ANCHOR DIAMOND Group

INSTALLATION GUIDE

ANCHOR DIAMOND™

FEATURING VERTICA® RETAINING WALL SYSTEM

DEVELOPED BY ANCHOR DIAMOND WALL INDUSTRY EXPERTS

Anchor Vertica® Retaining Wall System Construction and Quality Control For AASHTO and DoT Projects

INTRODUCTION

This manual is provided as guidance for the construction and quality control of Anchor Vertica retaining wall installations for AASHTO and DOT projects. This manual is intended to be a guide only. For more information regarding construction of MSE walls on government projects refer to the AASHTO code and subsequent Interim specifications and the FHWA NHI – 10 – 024/025 documents. This manual is to be used by the contractor, engineer of record and quality control inspector.

WALL CONSTRUCTION

Step 1

Stake out the Wall

• A surveyor shall locate the proposed base of wall location by offset staking. Verify the wall location with the project supervisor.

STEP 2

Excavation

• Excavate for the leveling pad to the lines and grades shown on the approved plans. Excavate enough soil behind the wall for the reinforcement material. In "cut" areas, the trench for the leveling pad should be a minimum width of 24" (600mm) and 18" (450 mm) deep.

Step 3

Leveling Pad

• Place leveling pad materials as shown on the drawings upon undisturbed soils, or foundation soils prepared in accordance with the specifications.

• Foundation soil and any cut banks shall be examined by the project geotechnical engineer or technician to ensure that the actual retained and foundation soil strengths meet or exceeds the strength required, as shown on the construction drawings.

• Examine cut banks for perched water or other water seepage. Perched or other water seepage from cut banks behind the reinforced soil zone, not anticipated in the original design, may require additional drainage features in the constructed wall. Notify the wall design engineer of record for clarification.

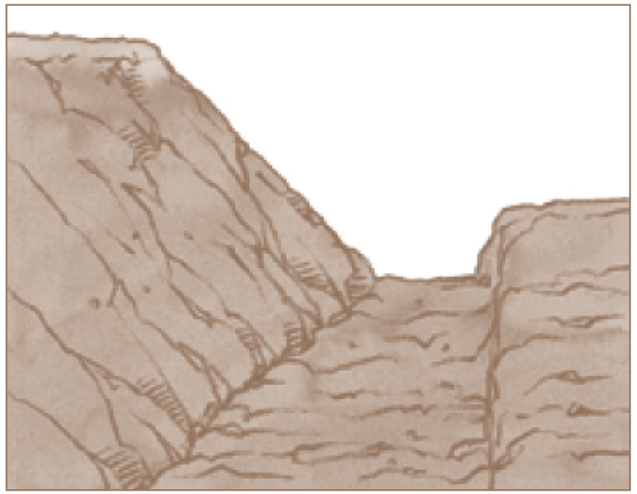
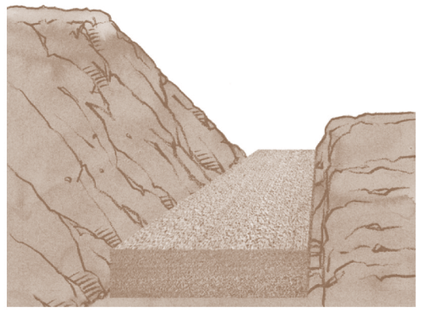


Diagram 1—Excavation

• For AASHTO/DOT projects a concrete leveling pad is preferred. The concrete leveling pad shall be unreinforced and have a minimum compressive strength of 3,000 psi (28 Mpa). The concrete leveling pad should be allowed to cure for a minimum of 12 hours prior to placement of the first course of modular units. The leveling pad shall be 6 inches (150mm) thick and 24 inches (600mm) wide, centered on the modular units. Ensure the top of the leveling pad is at the proper elevation.



• An aggregate leveling pad, where allowed, is composed of a good compactable base material of 0.75 inch (20 mm) minus, preferably with 10 to 15% fines. Compact the aggregate leveling pad, using ordinary compaction methods, to the appropriate lines and grades. Ensure the top of the leveling pad is at the proper elevation.

STEP 4

Foundation Course

• Placing the foundation units is one of the most important steps in the construction process, both structurally and aesthetically.

• Use the right tools; a shovel, a level and a rubber mallet.

• Begin laying the foundation units at the lowest elevation of the wall.

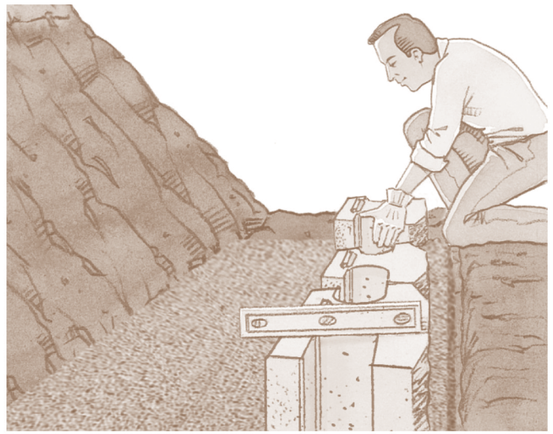
• Place first course of Vertica units on the prepared leveling pad. Place the units side by side. Make sure the units are in full contact with the leveling pad.

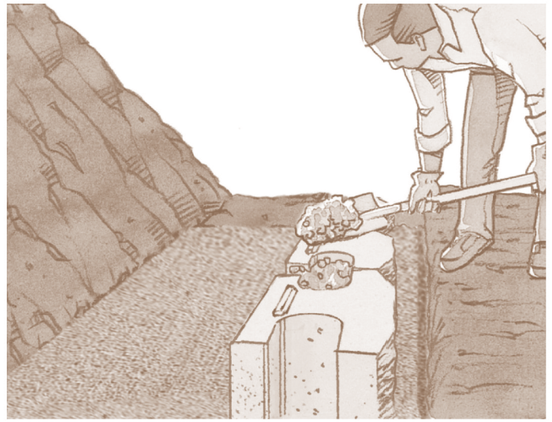
• Level each unit front to back and side to side with a torpedo level. Check adjacent units for level with a 4 ft (1.2m) level.

• When the base of wall grade steps up or down, shimming of the foundation unit may become necessary. When this occurs, a thin layer of sand is on top of the concrete leveling pad to reestablish foundation grade. A depth of no more than 1 inch of sand is allowed.

• When each block is level, check for alignment along the back of the units with a string line.

• Once the foundation course is installed, leveled and aligned, place in-fill soil in front and behind the base course. Pay careful attention to the type of fill required behind the foundation units. Reinforced zone fill or drainage aggregate may be required, refer to the project specific plans for specific details regarding material requirements. Carefully compact the fill placed in front and behind the base units with lightweight hand operated compaction equipment. Recheck the base units for level and alignment.





STEP 5
Subsequent Lift Construction and Drainage Design

- Free draining soils shall have at least 30 to 40% of the soil particles retained on the #40 sieve (425µm) and not more than 5% of the soil particles passing the #200 (75µm) sieve.

- Prior to placing the next course of units, clean any debris off the top of the existing course.

- Place the next course of units over the units placed for the base and pull the units forward to engage the shear key/locator.

- A maximum gap of 1/8 inch (3.2 mm) is allowed between units unless larger aggregates are used for core-fill.

- Each project is unique. The site grades will determine what elevation to install the drain pipe. Refer to the construction plans and specifications for details regarding the drain pipe type, location and drainage details.

- Place the drain pipe 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 the wall.

