

WALL BRACING

A site inspection was performed on 1-15-2020 to evaluate the retaining wall at the driveway. See the accompanying sketch. The wall consists of keystone mini units, battered, with no geogrid. The units are glued together. The wall is approximately 5' tall at its tallest point. The wall is failing, as the method of construction is wholly inadequate. The wall is leaning outward approximately 3" at the point of maximum failure. Because the wall has been pushed outward by the earth pressure, the driveway slab has settled accordingly. The driveway slab has settled approximately 3 1/2" at the point of maximum failure.

Engineering Tech Recommends replacing the existing wall with a new keystone wall using properly sized keystone units and geogrid reinforcement. Part of the existing driveway slab will need to be demolished to install the new wall. see the following pages for a recommended design.

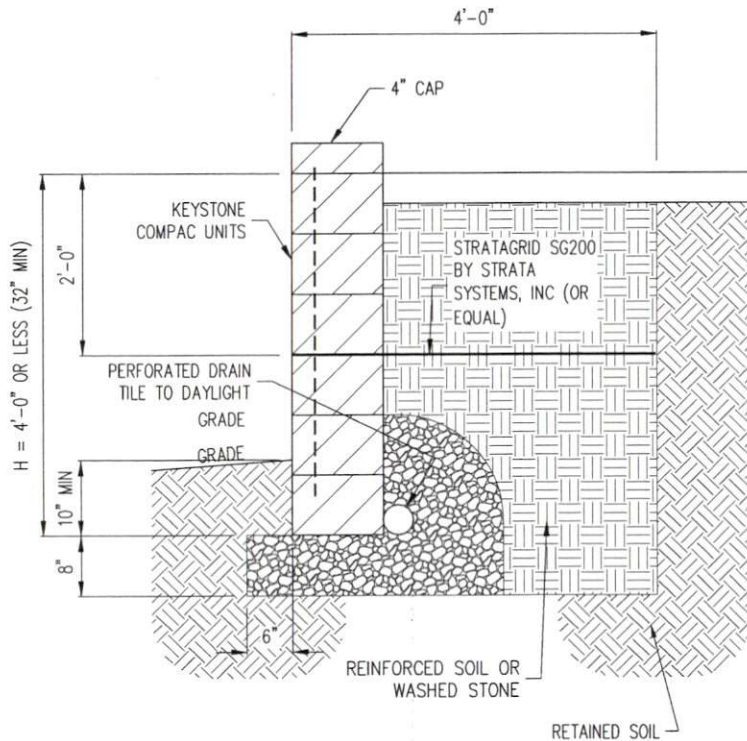
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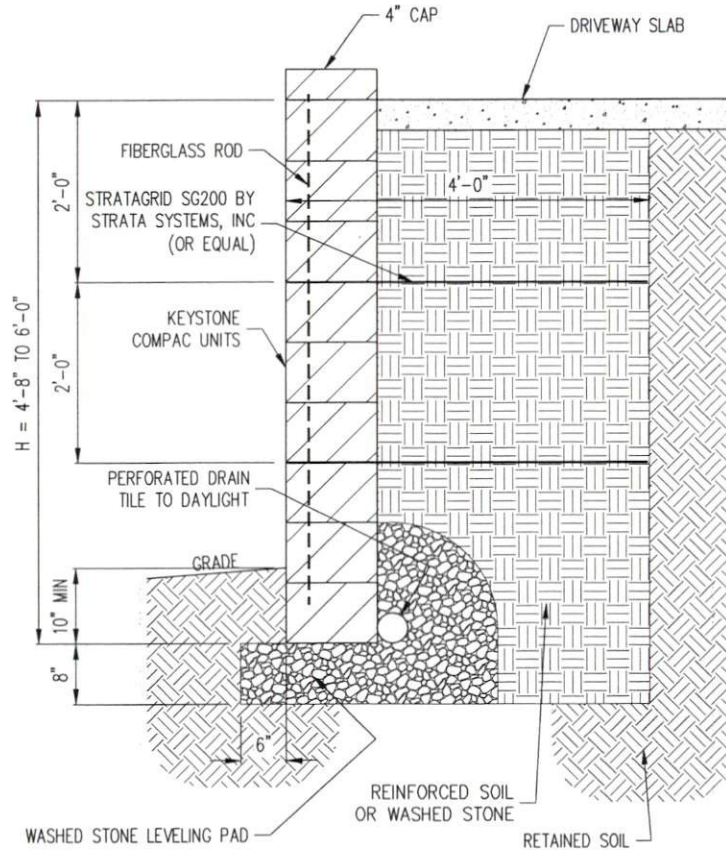
MURRAY AND CAMILLA CRIGS	
EVALUATE RETAINING WALL	
SCOPE	8055 nc-42 holly springs
LOC	

