Charlie A. Dooley
County Executive

Saint Louis
COUNTY
HIGHWAYS & TRAFFIC
PUBLIC WORKS

Sheryl L. Hodges, D.E., P.E., L.P.G.
Director

December 22, 2014

Mr. John E. Shively, P.E.
Millennia Professional Services
7413 Manchester Road
Saint Louis, MO 63143

Re: Masterplan Approval (Permit Number 14BLD-05964)
for the residential retaining wall master plans using the **Broadstone 6, 6-inch tall** block units.

Dear Mr. Shively:

I am pleased to inform you that the plans submitted for the review of **Broadstone 6, 6-inch** tall **block units** with geogrid **Miragrid** by Ten Cate Mirafi; or **Stratagrid** by Strata Systems; or **SF20/SF35** by Synteen Corporation, are approved and the new master plan numbers are as follows:

Retaining Wall Description	Master Plan #
5'-0 [6.33' from TOLevel'g Pad] Max Ht, Level, Crushed rock backfill, No surcharge:	**722-14-10.**
5'-0 [6.33' from TOLevel'g Pad] Max Ht, 3:1 slope, Crushed rock backfill, No surcharge:	**722-14-11.**
5'-0 [6.33' from TOLevel'g Pad] Max Ht, Level, Crushed rock backfill, 100psf Parking Surcharge:	**722-14-12.**
4'-0 [4.33' from TOLevel'g Pad] Max Ht ea. of 2 tiers, Level, Clean rock backfill, No Surcharge:	**722-14-13.**

Please inform Pavestone Company and its approved local block suppliers that applicants for residential permits in Saint Louis County Code Enforcement's jurisdiction will need to be provided by the approved local supplier with a copy of the 11-page approved drawing set, so that they may submit it along with the items listed below in the quantities indicated to Saint Louis County Code Enforcement for review:

1. Submit the **completed permit application** form that includes the master plan number and;

2. Where applicable (based on location of project property), **provide municipality zoning approval** in the form of four (4) sets of the zoning municipality's fresh-ink stamped, signed, dated site plans, and the receipt of approval of the municipality's zoning application form.

3. **Submit four (4) copies of the site plan** with the following noted on the plan:
   a. The location and length of the wall, dimensioned and drawn to scale;
   b. The direction of surface drainage;
   c. A minimum of three (3) each top-of-wall (TW) and bottom-of-wall (BW) grade elevations, typically at the wall ends and middle. TW/BW grade elevations should also be provided at any proposed corners;

d. Dimension the wall's distance(s) from any structures, parking lots and property lines.

4. Submit four (4) scaled drawings of the **front elevation view of the wall** with dimensions noted.

5. Submit **four (4) copy sets** of the approved master plan drawings **(11 pages total each copy set).**

Please call me at 314-615-5472 if you have any questions.

Sincerely,

Virginia Price, R.A., CBO, CBCO
Building Code Review Section
Division of Code Enforcement

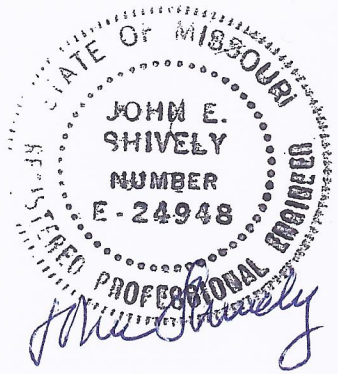
VP:vmp

PAVESTONE®

ST. LOUIS COUNTY MASTER PLAN
PAVESTONE BROADSTONE 6

PAVESTONE
2720 East Outer Road
Scott City, Missouri. 63780
573–332–8312

INDEX OF DRAWINGS:



PAVESTONE®

John E. Shively, P.E.

MILLENNIA

Millennia Professional Services
7413 Manchester Road
St. Louis, Missouri. 63143
314–440–5124

TITLE AND INDEX

Date: October 21, 2014

APPLICATION:

Application

Beautify your outdoor living spaces with Pavestone's elegant collection of **pavers**, **retaining walls**, **patio stones** and **edging**. Our BroadStone 6 retaining wall products transform landscapes into beautiful dreamscapes. The designs presented in this Master Plan are based on the assumptions detailed in the four design cases. Should you wish to build a wall that does not meet one of these design cases, we recommend that you contact a registered professional engineer experienced with the design of segmental block retaining walls to provide custom plans for your unique site.

Contact Pavestone for additional details regarding BroadStone 6 block products - office: 573-332-8312; www.pavestone.com. Consult with Millennia Professional Services of Illinois, Ltd., regarding design and construction issues - contact information below.

Design Procedure

Soil properties are presented below that will apply to most sites in St. Louis County, Missouri. A registered professional (geotechnical) engineer shall view the site and subsurface conditions and determine if the actual conditions meet or exceed the design parameters used herein. If the site and subsurface conditions do not meet the design parameters used herein, the retaining walls must be designed by a registered professional engineer experienced with the design of the Pavestone BroadStone 6 wall system. The parameters presented below are 'drained' soil parameters used to model long term effective strength conditions. High plasticity clay should be avoided unless site specific design recommendations are obtained from local geotechnical engineers, experienced in the design of segmental block retaining wall systems. The designs presented herein assume that groundwater, or ponded or running surface water is not present. Should groundwater, ponded water or running water be present, a site specific evaluation and design is needed and the plans presented herein are not valid. Walls with a slope at, below and/or near the toe of the wall should be avoided unless site specific design recommendations are obtained from local geotechnical engineers, experienced in the design of Pavestone BroadStone 6 retaining wall systems. This Master Plan is not valid for the design of any retaining wall with a slope at the toe of the wall.