- Drain pipe outlets shall be place at each low point of the wall and at 50 ft (15m) intervals along the wall.

- Depending on site and water conditions, a blanket drain below the reinforced soils or a chimney drain behind the reinforced soils may be necessary. Generally, it is necessary to encase chimney drains and cover blanket drains with filter fabric. This is dependent on the compatibility of the non-free draining reinforced zone soils and the drainage aggregate.

- Place a minimum of 12 inches (300mm) of drainage aggregate behind the units and around the drain pipe.

- Depending on compatibility of the drainage aggregate and reinforced zone soil, it may be necessary to place a filter fabric between the drainage aggregate and the reinforced fill to prevent migration of fine-grained soils into the drainage aggregate.

- Place the next course of units. Check for alignment with a string line on each course. Align the units as necessary to maintain straight wall lines or uniform curves.

- Check the units for vertical alignment with a level. Maintain vertical alignment and horizontal setback with shims as necessary. Strips of reinforcement should be used for shim material.

- Place the non-free draining reinforced fill in 6 to 8 inch (150 to 200 mm) loose lifts where lighter weight hand operated compaction equipment is used and not exceeding 12 inch (300mm) loose lifts where heavy drum type self-propelled compaction equipment is used, and compact to the specified densities.

ANCHOR VERTICA®
RETAINING WALL SYSTEM

- Heavy self-propelled compaction equipment should not be used within 3 feet (0.9 m) of the back of the modular units. Compact the backfill before the next course of units is placed. Check the units for level and alignment after compaction of the reinforced soil fill.

- Construction tolerances – Vertical and horizontal alignment of the wall face shall not vary by more than ¾-inch when measured along a 10-foot straightedge. Overall vertical tolerance (plumbness) of the wall shall not exceed 1 ¼-inch per 10-ft of wall height from the final wall batter. Negative (outward leaning) batter is not acceptable.

STEP 6
Reinforced Soil Placement and Compaction

- Place the reinforced soil fill in 6 to 8 inch (150 to 200 mm) loose lifts where lighter weight hand operated compaction equipment is used and not exceeding 12 inch (300mm) loose lifts where heavy drum type self-propelled compaction equipment is used, and compact to the specified densities.

- Only hand operated compaction equipment is allowed within 3 feet (1 m) of the back of the units.

- All fill placed in the reinforced zone must be compacted to a minimum of 95 percent of the soil's standard Proctor dry density (ASTM D 698) or as recommended by the project geotechnical engineer. Walls in excess of 15 to 20 feet (5 to 6 m) will require more stringent compaction and moisture control criteria. Refer to the construction specifications for specific details regarding compaction.

- The moisture content of the fill during placement and compaction operations shall not be more than 3 percentage points over the soils optimum moisture content as determined by standard proctor (ASTM 698).

- Compaction tests shall be taken in the reinforced soil zone. A minimum frequency of one test within the reinforced soil zone per every 5 feet (1.5 m) of wall height for every 100 feet (30 m) of wall is recommended.

- Prior to periods of construction inactivity, the reinforced backfill should be graded to drain away from the wall face. Trenches or berms may be needed to control surface drainage in the vicinity of the retained cut slope, reinforced backfill or wall toe area.

- Backfill must be placed flush with the top of the cap.

STEP 7
Reinforcement Placement

- Refer to the wall construction plans for the reinforcement type, strength and placement location. Measure and cut the reinforcement to the lengths shown on the wall construction plans.

- Ensure the backfill is placed flush with the top of the units at each reinforcement elevation, prior to reinforcement placement.

- Clean any debris off the top of the units and from prior to reinforcement placement.

- Ensure the backfill is graded reasonably flat prior to reinforcement placement.

- The reinforcement has a primary strength direction, which must be laid perpendicular to the wall face.

- Maintain the reinforcement within 1 inch (25mm) of the front of the units.

- Place the next course of units. Place the reinforcement in tension and place staples, stakes or fill at the back of the reinforcement to maintain reinforcement tension during backfill placement.

- Place a minimum of 6 inches (150mm) of backfill prior to operating equipment above the reinforcement. Avoid sudden braking or turning on fill placed over the reinforcement.

- Maximum reinforcement spacing is 24 inches.

STEP 8
Cap Placement

- Brush clean the top of the upper course of units. Lay out the Vertica cap units for the entire length of the wall starting at the lowest elevation. Trapezoidal caps must be laid by alternating the long and short faces on a straight section of wall. Cut cap units as required to obtain proper fit on radius curves and angled corners. At steps in wall elevation, stack two caps.

- Mortar is the preferred material to adhere the cap units to the upper course of modular units on AASHTO/DOT projects.

- Apply mortar to the top surface of the upper course of units, and place the cap unit into desired position. Place mortar into the channel in the cap units as well. A concrete adhesive may be used to attach the caps if the Agency is prepared to perform continuous maintenance checks to reattach caps as necessary.

- Use a string line to maintain proper cap alignment.

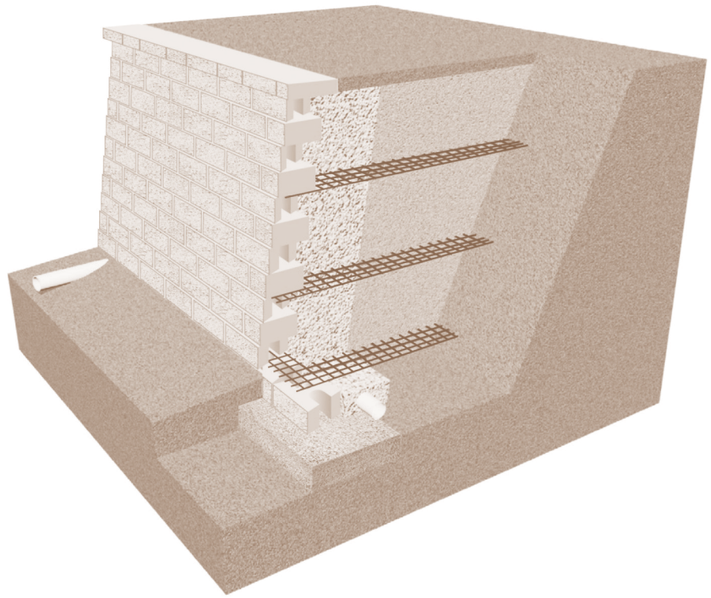
- Backfill and compact to finish grade, after mortar has set.

STEP 9
Finish Grade and Surface Drainage

- Prepare the finish grade behind the top and in front of the wall to prevent the concentration of overland flow of water.
- The upper 6" (150mm) of soil placed should be a low permeability fill to reduce infiltration into the reinforced soil and drainage aggregate.
- Depending on wall geometry, lined drainage swales can be placed behind the wall to facilitate drainage.
- Establish erosion control measures and plant vegetation.

STEP 10
Site Cleaning and Restoration

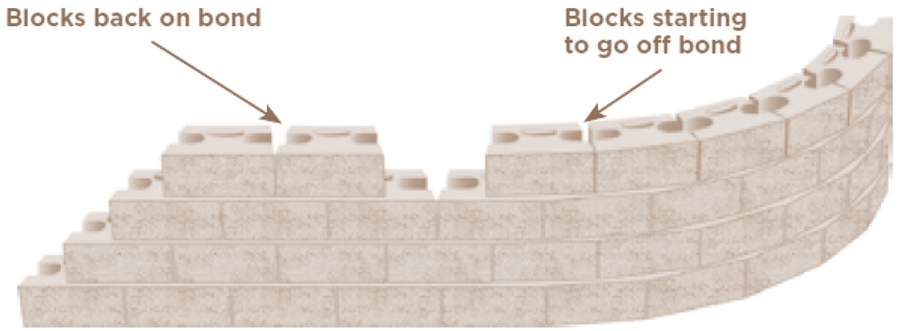
- Brush off the wall and remove any debris left from the construction process.
- Notify the appropriate project authority in writing that the construction of the wall is complete and project is ready for final inspection and acceptance.