ENG	KWT
DATE	1-24-20
PROJECT NO.	
20-65-040	
SHEET NO.	
S1	
1 of 4	

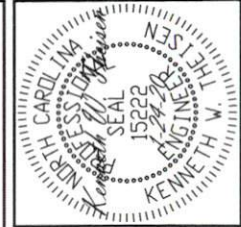
NOTE: REINFORCED SOIL TO BE SOIL WITH A MINIMUM INTERNAL ANGLE OF FRICTION OF 28°, MINIMUM MOIST DENSITY OF 115 PCF. COMPACT PER SECTION 3.05, SHEET SD5. OPTION: REINFORCED SOIL TO BE WASHED STONE OR GRAVEL



SECTION
KEYSTONE WALL, H =
4'-0" OR LESS
3/4" = 1'-0"



SECTION
KEYSTONE WALL, H =
4'-8" TO 6'-0"
3/4" = 1'-0"



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MURRAY AND CAMILLA CRIGGS
EVALUATE RETAINING WALL

SCOPE: 8055 nc-42 holly springs
LOC:

ENG: KWT
DATE: 1-24-20

PROJECT NO.
20-65-040

SHEET NO.
SD1

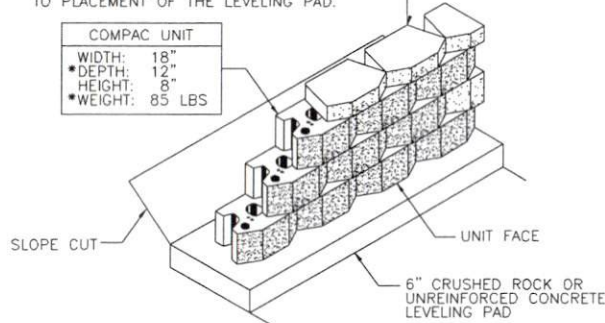
2 of 4

BASE LEVELING PAD NOTES:

1. THE LEVELING PAD IS TO BE CONSTRUCTED OF CRUSHED STONE OR 2,000 PSI± UNREINFORCED CONCRETE.
2. THE BASE FOUNDATION IS TO BE APPROVED BY THE SITE GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF THE LEVELING PAD.

MINI CAP UNIT
 WIDTH: 18"
 DEPTH: 10"
 HEIGHT: 4"
 WEIGHT: 45 LBS

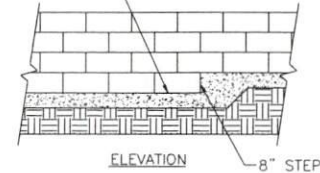
COMPAC UNIT
 WIDTH: 18"
 DEPTH: 12"
 HEIGHT: 8"
 WEIGHT: 85 LBS



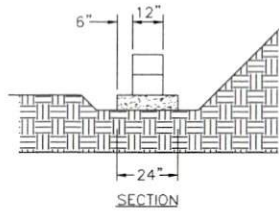
1/5 COMPAC UNIT/BASE PAD ISOMETRIC VIEW
 SCALE: 3/8" = 1'-0"

*DIMENSIONS & WEIGHT MAY VARY BY REGION

6" CRUSHED ROCK OR UNREINFORCED CONCRETE LEVELING PAD



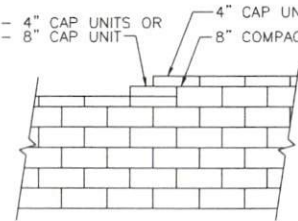
ELEVATION



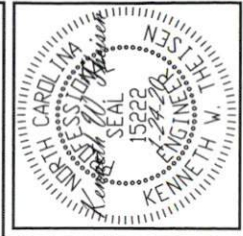
SECTION

2/5 LEVELING PAD DETAIL
 SCALE: 1/4" = 1'-0"

(2) - 4" CAP UNITS OR (1) - 8" CAP UNIT



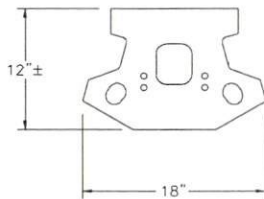
3/5 TOP OF WALL STEPS
 SCALE: 1/4" = 1'-0"



