Anchor®
RETAINING WALL SYSTEMS

Anchor Vertica®
Anchor Vertica Pro®

Estimating and Installation Manual

ANCHOR VERTICA®
ANCHOR VERTICA PRO®

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INDEX

Anchor™
RETAINING WALL SYSTEMS

Professionals who choose Anchor Wall Systems get superior support.

More and more architects, engineers and contractors are choosing Anchor as the ideal solution for everything from residential landscaping to high-volume, commercial tall walls. Why? Because every Anchor retaining wall system is backed with the support of a highly qualified team of manufacturing, design and engineering specialists. From design assistance to technical tools and installation information, Anchor stands ready to help make your retaining wall project a success.

At Anchor, our versatile retaining wall systems are also supported by an international network of knowledgeable producers, ready to provide you with comprehensive product information, recommendations and estimates to accurately project the requirements of a particular job. Every time you choose Anchor, you can be confident you'll receive the support you need to get the job done right.

THE ANCHOR VERTICA® AND VERTICA PRO® AN OUTSTANDING COMBINATION OF FORM AND FUNCTION.

The patented Anchor Vertica and Vertica Pro blocks are an unparalleled example of technical brilliance and functional versatility.

Molded into every Anchor Vertica and Vertica Pro block is a locator that automatically guides each new course, ensuring proper alignment and a precise set back. This superior design requires no mortar or pins.

Anchor Vertica and Vertica Pro retaining wall blocks are available in straight face and beveled three-way face styles and the flexible systems can be used to create radius curves, 90° inside and outside corners and terraced walls. Water applications are also an excellent use of Anchor Vertica and Vertica Pro blocks when designed using combinations of geosynthetic reinforcement and erosion protection.

REINFORCED AND NON-REINFORCED RETAINING WALLS

The Anchor Vertica and Vertica Pro walls are based on proven engineering principles developed for gravity and soil-reinforced retaining walls. A gravity wall, or non-reinforced wall, relies on the weight and set back of the retaining wall unit to resist the loads imposed on the structure by the retained soil.

In cases where the weight of the wall does not provide sufficient resistance against soil forces, a reinforced wall is built using geosynthetic reinforcement to stabilize the Anchor Vertica and Vertica Pro systems to virtually any wall height.

Even with geosynthetic reinforcement, there's no need for mechanical attachments or mortar because of the Anchor Vertica and Vertica Pro locator.

Non-Reinforced Walls

Anchor Vertica and Vertica Pro blocks can be used to create tall walls of varying heights. Non-reinforced retaining walls created with Anchor Vertica blocks can reach up to a maximum total wall height, including the buried course(s), of three feet (five feet for Vertica Pro), when the following conditions are present:

- Slopes or other wall terraces are not present above or below the wall
- Site soils are clean sand and gravel
- No surcharge loads are present

If these conditions are not present, the maximum gravity wall height will be less than three feet (five feet for Vertica Pro).

Geosynthetic Reinforced Walls

Anchor Vertica and Vertica Pro walls can be designed with geosynthetic reinforcement to attain heights in excess of 40 feet. The geosynthetics selected to provide reinforcement must have proven performance with the Anchor Vertica and Vertica Pro units through connection testing. Contact Anchor Wall Systems for connection testing results with many geosynthetic products.

Refer to the examples within this manual for geosynthetic reinforcement placement under varying conditions (slopes, soils and surcharges). It's important to note that all data provided in this manual is preliminary and for estimating purposes only, as your actual project conditions will vary. Your final design must be performed by a professional engineer registered in the state in which the structure will be built.

SPECIFICATIONS

GENERAL INFORMATION

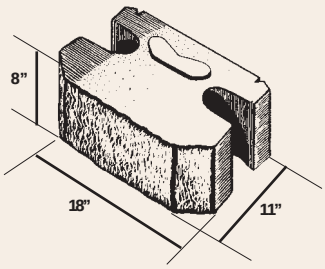
Compressive strength:	3500 psi min.
Absorption rate:	7.0% max.
Material composition: High-quality zero slump concrete	

COLORS

Manufacturer's standard colors include, but are not limited to, gray and tan. Additional colors vary by region. Custom colors are available by special order only.

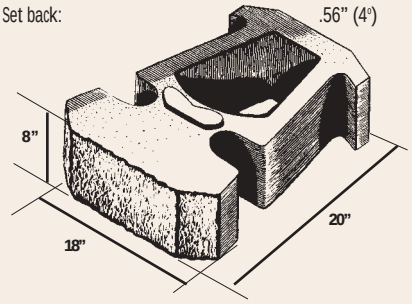
VERTICA®

Approximate Dimensions:	8" x 18" x 11"*
Approximate Weight:	86 lbs.**
Wall Facing:	1 sq. ft./unit
Set back:	.56" (4°)



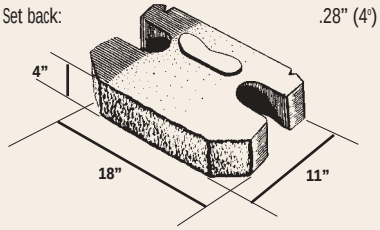
VERTICA PRO®

Approximate Dimensions:	8" x 18" x 20"*
Approximate Weight:	115 lbs.**
Wall Facing:	1 sq. ft./unit
Set back:	.56" (4°)



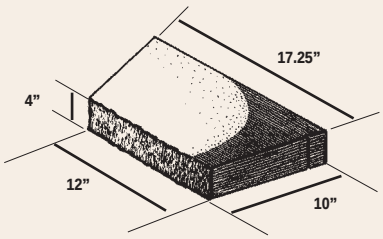
VERTICA® HALF-HIGH

Approximate Dimensions:	4" x 18" x 11"*
Approximate Weight:	43 lbs.*
Wall Facing:	.5 sq. ft./unit
Set back:	.28" (4°)



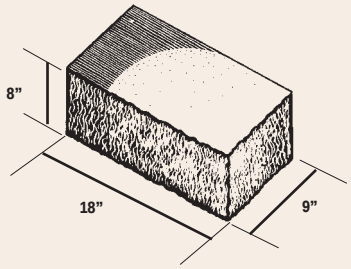
VERTICA® CAP

Approximate Dimensions:	4" x 17.25" x 10"*
Approximate Weight:	40 lbs.*



VERTICA® CORNER

Approximate Dimensions:	8" x 18" x 9"*
Approximate Weight:	101 lbs.*



* Nominal Dimensions. Actual dimensions and weight may vary from these nominal dimensions due to variations resulting from the manufacturing process. Specifications may change without notice. See your Anchor representative for details, color options, block dimensions and additional information.

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Retaining wall system constructed of concrete segmental retaining wall units.
B. Geosynthetic reinforcement fabric
C. Leveling pad base
D. Drainage aggregate
E. Backfill
F. Drainage pipe
G. Adhesives

1.02 RELATED SECTIONS

Note to Specifier: Include Section 01270 only if Article 3.12 is included.

A. Section 01270 – Unit Prices

Note to Specifier: Include Section 02300 below for finish grading, and/or add other paving or surfacing related sections if required.

B. Section 02300 – Earthwork: For Finish Grading

1.02 REFERENCES

A. American Association of State Highway Transportation Officials (AASHTO)
   1. AASHTO M288 Geotextile Specification for Highway Applications
   2. AASHTO Standard Specifications for Highway Bridges

B. American Society for Testing and Materials (ASTM)
   1. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units *[Last Update: 01ae1]*
   2. ASTM C1262 Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units *[Last Update: 98]*
   3. ASTM C1372 Standard Specification for Segmental Retaining Wall Units *[Last Update: 01a]*
   4. ASTM D448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction *[Last Update: 98]*
   5. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/f3)(600 kN-m/m3) *[Last Update: 00a]*
   6. ASTM D1556 Standard Test Method for Density and Unit Weight of Soil In Place by the Sand Cone Method *[Last Update: 00]*
   7. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f3)(2700 kN-m/m3) *[Last Update: 00]*
   8. ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System) *[Last Update: 00]*
   9. ASTM D2922 Standard Test Methods for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth) *[Last Update: 01]*
   10. ASTM D3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer pipe and Fittings *[Last Update: 00]*
   11. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils *[Last Update: 00]*
   12. ASTM D4595 Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method *[Last Update: 86 (2001)]*
   13. ASTM D5262 Standard Test Method for Evaluating the Unconfined Tension Creep Behavior of Geosynthetics *[Last Update: 97]*
   14. ASTM F405 Standard Specification for Corrugated Polyethylene (PE) Tubings and Fittings *[Last Update: 97]*
   15. ASTM G51 Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing *[Last Update: 95 (2000)]*

C. National Concrete Masonry Association (NCMA)
   1. NCMA Design Manual For Segmental Retaining Walls, Second Edition, Second Printing (1997)
   2. NCMA SRWU-1 Determination of Connection Strength Between Geosynthetics and Segmental Concrete Units
   3. NCMA SRWU-2 Determination of Shear Strength Between Segmental Concrete Units

1.03 DEFINITIONS

A. Soil which is used as fill behind the drainage aggregate, and within the reinforced soil mass (if applicable).
B. Drainage Aggregate: Material used within (if applicable), between, and directly behind the concrete retaining wall units.
C. Filter Fabric: Material used for separation and filtration of dissimilar soil types.
D. Foundation Soil: Soil mass supporting the leveling pad and reinforced soil zone of the retaining wall system.
E. Geosynthetic Reinforcement: Material specifically fabricated for use as a soil reinforcement.
F. Global Stability: The general mass movement of a soil reinforced segmental retaining wall structure and adjacent soil mass.
G. Project Geotechnical Engineer: A registered engineer employed by the Owner to perform site observations, provide recommendations for foundation support, and verify soil shear strength parameters.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300:
   1. Product Data: Material description and installation instructions for each manufactured product specified.

2. Shop Drawings: Retaining wall system design, including wall elevation views, geosynthetic reinforcement layout, pertinent details, and drainage provisions. The shop drawings shall be signed by a registered professional engineer licensed in the state of wall installation.
3. Design Calculations: Engineering design calculations prepared in accordance with the NCMA Design Manual For Segmental Retaining Walls, or the AASHTO Standard Specifications for Highway Bridges, Section 5.8 (whichever is applicable). Analysis of global stability must be addressed and incorporated into the shop drawings.
4. Samples
    a. Furnish one unit in the color and face pattern specified, if requested.
    b. Furnish 12 inch square or larger piece of the geosynthetic reinforcement specified.
5. Test Reports: Independent laboratory reports stating moisture absorption and compressive strength properties of the concrete retaining wall units meet the Project Specifications when tested in accordance with ASTM C140, Sections 6, 8 and 9.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle materials in accordance with manufacturer's recommendations, in such a manner as to prevent damage. Check the materials upon delivery to assure that proper material has been received. Store above ground on wood pallets or blocking. Remove damaged or otherwise unsuitable material, when so determined, from the site.
    1. Exposed faces of concrete wall units shall be free of chips, cracks, stains, and other imperfections detracting from their appearance, when viewed from a distance of 10 feet.
    2. Prevent mud, wet cement, adhesives and similar materials which may harm appearance of units, from coming in contact with system components.

1.06 EXTRA MATERIALS

A. Furnish Owner with three replacement units identical to those installed on the Project.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete Retaining Wall Units: “Anchor Vertica Retaining Wall Units” as manufactured under license from Anchor Wall Systems.
    1. Physical Requirements
        a. Meet requirements of ASTM C1372, except the maximum water absorption shall be limited to seven percent, and unit height dimensions shall not vary more than plus or minus 1/16 inch from that specified in the ASTM reference, not including textured face.
        b. Unit Face Area: Not less than 0.94 square feet.

Note to Specifier: In subparagraph below, select appropriate entity who will determine color.

        c. Color: Selected by the [Architect] [Engineer] [Owner] from manufacturer’s full range of standard colors.

Note to Specifier: In subparagraph below, select straight or beveled face.

        d. Face Pattern Geometry: [Straight] [Beveled].
        e. Texture: Split rock face.
        f. Include an integral concrete shear connection flange/locator.

B. Geosynthetic Reinforcement: Polyester fiber geogrid or geotextile, or polypropylene woven geotextile, as shown on the Drawings.

C. Leveling Pad Base
    1. Aggregate Base: Crushed stone or granular fill meeting the following gradation as determined in accordance with ASTM D448:

Sieve Size	Percent Passing
1 inch	100
No. 4	35 to 70
No. 40	10 to 35
No. 200	3 to 10

        a. Base Thickness: six inches (minimum compacted thickness).
    2. Concrete Base: Nonreinforced lean concrete base
        a. Compressive Strength: 500 psi (maximum)
        b. Base Thickness: At least two inches, but not more than three inches

D. Drainage Aggregate: Clean crushed stone or granular fill meeting the following gradation as determined in accordance with ASTM D448:

Sieve Size	Percent Passing
1 inch	100
3/4 inch	75 to 100
No. 4	0 to 60
No. 40	0 to 50
No. 200	0 to 5

E. Backfill: Soil free of organics and debris and consisting of either GP, GW, SP, SW, or SM type, classified in accordance with ASTM D2487 and the USCS classification system.
    1. Soils classified as SC and CL are considered suitable soils for segmental retaining walls with a total height of less than 15 feet unless the Plasticity Index (PI) is 20 or more.
    2. Maximum particle size for backfill is 2 inches
    3. Unsuitable soils are organic soils and those soils classified as CH, OH, MH, OL, or PT.

F. Impervious Material: Clayey soil or other similar material which will prevent percolation into the drainage zone behind the wall.
G. Drainage Pipe: Perforated or slotted PVC or corrugated HDPE pipe manufactured in accordance with D3034 and/or ASTM F405. The pipe may be covered with a geotextile filter fabric to function as a filter.
H. Construction Adhesive: Exterior grade adhesive as recommended by the retaining wall unit manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

Note to Specifier: In paragraph below, select appropriate entity.

A. Examine the areas and conditions under which the retaining wall system is to be erected, and notify the [Architect] [Engineer] [Owner] [Contractor] 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.
B. Promptly notify the wall design engineer of site conditions that may affect wall performance, soil conditions observed other than those assumed or other conditions that may require a reevaluation of the wall design.
C. Verify the location of existing structures and utilities prior to excavation.

3.02 PREPARATION

A. Ensure surrounding structures are protected from the effects of wall excavation.
B. Excavation support, if required, is the responsibility of the Contractor, including the stability of the excavation and it's influence on adjacent properties and structures.

3.03 EXCAVATION

Note to Specifier: In paragraph below, select appropriate entity.

A. Excavate to the lines and grades shown on the Drawings. Over-excavation not approved by the [Architect] [Engineer] [Owner (or Owner's representative)] will not be paid for by the Owner. Replacement of these soils with compacted fill and/or wall system components will be required at the Contractor's expense. Use care in excavating to prevent disturbance of the base beyond the lines shown.

3.04 FOUNDATION PREPARATION

A. Excavate foundation soil as required for footing or base dimension shown on the Drawings, or as directed by the Project geotechnical engineer.
B. The Project geotechnical engineer will examine foundation soil to ensure that the actual foundation soil strength meets or exceeds that indicated on the Drawings. Remove soil not meeting the required strength. Oversize resulting space sufficiently from the front of the block to the back of the reinforcement, and backfill with suitable compacted backfill soils.
C. The Project geotechnical engineer will determine if the foundation soils will require special treatment or correction to control total and differential settlement.
D. Fill over-excavated areas with suitable compacted backfill, as recommended by the Project geotechnical engineer.

3.05 BASE COURSE PREPARATION

A. Place base materials to the depths and widths shown on the Drawings, upon undisturbed soils, or foundation soils prepared in accordance with Article 3.04.
   1. Extend the leveling pad laterally at least six inches in front and behind the lowermost concrete retaining wall unit.
   2. Provide aggregate base compacted to six inches thick (minimum).
   3. The Contractor may, at his/her option, provide a concrete leveling pad as specified in Subparagraph 2.01.C.2, in lieu of the aggregate base.
   4. Where a reinforced footing is required by local code official, place footing below frost depth.
B. Compact aggregate base material to provide a level, hard surface on which to place the first course of units.
C. Prepare base materials to ensure complete contact with retaining wall units. Gaps are not allowed.

3.06 ERECTION

A. General: Erect units in accordance with manufacturer's instructions and recommendations, and as specified herein.
B. Place first course of concrete wall units on the prepared base material. Check units for level and alignment. Maintain the same elevation at the top of each unit within each section of the base course.
C. Ensure that foundation units are in full contact with natural or compacted soil base.
D. Place concrete wall units side-by-side for full length of wall alignment. Alignment may be done by using a string line measured from the back of the block. Gaps are not allowed between the foundation concrete wall units.
E. Place 12 inches (minimum) of drainage aggregate between and directly behind the concrete wall units. Fill voids in retaining wall units with drainage aggregate. Provide a drainage zone behind the wall units to within nine inches of the final grade. Cap the backfill and drainage aggregate zone with nine inches of impervious material.