Four wall configurations are presented in the Master Plan. One configuration is a wall with a horizontal toe slope, a horizontal backslope, and no surcharge. The second configuration is a horizontal toe slope, a horizontal backslope and a 100 pound per square foot surcharge. The surcharge is a load meant to represent a moderate load, such as a driveway with parked cars. The third configuration is a single wall with a horizontal toe slope, a backslope inclined at 4-Horizontal to 1-Vertical. The fourth configuration is a tiered wall with two walls, a level toe slope, a level terrace, a level back slope above the upper wall, and no surcharge.

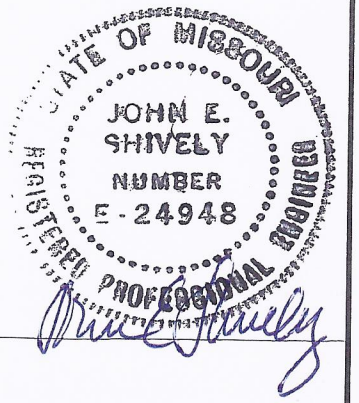
A retaining wall system consists of several elements: The block facing; reinforcing straps that connect to the block and are embedded in compacted select fill (reinforced fill); retained earth - the soil behind the retaining wall system; the leveling pad - the horizontal foundation that the first course of block is placed on; and the foundation soil - the soil that the wall system sits on.

The following is a summary of the design parameters and minumum factors of safety used for the three wall configurations:

	Friction Angle (degrees)	Unit Weight (pcf)	Cohesion (psf)
Reinforced Fill	28	125	0
Retained Soil	28	120	0
Foundation Soil	28	120	0

pcf = pounds per cubic foot
psf = pounds per square foot

Minimum Factors of Safety	
Reinforcement Pullout	1.5
Reinforcement Rupture	1.5
External Sliding	1.5
Overturning	2.0
Bearing Capacity:	2.0
Global Stability	1.3



SPECIFICATIONS:

Materials

Retaining wall units shall be BroadStone 6 units as manufactured by Pavestone . The units are 18" wide, 6" tall and 12 inches deep . Concrete wall units shall meet the requirements of ASTM C90-90 except compressive strength shall be a minimum 3000 psi and the maximum water absorption shall be limited to no more than 8.0 percent. The concrete shall have adequate freeze thaw resistance in accordance with ASTM C666-9 0.

The reinforced wall backfill material shall be compacted soil from on-site. The soil shall be free of organic materials, lumps, and rocks larger than 4". Do not use high plastic clay soils that have a PI>20 or LL>40.

Geogrid reinforcement shall be Miragrid 2XT or 3XT, as manufactured by Ten Cate Mirafi; Stratagrid SG150 or SG200, as manufactured by Strata Systems; or SF20 or SF35, as manufactured by Synteen Corporation. The geotextile filter fabric shall be a nonwoven fabric with a minimum weight of 3 .5 oz/sy.

The leveling pad shall be constructed of well graded crushed limestone similar to 1" minus.

The drainage rock shall be free draining aggregate such as 3/4" clean crushed limestone.

Wall Foundation

Foundation soil shall be excavated as needed to construct the leveling pad and the reinforced fill zones to the depths and locations shown on the plan sheets. The exposed foundation soil shall be observed by the prior to construction to verify that the exposed material is suitable for a net design bearing pressure of 2000 psf and that the base of the excavation is free of loose soil, uncompacted fill , water, or frozen material. Remove any unsuitable soil. Undercut areas shall be filled with crushed limestone and compacted to at least 95% of the material's standard Proctor maximum dry density .

Construct the crushed rock leveling pad to lines and grades shown on the plans. Construct the horizontal drainage layer at the lines and grades shown on the plans. The drainage rock shall be separated from the rock with a filter fabric.

Wall Construction

Install the first course of units on the leveling pad. Place the next units on top of the first units in a running bond pattern. Pull units forward. Backfill units and continue construction .

Cap units shall be glued in place at the top of the wall.

Drainage rock shall be placed in a horizontal layer at the base of the wall so the base of the discharge pipe will be level with the grade at the toe of the wall . The drainage rock shall be separated from the soil with a filter fabric.

Geogrid Reinforcement

Geogrid shall be cut to design lengths and placed between the blocks at the elevations indicated on the plans. The geogrid's primary strength direction will be directed perpendicular to the wall face and placed with the reinforced fill. Geogrid placed outside a plus or minus 4" zone of the geogrid design elevation will not be accepted. The geogrid shall be placed horizontally and lay flat on the reinforced fill soil. The geogrid shall be placed so that a minimum of 9" of grid is between the block layers. Slack in the geogrid shall be removed prior to placing additional backfill.

Wall Backfill

Wall backfill material shall be placed in maximum 8" loose lifts and compacted to at least 95% of the material's maximum dry density as determined by the standard Proctor method. Backfill shall be placed, spread, and compacted in such a manner that minimizes wrinkles and movement of the geogrid . Field density testing shall be conducted by a qualified soils technician to verify that at least the minimum degree of compaction is being obtained.

Place 12" of drainage rock layer behind units. Separate drainage rock and soil with the filter fabric.

During backfill placement, the 3 foot zone directly behind the wall shall be limited to the use of hand operated compaction equipment only.

Construction equipment shall not be operated directly on the geogrid.

Protection of Work

The surface of the wall backfill shall be graded at the end of each day of work to provide positive surface drainage away from the wall. Grading shall include proper contouring of fills In adjacent areas to prevent the flow of surface water into the reinforced earth zone.