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COMPAC ELEVATION



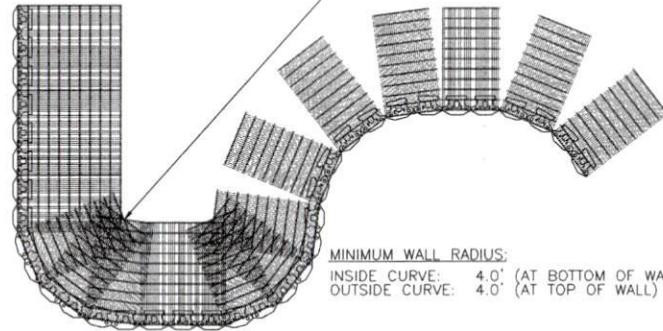
COMPAC PLAN

4/5 COMPAC UNIT
 SCALE: 1" = 1'-0"

NOTE:

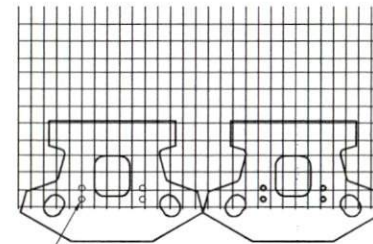
1. CHECK WITH MANUFACTURER SPECIFICATIONS ON CORRECT DIRECTION OF ORIENTATION FOR GEOGRID TO OBTAIN PROPER STRENGTH.

3" OF SOIL FILL IS REQUIRED BETWEEN OVERLAPPING GEOGRID FOR PROPER ANCHORAGE



MINIMUM WALL RADIUS:
 INSIDE CURVE: 4.0' (AT BOTTOM OF WALL)
 OUTSIDE CURVE: 4.0' (AT TOP OF WALL)

5/5 GEOGRID INSTALLATION ON CURVES
 SCALE: 5/32" = 1'-0"



GEOGRID IS TO BE PLACED ON LEVEL BACKFILL AND EXTENDED OVER THE FIBERGLASS PINS. PLACE NEXT UNIT. PULL GRID TAUGHT AND BACKFILL. STAKE AS REQUIRED.

6/5 GRID & PIN CONNECTION
 SCALE: 1" = 1'-0"

MURRAY AND CAMILLA CRIGS
 EVALUATE RETAINING WALL

SCOPE: 8055 nc-42 holly springs
 LOC:

ENG: KWT
 DATE: 1-24-20

PROJECT NO.
 20-65-040

SHEET NO.
 SD2
 3 of 4

MODULAR CONCRETE RETAINING WALL

PART 1: GENERAL

1.01 Description

- A. Work shall consist of furnishing and construction of a KEYSTONE Retaining Wall System or equal in accordance with these specifications and in reasonably close conformity with the lines, grades, design, and dimensions shown on the plans.
- B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill and backfill
- C. Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths designated on the construction drawings.

1.02 Reference Documents

A. American Society for Testing and Materials (ASTM)

1. ASTM C-1372 Specification for Segmental Retaining Wall Units
2. ASTM D-422 Particle Size Analysis
3. ASTM D-698 Laboratory Compaction Characteristics of Soil - Standard Effort
4. ASTM D-4318 Liquid Limit, Plastic Limit and Plasticity Index of Soils
5. ASTM D-4595 Tensile Properties of Geotextiles - Wide Width Strip
6. ASTM D-5262 Unconfined Tension Creep Behavior of Geosynthetics
7. ASTM D-3034 Polyvinyl Chloride Pipe (PVC)
8. ASTM D-1248 Corrugated Plastic Pipe

B. Geosynthetic Research Institute (GRI)

1. GRI-GG4 Determination of Long Term Design Strength of Geogrids
2. GRI-GG5 Determination of Geogrid (soil) Pullout

C. National Concrete Masonry Association (NCMA)

1. NCMA SRWU-1 Test Method for Determining Connection Strength of SRW
2. NCMA SRWU-2 Test Method for Determining Shear Strength of SRW

03 Delivery, Storage and Handling

- A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification has been received.
- B. Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

PART 2: PRODUCTS

2.01 Materials

- A. Modular Unit - a concrete retaining wall element made from portland cement, water, and aggregates.
- B. Structural Geogrid - a structural element formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as reinforcement.
- C. Unit Drainage Fill - drainage aggregate which is placed within and immediately behind the modular concrete units.
- D. Reinforced Backfill - compacted soil which is placed within the reinforced soil volume as outlined on the plans.

2.02 Modular Concrete Retaining Wall Units

- A. Modular concrete units shall conform to the following architectural requirements: face color - concrete gray - standard manufacturers' color may be specified by the Owner. face finish - sculptured rock face in angular tri-planer configuration. Other face finishes will not be allowed without written approval of Owner. bond configuration - running with bonds nominally located at midpoint vertically adjacent units, in both straight and curved alignments.

Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused lighting.

B. Modular concrete materials shall conform to the requirements of ASTM C1372 - Standard Specifications for Segmental Retaining Wall Units.