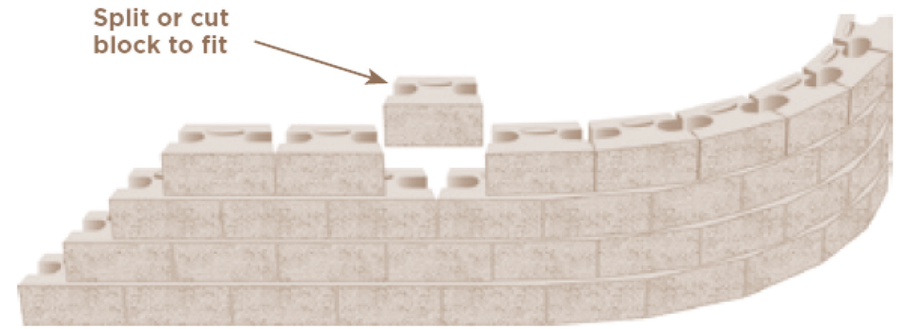


RUNNING BOND

Installation of Vertica walls with running bond is preferred. Running bond occurs when the units are centered over the vertical joint of the previous course. This enhances wall stability and aesthetic qualities.

STEP 1
Any wall that is not perfectly straight will eventually run off bond. When this happens, skip a block position and place the next block on proper running bond. Measure the remaining gap and cut a block to fit.



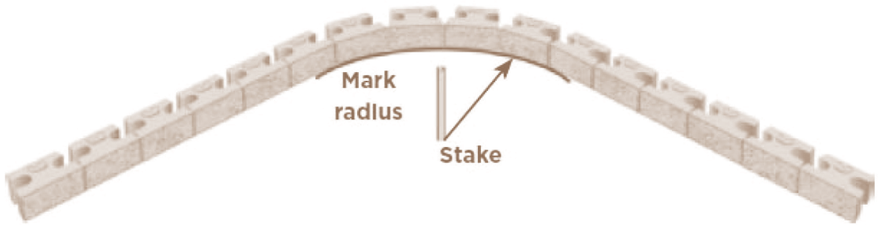


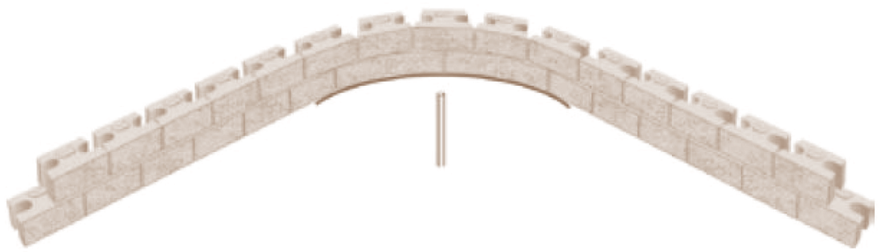
STEP 2
Partial units should not be less that 3" (75mm) in length and should not be placed directly on top of each other. Partial units should be staggered in the wall face. If the gap is larger than the length of one block, divide the measurement by two and place two partial units.

INSIDE CURVE

Check the wall construction or site grading plans for the dimension of the minimum radius curves to be constructed. The minimum inside radius curve, at the base of the wall, is 6' (1.8m).

STEP 1
Begin by driving a stake in the ground at the desired center of the curve. Attach a string line and rotate it in a circle around the stake to mark the radius at the front to the foundation units. Align each foundation unit with the desired radius curve and ensure level placement from front to back and side to side.





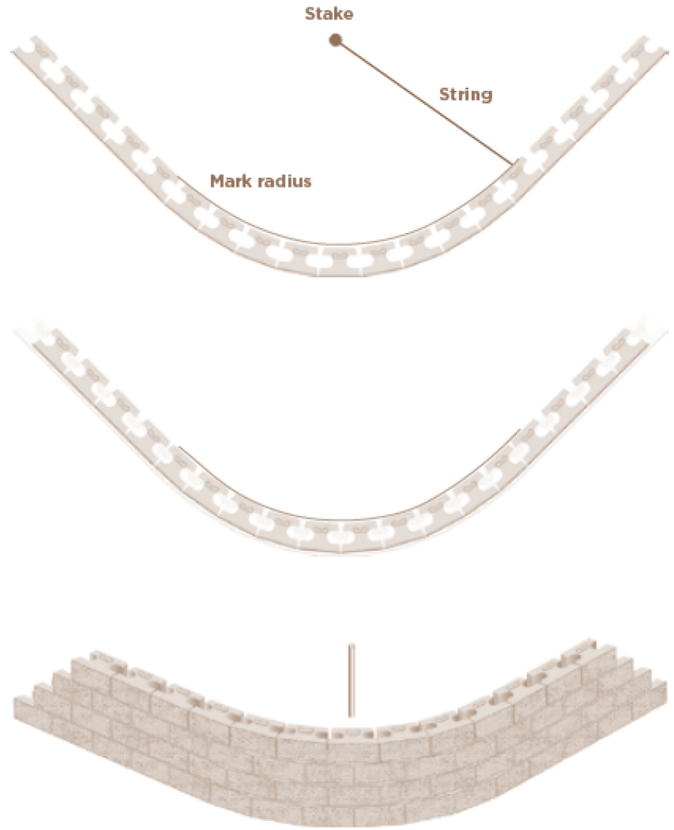
STEP 2
The set back of the block will cause the radius of each course to gradually increase and eventually affect the running bond of the wall. To maintain proper running bond, use partial units as necessary.

ANCHOR VERTICA®
RETAINING WALL SYSTEM

OUTSIDE CURVE

The minimum outside radius curve, at the top of the wall, is 7 feet.

STEP 1
When building an outside radius curve, begin by determining the desired radius at the top of the wall.* Drive a stake in the ground at the desired center of the curve. Attach a string line and rotate it in a circle around the stake to mark the radius at the back of the base units. Align each base unit with the desired radius curve and ensure level placement from front to back and side to side.



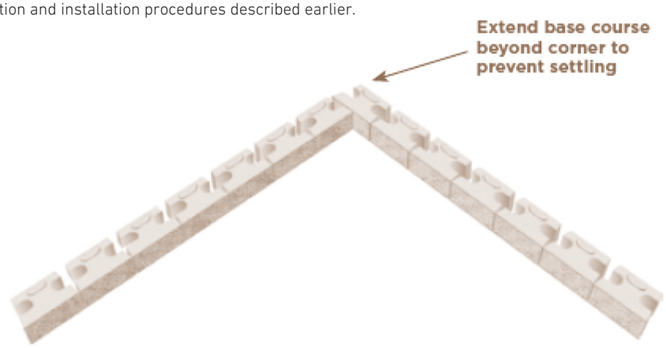
*To calculate the radius of the base course, given the radius at the top of the wall, add 1/4" (7mm) of radius for each course of block in the wall.

STEP 2
The setback of the units will cause the radius of each course to gradually decrease and eventually affect the running bond of the wall. To maintain proper running bond, place partial units as necessary.