The design of the walls are based on conditions and loads imposed on the wall at completion of the project. Prior to project completion, the wall is vulnerable to damages caused by construction activity adjacent to the wall. Of particular concern is operation of grading and pavement construction equipment on the retained backfill at the top of the wall. Only equipment with a weight not exceeding one ton can be used in the three foot zone directly behind the back of the block .

The soil in front of the walls shall be protected from future erosion.

STATE OF MISSOURI
JOHN E. SHIVELY
NUMBER E-24948
REGISTERED PROFESSIONAL ENGINEER

PAVESTONE®

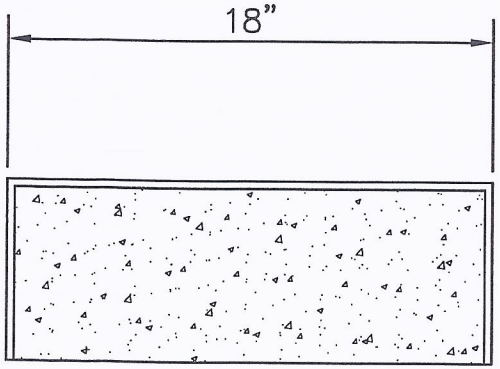
John E. Shively, P.E.

MILLENNIA

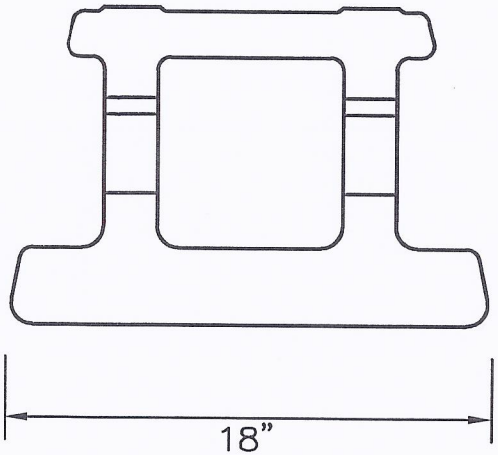
Millennia Professional Services
7413 Manchester Road
St. Louis, Missouri. 63143
314-440-5124

SPECIFICATIONS

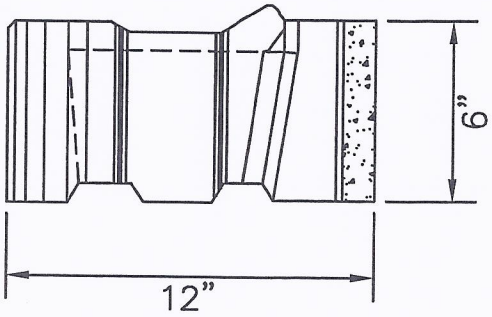
Date: October 21, 2014



FRONT VIEW



TOP VIEW



SIDE VIEW

BROADSTONE 6 UNIT

NOT TO SCALE

STATE OF MISSOURI
JOHN E. SHIVELY
NUMBER E-24948
REGISTERED PROFESSIONAL ENGINEER

PAVESTONE®

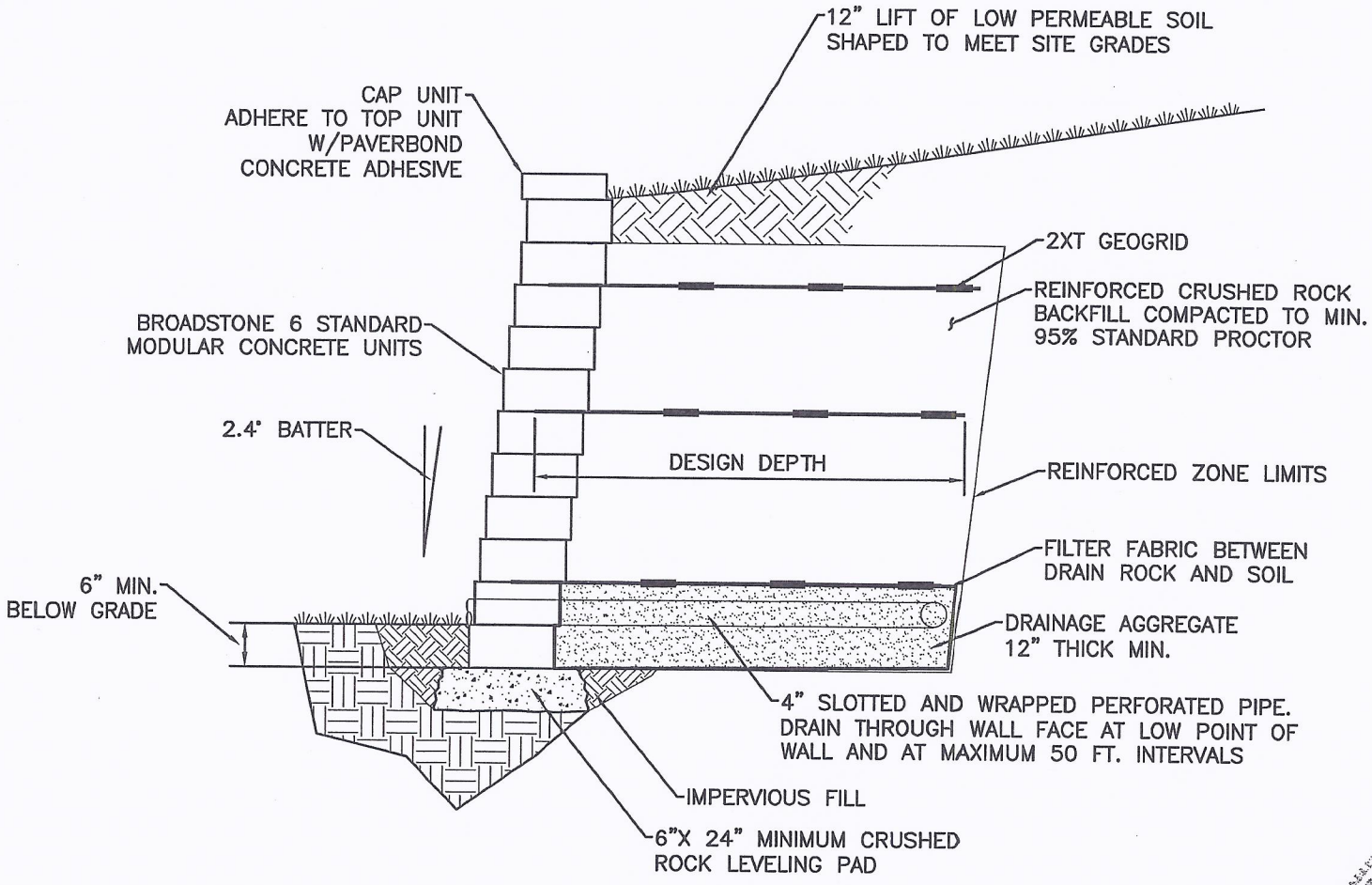
John E. Shively, P.E.

