced footing is required, place below the frost line.

3.05 ERECTION

A. Erect units as specified herein.
B. First course of concrete wall units shall be placed on the prepared base material. Units shall be checked for level and alignment. The top of all units in base course shall be at the same elevation.
C. Ensure that concrete wall units are in full contact with base.
D. Concrete wall units shall be placed side by side for full length of wall alignment. Alignment may be done by using a string line or offset of wall line.
E. Fill all voids between and within concrete wall units with drainage aggregate.
F. A minimum of 12.0 inches of drainage aggregate shall be placed behind the concrete wall units.
G. Driantile shall be installed at the lowest elevation possible to maintain gravity flow of water to outside of the reinforced zone. The drainage collection pipe shall be daylighted to an appropriate location away from the wall system at each low point or at 50.0-foot intervals along the wall.
H. Remove all excess fill from top of units and install next course. Ensure drainage aggregate and backfill are compacted before installation of next course.

I. Install each succeeding course. Backfill as each course is completed. Pull the units forward until the locating

surface of the unit contacts the locating surface of the units in the preceding course. Pull the units forward as far as possible.

J. Install geosynthetic reinforcement in accordance with geosynthetic manufacturer's recommendations and the design drawings.

3.06 BACKFILL PLACEMENT

A. Reinforced backfill shall be placed, spread and compacted in a manner that will minimize slack in the reinforcement.
B. Fill in the reinforced zone shall be placed and compacted in lifts not to exceed 6.0 to 8.0 inches (loose thickness) where hand-operated compaction equipment is used and not exceeding 12.0 inches (loose thickness) where heavy, self-propelled compaction equipment is used.
C. All fill placed in the reinforced zone must be compacted to a minimum of 95 percent of the soil's standard Proctor density (ASTM D698).
D. Only lightweight hand-operated equipment shall be allowed within 4.0 feet of the back of the retaining wall units, or one-half of the wall height, whichever is greater.

3.07 CAP UNIT INSTALLATION (if applicable)

A. Apply construction adhesive to the top surface of the unit below and place the cap unit into desired position.
B. Cap units may need to be cut to obtain the proper fit.
C. Backfill and compact to finish grade.

3.08 ADJUSTING AND CLEANING

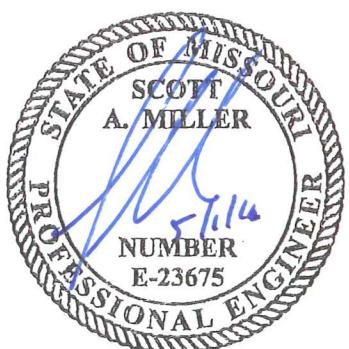
A. Damaged units should be replaced with new units during construction.
B. Contractor shall remove debris caused by wall construction and leave adjacent paved areas broom clean.

3.09 QUALITY CONTROL

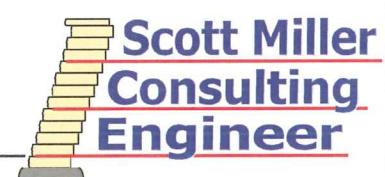
A. The wall installation contractor is responsible for quality control of installation of all materials. The contractor should enlist the assistance of a qualified independent third party to verify the correct installation of all materials according to these specifications and the construction drawings.
B. The Owner, at his own expenses, should retain a qualified professional to perform random quality assurance checks of the contractor's work.
C. Work found to be deficient according to these specifications or the construction drawings must be corrected at the contractor's expense.
D. The retaining wall will not be considered complete until excepted by the engineer or duly appointed owner's representative.

3.10 MEASUREMENT AND PAYMENT

A. Measurement of segmental retaining wall shall be on an installed square foot basis computed on the total face area of wall installed. Wall face area is taken from the bottom of the base course to the top of the wall.
B. Payment for the wall will be made on a square foot basis at the contract unit price.
1. Payment should be considered full compensation for all labor, materials, equipment and testing required to install the wall in accordance with these specifications and the construction drawings.
2. Quantities may vary from that shown on the construction drawings depending on existing topography. Change to the total quantity of wall face area will be paid or withheld at the contract unit bid price.



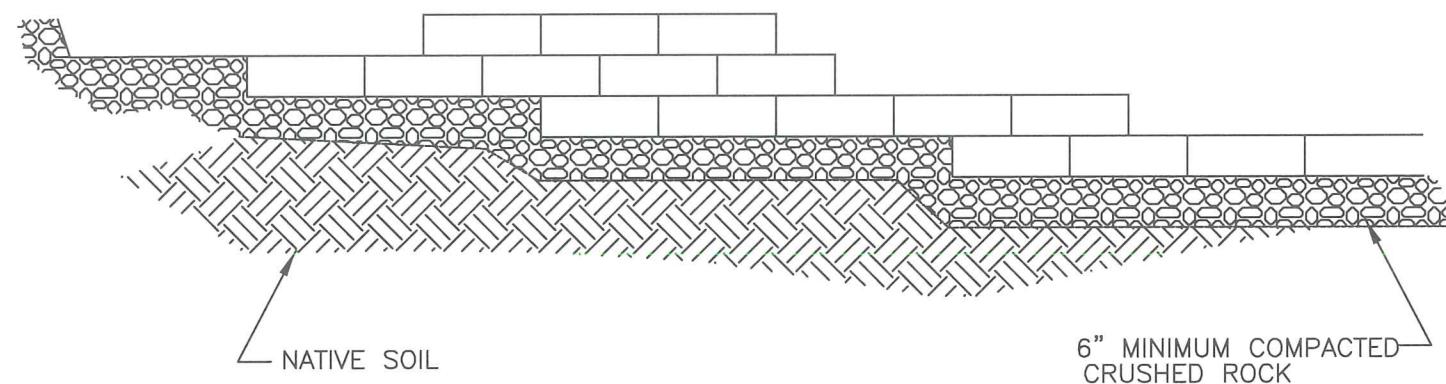
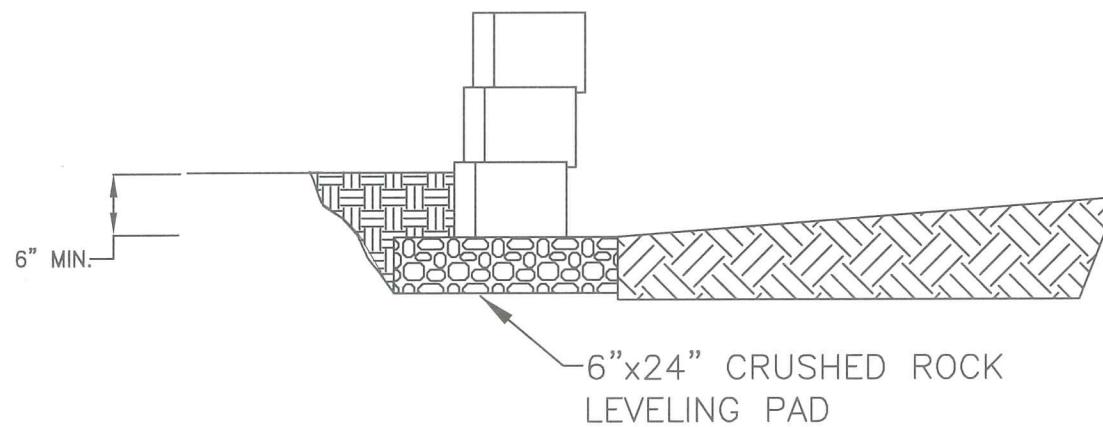
P.O. Box 94529 North Little Rock, AR 72190
Tel: 501.374.3546 Fax: 501.374.3547 E-mail: segwalls@gmail.com