F. Install drainage pipe at the lowest elevation possible, to maintain gravity flow of water to outside of the reinforced zone. Slope the main collection drainage pipe, located just behind the concrete retaining wall units, two percent (minimum) to provide gravity flow to the daylighted areas. Daylight the main collection drainage pipe through the face of the wall, and/or to an appropriate location away from the wall system at each low point or at 50-foot (maximum) intervals along the wall. Alternately, the drainage pipe can be connected to a storm sewer system at 50-foot (maximum) intervals.

G. Remove excess fill from top of units and install next course. Ensure drainage aggregate and backfill are compacted before installation of next course.

H. Check each course for level and alignment. Adjust units as necessary to maintain level and alignment prior to proceeding with each additional 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. Interlock wall segments that meet at corners by overlapping successive courses. Attach concrete retaining wall units at exterior corners with adhesive specified.

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

1. Orient geosynthetic reinforcement with the highest strength axis perpendicular to the wall face.
2. Prior to geosynthetic reinforcement placement, place the backfill and compact to the elevation of the top of the wall units at the elevation of the geosynthetic reinforcement.
3. Place geosynthetic reinforcement at the elevations and to the lengths shown on the Drawings.
4. Lay geosynthetic reinforcement horizontally on top of the concrete retaining wall units and the compacted backfill soils. Place the geosynthetic reinforcement within one inch of the face of the concrete retaining wall units. Place the next course of concrete retaining wall units on top of the geosynthetic reinforcement.
5. The geosynthetic reinforcement shall be in tension and free from wrinkles prior to placement of the backfill soils. Pull geosynthetic reinforcement hand-taut and secure in place with staples, stakes, or by hand-tensioning until the geosynthetic reinforcement is covered by six inches of loose fill.
6. The geosynthetic reinforcements shall be continuous throughout their embedment lengths. Splices in the geosynthetic reinforcement strength direction are not allowed.
7. Do not operate tracked construction equipment directly on the geosynthetic reinforcement. At least six inches of compacted backfill soil is required prior to operation of tracked vehicles over the geosynthetic reinforcement. Keep turning of tracked construction equipment to a minimum.
8. Rubber-tired equipment may pass over the geosynthetic reinforcement at speeds of less than five miles per hour. Turning of rubber-tired equipment is not allowed on the geosynthetic reinforcement.

3.07 BACKFILL PLACEMENT

A. Place reinforced backfill, spread and compact in a manner that will minimize slack in the reinforcement.

B. Place fill within the reinforced zone and compact in lifts not exceeding six to eight inches (loose thickness) where hand-operated compaction equipment is used, and not exceeding 12 inches (loose thickness) where heavy, self-propelled compaction equipment is used.

1. Only lightweight hand-operated compaction equipment is allowed within four feet of the back of the retaining wall units. If the specified compaction cannot be achieved within four feet of the back of the retaining wall units, replace the reinforced soil in this zone with drainage aggregate material.

Note to Specifier: In paragraph below, select revised modified Proctor densities if necessary, in lieu of standard Proctor densities specified.

C. Minimum Compaction Requirements for Fill Placed in the Reinforced Zone

1. Walls Less Than 15 Feet High: Compact to 95 percent of the soil's standard Proctor maximum dry density (ASTM D698) [modified Proctor maximum dry density (ASTM D1557)] for the entire wall height.
2. Walls 15 Feet High BUT NOT MORE THAN 30 Feet High: Change compaction requirements to 98 percent of the soil's standard Proctor maximum dry density (ASTM D698) [modified Proctor maximum dry density (ASTM D1557)] for depths below 15 feet.
3. Walls Over 30 Feet High: Change compaction requirements to 100 percent of the soil's standard Proctor maximum dry density (ASTM D698) [modified Proctor maximum dry density (ASTM D1557)] for depths below 30 feet.
4. Increase compaction requirements for retaining walls with slope heights at the back of the reinforced soil zone greater than five feet above the top of wall. Verify compaction requirements with Project geotechnical engineer.

5. Utility Trench Backfill: Compact utility trench backfill in or below the reinforced soil zone to 98 percent of the soil's standard Proctor maximum dry density (ASTM D698) [modified Proctor maximum dry density (ASTM D1557)], or as recommended by the Project geotechnical engineer. If the height from the utility to finish grade is higher than 30 feet, increase compaction to 100 percent of the standard Proctor density [modified Proctor density].
    a. Utilities must be properly designed (by others) to withstand all forces from the retaining wall units, reinforced soil mass, and surcharge loads, if any.
6. Moisture Content: Within two percentage points of the optimum moisture content for all wall heights.
7. These specifications may be changed based on recommendations by the Project geotechnical engineer.
    a. If changes are required, the Contract Sum will be adjusted by written Change Order.

D. At the end of each day's operation, slope the last level of compacted backfill away from the interior (concealed) face of the wall to direct surface water runoff away from the wall face.
1. The General Contractor is responsible for ensuring that the finished site drainage is directed away from the retaining wall system.
2. In addition, the General Contractor is responsible for ensuring that surface water runoff from adjacent construction areas is not allowed to enter the retaining wall area of the construction site.

E. Refer to Article 3.10 for compaction testing.

3.08 CAP UNIT INSTALLATION

A. Apply adhesive to the top surface of the unit below and place the cap unit into desired position.
B. Cut cap units as necessary to obtain the proper fit.
C. Backfill and compact to top of cap unit.

3.09 SITE CONSTRUCTION TOLERANCES

A. Site Construction Tolerances
1. Vertical Alignment: Plus or minus 1-1/2 inches over any 10-foot distance, with a maximum differential of three inches over the length of the wall.
2. Horizontal Location Control from Grading Plan
    a. Straight Lines: Plus or minus 1-1/2 inches over any 10-foot distance.
    b. Corner and Radius Locations: Plus or minus 12 inches.
    c. Curves and Serpentine Radii: Plus or minus two feet.
3. Immediate Post Construction Wall Batter: Within two degrees of the design batter of the concrete retaining wall units.
4. Bulging: Plus or minus 1-1/4 inches over any 10-foot distance.

3.10 FIELD QUALITY CONTROL

A. Installer is responsible for quality control of installation of system components. Employ a qualified independent third party to verify the correct installation of system components in accordance with these specifications and the Drawings.
B. The Owner, at their expense, will retain a qualified professional to perform quality assurance checks of the installer's work.
C. Correct work which does not meet these specifications or the requirements shown on the Drawings at the installer's expense.
D. Perform compaction testing of the reinforced backfill placed and compacted in the reinforced backfill zone.
1. Testing Frequency
    a. One test for every two feet (vertical) of fill placed and compacted, for every 50 lineal feet of retaining wall.
    b. Vary compaction test locations to cover the entire area of the reinforced soil zone, including the area compacted by the hand-operated compaction equipment.

3.11 ADJUSTING AND CLEANING

A. Replace damaged units with new units as the work progresses.
B. Remove debris caused by wall construction and leave adjacent paved areas broom clean.

Note to Specifier: Include Article 3.12 ONLY for municipal work when required.

3.12 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 includes the bottom of the base course to the top of the wall, and the entire length of the wall.
B. Payment for the wall will be made on a square foot basis at the agreed upon Contract Unit Price.
1. Payment should be considered full compensation for labor, materials, equipment and testing required to install the wall in accordance with these specifications and the Drawings.
2. Quantities may vary from that shown on the Drawings depending on existing topography. Change to the total quantity of wall face area will be paid or withheld at the agreed upon Contract Unit Price.

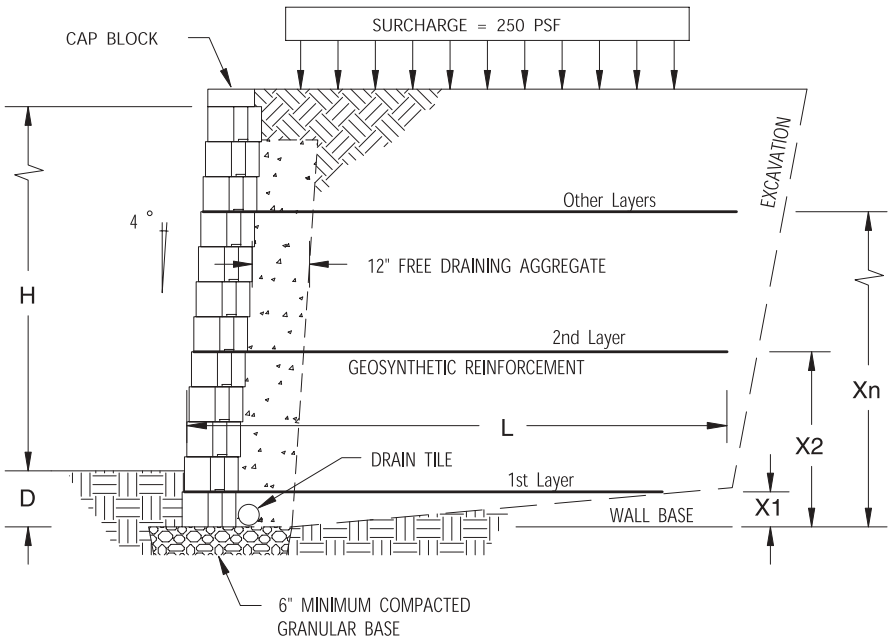
Table 1

SAND/GRAVEL

$\phi = 34^o$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 1 — 250 PSF SURCHARGE

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.						
				X1	X2	X3	X4	X5	X6	X7
1' 6"	6"	3	5' 0"	1' 4"						
3' 6"	6"	6	5' 6"	1' 4"	3' 4"					
5' 6"	6"	9	6' 6"	1' 4"	3' 4"	5' 4"				
7' 6"	6"	12	8' 0"	1' 4"	3' 4"	5' 4"	7' 4"			
9' 6"	6"	15	9' 0"	0' 8"	2' 0"	3' 4"	5' 4"	7' 4"	9' 4"	
11' 4"	8"	18	10' 0"	0' 8"	2' 0"	3' 4"	5' 4"	7' 4"	9' 4"	11' 4"

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max value of 1005 lbs/ft.

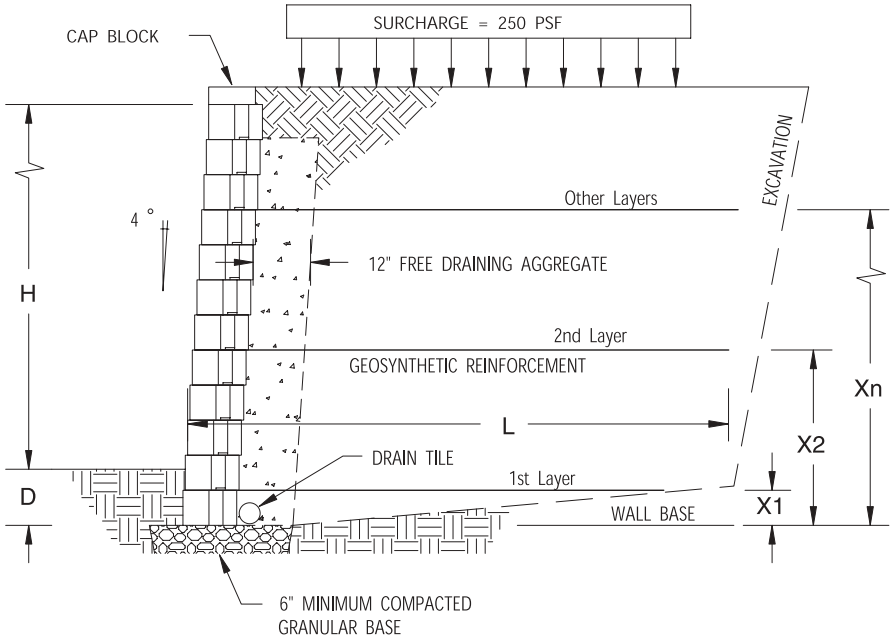
NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

SILTY SAND

$\phi = 30^{o}$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 2 — 250 PSF SURCHARGE

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.					
				X1	X2	X3	X4	X5	X6
1' 6"	6"	3	6' 6"	1' 4"					
3' 6"	6"	6	6' 6"	1' 4"	3' 4"				
5' 6"	6"	9	8' 0"	1' 4"	3' 4"	5' 4"			
7' 6"	6"	12	9' 6"	0' 8"	2' 0"	3' 4"	5' 4"	7' 4"	
9' 6"	6"	15	10' 6"	0' 8"	2' 0"	3' 4"	5' 4"	7' 4"	9' 4"

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max value of 1005 lbs/ft.

NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

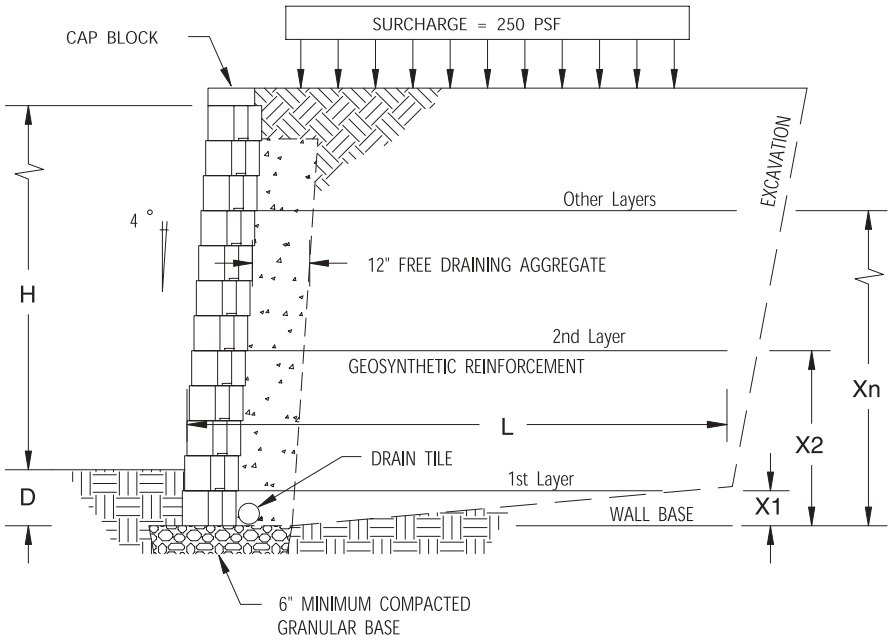
Table 3

SILTS/CLAY

$\phi = 26^{o}$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 3 — 250 PSF SURCHARGE

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.					
				X1	X2	X3	X4	X5	X6
1' 6"	6"	3	8' 6"	1' 4"					
3' 6"	6"	6	8' 6"	1' 4"	3' 4"				
5' 6"	6"	9	10' 0"	0' 8"	2' 0"	3' 4"	5' 4"		
7' 6"	6"	12	11' 6"	0' 8"	2' 0"	3' 4"	5' 4"	7' 4"	
9' 6"	6"	15	12' 6"	0' 8"	2' 0"	3' 4"	5' 4"	7' 4"	9' 4"

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max value of 1005 lbs/ft.

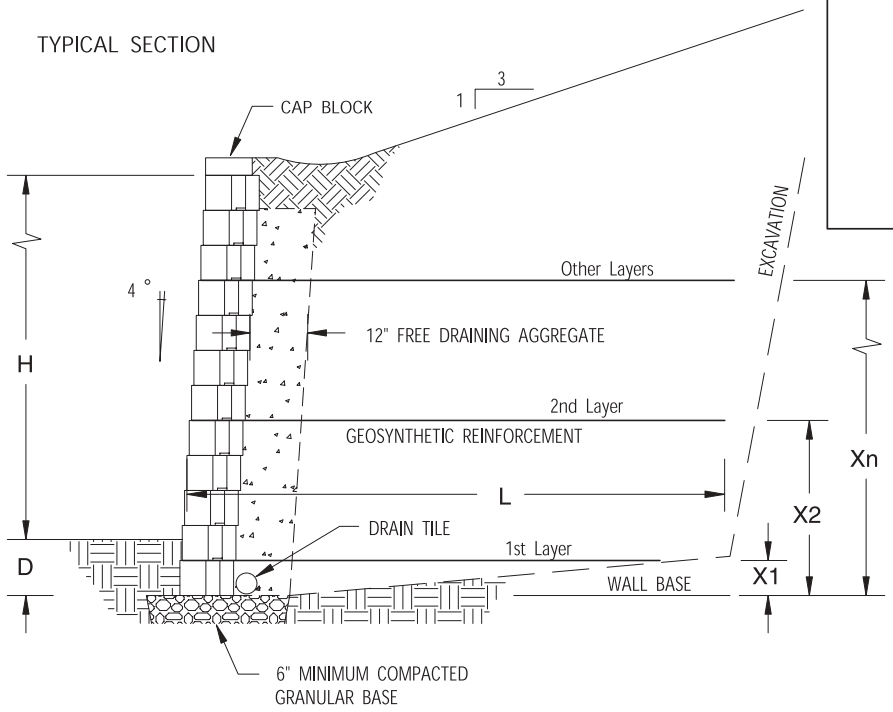
NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

SAND/GRAVEL

$\phi = 34^o$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 4 — 3:1 SLOPED BACKFILL

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.						
				X1	X2	X3	X4	X5	X6	X7
2' 10"	6"	5	4' 0"	2' 0"						
4' 2"	6"	7	4' 6"	1' 4"	3' 4"					
5' 6"	6"	9	5' 6"	0' 8"	2' 8"	4' 8"				
7' 6"	6"	12	7' 0"	0' 8"	2' 8"	4' 8"	6' 8"			
9' 6"	6"	15	8' 0"	0' 8"	2' 8"	4' 8"	6' 8"	8' 8"		
11' 4"	8"	18	9' 6"	0' 8"	2' 0"	3' 4"	4' 8"	6' 8"	8' 8"	10' 8"

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max value of 1005 lbs/ft.

NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

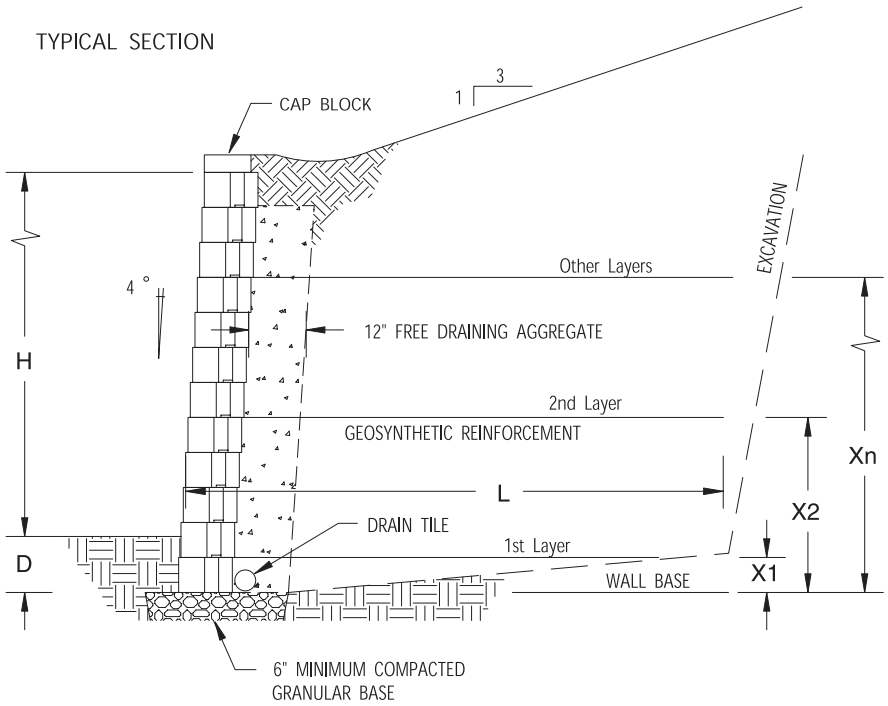
Table 5

SILTY SAND

$\phi = 30^o$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 5 — 3:1 SLOPED BACKFILL

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK 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"	0' 8"	2' 8"				
5' 6"	6"	9	6' 0"	0' 8"	2' 8"	4' 8"			
7' 6"	6"	12	7' 6"	0' 8"	2' 8"	4' 8"	6' 8"		
9' 6"	6"	15	9' 0"	0' 8"	2' 0"	3' 4"	5' 4"	6' 8"	8' 8"

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max value of 1005 lbs/ft.

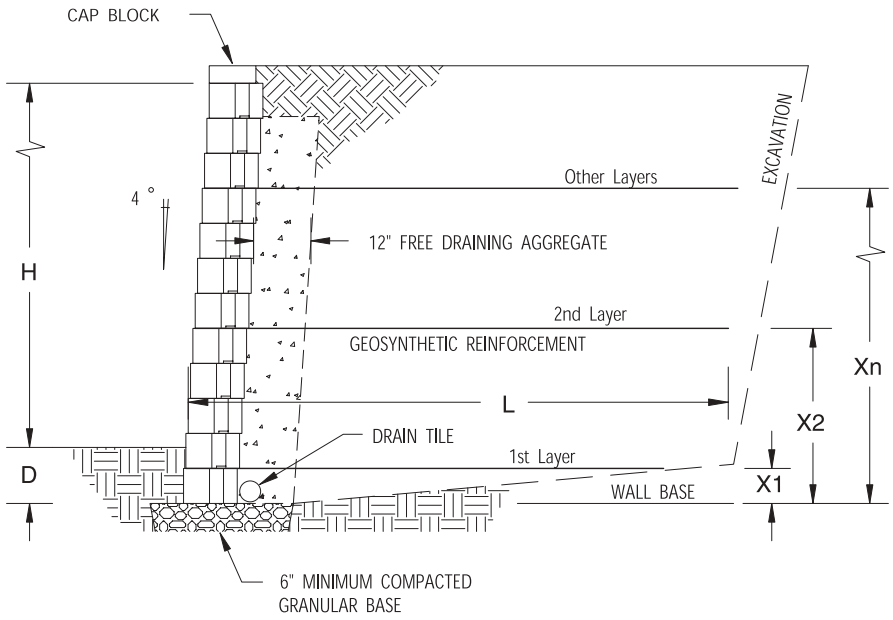
NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

SAND/GRAVEL

$\phi = 34^{o}$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 6 — LEVEL BACKFILL

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.					
				X1	X2	X3	X4	X5	X6
2' 10"	6"	5	4' 0"	1' 4"					
3' 6"	6"	7	4' 0"	0' 8"	2' 8"				
5' 6"	6"	9	4' 6"	0' 8"	2' 0"	4' 0"			
7' 6"	6"	12	5' 6"	0' 8"	2' 0"	4' 0"	6' 0"		
9' 6"	6"	15	7' 0"	0' 8"	2' 0"	4' 0"	6' 0"	8' 0"	
11' 4"	6"	18	8' 0"	0' 8"	2' 0"	4' 0"	6' 0"	8' 0"	10' 0"

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max value of 1005 lbs/ft.

NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

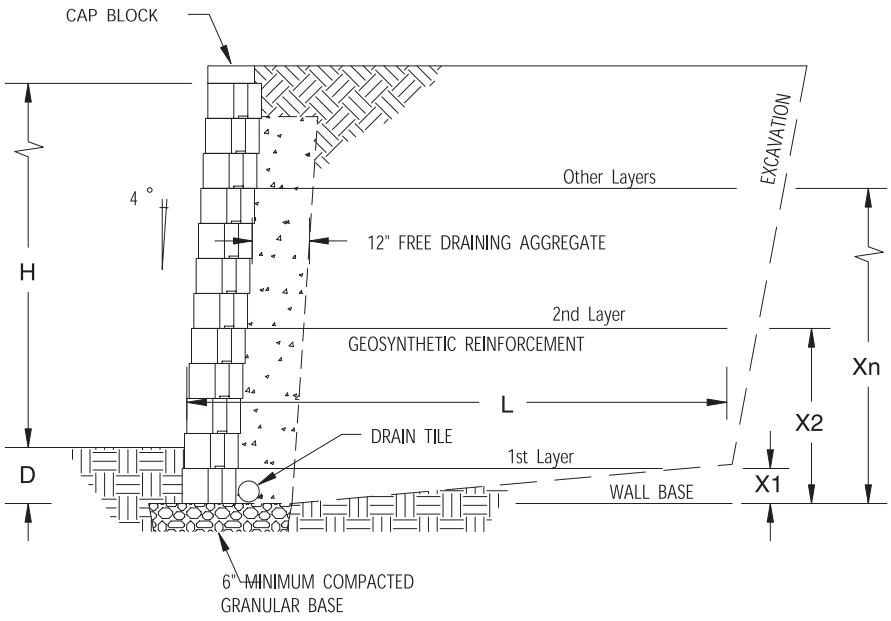
Table 7

SILTY SAND

$\phi = 30^{o}$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 7 — LEVEL BACKFILL

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.					
				X1	X2	X3	X4	X5	X6
2' 10"	6"	5	4' 6"	2' 0"					
4' 2"	6"	7	4' 6"	0' 8"	2' 8"				
5' 6"	6"	9	5' 0"	0' 8"	2' 0"	4' 0"			
7' 6"	6"	12	6' 0"	0' 8"	2' 0"	4' 0"	6' 0"		
9' 6"	6"	15	7' 6"	0' 8"	2' 0"	4' 0"	6' 0"	8' 0"	
11' 4"	8"	18	8' 6"	0' 8"	2' 0"	4' 0"	6' 0"	8' 0"	10' 0"

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max value of 1005 lbs/ft.

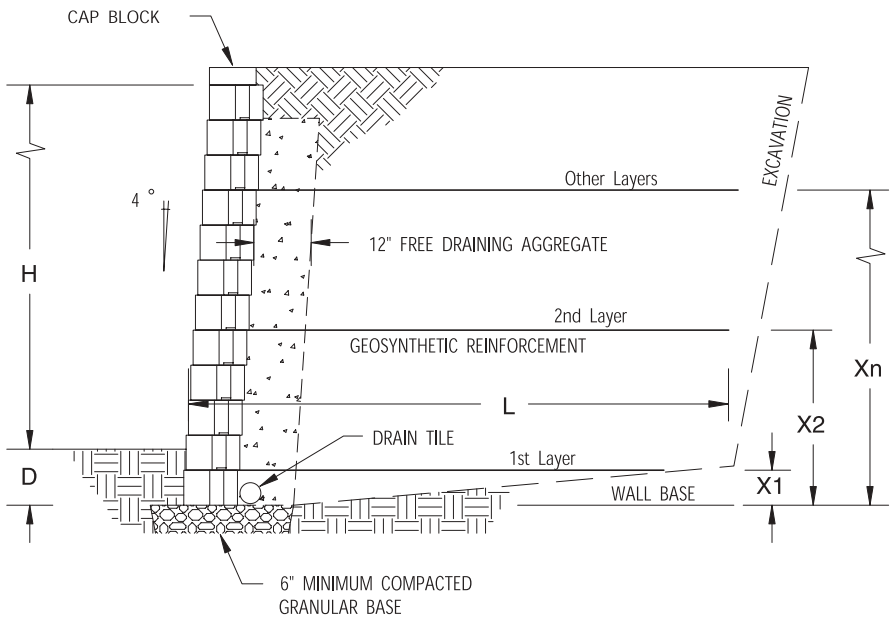
NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

SILTS/CLAY

$\phi = 26^{o}$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 8 LEVEL BACKFILL

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.						
				X1	X2	X3	X4	X5	X6	X7
2' 2"	6"	4	4' 0"	1' 4"						
3' 6"	6"	6	4' 6"	0' 8"	2' 8"					
5' 6"	6"	9	6' 0"	0' 8"	2' 8"	4' 8"				
7' 6"	6"	12	7' 6"	0' 8"	2' 8"	4' 8"	6' 8"			
9' 6"	6"	15	8' 6"	0' 8"	2' 8"	4' 8"	6' 8"	8' 8"		
11' 4"	8"	18	10' 0"	0' 8"	2' 0"	3' 4"	4' 8"	6' 8"	8' 8"	10' 8"

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max value of 1005 lbs/ft.

NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

Anchor Vertica® and Vertica Pro®
Units Required Given Wall Length and Height
8-Inch High Units

UNITS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HEIGHT	8"	1'4"	2'0"	2'8"	3'4"	4'0"	4'8"	5'4"	6'0"	6'8"	7'4"	8'0"	8'8"	9'4"	10'0"
LENGTH (FT)															
5	4	7	10	13	17	20	23	27	30	34	37	40	44	47	50
10	7	13	20	27	34	40	47	54	60	67	74	80	87	94	101
15	10	20	30	40	50	60	70	80	90	101	111	121	131	141	151
20	14	27	40	54	67	80	94	107	121	134	147	161	174	188	201
30	20	40	60	80	101	121	141	161	181	201	221	241	261	281	302
35	24	47	70	94	117	141	164	188	211	235	258	281	305	328	352
40	27	54	80	107	134	161	188	214	241	268	295	322	348	375	402
45	30	60	90	121	151	181	211	241	271	302	332	362	392	422	452
50	34	67	101	134	168	201	235	268	302	335	369	402	436	469	503
55	37	74	111	147	184	221	258	295	332	369	405	442	479	516	553
60	40	80	121	161	201	241	281	322	362	402	442	482	523	563	603
70	47	94	141	188	235	281	328	375	422	469	516	563	610	657	704
75	50	101	151	201	251	302	352	402	452	503	553	603	653	704	754
80	54	107	161	214	268	322	375	429	482	536	590	643	697	750	804
90	60	121	181	241	302	362	422	482	543	603	663	724	784	844	905
100	67	134	201	268	335	402	469	536	603	670	737	804	871	938	1005
125	84	168	251	335	419	503	586	670	754	838	921	1005	1089	1173	1256
150	100	201	302	402	503	603	704	804	905	1005	1106	1206	1307	1407	1508
175	117	235	352	469	586	704	821	938	1055	1173	1290	1407	1524	1642	1759
200	134	268	402	536	670	804	928	1072	1206	1340	1474	1608	1742	1876	2010
300	201	402	603	804	1005	1206	1407	1608	1809	2010	2211	2412	2613	2814	3000

Section 02832: Retaining Wall Specification

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Retaining wall system constructed of concrete segmental retaining wall units.
B. Geosynthetic reinforcement fabric
C. Leveling pad base
D. Drainage aggregate
E. Backfill
F. Drainage pipe
G. Adhesives

1.02 RELATED SECTIONS

Note to Specifier: Include Section 01270 only if Article 3.12 is included.

A. Section 01270 – Unit Prices

Note to Specifier: Include Section 02300 below for finish grading, and/or add other paving or surfacing related sections if required.

B. Section 02300 – Earthwork: For Finish Grading.

1.02 REFERENCES

A. American Association of State Highway Transportation Officials (AASHTO)
   1. AASHTO M288 Geotextile Specification for Highway Applications
   2. AASHTO Standard Specifications for Highway Bridges
B. American Society for Testing and Materials (ASTM)
   1. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units *[Last Update: 01ae1]*
   2. ASTM C1262 Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units *[Last Update: 98]*
   3. ASTM C1372 Standard Specification for Segmental Retaining Wall Units *[Last Update: 01a]*
   4. ASTM D448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction *[Last Update: 98]*
   5. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/f3)(600 kN-m/m3) *[Last Update: 00a]*
   6. ASTM D1556 Standard Test Method for Density and Unit Weight of Soil In Place by the Sand Cone Method *[Last Update: 00]*
   7. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f3)(2700 kN-m/m3) *[Last Update: 00]*
   8. ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System) *[Last Update: 00]*
   9. ASTM D2922 Standard Test Methods for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth) *[Last Update: 01*
   10. ASTM D3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer pipe and Fittings *[Last Update: 00]*
   11. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils *[Last Update: 00]*
   12. ASTM D4595 Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method *[Last Update: 86 (2001)]*
   13. ASTM D5262 Standard Test Method for Evaluating the Unconfined Tension Creep Behavior of Geosynthetics *[Last Update: 97]*
   14. ASTM F405 Standard Specification for Corrugated Polyethylene (PE) Tubings and Fittings *[Last Update: 97]*
   15. ASTM G51 Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing *[Last Update: 95 (2000)]*
C. National Concrete Masonry Association (NCMA)
   1. NCMA Design Manual For Segmental Retaining Walls, Second Edition, Second Printing (1997)
   2. NCMA SRWU-1 Determination of Connection Strength Between Geosynthetics and Segmental Concrete Units
   3. NCMA SRWU-2 Determination of Shear Strength Between Segmental Concrete Units

1.03 DEFINITIONS

A. Backfill: Soil which is used as fill behind the drainage aggregate, and within the reinforced soil mass (if applicable).
B. Drainage Aggregate: Material used within (if applicable), between, and directly behind the concrete retaining wall units.
C. Filter Fabric: Material used for separation and filtration of dissimilar soil types.
D. Foundation Soil: Soil mass supporting the leveling pad and reinforced soil zone of the retaining wall system.
E. Geosynthetic Reinforcement: Material specifically fabricated for use as a soil reinforcement.
F. Global Stability: The general mass movement of a soil reinforced segmental retaining wall structure and adjacent soil mass.
G. Project Geotechnical Engineer: A registered engineer employed by the Owner to perform site observations, provide recommendations for foundation support, and verify soil shear strength parameters.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300:
   1. Product Data: Material description and installation instructions for each manufactured product specified.