MILLENNIA

Millennia Professional Services
7413 Manchester Road
St. Louis, Missouri. 63143
314-440-5124

BLOCK DETAILS

Date: October 21, 2014



TYPICAL SECTION–REINFORCED RETAINING WALL

NOT TO SCALE

STATE OF MISSOURI
JOHN E. SHIVELY
NUMBER E-24948
REGISTERED PROFESSIONAL ENGINEER

PAVESTONE®

John E. Shively, P.E.

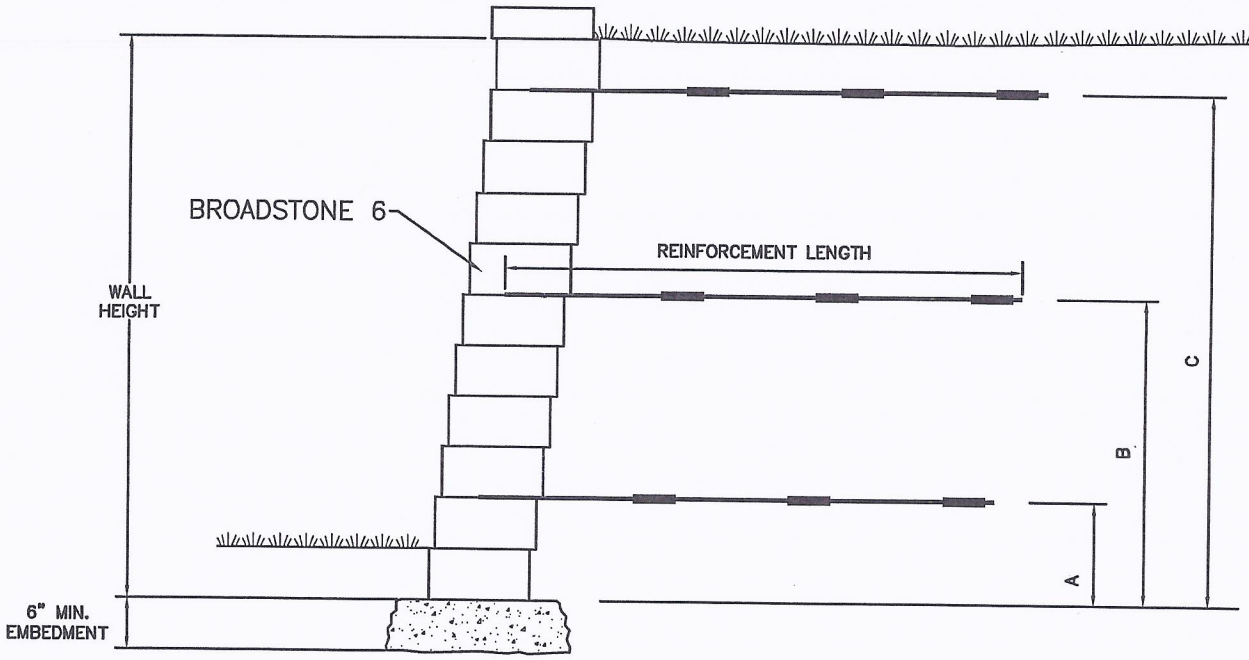
MILLENNIA

Millennia Professional Services
7413 Manchester Road
St. Louis, Missouri. 63143
314–440–5124

TYPICAL CROSS SECTION

Sheet 5 of 11

Date: October 21, 2014



GEOGRID LAYOUT – LEVEL BACKFILL

NOT TO SCALE

LEVEL:

WALL HEIGHT	BROADSTONE 6 WALL UNITS				
	# GEOGRID LAYERS	GEOGRID LENGTH	A	B	C
2'	NO GEOGRID REQUIRED				
3'	2	3.0'	1.0	2.5	
4'	2	3.5'	1.0	3.0	
5'	3	4.0'	1.0	2.5	4.0

All geogrids are to be Miragrid 2XT or 3XT;
Stratgrid SG150 or SG200; or Synteen SF20 or SF35

STATE OF MISSOURI
JOHN E. SHIVELY
NUMBER E-24948
REGISTERED PROFESSIONAL ENGINEER

PAVESTONE®

John E. Shively, P.E.