PAVESTONE
2720 EAST OUTER ROAD
SCOTT CITY, MISSOURI 63780
573-332-8312

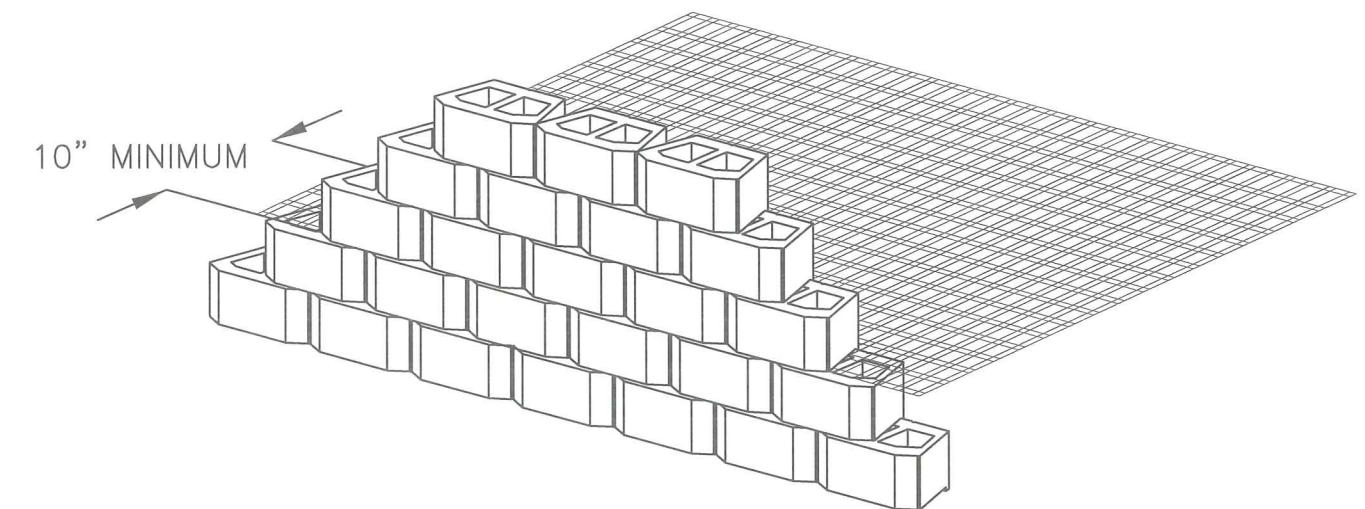


SPECIFICATIONS
Sheet 4 of 12
Date: May 1, 2018



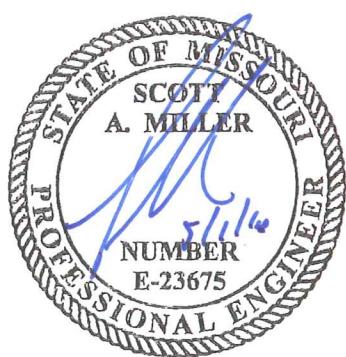
LEVELING PAD DETAIL

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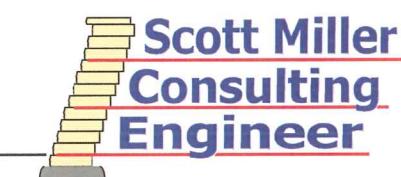


CONNECTION DETAIL

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P.O. Box 94529 North Little Rock, AR 72190
Tel: 501.374.3546 Fax: 501.374.3547 E-mail: segwalls@gmail.com



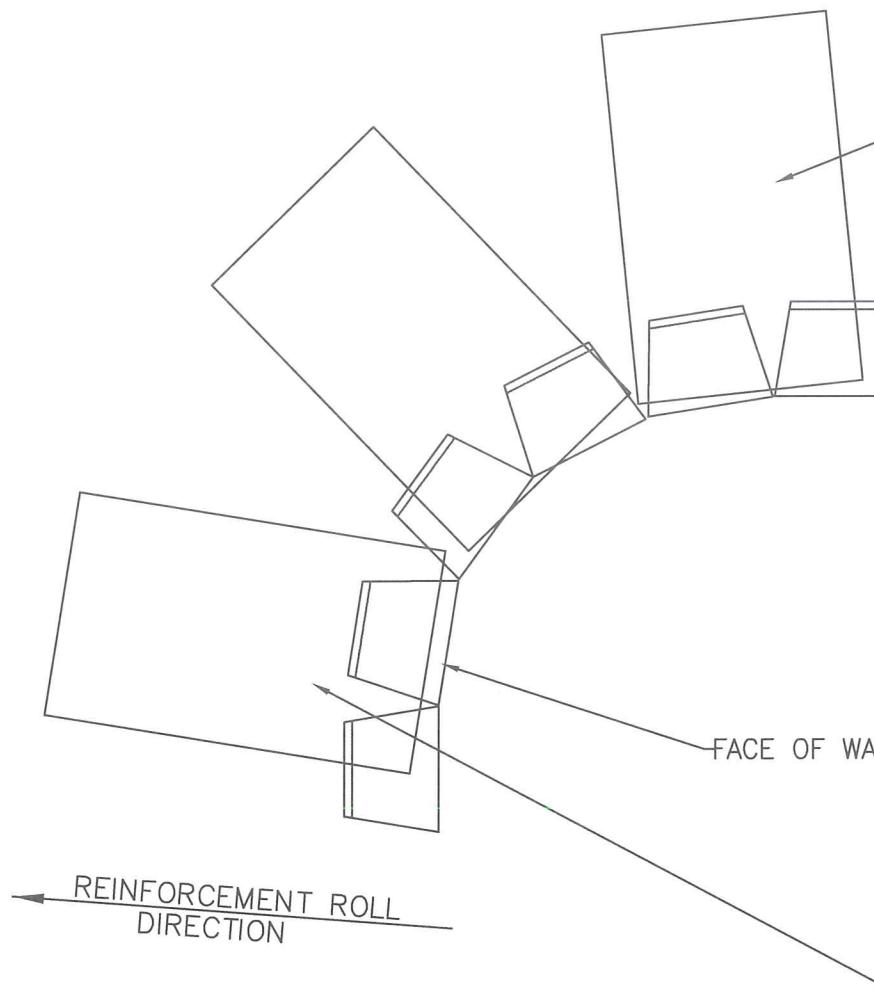
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DETAILS