C. Modular concrete units shall conform to the following structural and geometric requirements measured in accordance with appropriate references:

compressive strength = 3000 psi minimum;
absorption = 8 % maximum (6% in northern states) for standard weight aggregates;

dimensional tolerances = ± 1/8" from nominal unit dimensions not including rough split face, ±1/16" unit height - top and bottom planes;

unit size - 8" (H) x 18" (W) x 12" (D) minimum;

unit weight - 75 lbs/unit minimum for standard weight aggregates;
inter-unit shear strength - 600 plf minimum at 2 psi normal pressure;

geogrid/unit peak connection strength - 600 plf minimum at 2 psi normal force.

D. Modular concrete units shall conform to the following constructability requirements:

vertical setback = No vertical setback.

alignment and grid positioning mechanism - fiberglass pins, two per unit minimum; maximum horizontal gap between erected units shall be - 1/2 inch.

2.03 Shear Connectors

- A. Shear connectors shall be 1/2 inch diameter thermoset isophthalic polyester resin-pultruded fiberglass reinforcement rods or equivalent to provide connection between vertically and horizontally adjacent units. Strength of shear connectors between vertical adjacent units shall be applicable over a design temperature of 10 degrees F to + 100 degrees F.

- B. Shear connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.

2.04 Base Leveling Pad Material

- A. Material shall consist of a compacted crushed stone base or non-reinforced concrete as shown on the construction drawings.
- B. The maximum aggregate size shall be limited to 3/4 inch unless field tests have been performed to evaluate potential strength reductions to the geogrid design due to damage during construction.
- C. Material can be site excavated soils where the above requirements can be met. Unsuitable soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.

2.07 Geogrid soil reinforcement

- A. Geosynthetic reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high density polyethylene. Polyester geogrid shall be knitted from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 Meg/m and a carboxyl end group values less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking, and stripping.
- B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.
- C. Install shear/connecting devices per manufacturer's recommendations.

- D. Place and compact drainage fill within and behind wall units. Place and compact backfill soil behind drainage fill. Follow wall erection and drainage fill closely with structure backfill.

2.08 Drainage pipe

- A. If required, the drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D-3834 or corrugated HDPE pipe manufactured in accordance with ASTM D-1248.

PART 3 EXECUTION

3.01 Base Leveling Pad

- A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6 inches and extend laterally a minimum of 6" in front and behind the modular wall unit.

- B. Soil leveling pad materials shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698

- C. Leveling pad shall be prepared to insure full contact to the base surface of the concrete units.

3.03 Modular Unit Installation

- A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions and insure that all units are in full contact with the base and properly seated.

- B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.

- C. Install shear/connecting devices per manufacturer's recommendations.

- D. Place and compact drainage fill within and behind wall units. Place and compact backfill soil behind drainage fill. Follow wall erection and drainage fill closely with structure backfill.

- E. Maximum stacked vertical height of wall units, prior to unit drainage fill and backfill placement and compaction, shall not exceed two courses.

3.04 Structural Geogrid Installation

- A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.

- B. Geogrid reinforcement shall be placed at the strengths, lengths, and elevations shown on the construction design drawings or as directed by the Engineer.

- C. The geogrid shall be laid horizontally on compacted backfill and attached to the modular wall units. Place the next course of modular concrete units over the geogrid. The geogrid shall be pulled taut, and anchored prior to backfill placement on the geogrid.

- D. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100% coverage at each level. Spliced connections between shorter pieces of geogrid or gaps between adjacent pieces of geogrid are not permitted.

3.05 Reinforced Backfill Placement

- A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage.

- B. Reinforced backfill shall be placed and compacted in lifts not to exceed 6 inches where hand compaction is used, or 8 - 10 inches where heavy compaction equipment is used. Lift thickness shall be decreased to achieve the required density as required.

- C. Reinforced backfill shall be compacted to 95% of the maximum density as determined by ASTM D698. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be dry of optimum, + 0%, - 3%.

- D. Only lightweight hand-operated equipment shall be allowed within 3 feet from the tail of the modular concrete unit.

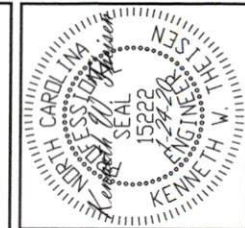
- E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

- F. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 10 MPH. Sudden braking and sharp turning shall be avoided.

- G. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3.06 Cap Installation

- A. Cap units shall be glued to underlying units with an all-weather adhesive recommended by the manufacturer.



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SCOPE	LOC.
8055 nc-42 holly springs	

ENG	KWT
DATE	1-24-20

PROJECT NO.	20-65-040
SHEET NO.	SD3