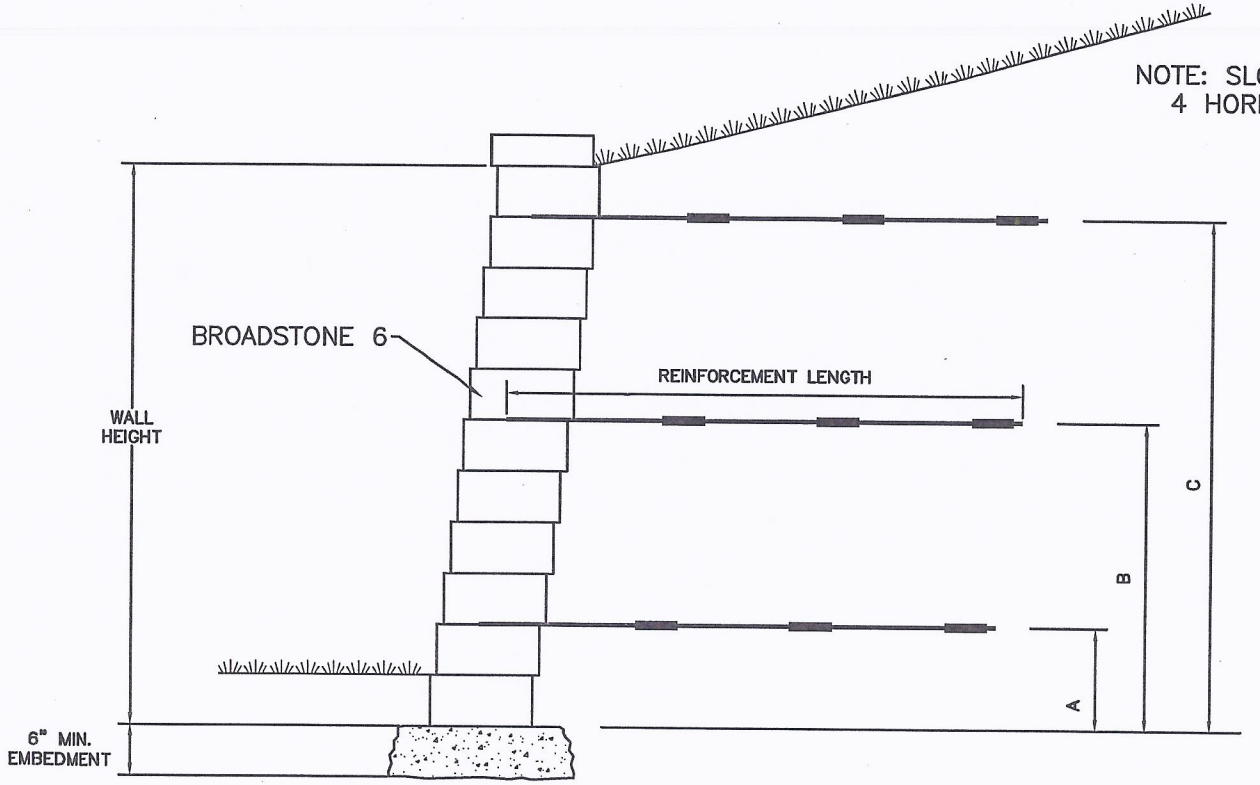
MILLENNIA

Millennia Professional Services
7413 Manchester Road
St. Louis, Missouri. 63143
314-440-5124

LEVEL BACKFILL

Date: October 21, 2014

NOTE: SLOPE NO STEEPER THAN
4 HORIZONTAL: 1 VERTICAL



GEOGRID LAYOUT – SLOPING BACKFILL

NOT TO SCALE

SLOPE:

WALL HEIGHT	BROADSTONE 6 WALL UNITS				
	# GEOGRID LAYERS	GEOGRID LENGTH	A	B	C
2'	NO GEOGRID REQUIRED				
3'	2	4.0'	1.0	2.5	
4'	3	4.0'	0.5	2.0	3.5
5'	3	4.5'	1.0	2.5	4.0

All geogrids are to be Miragrid 2XT or 3XT;
Stratgrid SG150 or SG200; or Synteen SF20 or SF35