Sheet 8 of 12

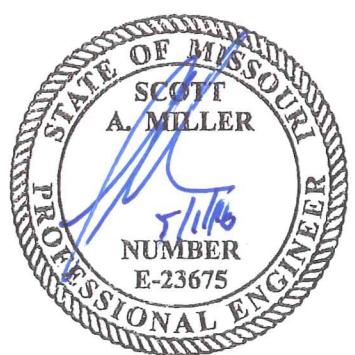
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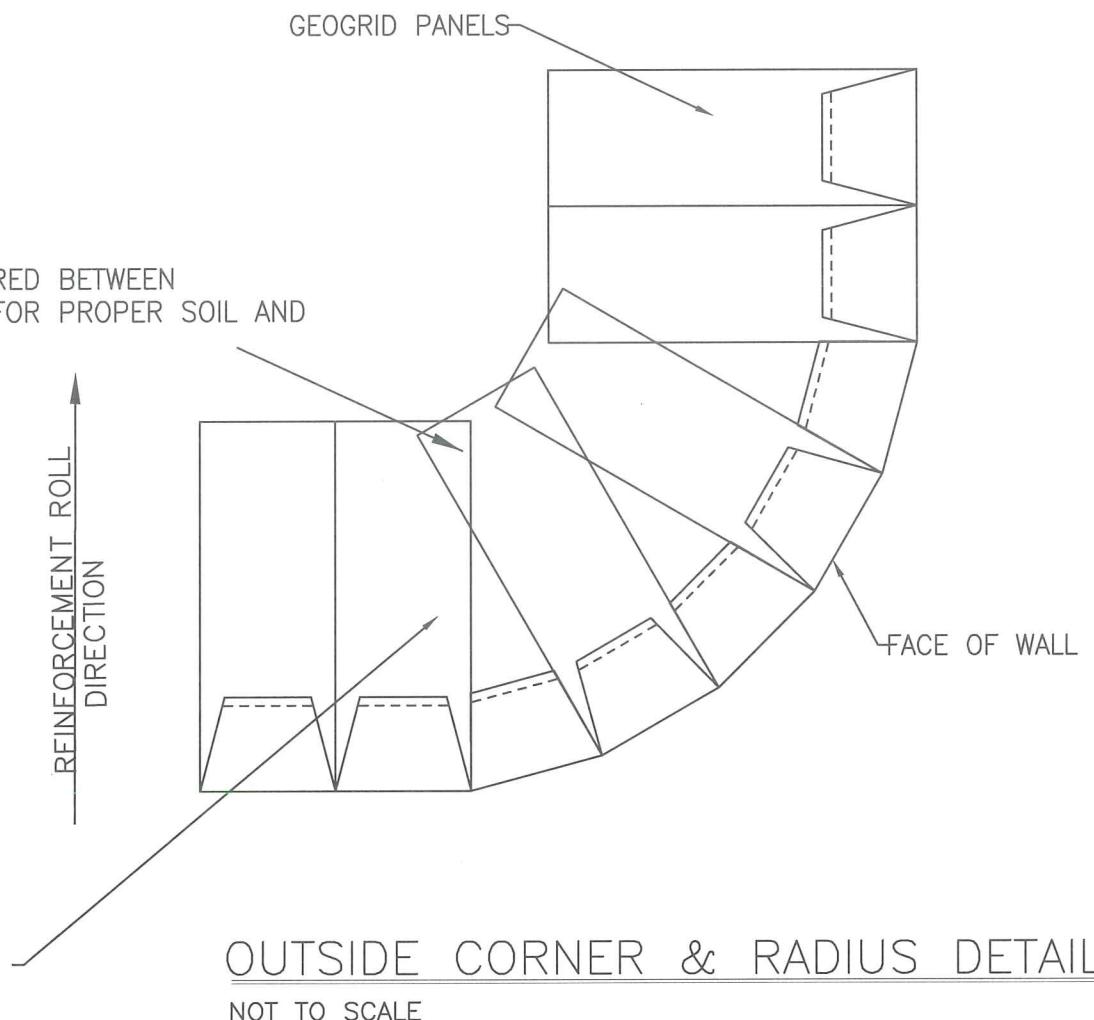
INSIDE CORNER & RADIUS DETAIL

NOT TO SCALE

PLACE ADDITIONAL REINFORCEMENT ON THE NEXT COURSE OF SEGMENTAL UNITS IMMEDIATELY ABOVE THE SPECIFIED PLACEMENT ELEVATION IN A MANNER THAT ELIMINATES GAPS LEFT BY THE PREVIOUS LAYER OF GEOGRID AT THE SPECIFIED REINFORCEMENT ELEVATION.



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Tel: 501.374.3546 Fax: 501.374.3547 E-mail: segwalls@gmail.com