INSIDE 90° CORNERS

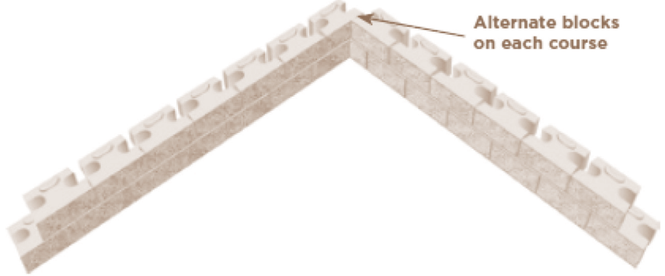
STEP 1

To create an inside 90° corner, begin by placing a wall unit at the corner. Then lay a second wall unit perpendicular and adjacent 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 the standard site preparation and installation procedures described earlier.



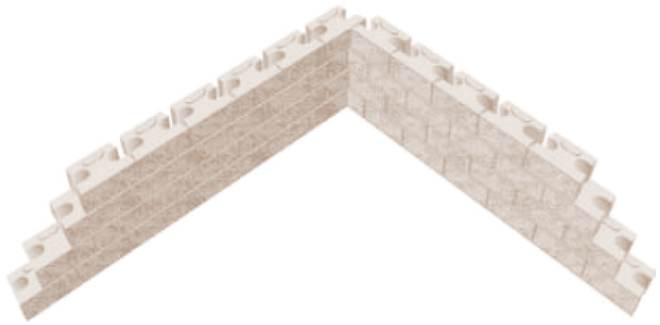
STEP 2

On the second course, place all units starting at the corner for the side of the corner that extends beside the adjacent foundation units. Place the next course of units on running bond on the adjacent course, leaving a gap at the corner. Place a partial unit(s) in the gap. The partial unit will have to be cut at an angle that matches the angle built into the split face of the standard units. Remove the lower lock flange of the "woven" units, to allow these units to sit flush on the adjacent lower course.



STEP 3

Placement of partial units in the corner should alternate on both sides of the corner with each succeeding course. This will create and inside 90° corner that is woven together, enhancing wall stability.



ANCHOR VERTICA®
RETAINING WALL SYSTEM

OUTSIDE 90° CORNERS

STEP 1

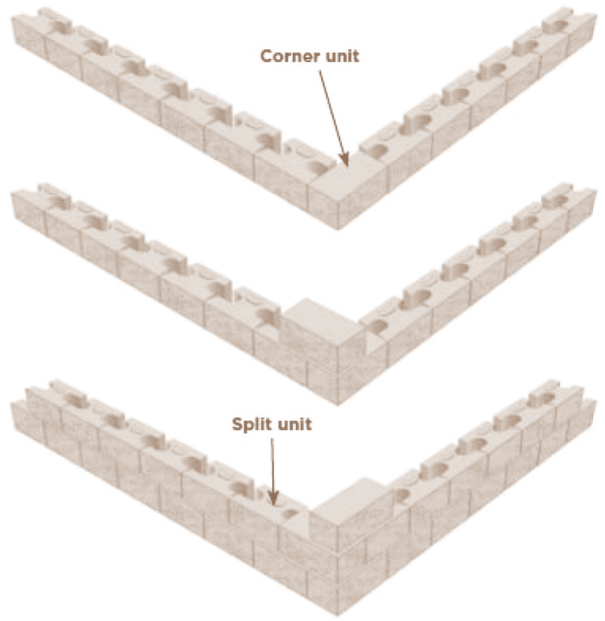
To build an outside 90° corner, begin by placing a corner unit and working from the corner unit outward

STEP 2

Lay a corner block perpendicular to the one below and glue the block in place with a concrete adhesive. Two or three blocks away from the corner lay full blocks, maintaining running bond with course below. Lay block back towards the corner block, leaving space for the final split units required to complete the course

STEP 3

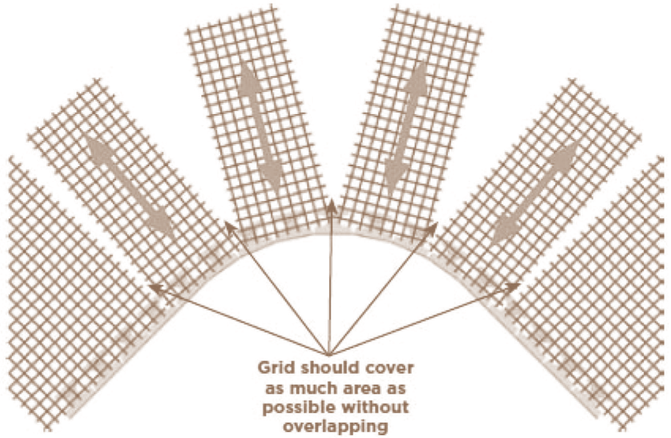
Use split units immediately adjacent to the corner block to complete the course. Continue to alternate the corner unit orientation with each course and always use a concrete adhesive on all corner units and split units.



REINFORCEMENT PLACEMENT - INSIDE RADIUS CURVES

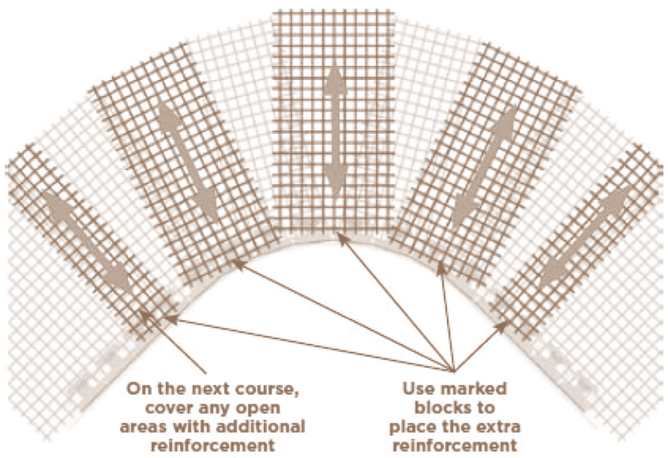
STEP 1

Cut the reinforcement to the length shown on the wall construction plans. Lay segments of reinforcement within 1 inch of the face of the wall, making sure that the strength direction of each section is perpendicular to the wall face. Avoid overlapping the reinforcement.



STEP 2

If the gap between the reinforcement is more than 2' (600mm) at a distance of 10' (3m) behind the units, mark the top of the units on the course above the layer of reinforcement, at the junction of adjacent panels of reinforcement. Place and compact the backfill. Place additional layers of reinforcement on the next course above the design reinforcement elevation, centered on the mark on the units made previously. The width of these additional panels of reinforcement should be sufficient to cover the span between the back of adjacent panels of reinforcement on the course below. Repeat this procedure throughout the construction of the radius curve. Refer to the wall construction plans for additional details.