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2. Shop Drawings: Retaining wall system design, including wall elevation views, geosynthetic reinforcement layout, pertinent details, and drainage provisions. The shop drawings shall be signed by a registered professional engineer licensed in the state of wall installation.
3. Design Calculations: Engineering design calculations prepared in accordance with the NCMA Design Manual For Segmental Retaining Walls, or the AASHTO Standard Specifications for Highway Bridges, Section 5.8 (whichever is applicable). Analysis of global stability must be addressed and incorporated into the shop drawings.
4. Samples
    a. Furnish one unit in the color and face pattern specified, if requested.
    b. Furnish 12-inch square or larger piece of the geosynthetic reinforcement specified.
5. Test Reports: Independent laboratory reports stating moisture absorption and compressive strength properties of the concrete retaining wall units meet the Project Specifications when tested in accordance with ASTM C140, Sections 6, 8 and 9.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle materials in accordance with manufacturer's recommendations, in such a manner as to prevent damage. Check the materials upon delivery to assure that proper material has been received. Store above ground on wood pallets or blocking. Remove damaged or otherwise unsuitable material, when so determined, from the site.
    1. Exposed faces of concrete wall units shall be free of chips, cracks, stains, and other imperfections detracting from their appearance, when viewed from a distance of 10 feet.
    2. Prevent mud, wet cement, adhesives and similar materials that may harm appearance of units, from coming in contact with system components.

1.06 EXTRA MATERIALS

A. Furnish Owner with three replacement units identical to those installed on the Project.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete Retaining Wall Units: "Anchor Vertica Pro Retaining Wall Units" as manufactured under license from Anchor Wall Systems.
    1. Physical Requirements
        a. Meet requirements of ASTM C1372, except the maximum water absorption shall be limited to seven percent, and unit height dimensions shall not vary more than plus or minus 1/16 inch from that specified in the ASTM reference, not including textured face.
        b. Unit Face Area: Not less than 0.94 square feet.

Note to Specifier: In subparagraph below, select appropriate entity who will determine color.

        c. Color: Selected by the [Architect] [Engineer] [Owner] from manufacturer's full range of standard colors.

Note to Specifier: In subparagraph below, select straight or beveled face.

        d. Face Pattern Geometry: [Straight] [Beveled].
        e. Texture: Split rock face.
        f. Include an integral concrete shear connection flange/locator.

B. Geosynthetic Reinforcement: Polyester fiber geogrid or geotextile, or polypropylene woven geotextile, as shown on the Drawings.

C. Leveling Pad Base
    1. Aggregate Base: Crushed stone or granular fill meeting the following gradation as determined in accordance with ASTM D448:

Sieve Size	**Percent Passing**
1 inch	100
No. 4	35 to 70
No. 40	10 to 35
No. 200	3 to 10

        a. Base Thickness: six inches (minimum compacted thickness).
    2. Concrete Base: Nonreinforced lean concrete base
        a. Compressive Strength: 500 psi (maximum)
        b. Base Thickness: At least two inches, but not more than three inches.

D. Drainage Aggregate: Clean crushed stone or granular fill meeting the following gradation as determined in accordance with ASTM D448:

Sieve Size	**Percent Passing**
1 inch	100
3/4 inch	75 to 100
No. 4	0 to 60
No. 40	0 to 50
No. 200	0 to 5

E. Backfill: Soil free of organics and debris and consisting of either GP, GW, SP, SW, or SM type, classified in accordance with ASTM D2487 and the USCS classification system.
    1. Soils classified as SC and CL are considered suitable soils for segmental retaining walls with a total height of less than 15 feet unless the Plasticity Index (PI) is 20 or more.

2. Maximum particle size for backfill is two inches.
3. Unsuitable soils are organic soils and those soils classified as CH, OH, MH, OL, or PT.

F. Impervious Material: Clayey soil or other similar material which will prevent percolation into the drainage zone behind the wall.

G. Drainage Pipe: Perforated or slotted PVC or corrugated HDPE pipe manufactured in accordance with D3034 and/or ASTM F405. The pipe may be covered with a geotextile filter fabric to function as a filter.

H. Construction Adhesive: Exterior grade adhesive as recommended by the retaining wall unit manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

Note to Specifier: In Paragraph below, select appropriate entity.

A. Examine the areas and conditions under which the retaining wall system is to be erected, and notify the [Architect] [Engineer] [Owner] [Contractor] 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.

B. Promptly notify the wall design engineer of site conditions which may affect wall performance, soil conditions observed other than those assumed, or other conditions that may require a reevaluation of the wall design.

C. Verify the location of existing structures and utilities prior to excavation.

3.02 PREPARATION

A. Ensure surrounding structures are protected from the effects of wall excavation.

B. Excavation support, if required, is the responsibility of the Contractor, including the stability of the excavation and it's influence on adjacent properties and structures.

3.03 EXCAVATION

Note to Specifier: In Paragraph below, select appropriate entity.

A. Excavate to the lines and grades shown on the Drawings. Over-excavation not approved by the [Architect] [Engineer] [Owner (or Owner's representative)] will not be paid for by the Owner. Replacement of these soils with compacted fill and/or wall system components will be required at the Contractor's expense. Use care in excavating to prevent disturbance of the base beyond the lines shown.

3.04 FOUNDATION PREPARATION

A. Excavate foundation soil as required for footing or base dimension shown on the Drawings, or as directed by the Project geotechnical engineer.

B. The Project geotechnical engineer will examine foundation soil to ensure that the actual foundation soil strength meets or exceeds that indicated on the Drawings. Remove soil not meeting the required strength. Oversize resulting space sufficiently from the front of the block to the back of the reinforcement, and backfill with suitable compacted backfill soils.

C. The Project geotechnical engineer will determine if the foundation soils will require special treatment or correction to control total and differential settlement.

D. Fill over-excavated areas with suitable compacted backfill, as recommended by the Project geotechnical engineer.

3.05 BASE COURSE PREPARATION

A. Place base materials to the depths and widths shown on the Drawings, upon undisturbed soils, or foundation soils prepared in accordance with Article 3.04.
1. Extend the leveling pad laterally at least six inches in front and behind the lowermost concrete retaining wall unit.
2. Provide aggregate base compacted to six inches thick (minimum).
3. The Contractor may at their option, provide a concrete leveling pad as specified in Subparagraph 2.01.C.2, in lieu of the aggregate base.
4. Where a reinforced footing is required by local code official, place footing below frost depth.

B. Compact aggregate base material to provide a level, hard surface on which to place the first course of units.

C. Prepare base materials to ensure complete contact with retaining wall units. Gaps are not allowed.

3.06 ERECTION

A. General: Erect units in accordance with manufacturer's instructions and recommendations, and as specified herein.

B. Place first course of concrete wall units on the prepared base material. Check units for level and alignment. Maintain the same elevation at the top of each unit within each section of the base course.

C. Ensure that foundation units are in full contact with natural or compacted soil base.

D. Place concrete wall units side-by-side for full length of wall alignment. Alignment may be done by using a string line measured from the back of the block. Gaps are not allowed between the foundation concrete wall units.

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E. Place 12 inches (minimum) of drainage aggregate between, and directly behind the concrete wall units. Fill voids in retaining wall units with drainage aggregate. Provide a drainage zone behind the wall units to within nine inches of the final grade. Cap the backfill and drainage aggregate zone with nine inches of impervious material.

F. Install drainage pipe at the lowest elevation possible, to maintain gravity flow of water to outside of the reinforced zone. Slope the main collection drainage pipe, located just behind the concrete retaining wall units, two percent (minimum) to provide gravity flow to the daylighted areas. Daylight the main collection drainage pipe through the face of the wall, and/or to an appropriate location away from the wall system at each low point or at 50-foot (maximum) intervals along the wall. Alternately, the drainage pipe can be connected to a storm sewer system at 50-foot (maximum) intervals.

G. Remove excess fill from top of units and install next course. Ensure drainage aggregate and backfill are compacted before installation of next course.

H. Check each course for level and alignment. Adjust units as necessary to maintain level and alignment prior to proceeding with each additional 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. Interlock wall segments that meet at corners by overlapping successive courses. Attach concrete retaining wall units at exterior corners with adhesive specified.

J. Install geosynthetic reinforcement in accordance with geosynthetic manufacturer's recommendations and the shop drawings.
   1. Orient geosynthetic reinforcement with the highest strength axis perpendicular to the wall face.
   2. Prior to geosynthetic reinforcement placement, place the backfill and compact to the elevation of the top of the wall units at the elevation of the geosynthetic reinforcement.
   3. Place geosynthetic reinforcement at the elevations and to the lengths shown on the Drawings.
   4. Lay geosynthetic reinforcement horizontally on top of the concrete retaining wall units and the compacted backfill soils. Place the geosynthetic reinforcement within one inch of the face of the concrete retaining wall units. Place the next course of concrete retaining wall units on top of the geosynthetic reinforcement.
   5. The geosynthetic reinforcement shall be in tension and free from wrinkles prior to placement of the backfill soils. Pull geosynthetic reinforcement hand-taut and secure in place with staples, stakes, or by hand-tensioning until the geosynthetic reinforcement is covered by six inches of loose fill.
   6. The geosynthetic reinforcements shall be continuous throughout their embedment lengths. Splices in the geosynthetic reinforcement strength direction are not allowed.
   7. Do not operate tracked construction equipment directly on the geosynthetic reinforcement. At least six inches of compacted backfill soil is required prior to operation of tracked vehicles over the geosynthetic reinforcement. Keep turning of tracked construction equipment to a minimum.
   8. Rubber-tired equipment may pass over the geosynthetic reinforcement at speeds of less than five miles per hour. Turning of rubber-tired equipment is not allowed on the geosynthetic reinforcement.

3.07 BACKFILL PLACEMENT

A. Place reinforced backfill, spread and compact in a manner that will minimize slack in the reinforcement.

B. Place fill within the reinforced zone and compact in lifts not exceeding six to eight inches (loose thickness) where hand-operated compaction equipment is used, and not exceeding 12 inches (loose thickness) where heavy, self-propelled compaction equipment is used.
   1. Only lightweight hand-operated compaction equipment is allowed within four feet of the back of the retaining wall units. If the specified compaction cannot be achieved within four feet of the back of the retaining wall units, replace the reinforced soil in this zone with drainage aggregate material.

Note to Specifier: In paragraph below, select revised modified Proctor densities if necessary, in lieu of standard Proctor densities specified.

C. Minimum Compaction Requirements for Fill Placed in the Reinforced Zone
   1. Walls Less Than 15 Feet High: Compact to 95 percent of the soil's standard Proctor maximum dry density (ASTM D698) [modified Proctor maximum dry density (ASTM D1557)] for the entire wall height.
   2. Walls 15 Feet High BUT NOT MORE THAN 30 Feet High: Change compaction requirements to 98 percent of the soil's standard Proctor maximum dry density (ASTM D698) [modified Proctor maximum dry density (ASTM D1557)] for depths below 15 feet.
   3. Walls Over 30 Feet High: Change compaction requirements to 100 percent of the soil's standard Proctor maximum dry density (ASTM D698) [modified Proctor maximum dry density (ASTM D1557)] for depths below 30 feet.

4. Increase compaction requirements for retaining walls with slope heights at the back of the reinforced soil zone greater than five feet above the top of wall. Verify compaction requirements with Project geotechnical engineer.
5. Utility Trench Backfill: Compact utility trench backfill in or below the reinforced soil zone to 98 percent of the soil's standard Proctor maximum dry density (ASTM D698) [modified Proctor maximum dry density (ASTM D1557)], or as recommended by the Project geotechnical engineer. If the height from the utility to finish grade is higher than 30 feet, increase compaction to 100 percent of the standard Proctor density [modified Proctor density].
    a. Utilities must be properly designed (by others) to withstand all forces from the retaining wall units, reinforced soil mass, and surcharge loads, if any.
6. Moisture Content: Within two percentage points of the optimum moisture content for all wall heights.
7. These specifications may be changed based on recommendations by the Project geotechnical engineer.
    a. If changes are required, the Contract Sum will be adjusted by written Change Order.

D. At the end of each day's operation, slope the last level of compacted backfill away from the interior (concealed) face of the wall to direct surface water runoff away from the wall face.
1. The General Contractor is responsible for ensuring that the finished site drainage is directed away from the retaining wall system.
2. In addition, the General Contractor is responsible for ensuring that surface water runoff from adjacent construction areas is not allowed to enter the retaining wall area of the construction site.

E. Refer to Article 3.10 for compaction testing.

3.08 CAP UNIT INSTALLATION

A. Apply adhesive to the top surface of the unit below and place the cap unit into desired position.
B. Cut cap units as necessary to obtain the proper fit.
C. Backfill and compact to top of cap unit.

3.09 SITE CONSTRUCTION TOLERANCES

A. Site Construction Tolerances
1. Vertical Alignment: Plus or minus 1-1/2 inches over any 10-foot distance, with a maximum differential of three inches over the length of the wall.
2. Horizontal Location Control From Grading Plan
    a. Straight Lines: Plus or minus 1-1/2 inches over any 10-foot distance.
    b. Corner and Radius Locations: Plus or minus 12 inches.
    c. Curves and Serpentine Radii: Plus or minus two feet.
3. Immediate Post Construction Wall Batter: Within two degrees of the design batter of the concrete retaining wall units.
4. Bulging: Plus or minus 1-1/4 inches over any 10-foot distance.

3.10 FIELD QUALITY CONTROL

A. Installer is responsible for quality control of installation of system components. Employ a qualified independent third party to verify the correct installation of system components in accordance with these specifications and the Drawings.
B. The Owner, at their expense, will retain a qualified professional to perform quality assurance checks of the installer's work.
C. Correct work which does not meet these specifications or the requirements shown on the Drawings at the installer's expense.
D. Perform compaction testing of the reinforced backfill placed and compacted in the reinforced backfill zone.
1. Testing Frequency
    a. One test for every two feet (vertical) of fill placed and compacted, for every 50 lineal feet of retaining wall.
    b. Vary compaction test locations to cover the entire area of the reinforced soil zone, including the area compacted by the hand-operated compaction equipment.

3.11 ADJUSTING AND CLEANING

A. Replace damaged units with new units as the work progresses.
B. Remove debris caused by wall construction and leave adjacent paved areas broom clean.

Note to Specifier: Include Article 3.12 ONLY for municipal work when required.

3.12 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 includes the bottom of the base course to the top of the wall, and the entire length of the wall.
B. Payment for the wall will be made on a square-foot basis at the agreed-upon Contract Unit Price.
1. Payment should be considered full compensation for labor, materials, equipment and testing required to install the wall in accordance with these specifications and the Drawings.
2. Quantities may vary from that shown on the Drawings depending on existing topography. Change to the total quantity of wall face area will be paid or withheld at the agreed upon Contract Unit Price.

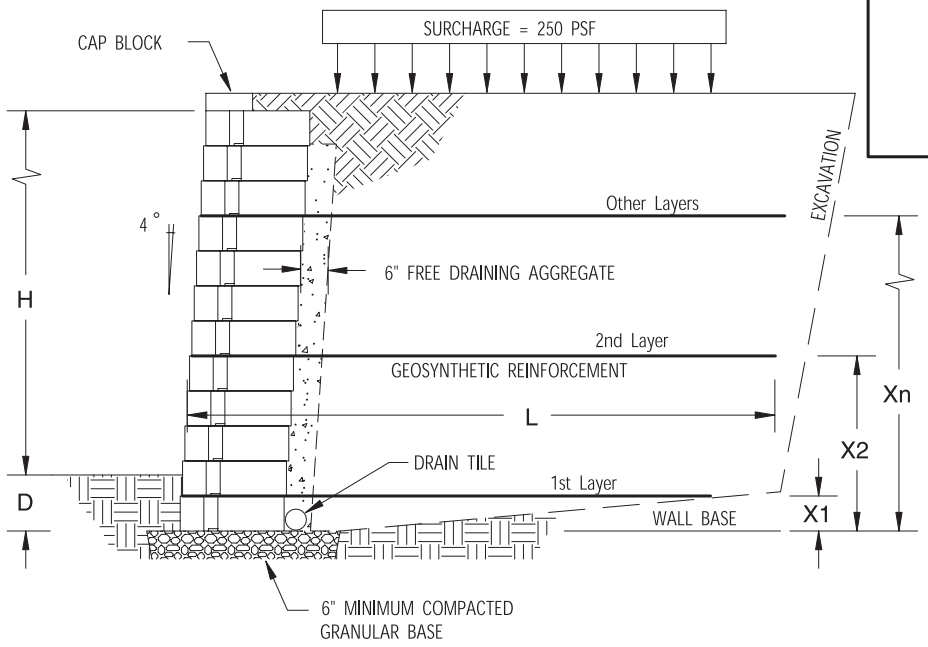
Table 1

SAND/GRAVEL

$\phi = 34^{o}$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 1 — 250 PSF SURCHARGE

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK 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"	0' 8"					
3' 6"	6"	6	6' 0"	2' 0"					
5' 6"	6"	9	6' 6"	1' 4"	4' 4"				
7' 6"	6"	12	7' 6"	0' 8"	3' 4"	6' 0"			
9' 6"	6"	15	8' 6"	0' 8"	2' 8"	5' 4"	8' 0"		
11' 4"	8"	18	10' 0"	0' 8"	2' 8"	4' 8"	7' 4"	10' 0"	

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. Connection value of 670 lbs/ft, 10 degrees and max value of 1005 lb/ft.