OUTSIDE CORNER & RADIUS DETAIL

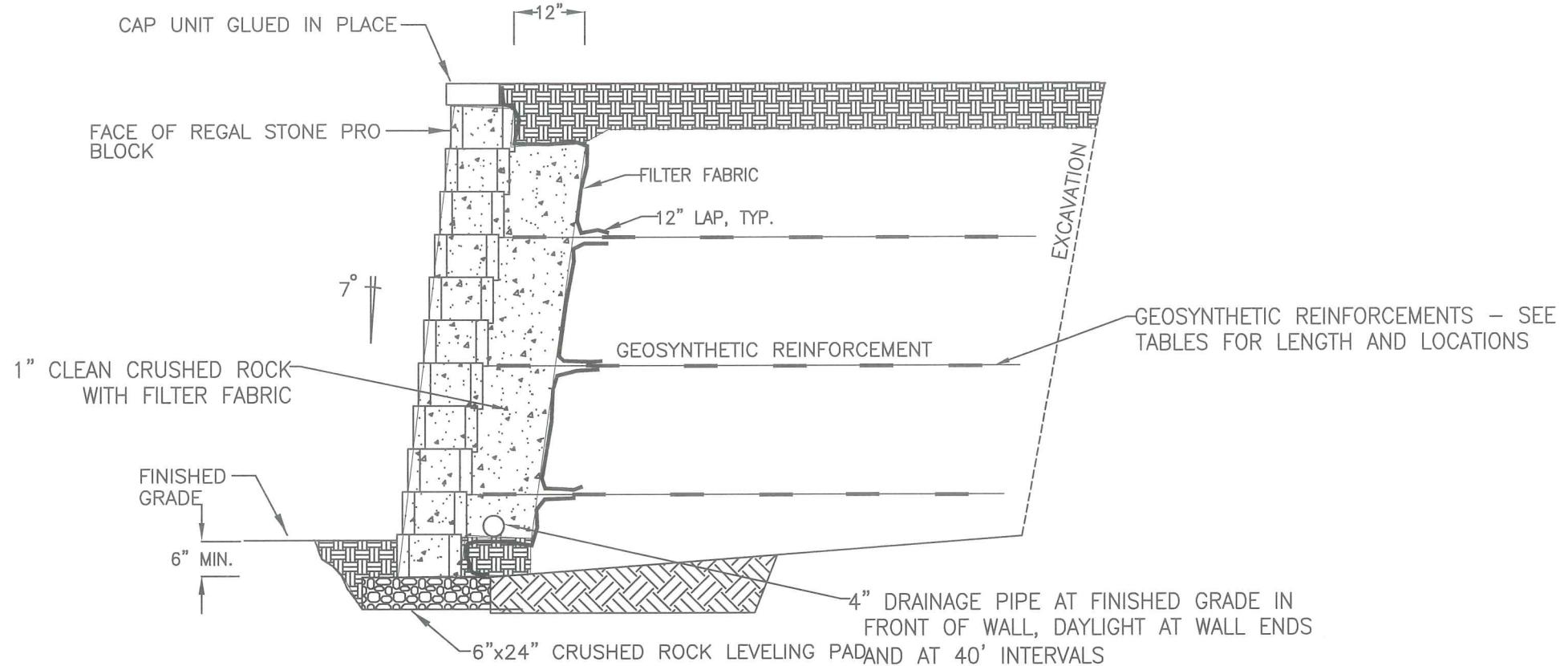
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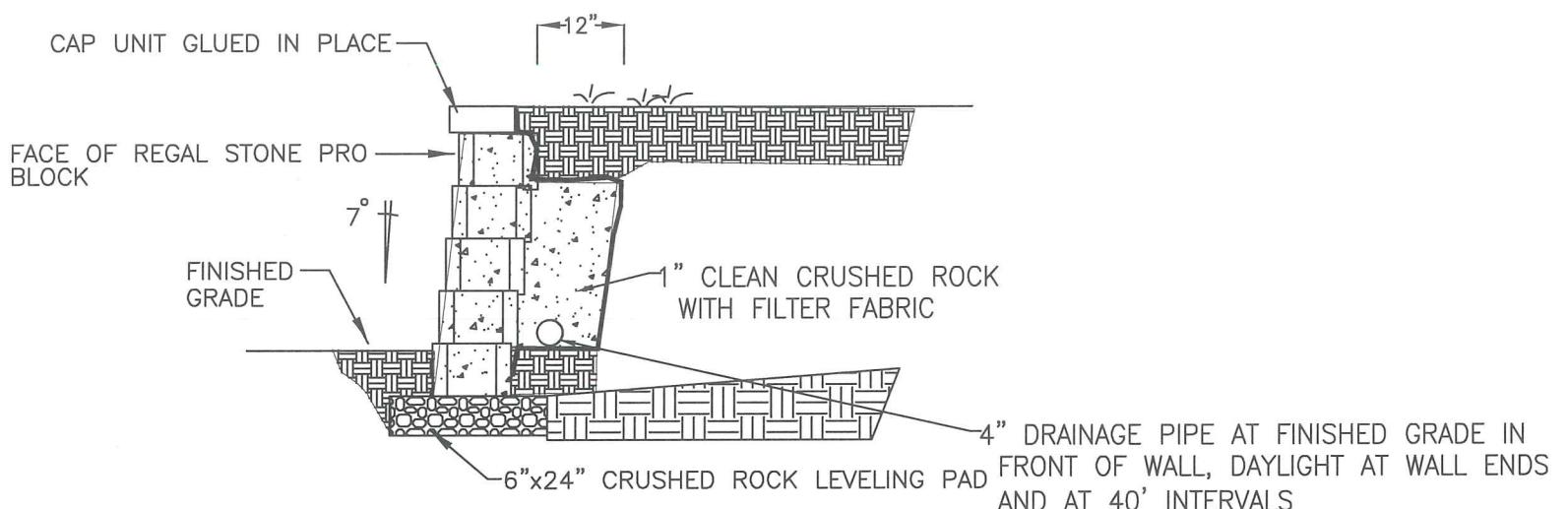
Sheet 7 of 12

Date: May 1, 2018



TYPICAL SECTION – WITH REINFORCEMENT

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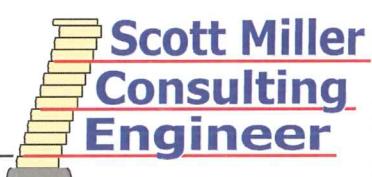