STATE OF MISSOURI
JOHN E. SHIVELY
NUMBER E-24948
REGISTERED PROFESSIONAL ENGINEER

PAVESTONE®

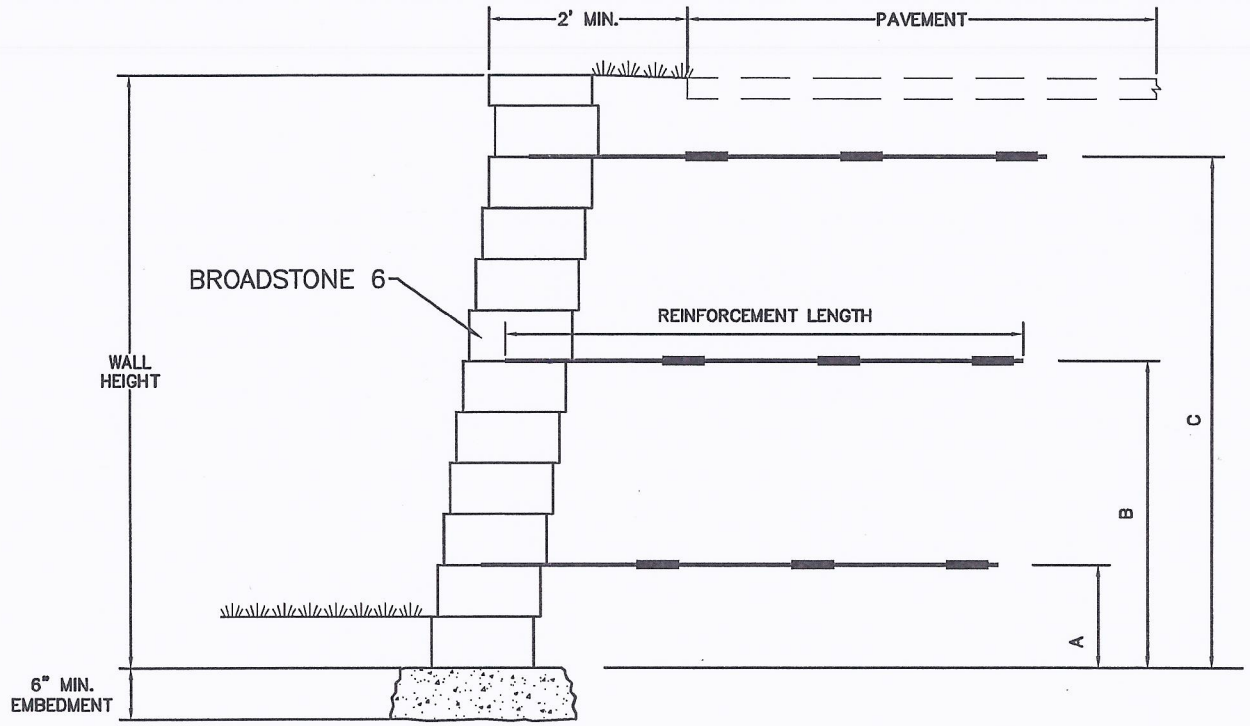
John E. Shively, P.E.

MILLENNIA

Millennia Professional Services
7413 Manchester Road
St. Louis, Missouri. 63143
314-440-5124

SLOPING BACKFILL

Date: October 21, 2014



GEOGRID LAYOUT – PARKING SURCHARGE (100 PSF)

NOT TO SCALE

FLAT:

WALL HEIGHT	BROADSTONE 6 WALL UNITS				
	# GEOGRID LAYERS	GEOGRID LENGTH	A	B	C
2'	NO GEOGRID REQUIRED				
3'	2	3.0	1.0	2.5	
4'	2	4.0	1.0	3.0	
5'	3	3.0	1.0	2.5	4.0

STATE OF MISSOURI
JOHN E. SHIVELY
NUMBER E-24948
REGISTERED PROFESSIONAL ENGINEER

Note; This design condition is for residential driveways and pavements. This condition excludes commercial parking lots and public roads.

All geogrids are to be Miragrid 2XT or 3XT; Stratgrid SG150 or SG200; or Synteen SF20 or SF35

PAVESTONE®

John E. Shively, P.E.