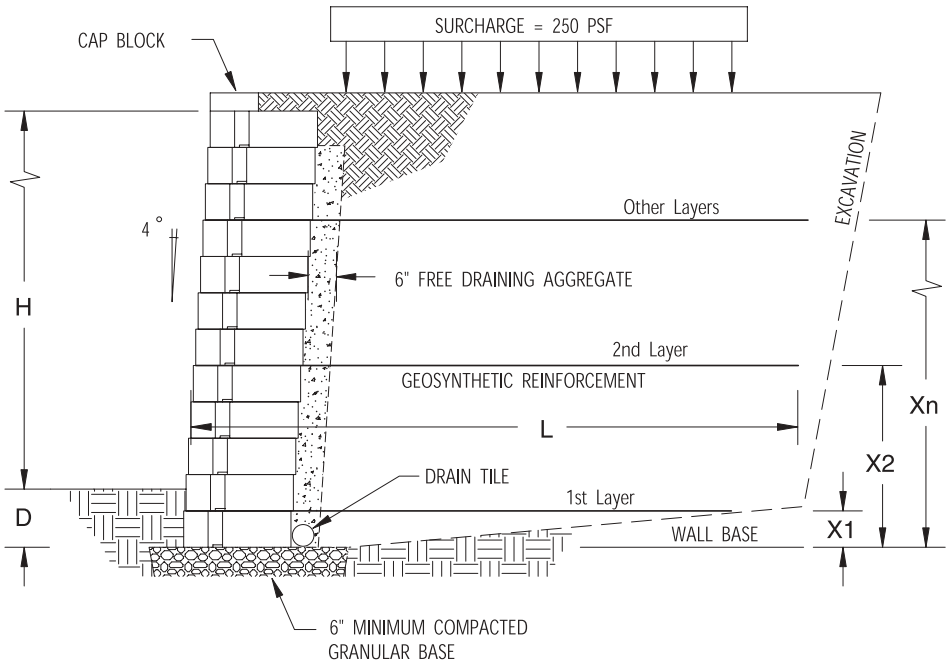
NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

SILTY SAND

$\phi = 30^o$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 2 — 250 PSF SURCHARGE

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK 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' 6"	0' 8"					
3' 6"	6"	6	5' 6"	0' 8"	2' 0"				
5' 6"	6"	9	7' 0"	0' 8"	2' 0"	4' 0"			
7' 6"	6"	12	8' 6"	0' 8"	2' 0"	4' 0"	6' 0"		
9' 6"	6"	15	9' 6"	0' 8"	2' 0"	4' 0"	6' 0"	8' 0"	
11' 4"	8"	18	11' 0"	0' 8"	2' 0"	4' 0"	6' 0"	8' 0"	10' 0"

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees, and max value of 1005 lbs/ft.

NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

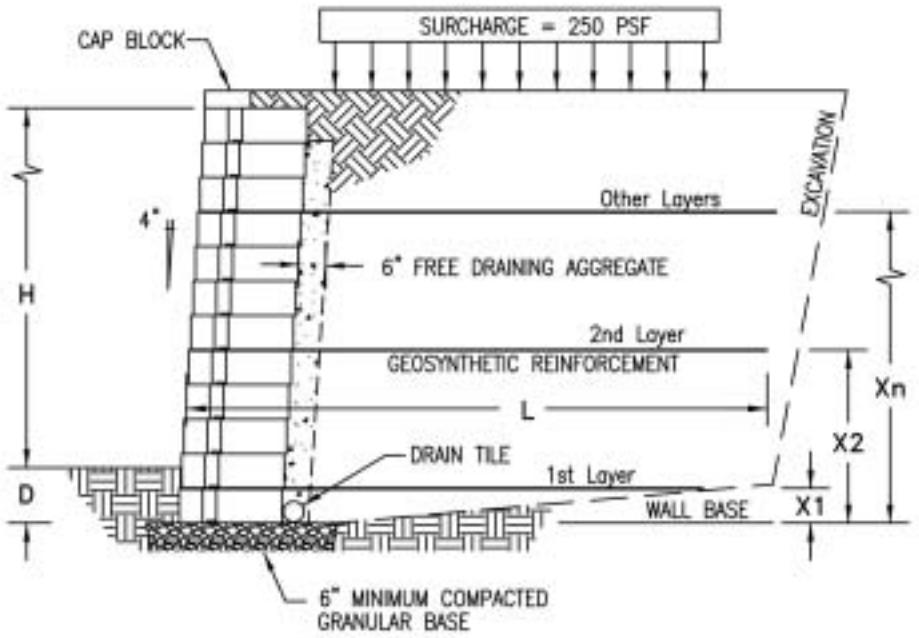
Table 3

SILTS/CLAY

ϕ = 26°

γ = 125 pcf

TYPICAL SECTION



ESTIMATING TABLE 3 **250 PSF SURCHARGE**

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.						
				X1	X2	X3	X4	X5	X6	X7
1' 6"	6"	3	5' 6"	0' 8"						
3' 6"	6"	6	6' 6"	0' 8"	2' 0"					
5' 6"	6"	9	8' 6"	0' 8"	2' 0"	4' 0"				
7' 6"	6"	12	10' 0"	0' 8"	2' 0"	4' 0"	6' 0"			
9' 6"	6"	15	11' 6"	0' 8"	2' 0"	4' 0"	6' 0"	8' 0"		
11' 4"	8"	18	12' 6"	0' 8"	2' 0"	3' 4"	4' 8"	6' 0"	8' 0"	10' 0"

DESIGN PARAMETERS:
Methodology – NCMA SRW Design Manual
Geosynthetic Reinforcement – LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees, and max. value of 1005 lbs/ft.

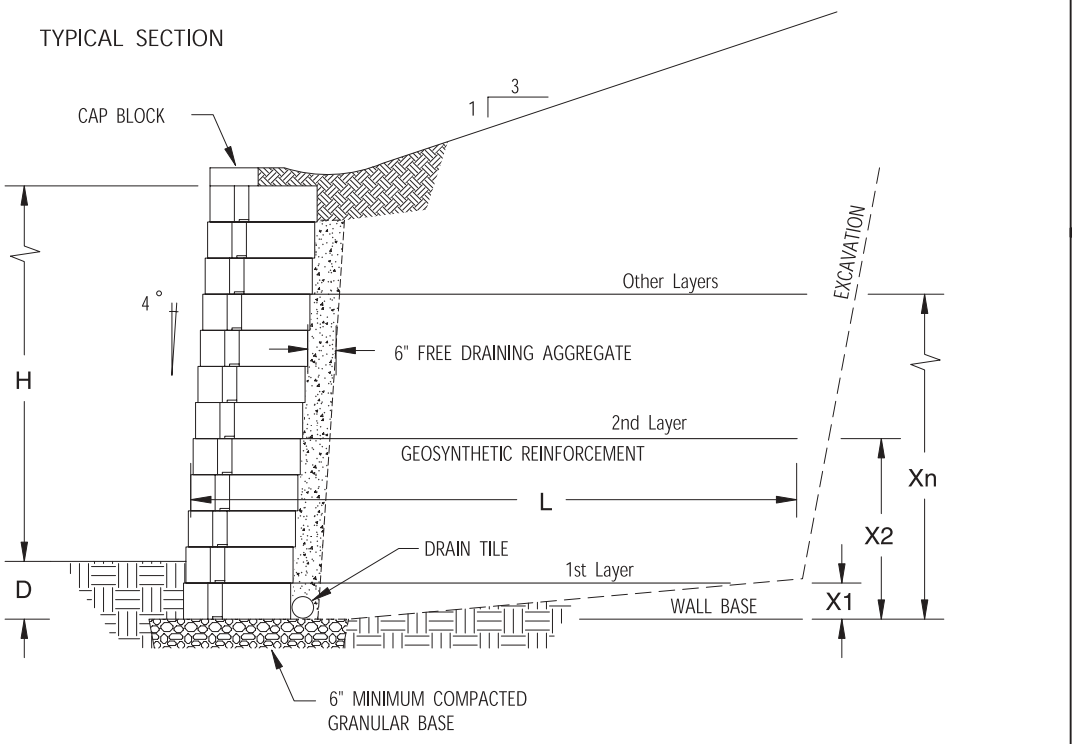
NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

SAND/GRAVEL

$\phi = 34^o$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 4 — 3:1 SLOPED BACKFILL

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.					
				X1	X2	X3	X4	X5	X6
3' 6"	6"	6	4' 6"	2' 0"					
5' 6"	6"	9	5' 6"	1' 4"	4' 0"				
7' 6"	6"	12	7' 0"	0' 8"	3' 4"	6' 0"			
9' 6"	6"	15	8' 6"	0' 8"	2' 8"	5' 4"	8' 0"		
11' 4"	8"	18	10' 0"	0' 8"	2' 8"	4' 8"	7' 4"	10' 0"	

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max. value of 1005 lbs/ft.

NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

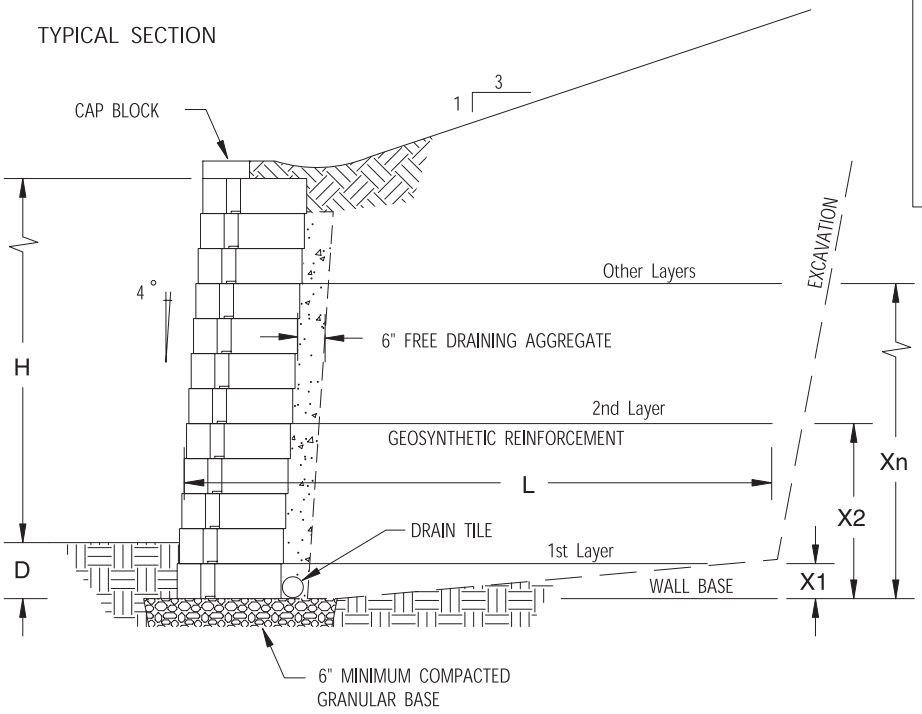
Table 5

SILTY SAND

$\phi = 30^{o}$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 5 — 3:1 SLOPED BACKFILL

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.					
				X1	X2	X3	X4	X5	X6
3' 6"	6"	6	5' 6"	2' 0"					
5' 6"	6"	9	6' 6"	1' 4"	4' 0"				
7' 6"	6"	12	7' 6"	0' 8"	2' 0"	4' 0"	6' 0"		
9' 6"	6"	15	9' 6"	0' 8"	2' 0"	4' 0"	6' 0"	8' 0"	
11' 4"	8"	18	11' 0"	0' 8"	2' 0"	3' 4"	5' 4"	7' 4"	10' 0"

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max value of 1005 lbs/ft.

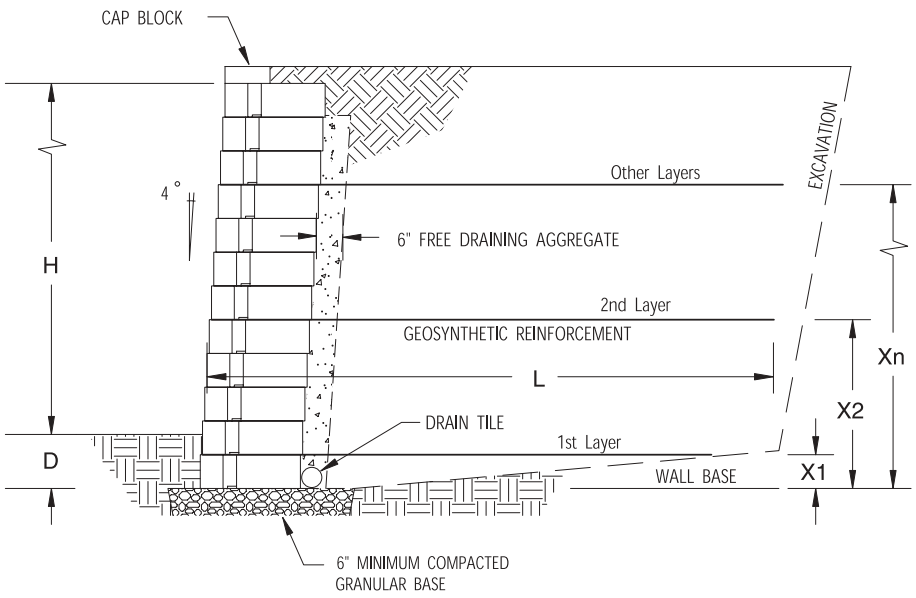
NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

SAND/GRAVEL

$\phi = 34^{o}$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 6 — LEVEL BACKFILL

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.					
				X1	X2	X3	X4	X5	X6
5' 6"	6"	9	5' 0"	1' 4"	4' 0"				
7' 6"	6"	12	6' 6"	0' 8"	3' 4"	6' 0"			
9' 6"	6"	15	7' 6"	0' 8"	2' 8"	5' 4"	8' 0"		
11' 4"	8"	18	8' 6"	0' 8"	2' 8"	4' 8"	7' 4"	10' 0"	

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees and max value of 1005 lbs/ft.

NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

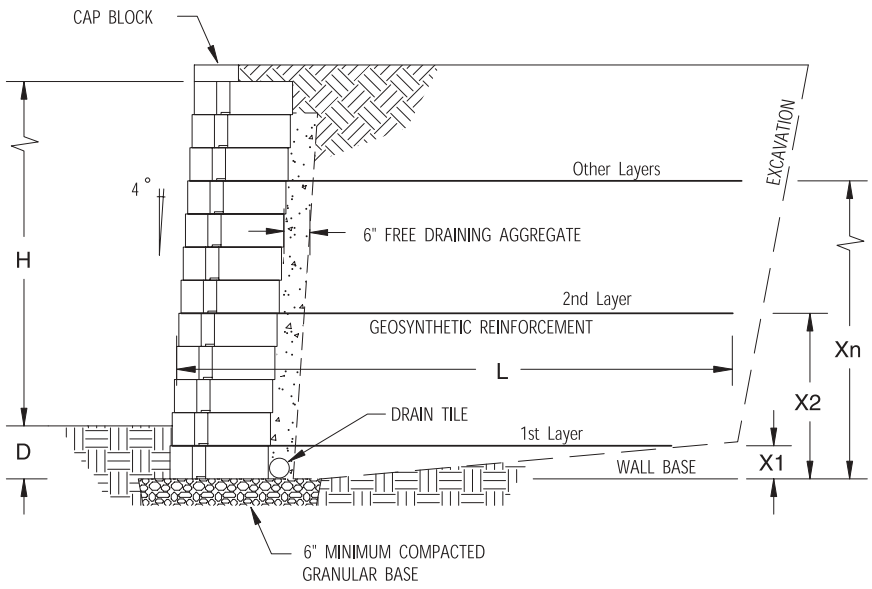
Table 7

SILTY SAND

$\phi = 30^{o}$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 7 — LEVEL BACKFILL

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.					
				X1	X2	X3	X4	X5	X6
3' 6"	6"	6	5' 0"	2' 0"					
5' 6"	6"	9	5' 6"	0' 8"	3' 4"				
7' 6"	6"	12	7' 0"	0' 8"	2' 8"	5' 4"			
9' 6"	6"	15	8' 0"	0' 8"	2' 8"	4' 8"	7' 4"		
11' 4"	8"	18	9' 6"	0' 8"	2' 8"	4' 8"	6' 8"	9' 4"	

DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. Connection value of 670 lbs/ft, 10 degrees and max value of 1005 lb/ft.