TYPICAL SECTION – WITHOUT REINFORCEMENT

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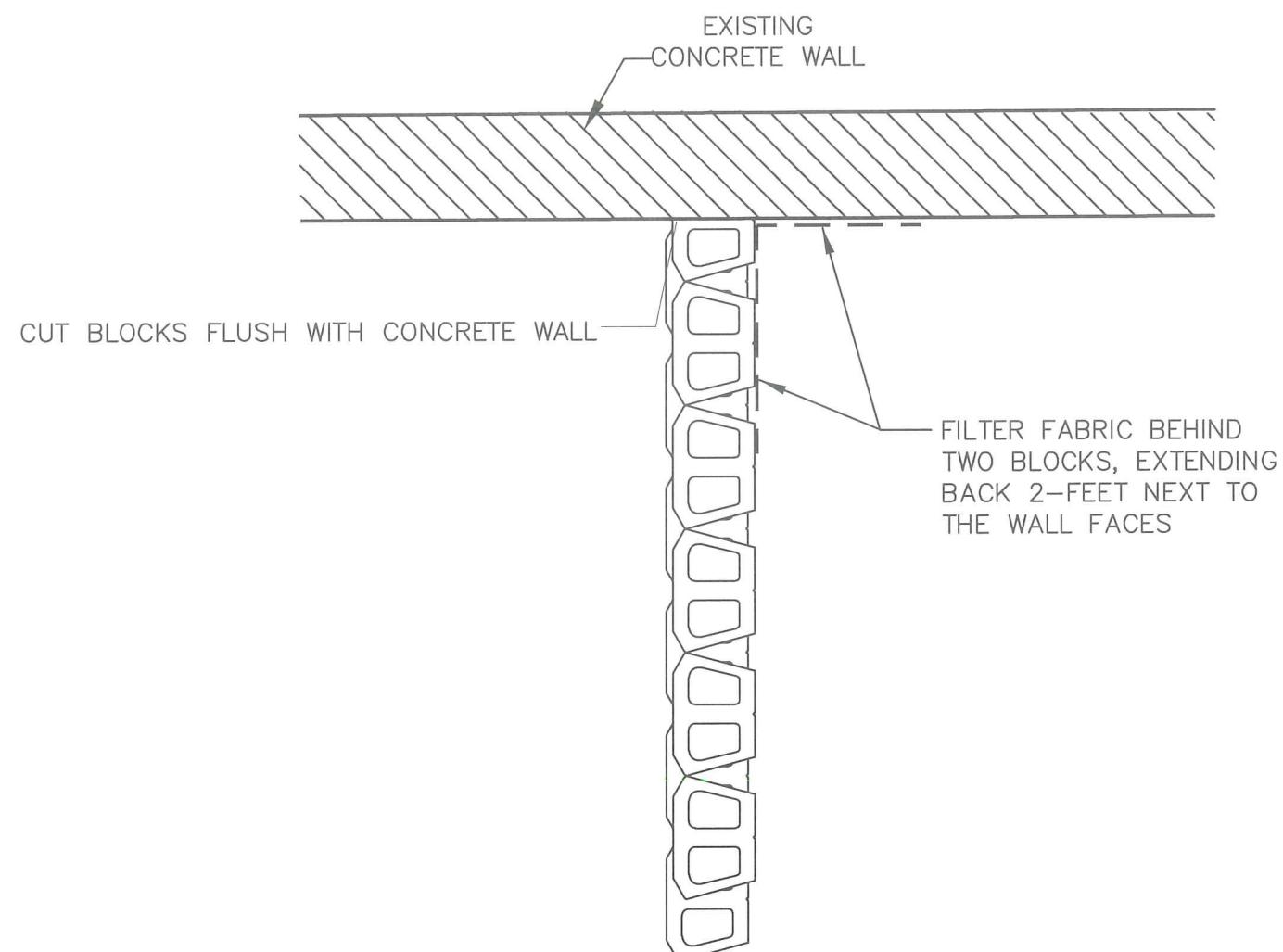
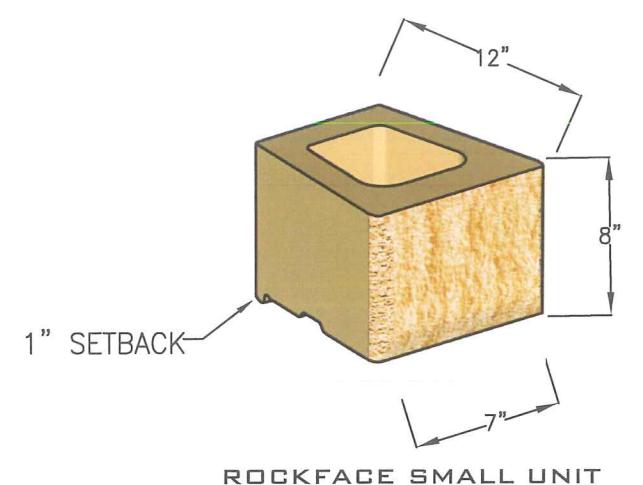
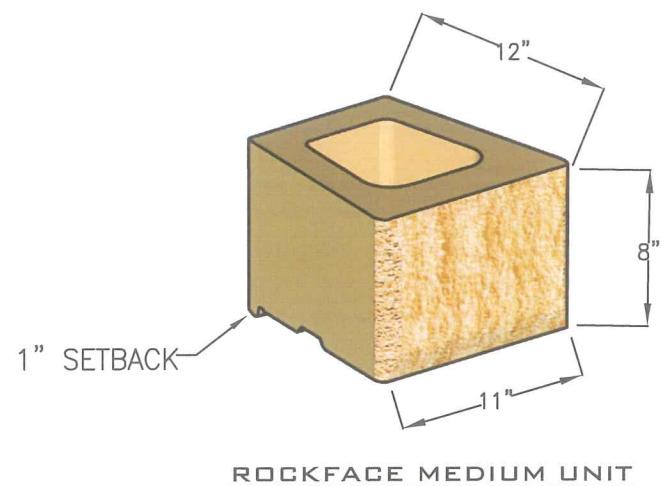
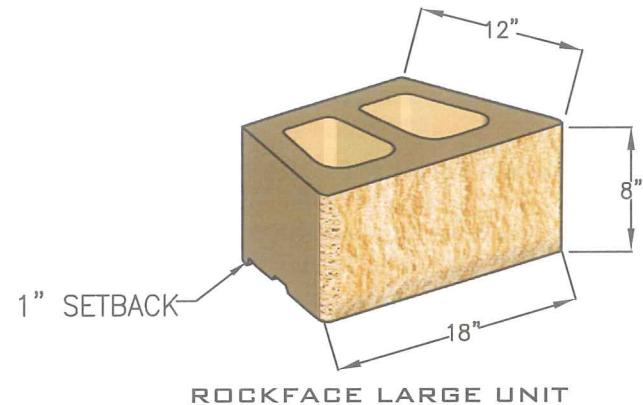
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DETAILS

Sheet 6 of 12

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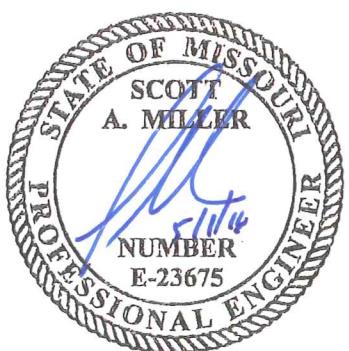
ABUTMENT DETAIL

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BLOCK DETAILS

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BLOCK AVAILABLE IN 3 DIFFERENT FACES:
ROCKFACE LARGE, ROCKFACE COMBO AND STRAIGHT



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Tel: 501.374.3546 Fax: 501.374.3547 E-mail: segwalls@gmail.com