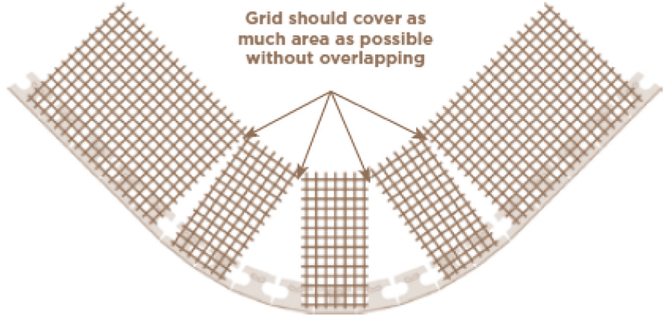


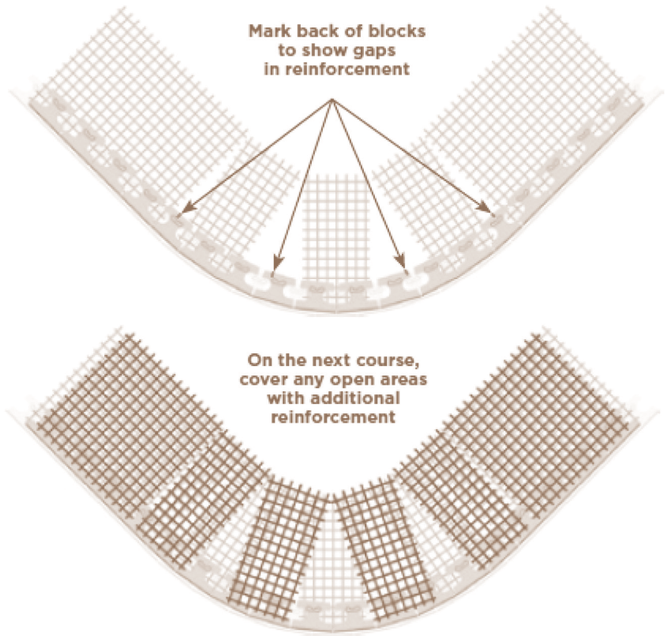
ANCHOR VERTICA®
RETAINING WALL SYSTEM

REINFORCEMENT PLACEMENT - OUTSIDE RADIUS CURVES

STEP 1

Cut the reinforcement to the required lengths as shown on the wall construction plans. The width of reinforcement panels along the wall will depend on the degree of curvature of the radius. To avoid significant overlapping of the back of the reinforcement on tighter radius curves, it is necessary to place the reinforcement perpendicular to the units, with a gap between adjacent panels of reinforcement at the wall face. Place the reinforcement and maintain the reinforcement within 1" (25mm) of the face of the units





STEP 2

Place the next course of units, marking the blocks to identify the unreinforced areas. Place and compact the backfill soils. Center subsequent layers of reinforcement on the marked blocks to ensure full reinforcement coverage. The width of these additional panels of reinforcement should be sufficient to cover the span between the adjacent panels of reinforcement on the course below. An alternative on gradual curves is to place the reinforcement panels adjacent to each other at the face of the wall and overlap the back of the reinforcement. If this approach is used a minimum of 1 inch (25mm) of soil shall be placed between overlapped reinforcement layers.

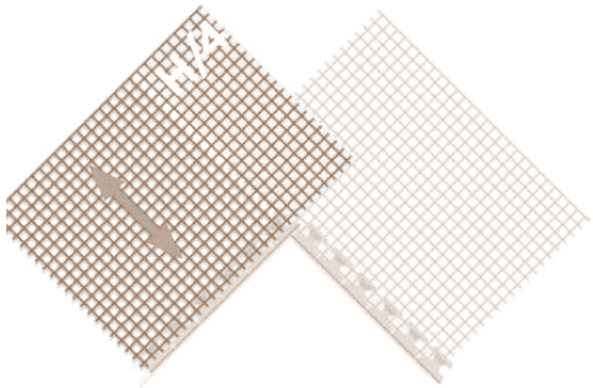
REINFORCEMENT PLACEMENT - INSIDE 90º CORNERS

STEP 1

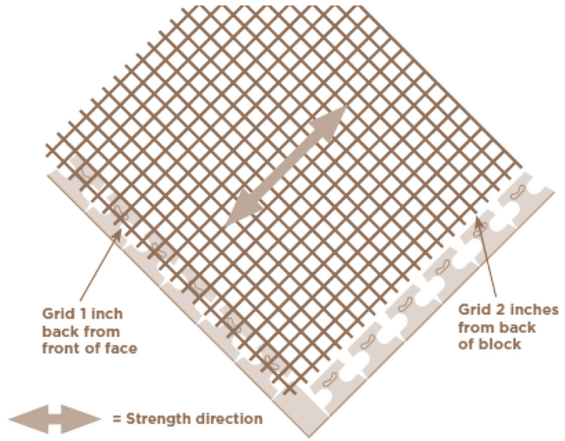
To install reinforcement on an inside 90º corner, begin by checking the construction plans to determine the reinforcement lengths and elevations. Cut the reinforcement to the lengths shown on the wall construction plans. On one side of the corner, the reinforcement should extend beyond the corner a distance equal to the height of the wall divided by 4 (H/4). Measure this distance from the front of the adjoining wall and begin the reinforcement placement there. Maintain the reinforcement within 1" (25mm) of the face of the units. Place the reinforcement on the adjacent wall section at the same design elevation and abutting the edge of the adjacent layer.

STEP 2

Place the next course(s) of units. At the next plan reinforcement elevation, the H/4 extension of the reinforcement should be placed on the opposite side of the corner.



ANCHOR VERTICA®
RETAINING WALL SYSTEM

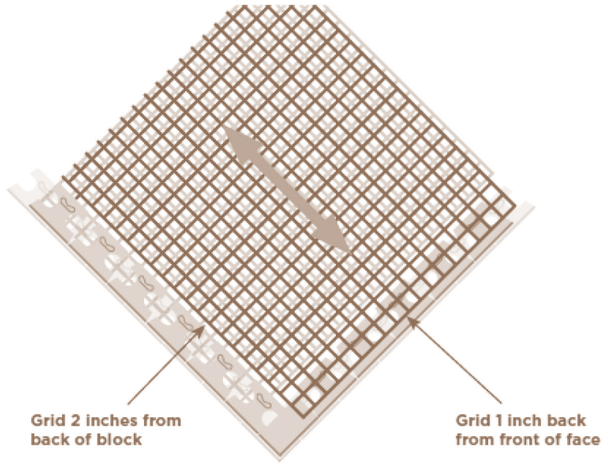


REINFORCEMENT PLACEMENT - OUTSIDE 90º CORNERS

STEP 1

Begin by checking the construction plans to determine reinforcement lengths and elevations.

Place the reinforcement and maintain the reinforcement within 1" (25mm) of the face of the units and running along the back of the adjacent wall units.