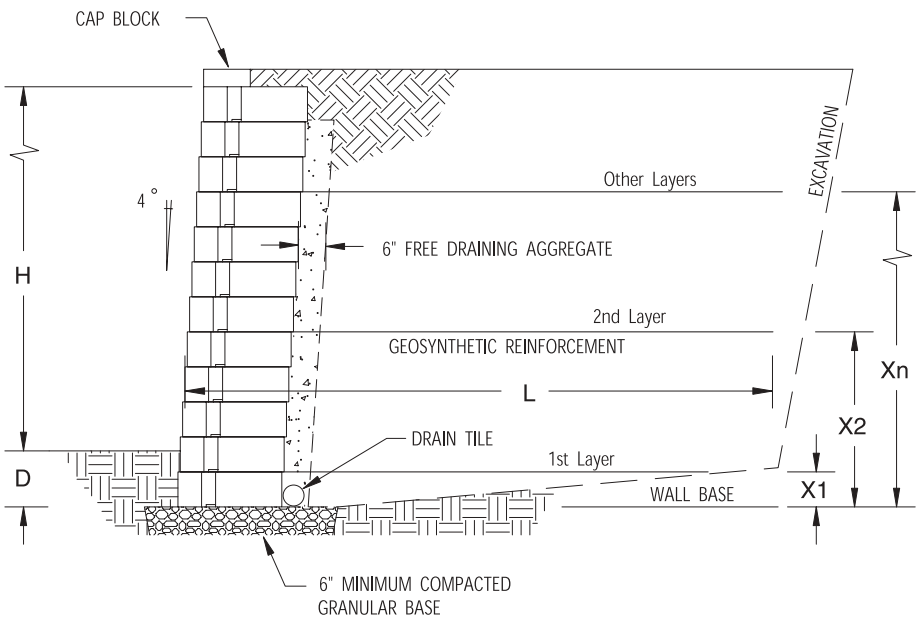
NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

SILTS/CLAY

$\phi = 26^o$

$\gamma = 125$ pcf

TYPICAL SECTION



ESTIMATING TABLE 8 — 250 PSF SURCHARGE

EXPOSED WALL HEIGHT H	DEPTH BELOW GRADE D	TOTAL NO. OF BLOCK FOR FINISHED WALL	LENGTH L	GEOSYNTHETIC REINFORCEMENT PLACEMENT DISTANCE UP FROM WALL BASE IN FT.					
				X1	X2	X3	X4	X5	X6
3' 6"	6"	6	6' 0"	2' 0"					
5' 6"	6"	9	6' 6"	0' 8"	3' 4"				
7' 6"	6"	12	7' 6"	0' 8"	2' 8"	5' 4"			
9' 6"	6"	15	9' 0"	0' 8"	2' 8"	4' 8"	7' 4"		
11' 4"	8"	18	10' 0"	0' 8"	2' 0"	3' 4"	5' 4"	7' 4"	9' 4"

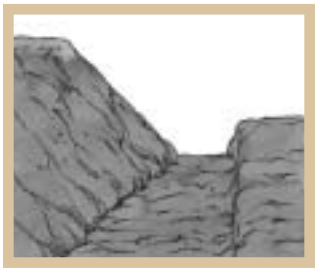
DESIGN PARAMETERS:
Methodology - NCMA SRW Design Manual
Geosynthetic Reinforcement - LTDS = 670 lbs/ft (min)
Min. connection value of 670 lbs/ft, 10 degrees, and max value of 1005 lbs/ft.

NOTE: For cost estimating purposes only. Professional engineering must be considered for proper design and reinforcement placement.

Anchor Vertica and Vertica Pro
Units Required Per Square Foot of Wall Face Area
8-Inch High Units

UNITS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HEIGHT	8"	1'4"	2'0"	2'8"	3'4"	4'0"	4'8"	5'4"	6'0"	6'8"	7'4"	8'0"	8'8"	9'4"	10'0"
LENGTH (FT)															
5	4	7	10	13	17	20	23	27	30	34	37	40	44	47	50
10	7	13	20	27	34	40	47	54	60	67	74	80	87	94	101
15	10	20	30	40	50	60	70	80	90	101	111	121	131	141	151
20	14	27	40	54	67	80	94	107	121	134	147	161	174	188	201
30	20	40	60	80	101	121	141	161	181	201	221	241	261	281	302
35	24	47	70	94	117	141	164	188	211	235	258	281	305	328	352
40	27	54	80	107	134	161	188	214	241	268	295	322	348	375	402
45	30	60	90	121	151	181	211	241	271	302	332	362	392	422	452
50	34	67	101	134	168	201	235	268	302	335	369	402	436	469	503
55	37	74	111	147	184	221	258	295	332	369	405	442	479	516	553
60	40	80	121	161	201	241	281	322	362	402	442	482	523	563	603
70	47	94	141	188	235	281	328	375	422	469	516	563	610	657	704
75	50	101	151	201	251	302	352	402	452	503	553	603	653	704	754
80	54	107	161	214	268	322	375	429	482	536	590	643	697	750	804
90	60	121	181	241	302	362	422	482	543	603	663	724	784	844	905
100	67	134	201	268	335	402	469	536	603	670	737	804	871	938	1005
125	84	168	251	335	419	503	586	670	754	838	921	1005	1089	1173	1256
150	100	201	302	402	503	603	704	804	905	1005	1106	1206	1307	1407	1508
175	117	235	352	469	586	704	821	938	1055	1173	1290	1407	1524	1642	1759
200	134	268	402	536	670	804	928	1072	1206	1340	1474	1608	1742	1876	2010
300	201	402	603	804	1005	1206	1407	1608	1809	2010	2211	2412	2613	2814	3000

WALL CONSTRUCTION



Step 1
Stake Out the Wall
- Have a surveyor stake out the wall's placement. Verify the locations with the project supervisor.

Excavation
- Excavate for the leveling pad to the lines and grades shown on the approved plans and excavate enough soil behind the wall for the reinforcement material. The trench for the leveling pad should be a minimum of the width of the unit plus one foot and 14 inches deep.

Step 2
Leveling Pad
- An aggregate leveling pad is made of a good compactible base material of 3/4 inch minus with fines.
- The pad must extend six inches in front and behind the first course of block, and be at least six inches deep.
- Compact the aggregate and make sure it's level.

Step 3
Base Course
- The most important step in the construction process.
- Run a string line along the back of the block to align the wall units.
- Use the right tools: a shovel, a level and a rubber mallet.
- Begin laying block at the lowest elevation of the wall.
- Place the blocks side by side, flush against each other and make sure the blocks are in full contact with the leveling pad.
- Level front to back and side to side. If the wall site is on an incline, don't slope the blocks; step them up so they remain consistently level.
- Check the blocks for proper alignment before moving onto the next step.

Step 4
Next Lift Construction
- Clean any debris off the top of the blocks.
- Place the second course of blocks on the base course while maintaining running bond and pull each block forward as far as possible to ensure the correct set back.
- Backfill with drainage aggregate within and directly behind the block. Place soil fill behind the aggregate.
- Compact the backfill before the next course is laid.
- Get to know the other contractors to make sure they don't drive heavy equipment near the wall.
- Self-propelled compaction equipment should not be used within four feet of the wall units.

Step 5

Drainage Design

- Each project is unique. The grades on your site will determine the level to install the drain tile.
- Place the drain tile as low as possible behind the wall so water drains down and away from the wall into a storm drain, or to an area lower than and away from the wall.
- Fill in the area within and behind the blocks with drainage aggregate, at least 12 inches from the wall.
- You may need to place and backfill several courses to achieve the proper drainage level.
- For best results, cover the drain tile with a geotextile sock which acts as a filter. The drain tile outlet pipes should be spaced not more than every 75 feet and at low points of the wall. In order for the drainage aggregate to function properly, it must keep clear of regular soil fill.

Step 6

Compaction

- Place the in-fill soil behind the drainage aggregate and compact the in-fill with a hand-operated compactor.
- Make sure the aggregate is level with or slightly below the top of the base course.
- Do the same at the front of the wall, adding and compacting in-fill soil.

Step 7

Reinforcement

- Check your Wall Construction plan for which courses will need reinforcement.
- Clean any debris off the top layer of blocks.
- Measure and cut the reinforcement to the design length shown in the plans.
- The reinforcement has a design strength direction, which must be laid perpendicular to the wall.
- Place the front edge of the material on the top course, two inches from the face of the block.
- Apply the next course of blocks to secure it in place.
- To keep it from wrinkling, pull the reinforcement taut and pin the back edge in place with stakes or staples.
- Add drainage aggregate within and behind the blocks, then add the in-fill soil and compact it.
- Know how your choice of reinforcement works. The strength direction of the reinforcement must be placed perpendicular to the wall.
- Remember – Place the front edge of the reinforcement on top of the block, making sure it's within two inches of the face of the block. Correct placement ensures that you maximize the connection strength and keep the batter consistent.
- A minimum of six inches of backfill is required prior to operating vehicles on the reinforcement. And remember, avoid sudden turning or braking, and don't go over 10 miles per hour.

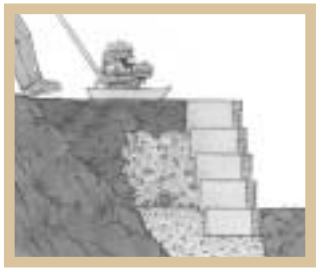
Step 8

Finish Grade and Surface Drainage

- Protect your wall with a finished grade at the top and bottom.
- To ensure proper water drainage away from the wall, use six inches of soil with low permeability. This will minimize water seeping into the soil and drainage aggregate behind the wall.

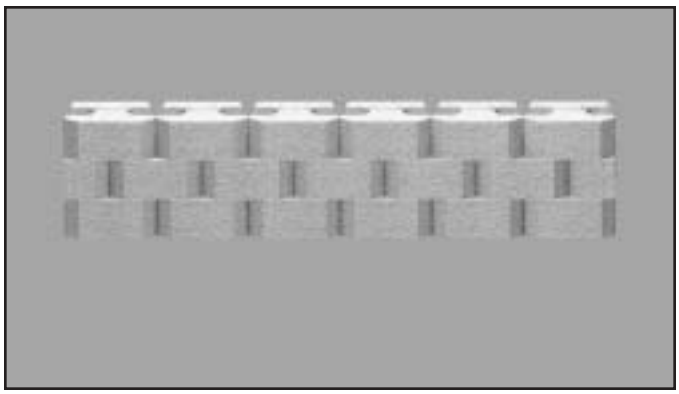
Step 9

Site Cleaning & Restoration

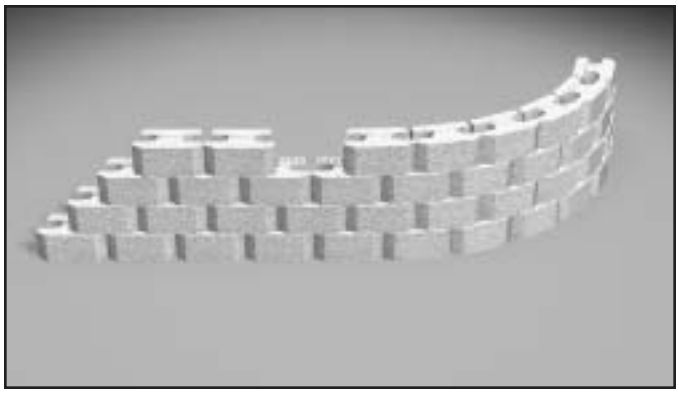


- Brush off the wall and pick up any debris left from the construction process.
- Notify the job superintendent in writing that the construction of the wall is complete and the project is ready for final inspection and acceptance.
- Following these Best Practices for construction will ensure the success of your Anchor retaining wall.
- Planting vegetation in front and on top of the wall will help reduce the chance of erosion.

RUNNING BOND

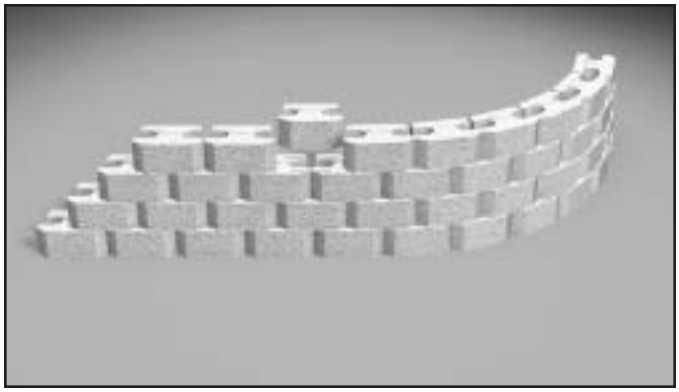


Step 1
Proper installation of any Anchor retaining wall requires that running bond be maintained. Running bond occurs when the blocks are centered over the vertical joints of the previous course. This adds to wall stability and makes your wall system aesthetically beautiful.



Step 2
Any wall that is not perfectly straight will eventually run off bond. When this happens, skip a block position and place the next block into the next place where it is back on bond. Measure the remaining gap and cut a block to fit.

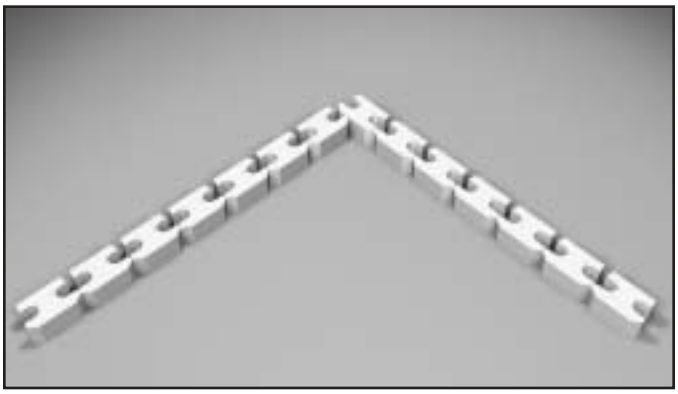
Tip: It may be possible to run the off bond block into the soil bank to avoid cutting of partial units.



Step 3
Once the partial unit is in place, adhere with a concrete adhesive. Partial units should not be less than five inches and should not be placed directly on top of each other. If the gap is larger than the length of one block, divide the measurement by two and put two partial units in place.

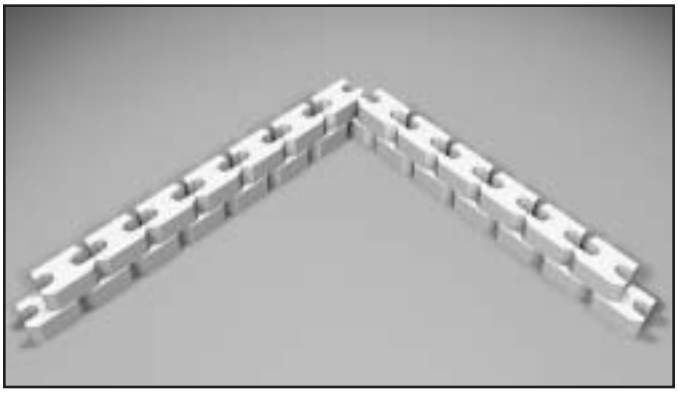
INSIDE 90˚ CORNERS

Step 1
To create an inside 90° corner, begin by placing a block at the corner. Then lay a second block perpendicular to the first and continue laying out the rest of the base course working from the corner out. Make sure to construct the base course according to standard site prep and installation procedures described earlier.

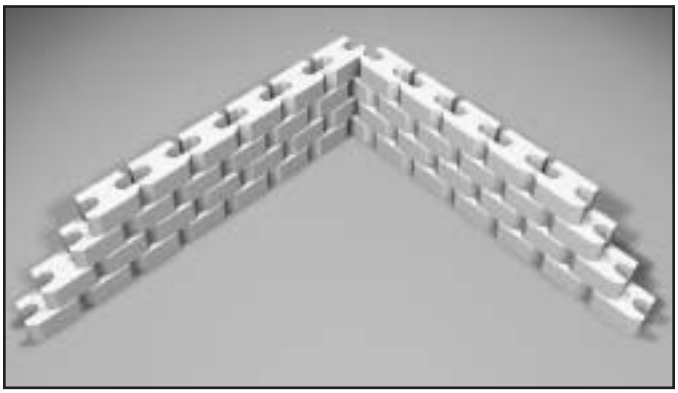


Step 2
On the second course, place all blocks on bond along one side of the corner. Once the second course of one wall is established, begin the second course of the adjacent wall.

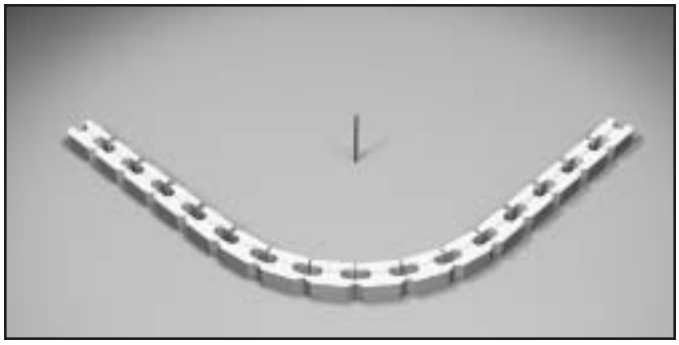
Split units may be required on this wall to maintain running bond. To split a block use a mechanical splitter.



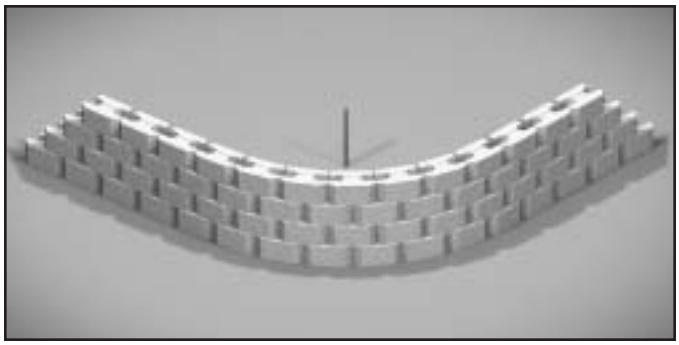
Step 3
Block placement in the corner should alternate direction with each succeeding course.