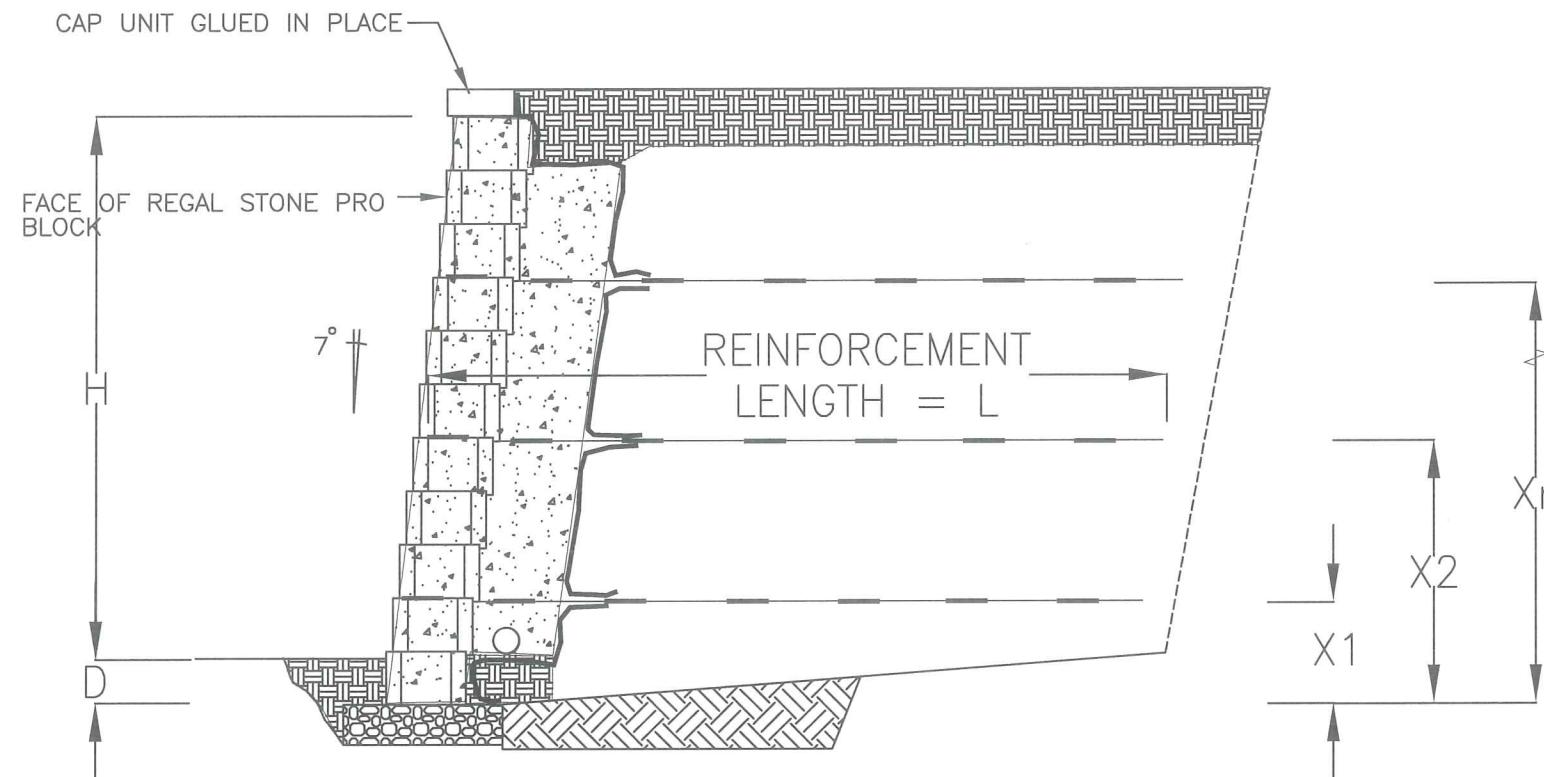
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DETAILS

Sheet 5 of 12

Date: May 1, 2018



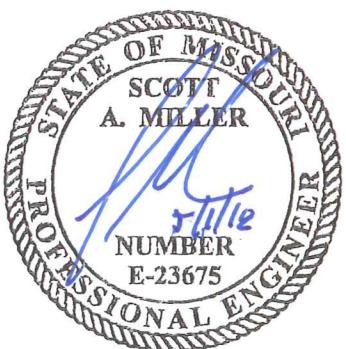
TYPICAL SECTION

NOT TO SCALE

DESIGN TABLE

Exposed Wall Height H	Depth Below Grade D	Total No. Courses For Finished Wall	Length L	Geosynthetic Reinforcement Placement Distance Up From Wall Base In Ft.					
				X1	X2	X3	X4	X5	X6
2'-2"	6"	4	4'-0"	1'-4"					
3'-6"	6"	6	4'-6"	2'-0"					
5'-6"	6"	9	5'-0"	2'-0"	4'-0"				