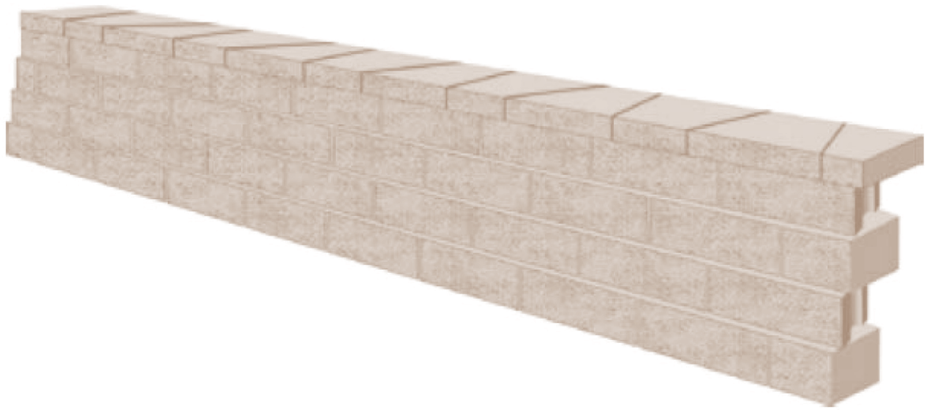
STEP 2

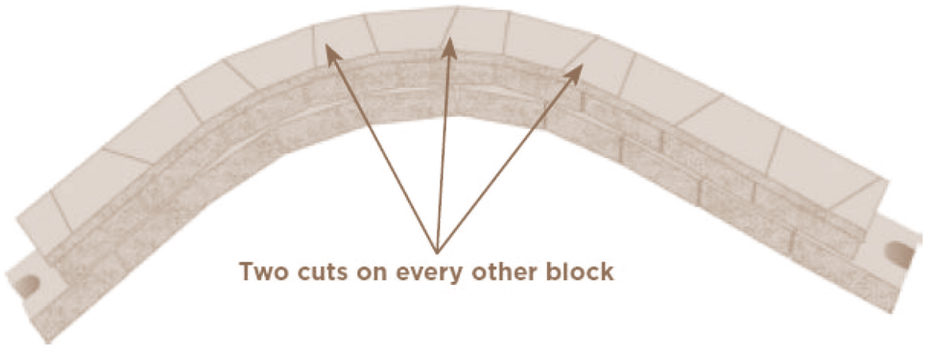
Place the next course of units, backfill and compact. Place the next layer of reinforcement on the opposite side (second side) of the corner from the previously placed layer of reinforcement. Maintain the strength direction perpendicular to the appropriate wall face, within 1" (25mm) of the face of the units and along the back of the adjacent block. On the second side, drop the reinforcement down to the design elevation beyond the tail end of the reinforcement on the adjacent or first side of the corner.

CAP UNITS

STEP 1

Always start capping form the lowest elevation. Caps are trapezoidal in shape and must be laid with the short and long faces alternating, to achieve a straight line. If the 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 the end cap units to create a rough face on the exposed side. Place the split cap unit(s) directly on top of the capped portion of the wall with both split faces exposed. On a 90^0 corner wall, the cap units need to be saw cut to achieve a 45^0 mitered corner.

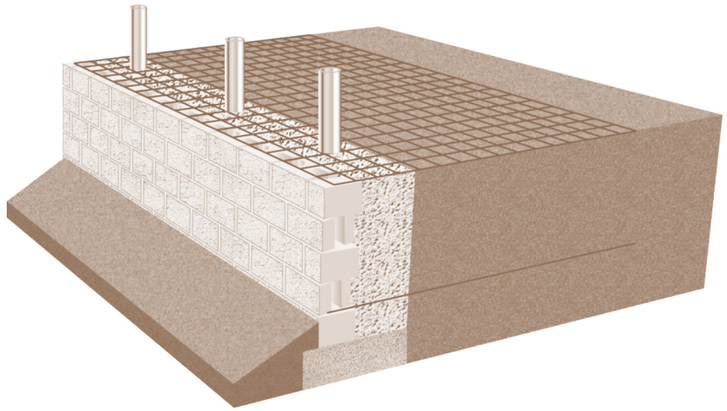




STEP 2

After the layout is complete and the caps are saw cut or split to size, carefully adhere the caps with mortar as previously discussed. Use a string line to adjust the cap location.

ANCHOR VERTICA®
RETAINING WALL SYSTEM

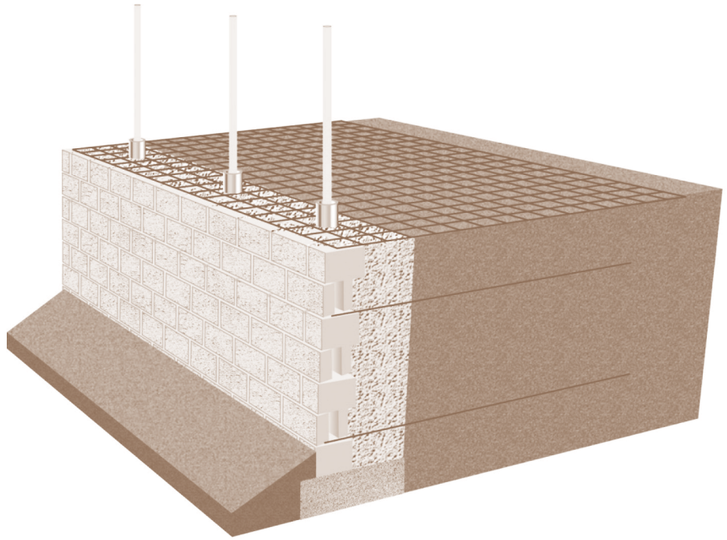


FENCES

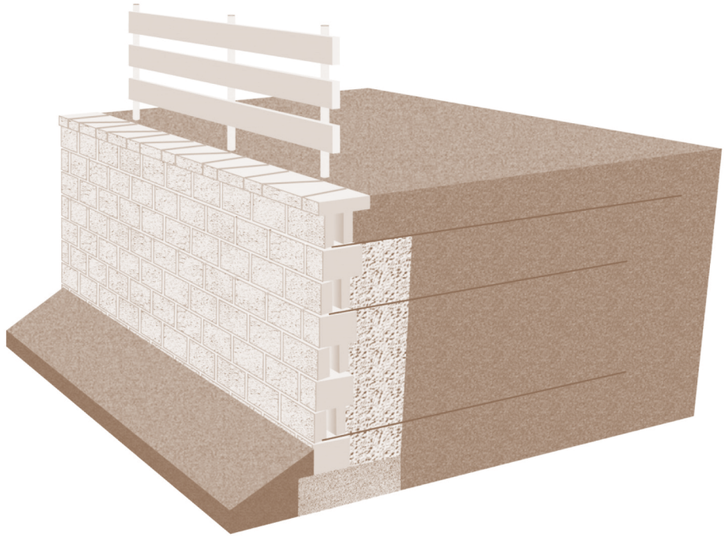
Ideally, fence posts should be placed at least 2 to 3' (600 to 900mm) behind the wall. If the fence is installed within 3' (900mm), there may be additional load transferred to the wall from wind, snow or pedestrians. Any additional load on the wall must be taken into account in the wall design. Additional reinforcement layers within the depth of the fence posts may be required if the posts are within 3 feet (900mm) of the wall. Small diameter posts, 3 inches (75mm) or less, can be driven into the reinforced soil zone and through the reinforcement.

STEP 1

Larger diameter posts should be installed in specially placed sleeves placed within the backfill at the correct fence post spacing during wall construction.



The sleeves should be rigid enough to limit deformation of the sleeves during backfill placement and compaction operations. The sleeves should be a minimum of 4" (100mm) larger in diameter than the fence posts.

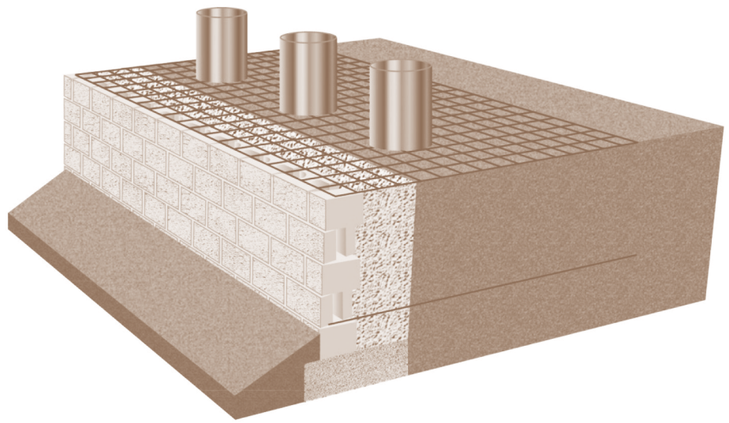


STEP 2
The posts must be grouted into the sleeves after the wall is built. The maximum aggregate size of the grout should be 0.5" (12mm).