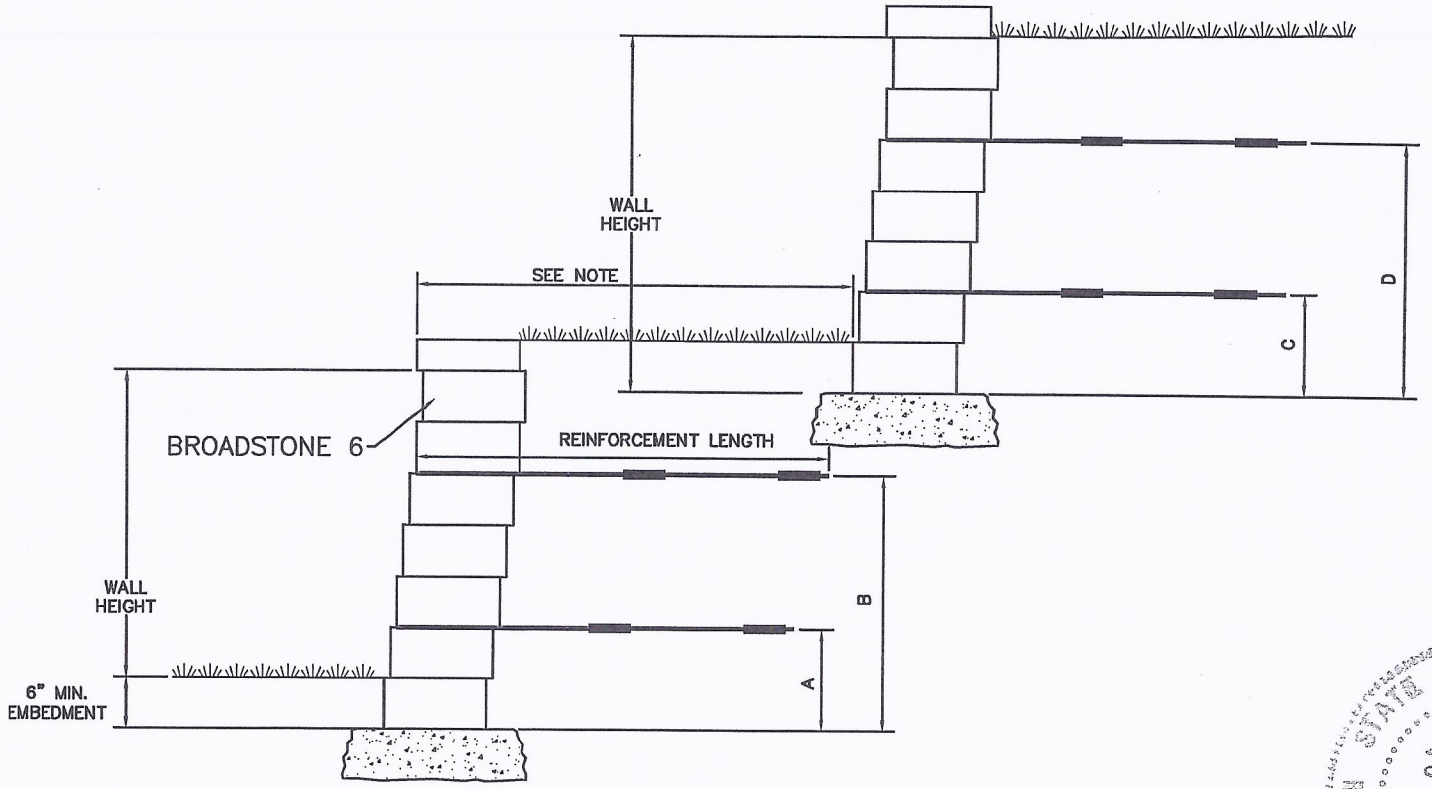
MILLENNIA

Millennia Professional Services
7413 Manchester Road
St. Louis, Missouri. 63143
314-440-5124

PARKING SURCHARGE

Sheet 8 of 11

Date: October 21, 2014



GEOGRID LAYOUT – TIERED WALL

NOT TO SCALE

STATE OF MISSOURI
JOHN E. SHIVELY
NUMBER E-24948
REGISTERED PROFESSIONAL ENGINEER

TIERED:

WALL HEIGHT	BROADSTONE 6 WALL UNITS					
	# GEOGRID LAYERS	GEOGRID LENGTH	A	B	C	D
2'	2.0	3.0	1.0		1.0	
3'	3.0	3.0	1.0	2.5	1.0	
4'	4.0	3.0	1.0	2.5	1.0	2.5

NOTE: This distance is typically 3 to 4 feet. If the distance is more than two times the wall height then each wall are treated as an individual wall.

All geogrids are to be Miragrid 2XT or 3XT; Stratgrid SG150 or SG200; or Synteen SF20 or SF35

PAVESTONE®

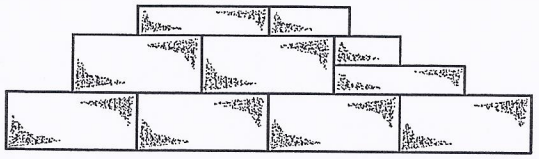
John E. Shively, P.E.

MILLENNIA

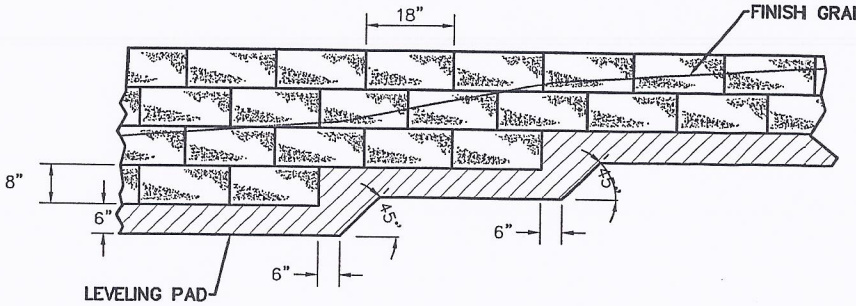
Millennia Professional Services
7413 Manchester Road
St. Louis, Missouri. 63143
314–440–5124