All geogrids are to be Mirafi 3XT



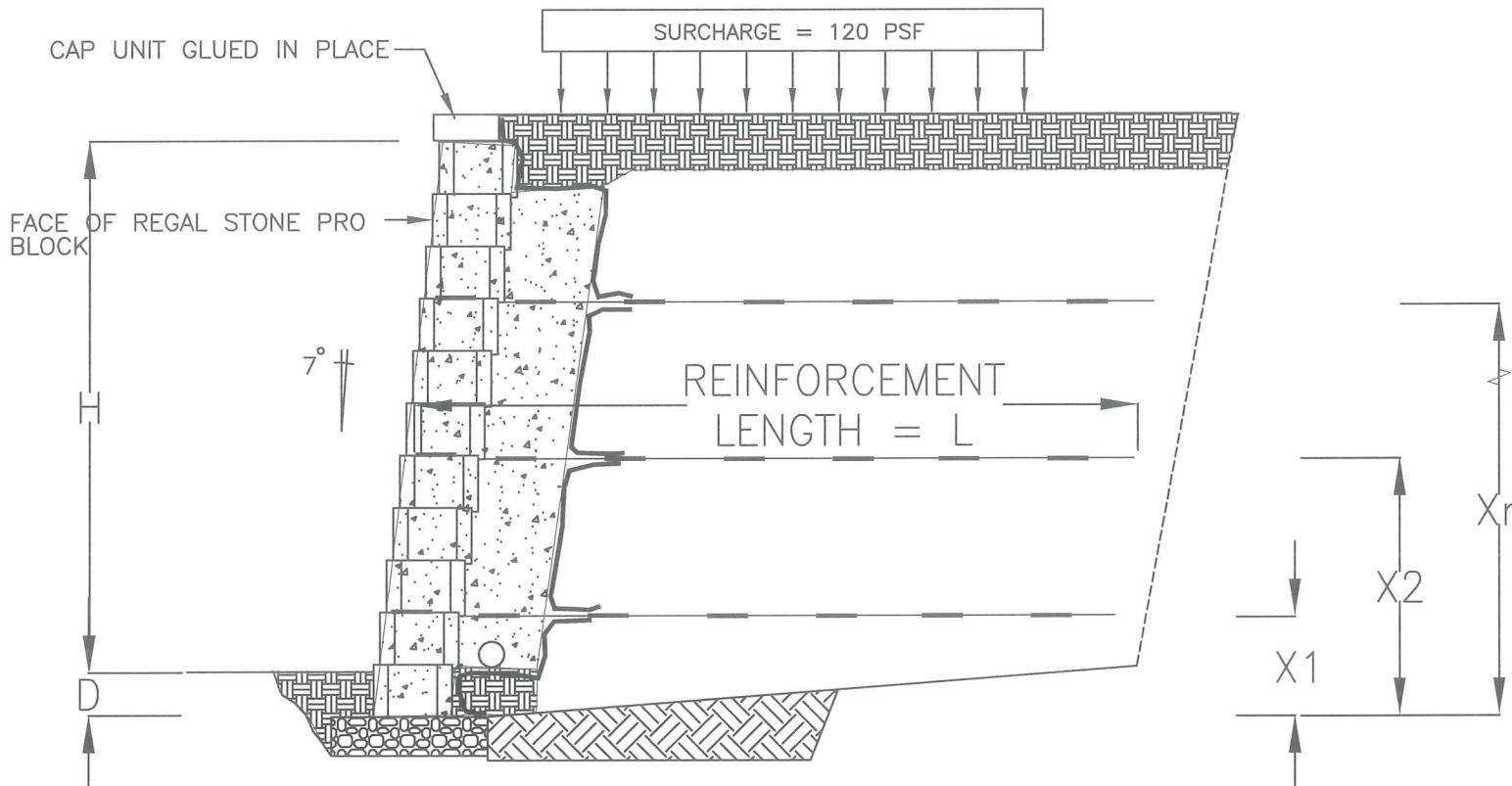
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Tel: 501.374.3546 Fax: 501.374.3547 E-mail: segwalls@gmail.com



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HORIZONTAL GRADE
Sheet 9 of 12
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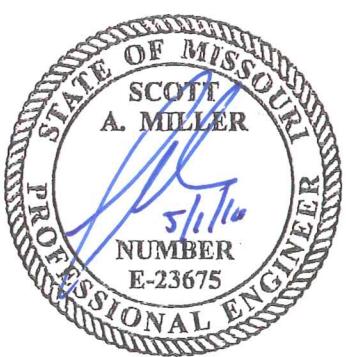
TYPICAL SECTION

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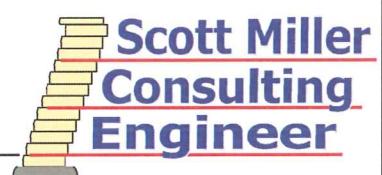
DESIGN TABLE

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2'-2"	6"	4	4'-6"	0'-8"					
3'-6"	6"	6	5'-0"	0'-8"	2'-8"				
5'-6"	6"	9	6'-0"	0'-8"	2'-8"	4'-8"			

All geogrids are to be Mirafi 3XT



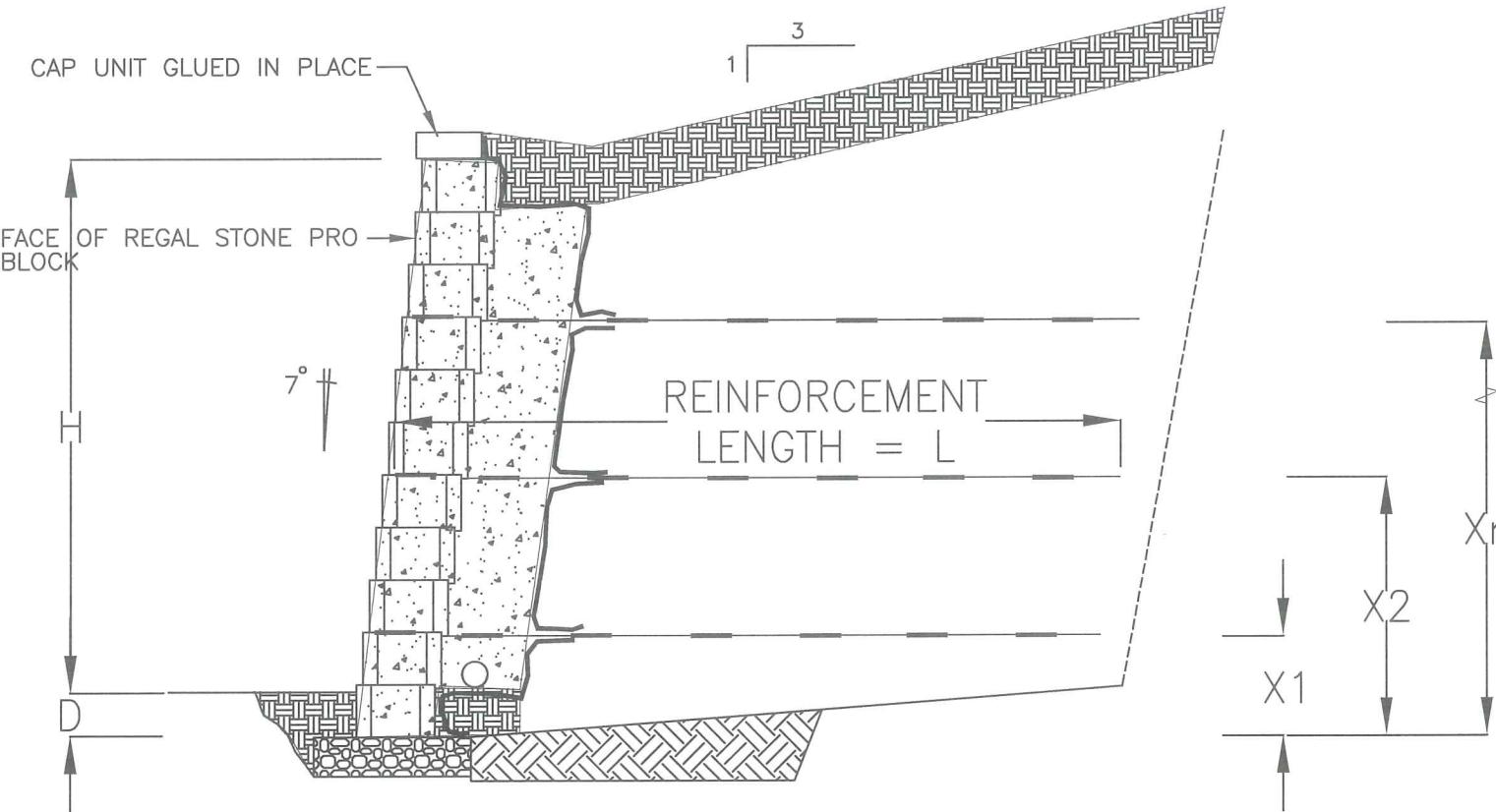
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HORIZONTAL GRADE
Sheet 10 of 12
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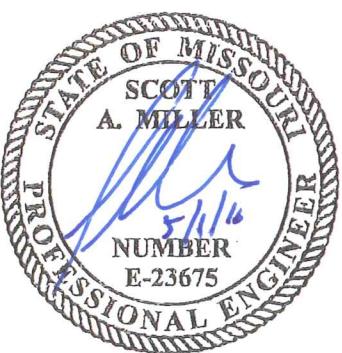
TYPICAL SECTION