OUTSIDE CURVE



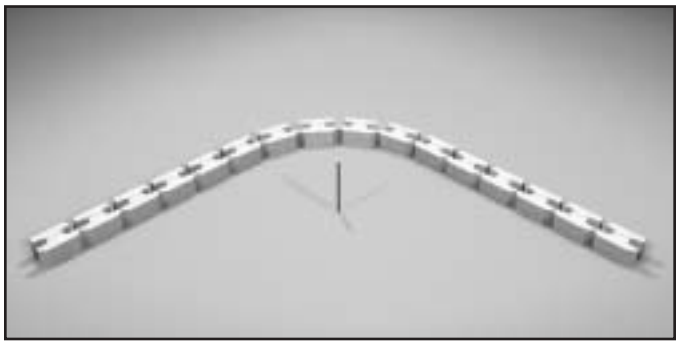
Step 1
When building an outside radius curve, begin by calculating the radius of your top course. This will be the smallest radius in the wall and must not be less than the minimum for the block system you are using*. Drive a stake into the ground at the desired center of the curve. Attach a string and rotate it in a circle around the stake to mark the radius in the soil. Align the back of the block with the radius curve and ensure level placement from side to side and front to back.



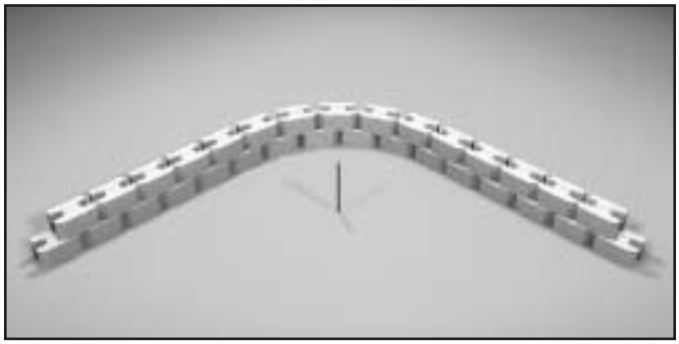
Step 2
For each course, make sure the locator of each block is in contact with the units below to ensure structural stability. The set back of the block will cause the radius of each course to gradually decrease and eventually affect the running bond of the wall. To maintain proper running bond, use partial units as needed. Once a split unit is cut to size, adhere in place with a concrete adhesive.

** To calculate the radius of your top course, add 1/4 inch to the set back of your block and multiply that amount by the number of courses in your finished wall. Then subtract the result from the radius of the base course. This number must exceed the minimum requirements for the block system you're using.*

INSIDE CURVE



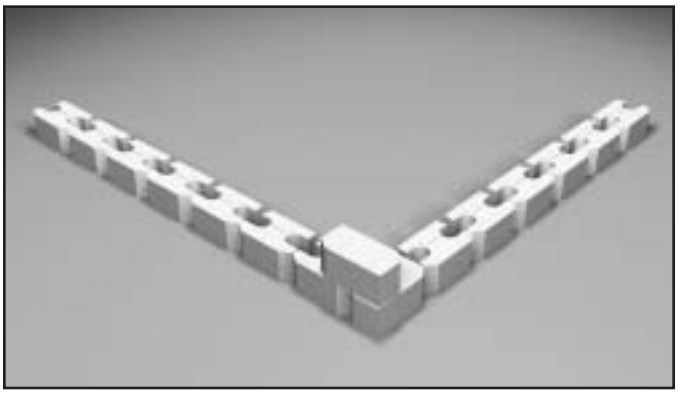
Step 1
Check your wall plan to determine the radius of your base course. This will be the smallest radius in the wall and must not be less than the minimum for the block system you are using. Begin by driving a stake into the ground at the desired center of the curve. Attach a string and rotate it in a circle around the stake to mark the radius in the soil. Align each block face with the radius curve and ensure level placement from side to side and front to back.



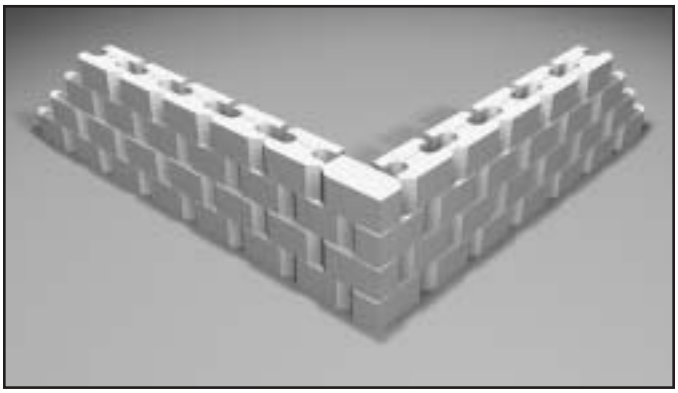
Step 2
For the second course, make sure the locator of each block is in contact with the units below to ensure structural stability. The set back of the block will cause the radius of each course to gradually increase and eventually affect the running bond of the wall. To maintain proper running bond, use partial units as needed. Once a partial unit is cut to size, adhere in place with a concrete adhesive.

OUTSIDE 90˚ CORNERS

Step 1
To build an outside 90° corner, begin by placing a corner unit at the corner. Then lay the rest of the base course working from the corner unit out.



Step 2
Begin the second course with a corner unit in the alternate direction. Place the second and third blocks on either side of the corner unit. Once the corner unit is in position, adhere block in place with a concrete adhesive. Continue to alternate the corner unit orientation with each course and always use a concrete adhesive.

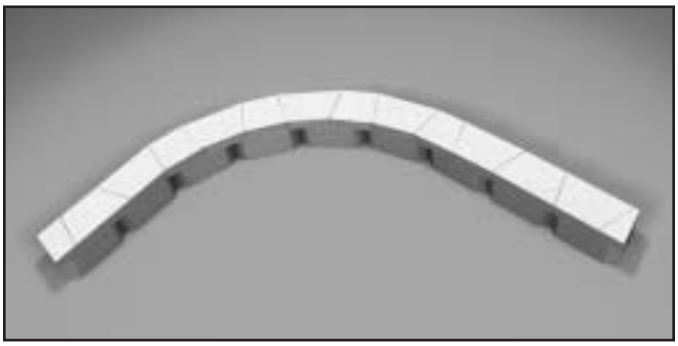


Step 3
Use split units as necessary to maintain running bond. To split a block, use a mechanical splitter.

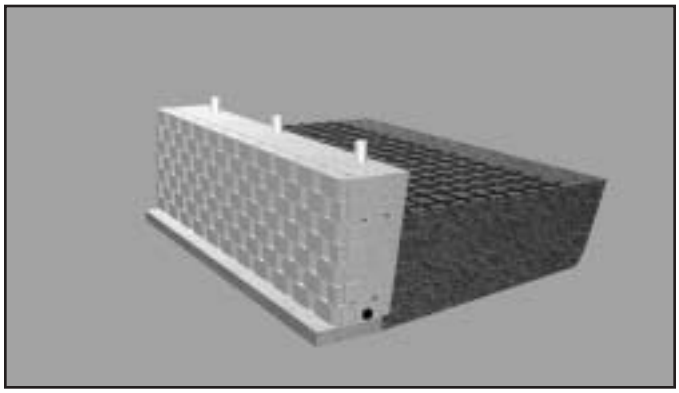
CAP UNITS

Step 1
Always start capping from the lowest elevation. Caps are trapezoidal in shape and must be laid alternatively short and long cap faces to achieve a straight line. If your wall elevation changes, caps can be stacked where the wall steps up. Begin laying caps at the elevation change and work your way back toward the previous step up. Split a cap unit to create a rough face on the exposed side. Place the half unit directly on top of the capped portion of the wall with all three split faces exposed. On a 90° corner wall, the corner caps need to be saw cut to achieve a 45° mitered corner. After layout is complete and caps are saw cut or split to size, carefully adhere with a concrete adhesive. For capping inside and outside radius curves, lay the cap units side by side without alternating long and short cap faces.

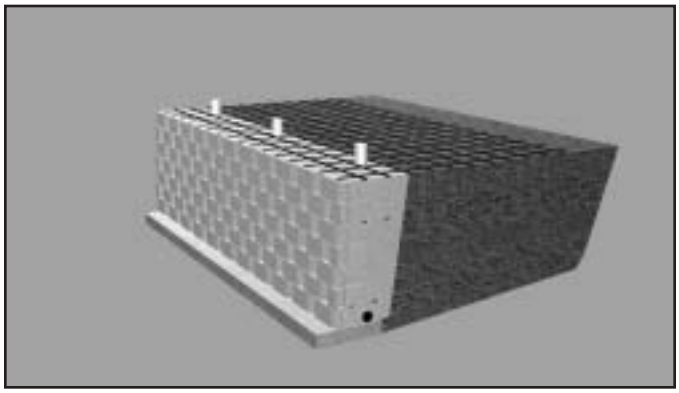
Tip: To determine the minimum number of caps needed on an average straight wall, measure the length of the wall. Multiply the length of the wall by 12 inches and divide by 14.5. Additional caps will be needed for elevation changes and radius curves.



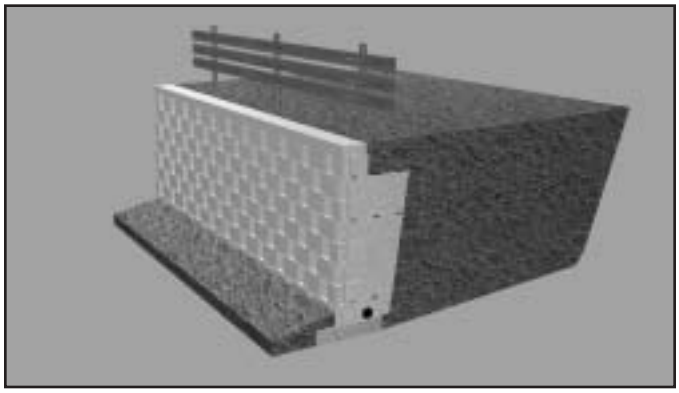
FENCES



Step 1
Know the specific dimensions of the fence to determine the placement of the sleeves. Sleeves should be at least one inch larger in radius than the fence posts to allow for mortar or grout. Install the sleeves according to the wall plan during the construction of your wall.

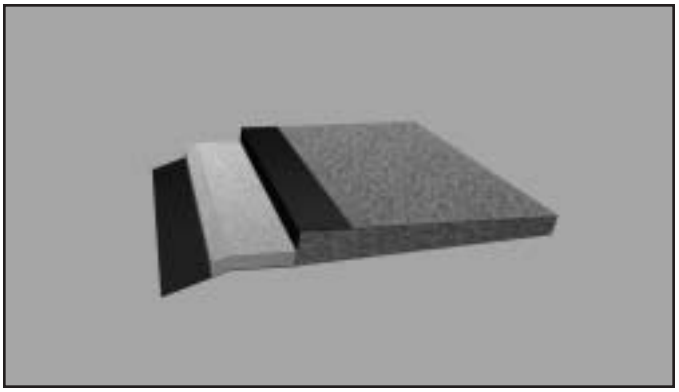


Step 2
If the fence is at least three feet behind the wall, generally no additional reinforcement is required. If the fence is installed within three feet, there may be some load transferred to the wall from wind, snow or pedestrians. Additional reinforcement around the fence sleeves may be needed.



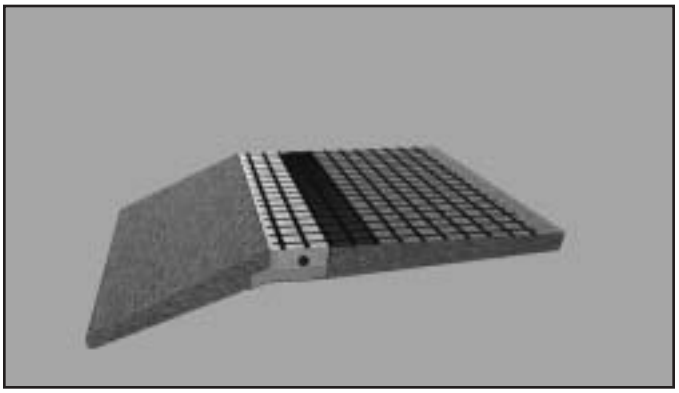
Step 3
Grout the fence post into the sleeve after the wall is built.

WATER

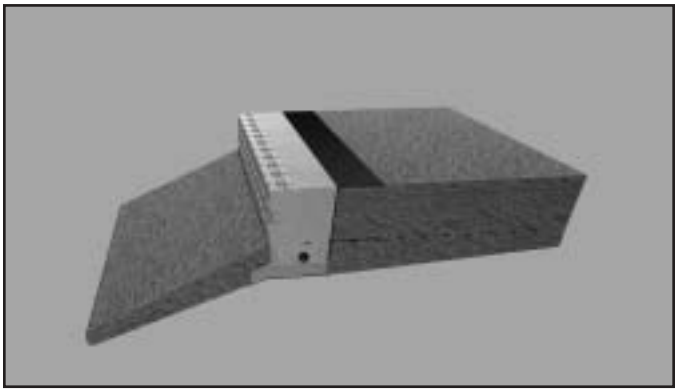


Step 1
Place a filter fabric with extra length in front of the wall.

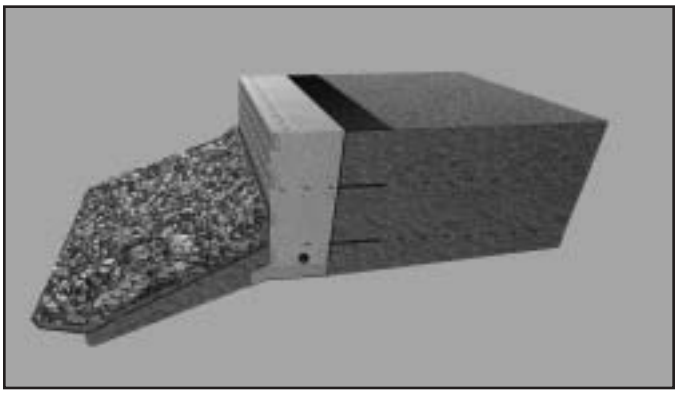
Note: In water applications, the reinforced zone should consist of free draining soil.



Step 2
Install your leveling pad and the first course of block, including drain tile and drainage aggregate. Wrap the extended filter fabric up along the face of the base course. Place soil fill in front of the wall and compact. Install another section of filter fabric in front of the wall to protect against erosion. Cover the fabric with a minimum of three inches of sand.



Step 3
Install larger stones such as rip-rap to hold it in place. Continue constructing your wall. Drainage is vital. To prevent clogging of the drainage aggregate and drain tile by fine-grained soils, a geosynthetic filter fabric is installed to separate the drainage aggregate from the reinforce soils.

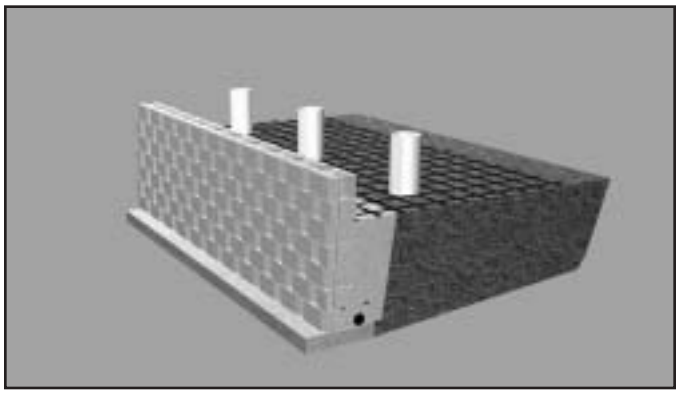


Step 4
Continue these steps until your wall is complete. The last section of filter fabric should cover the drainage aggregate and run up against the back of the top course of block. Add fill soil and compact. Keep in mind there are numerous issues related to water wall applications including wave or ice impact, erosion or scour in front of the wall and ice uplift of the wall.

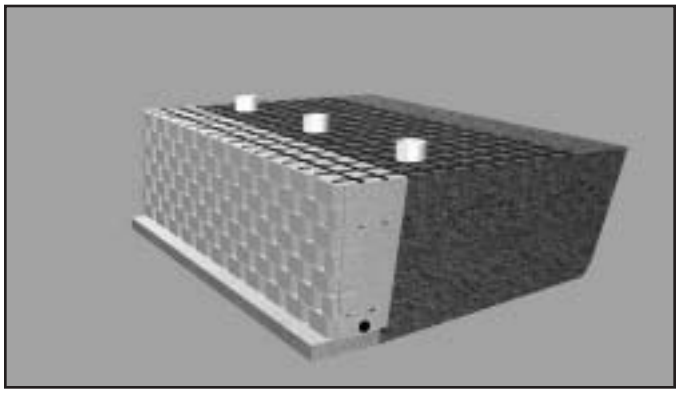
For more information, consult with a qualified engineer.