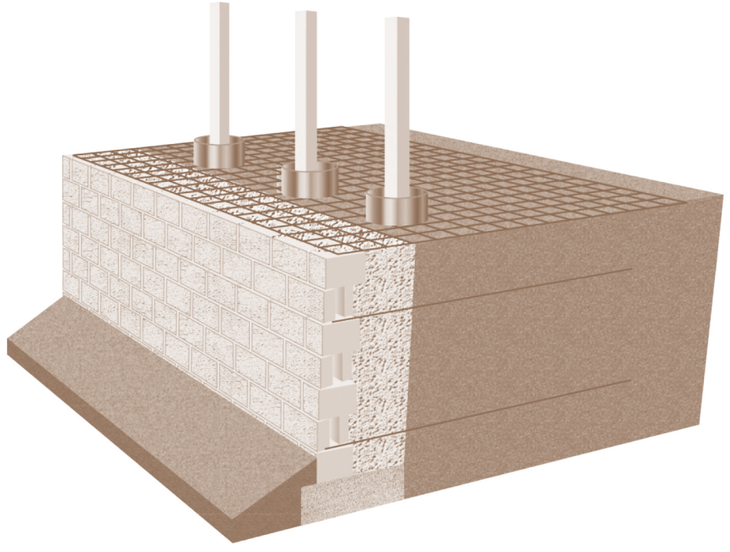
GUARDRAILS

Guardrail systems with posts should be placed at least 3.3' (1m) from the face of the wall units. Guardrail posts, especially those placed within 3.3 feet (1m), will impart additional load on the wall, which must be taken into account in the wall design. Consult the wall construction plans for project specific details. Poured in place jersey type barriers with integral moment slabs are another option for guardrail systems.

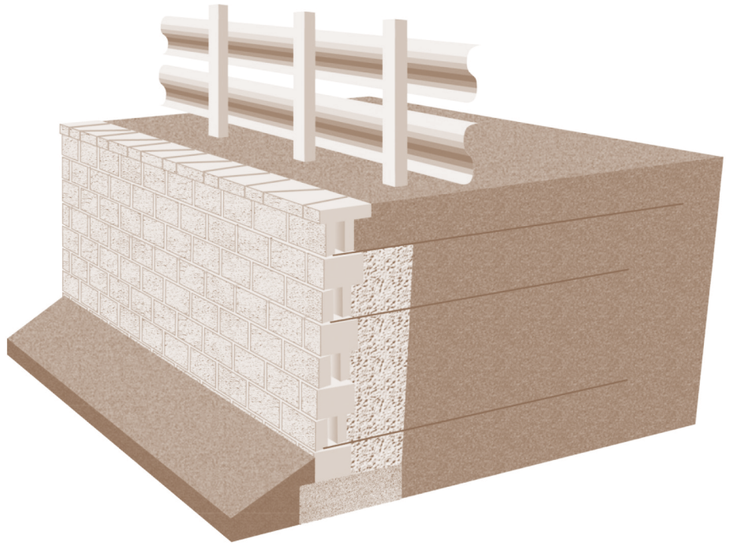
STEP 1
Guardrails with post anchorage systems should be placed in sleeves installed during wall construction. The sleeves should be rigid enough to limit deformation of the sleeves during backfill placement and compaction operations. The sleeves should be a minimum of 4" (100mm) larger in diameter than the guardrail posts.



ANCHOR VERTICA®
RETAINING WALL SYSTEM



STEP 2
Reinforcement should be placed just below the top course for additional stability. The posts should be at least 4.5' (1.4m) below grade and should penetrate at least the upper two layers of reinforcement.

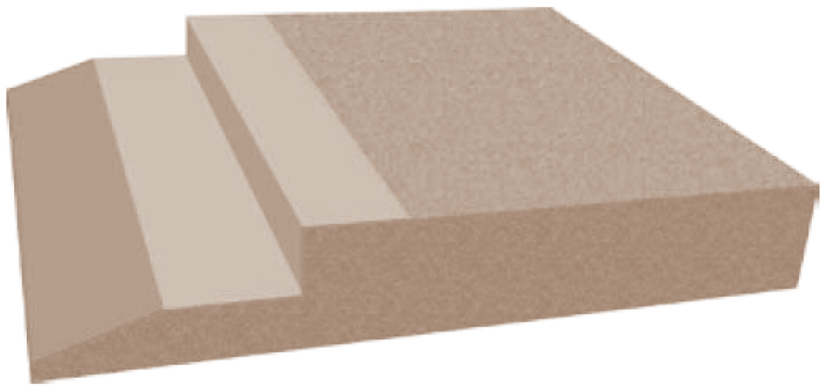


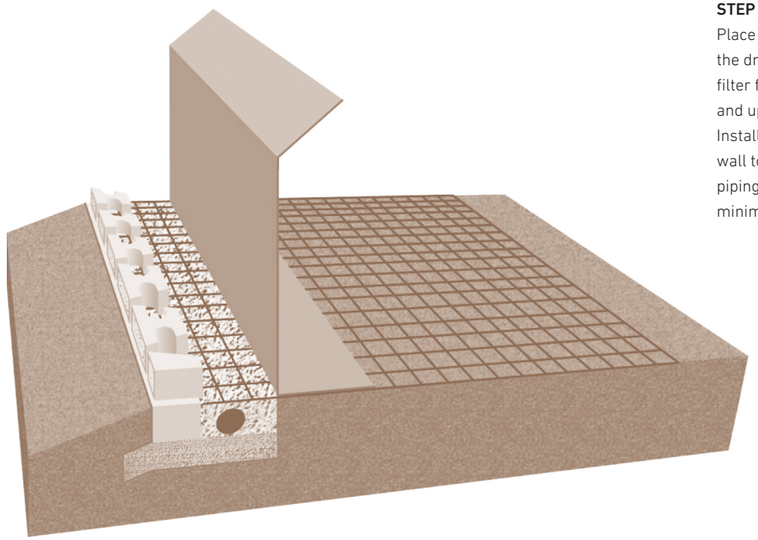
STEP 3
Once the wall is built, insert the posts and grout into place. The maximum aggregate size of the grout should be 0.5" (12mm).

WATER APPLICATIONS

In water applications the reinforced soil zone shall consist of free-draining soil to 1' (300mm) above the 100 year flood elevation. Refer to the construction plans for the specific details regarding construction of Landmark walls in water applications.

STEP 1
Place a filter fabric with 2' (600mm) extra length in front of the concrete leveling pad. Place the leveling pad on the filter fabric.