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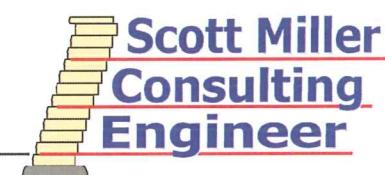
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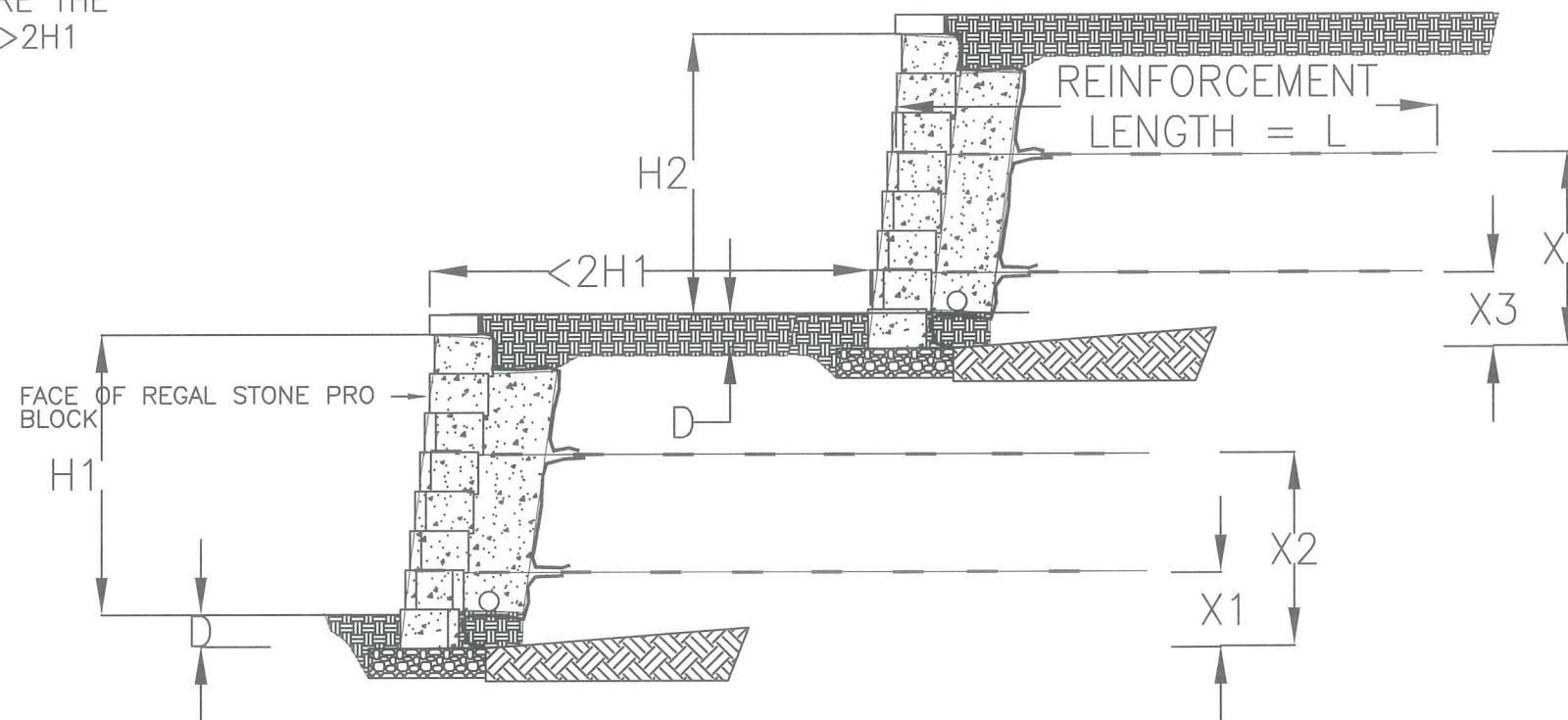


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SLOPING GRADE
Sheet 11 of 12
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FOR ALL TIERED WALLS WHERE THE
DISTANCE BETWEEN WALLS $>2H1$
USE SHEETS 9-11



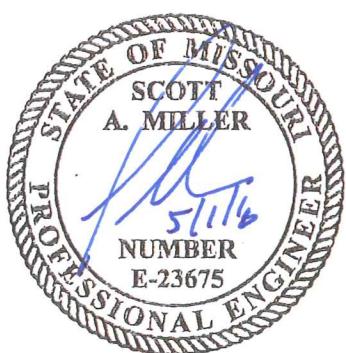
TYPICAL SECTION

NOT TO SCALE

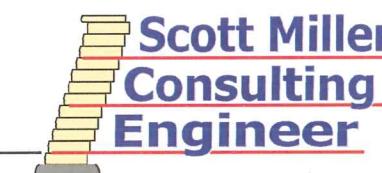
DESIGN TABLE

Exposed Wall Height H1&H2	Depth Below Grade D	Total No. Courses For Finished Wall	Geosynthetic Reinforcement Placement Distance Up From Wall Base In Ft.					
			X1	L	X2	L	X3	L
2'-2"	6"	4	0'-8"	6'-0"			1'-4"	4'-0"
3'-6"	6"	6	0'-8"	6'-0"	2'-0"	6'-0"	2'-0"	4'-0"

All geogrids are to be Mirafi 3XT



P.O. Box 94529 North Little Rock, AR 72190
Tel: 501.374.3546 Fax: 501.374.3547 E-mail: segwalls@gmail.com



PAVESTONE
2720 EAST OUTER ROAD
SCOTT CITY, MISSOURI 63780
573-332-8312



TIERED WALL
Sheet 12 of 12
Date: May 1, 2018