TIERED WALLS

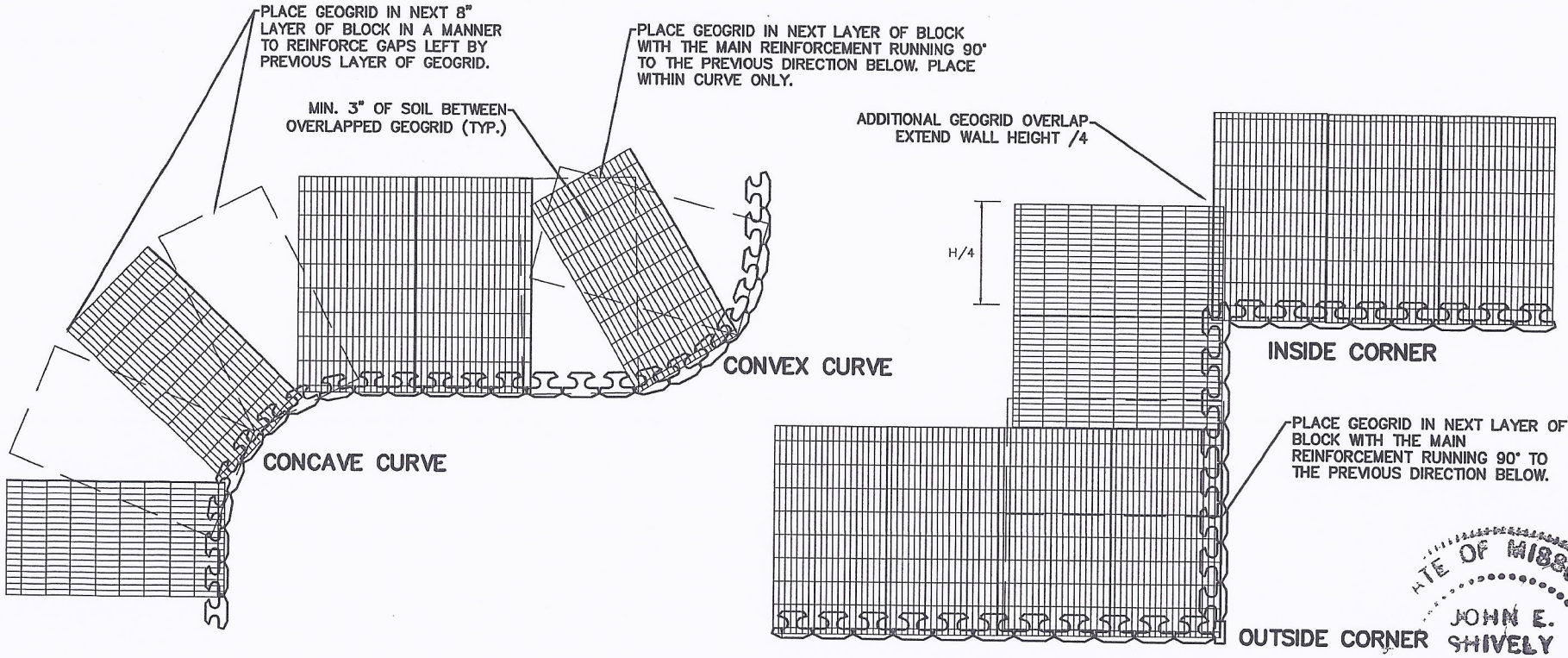
Date: October 21, 2014



UNIVERSAL CAP STEP DETAIL



LEVELING PAD STEP DETAIL



GEOGRID PLACEMENT

STATE OF MISSOURI
JOHN E. SHIVELY
NUMBER E-24948
REGISTERED PROFESSIONAL ENGINEER

PAVESTONE®

John E. Shively, P.E.

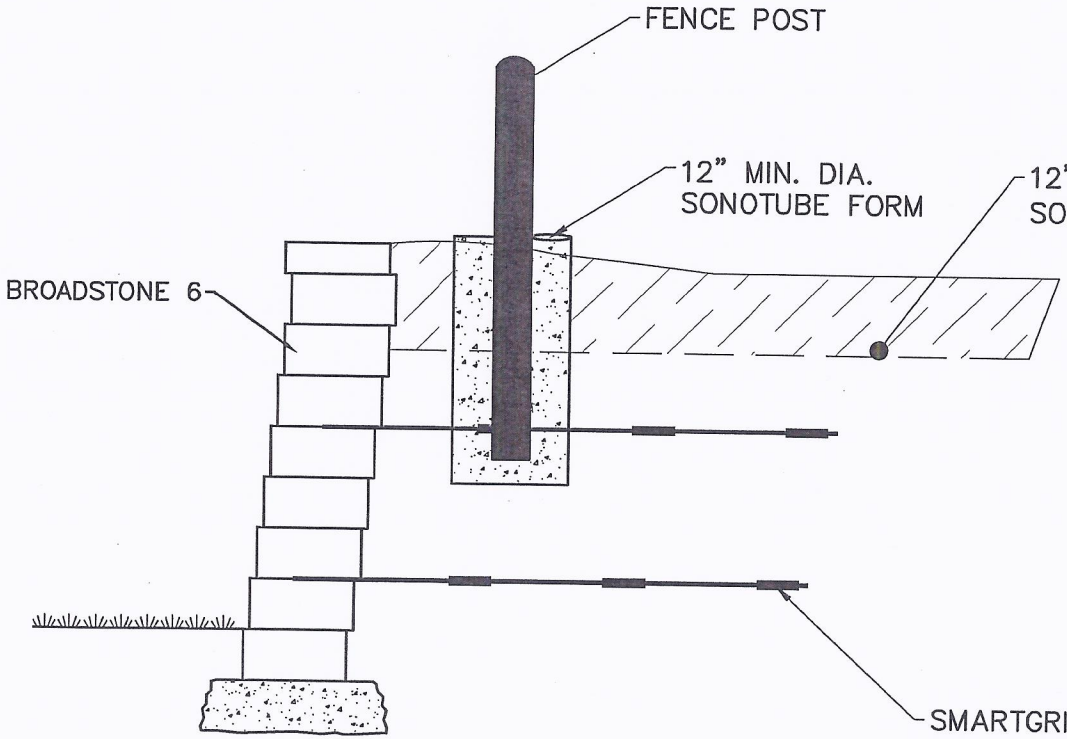
MILLENNIA

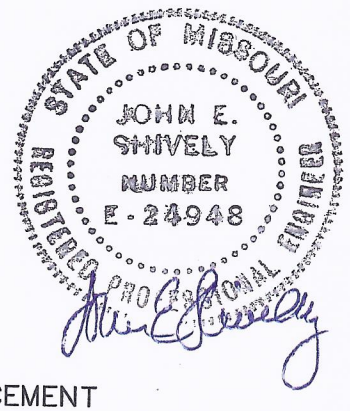
Millennia Professional Services
7413 Manchester Road
St. Louis, Missouri. 63143
314-440-5124

BLOCK PLACEMENT DETAILS

Sheet 10 of 11

Date: October 21, 2014





NOTE: Where post foundation intersects geogrid, cut hole (neat) in geogrid. Install sonotube–type foundation form as wall is constructed. Do not drill hole through geogrid after the wall is complete.

PAVESTONE®	John E. Shively, P.E.	MILLENNIA	Millennia Professional Services 7413 Manchester Road St. Louis, Missouri. 63143 314–440–5124	**FENCE POST DETAIL**	Sheet 11 of 11 Date: October 21, 2014