GUARDRAILS

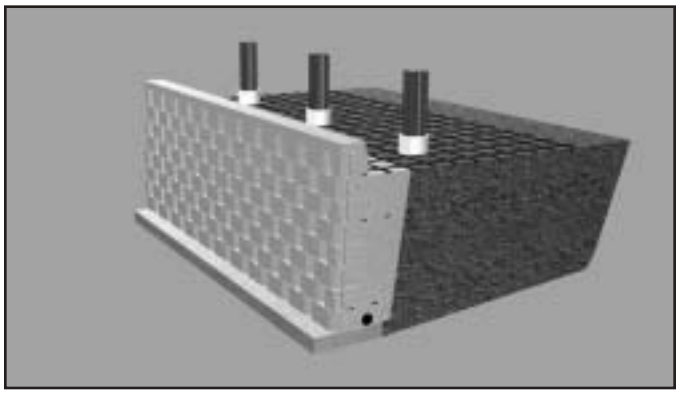
Step 1
Impact on a guardrail system can transfer additional load to your wall. This must be accounted for in the design and construction of the wall. Install a sleeve in the backfill soil at post locations during construction at least three feet from the face of the wall.



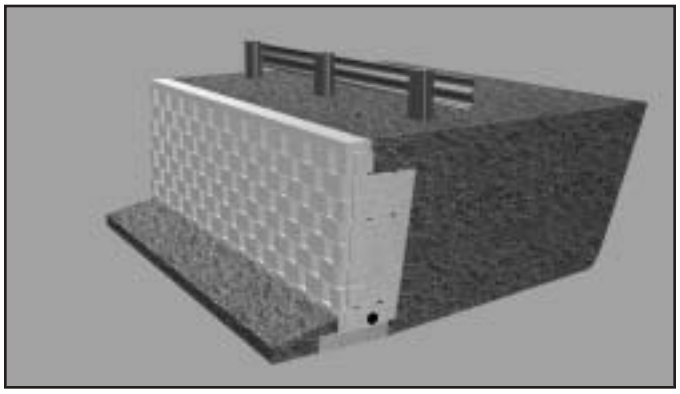
Step 2
Depending on impact loads, the post of the guardrail has to be buried deep enough so that it penetrates multiple layers of reinforcement.



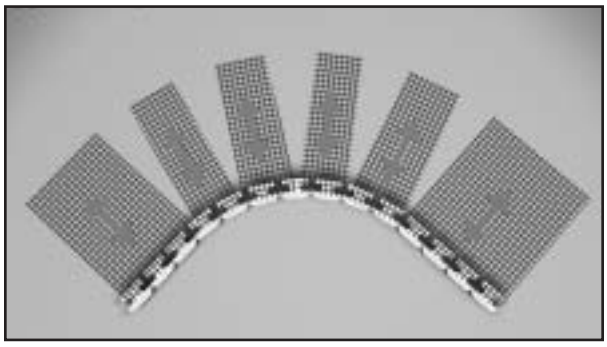
Step 3
An additional layer of reinforcement should be placed just below the top course for additional stability.



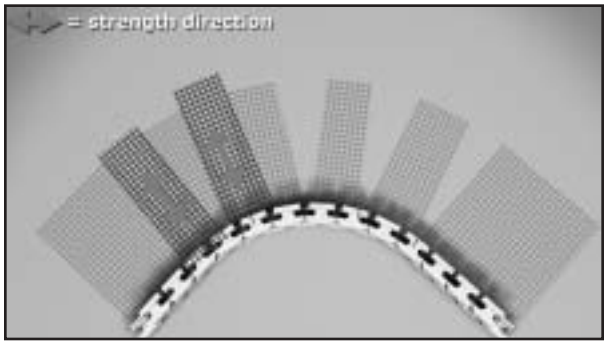
Step 4
Once the wall is constructed, insert the posts and apply grout.



REINFORCEMENT–INSIDE CURVE

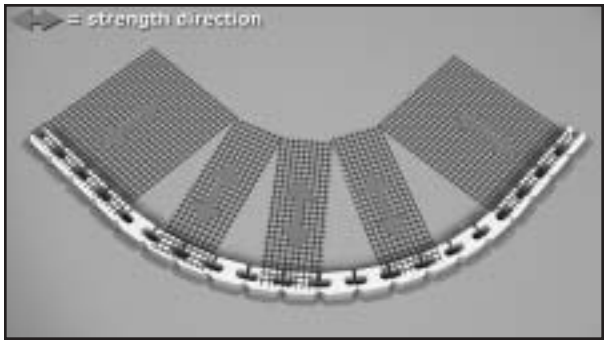


Step 1
Cut reinforcement to the required lengths as specified in your wall plan. Lay segments of reinforcement within two inches of the face of the wall, making sure that the strength direction of each section is perpendicular to the wall face.

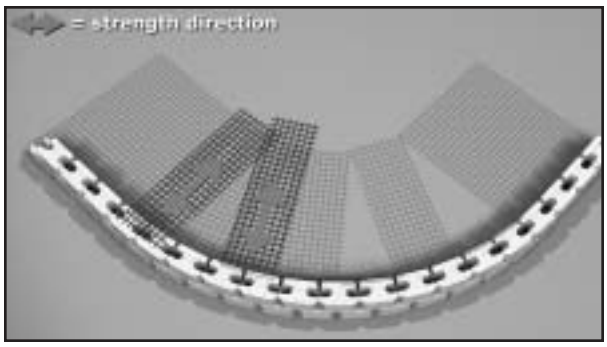


Step 2
Place the next course of blocks, marking the backs of blocks to identify the middle of unreinforced areas. Backfill and compact. Center subsequent sections of reinforcement on the marked blocks to ensure full reinforcement coverage. Repeat this procedure throughout the construction of the radius curve when reinforcement is required.

REINFORCEMENT–OUTSIDE CURVE



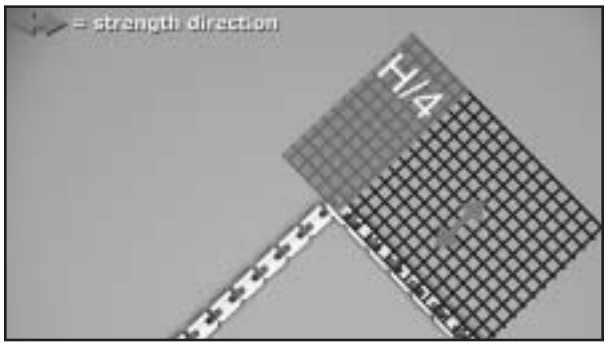
Step 1
Cut reinforcement to the required lengths as specified in your wall plan. Lay sections of the reinforcement within two inches of the face of the wall with the strength direction perpendicular to the wall face. Avoid overlapping the reinforcement by separating each section. Place the next course of blocks, marking the backs of blocks to identify unreinforced areas. This step is important because when this course is backfilled, it's impossible to locate the unreinforced areas.



Step 2
Place the next course of blocks, marking the backs of blocks to identify unreinforced areas. This step is important because when this course is backfilled, it's impossible to locate the unreinforced areas. Use the marked blocks as a guide, placing subsequent sections of reinforcement to overlap the gaps left on the previous course. This will ensure total reinforcement coverage. Repeat this procedure throughout the construction of the radius curve when reinforcement is required.

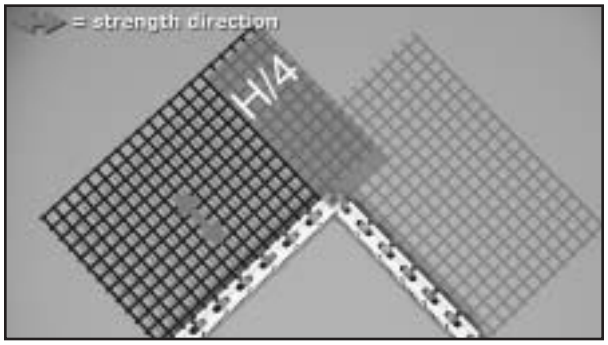
REINFORCEMENT–INSIDE 90˚ CORNERS

Step 1
To install reinforcement on an inside 90° corner begin by checking your wall plan to determine reinforcement lengths and elevations. Cut your reinforcement to the lengths identified in your wall plan, paying attention to the reinforcement strength direction. Next, determine the proper placement of the reinforcement by dividing the total proposed height of the wall by four. This represents the distance that reinforcement should extend beyond the front of the adjoining wall. Measure this distance from the front of the adjoining wall and begin your grid placement here. Make sure the grid is placed within two inches of the face of the wall and runs along the back of the adjoining wall.



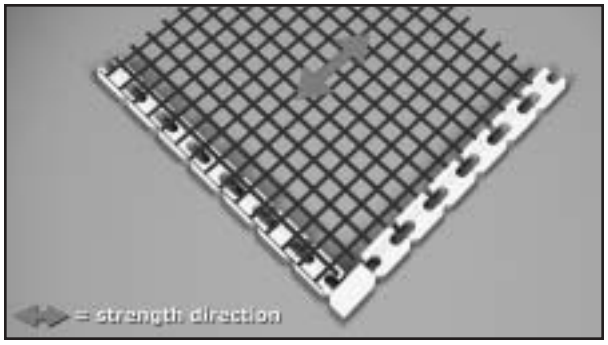
Example: *If your overall wall height is eight feet, the reinforcement extension would be two feet.*

Step 2
The next section of reinforcement on the adjoining wall then can be placed using the same formula to determine placement in front of adjoining wall. The reinforcement should not overlap and should lie flush with previously placed sections. Once reinforcement is in place, the next courses of block can be installed. Alternate the reinforcement extension on each course where reinforcement is required.

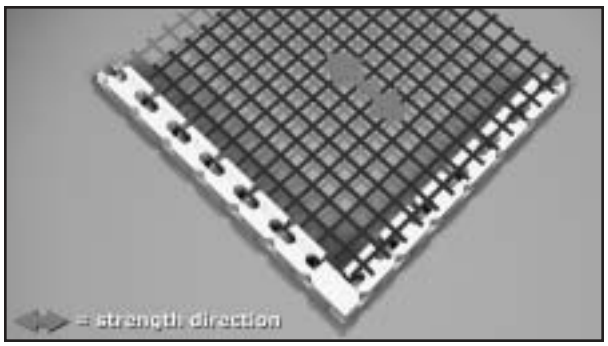


REINFORCEMENT–OUTSIDE 90˚ CORNERS

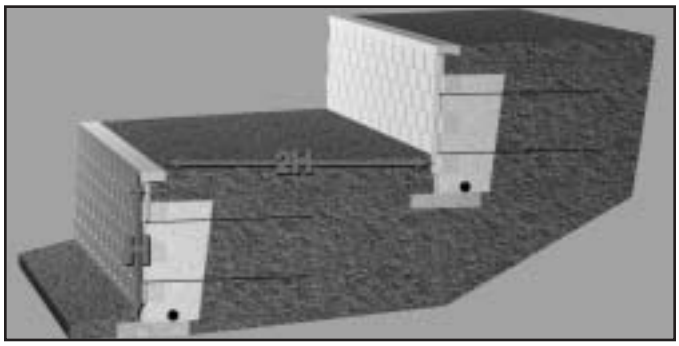
Step 1
Begin by checking your wall plan to determine reinforcement lengths and elevations. Lay a section of reinforcement near the corner of the wall, ensuring that it's placed within two inches of the face of the block and running along the back of the adjoining wall.



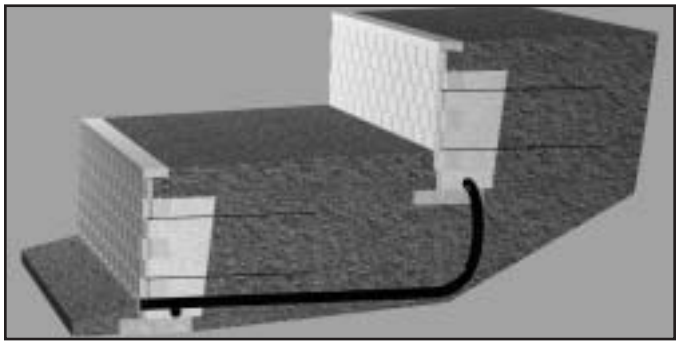
Step 2
Lay the next course of block, backfill and compact. When installing the next section of reinforcement, place within two inches of the face of the block and running along the back of the adjacent wall. Alternate the reinforcement extension on each course where reinforcement is required.



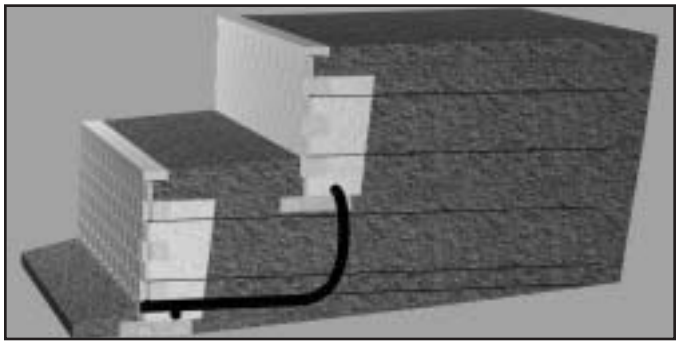
TERRACES



Step 1
Independent Terraced Walls.
For each wall to be independent of the other, each must be built using a 2:1 ratio — the upper wall must be built a distance away from the lower wall of at least twice the height of the lower wall. In addition, the upper wall also must be equal to or less than the height of the lower wall. Exceptions to this general rule include weak soil conditions or instances where slopes exist above, below or between wall locations. (i.e. If the lower terrace is three feet tall the distance between the upper terrace must be six feet.)



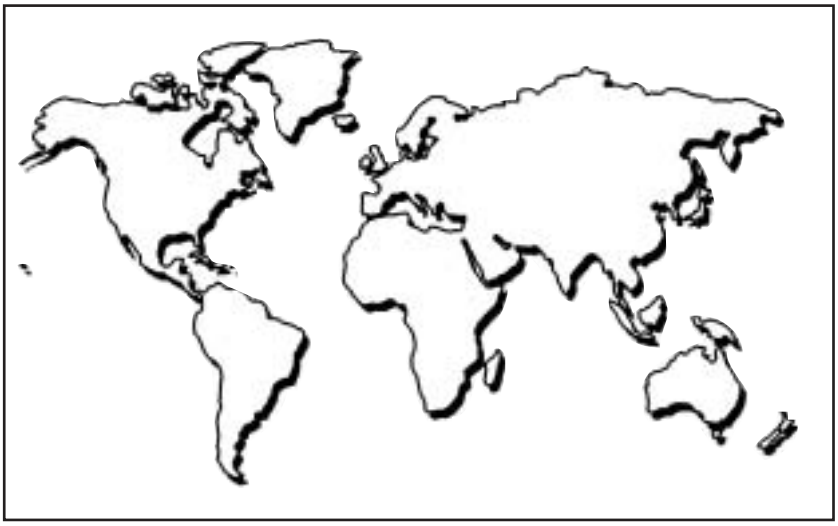
Step 2
Proper drainage is vital to maintaining stable, long-lasting terraced walls. Drain tile must be installed so that the water is directed around or under the lower wall (never place the drain tile outlet above or behind the lower wall).



Step 3
Dependent Walls.
When the distance between the lower and upper walls is less than twice the height of the lower wall, the walls become structurally dependent on each other. In this situation, it is important to take global stability into account, incorporating additional reinforcement and longer layers into the wall plan. In addition, structurally dependent walls require even more excavation, backfill and time, so plan ahead. Be sure to check the wall plan for specific requirements. For structually dependent walls, consult a qualified engineer.

An international network is ready to deliver Anchor retaining wall products when you need them, where you need them. Anchor products are available in:

Australia
Canada
China
Fiji
Japan
New Zealand
Philippines
Portugal
South Korea
Spain
Sweden
United Kingdom
United States



INSTALLATION: Anchor Vertica® and Vertica Pro® brand blocks are engineered to attain a maximum total wall height* of approximately three feet, four inches as a gravity wall without reinforcement. These heights assume level backfill and clean, compacted sand or gravel and no surcharge. For higher walls, or if these conditions are not present, professional engineering must be considered for proper design and reinforcement placement. It is the user's responsibility to obtain such design advice. Neither Anchor Wall Systems, Inc., nor its authorized manufacturers, assume any responsibility for the design and/or installation of walls constructed with the retaining wall products.

Warranty: In the United States, Anchor Wall Systems products are backed by a five-year limited warranty. For a complete copy of the Anchor Wall Systems warranty, visit your local retailer or contact Anchor Wall Systems at 1-877-295-5415 or www.anchorwall.com.

*Total wall height includes the height of any buried courses.

Anchor Wall Systems, Inc., 5959 Baker Road, Suite 390, Minnetonka, MN 55345-5996
1-877-295-5415 www.anchorwall.com

VI55 9/02

Anchor™
RETAINING WALL SYSTEMS