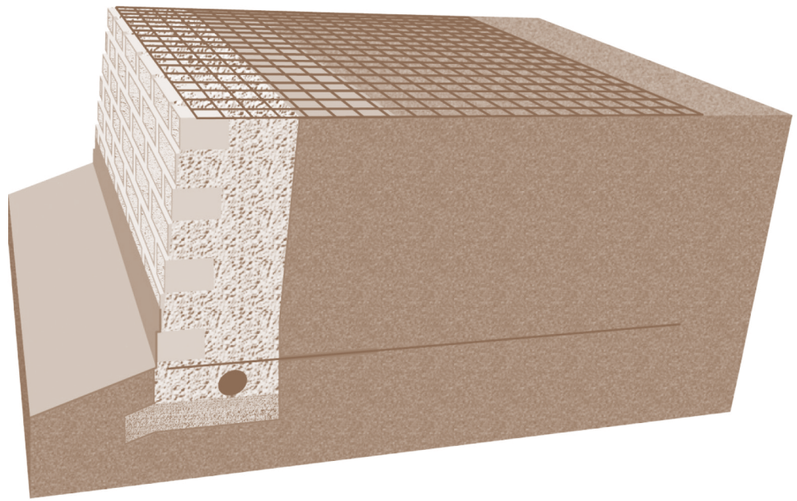
STEP 2
Place the first course of foundation units, including the drain tile and drainage aggregate. Wrap the filter fabric over the leveling pad and up along the face of the foundation units. Install another section of filter fabric in front of the wall to protect against erosion and piping of fine-grained soil. Cover the fabric with a minimum of 3" (75mm) of sand.

ANCHOR VERTICA®
RETAINING WALL SYSTEM

STEP 3
Install larger stones such as rip-rap over the sand and filter fabric. Drainage of water application walls is essential. To prevent clogging of the drain tile by fine-grained soils, a filter fabric is placed between the drainage aggregate and the reinforced soils.

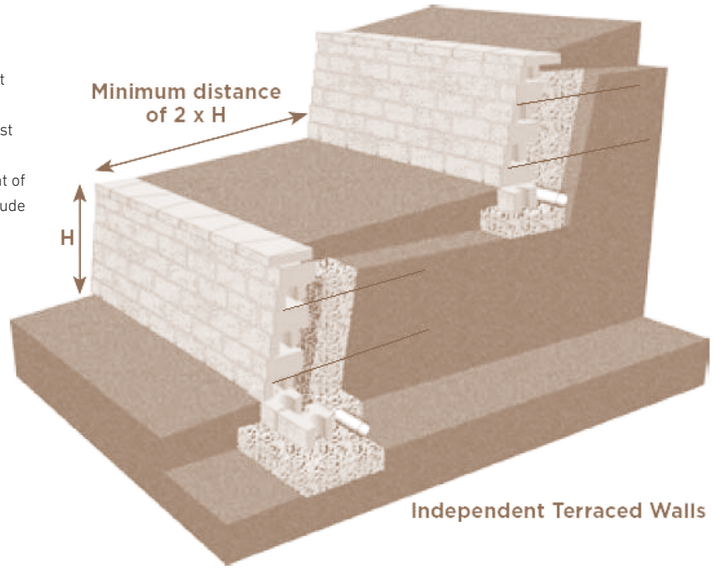
STEP 4
Continue these steps until the wall is complete. The last section of filter fabric should cover the drainage aggregate and run up the back of the top one half course of block. Add fill soil and compact.

Keep in mind there are numerous issues related to water wall applications including wave or ice impact, erosion or scour in front or above the wall, wall drainage, seepage forces and others. Refer to the site specific construction plan details. For more information on this consult with a qualified engineer.

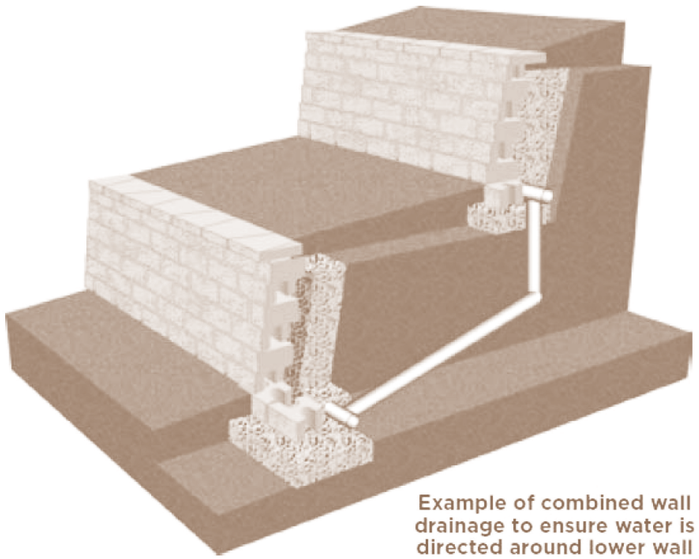


TERRACED WALLS

STEP 1
Independent Terraced Walls
For each wall to be independent they must be built using at least 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 must be equal to or less than the height of the lower wall. Exceptions to this general rule include weak soil conditions, or where slopes exist below, between or above the wall locations. Independent walls are designed as stand-alone walls.



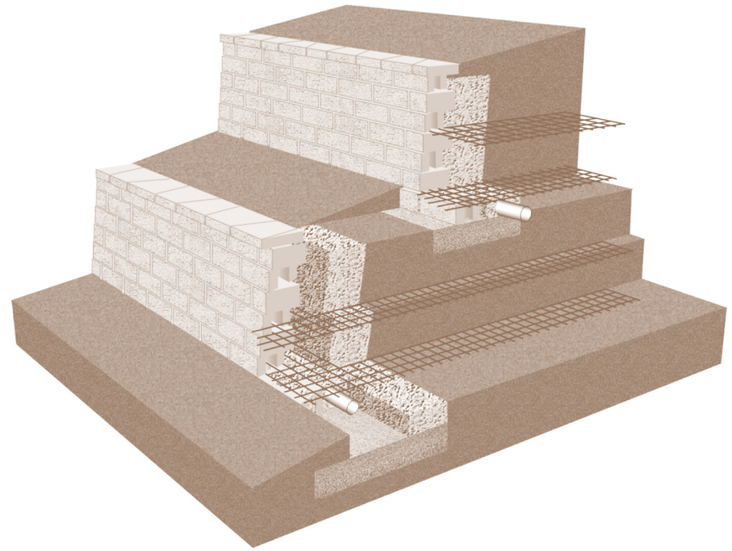
Independent Terraced Walls


Example of combined wall drainage to ensure water is directed around lower wall

STEP 2
Proper drainage is vital to maintaining stable, long lasting walls. The 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.

ANCHOR VERTICA®
RETAINING WALL SYSTEM

STEP 3
When the distance between the lower and upper walls is less than twice the height of the lower wall, or when weaker soils or slopes are present, the walls become structurally dependent on each other. Global stability of terraced dependent walls is required to determine the length, strength and density of reinforcement in the lower portion of the wall(s). Structurally dependent walls require additional layers and length of reinforcement, more excavation, backfill and time. Check the site specific construction plans and specifications for additional details.



POST CONSTRUCTION WALL INSPECTION GUIDE

It is recommended a qualified representative of the owner inspect the wall and surrounding areas within one month and two months of wall construction and at six month intervals thereafter, for a period of two years and two months of post construction wall inspection.

Inspection Checklist

The inspector should look for:
- Signs of wall face movement including tilting or bulging.
- Signs of wall or backfill settlement.
- Tension cracks in the soil behind the wall.
- Displacement or fracturing of individual wall units.
- Indications of erosion and establishment of proper vegetative cover.
- Functioning of drainage tiles and swales and ponding of water behind or below the wall.

The inspector shall notify the proper project authorities of the post wall construction inspection.

ANCHOR
DIAMOND™

FEATURING VERTICA® RETAINING WALL SYSTEM

ANCHOR DIAMOND Group
5909 Baker Rd. Suite 550
Minnetonka, MN 55345
1-952-933-8855

For more info visit
AnchorDiamond.com