SECTION C

CONSTRUCTION OF CORNERS & CURVES

So far the discussion regarding the installation of a Keystone retaining wall has centered on the installation of units through the straight line sections of the wall. Equally important to the final aesthetic and function of any wall is the construction of corners and curves.

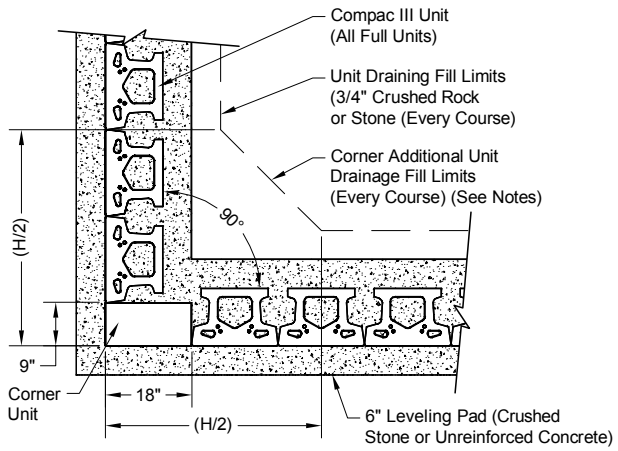
A corner is typically constructed as either an outside 90° corner or inside 90° corner. When a wall needs to make a turn greater than 90° or less than 75° it is recommended that a radius curve be utilized. For curves in the wall, Keystone units typically have a minimum radius depending on the face style. The flexibility of the Keystone units allows for the construction of multiple corners or curves within the same wall. The following information will provide a general explanation of construction techniques for building retaining walls with corner and curve layouts.

90° Outside Corner: Installation Details

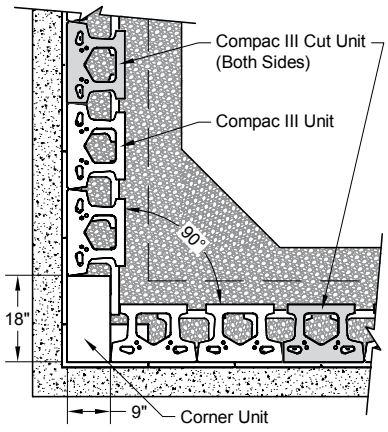
For ease of construction of outside 90° corners, Keystone producers typically provide a corner unit specifically designed for this purpose. Corner unit options and product designs may vary by manufacturer; please contact your local manufacturer for availability before you begin your project planning. Details below show a typical corner unit available in many locations. If corner units are not available, Keystone recommends transitioning the wall from a corner to a radius curve in the wall and avoiding mitered corners. This will enable the wall to maintain its connection integrity and running bond wall configuration for continued wall stability and performance. Please contact your local Keystone representative for assistance if corner units are not available.

Due to the fixed wall batter (1 deg or 8 deg.), as the wall rises vertically, it creates a need to trim structural units on both sides of the corner to maintain a proper running bond pattern in the straight sections of the wall. There will be less trimming necessary in the near vertical position vs. the 1⅛ inch setback position. Keystone has developed an illustration to show the proper location for trimmed units. This illustration is based on a full running bond pattern on the base course, with no trimmed units. In the case of two corners near each other, it is best to set each corner unit base first to establish corner location, and then set the base course of structural units running to the corners and trim units as necessary.

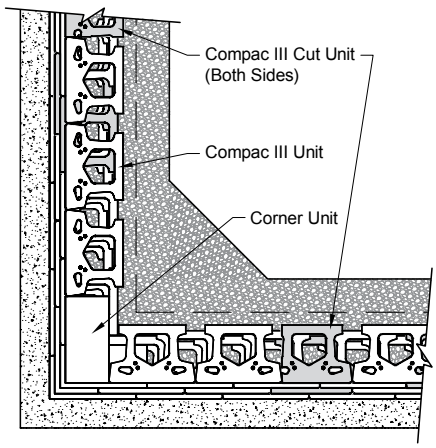
C:1 - OUTSIDE CORNER: ODD COURSE



C:2 - TYPICAL SECOND: EVEN COURSES



C:3 - CORNER PLAN VIEW



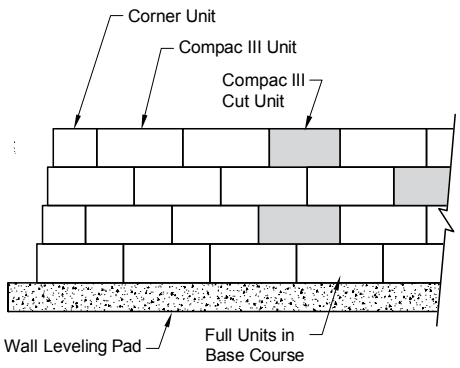
NOTES:

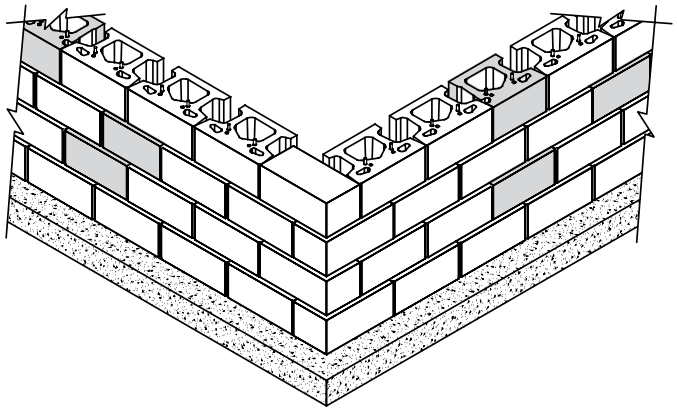
- Full uncut units to be used for the base course and as indicated in the details vertically up the wall corner.
- Due to corner perpendicular wall setback per course, trimming units is necessary to maintain running bond course alignment. Trim adjoining block units a minimum of 1 corner unit and 2 or more full units away from the corner in both directions for proper wall joint alignment. Do not stack cut pieces. Stagger cut units as needed.
- Shaded units are for cut unit designation. Cut units shall not be less than 6-inches in width.
- Secure corner units, and all cut units, together with exterior grade concrete adhesive.
- Verify actual cut lengths as wall is constructed.
- Place additional unit drainage fill at outside wall corners to extend back from wall face each way, a distance equal to the wall height / 2, (H/2).

The information contained herein has been compiled by Keystone Retaining Wall Systems® LLC and to the best of our knowledge, accurately represents the Keystone product used in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Design and analysis shall be performed by a qualified engineer.

90° Outside Corner: Installation Details

C:4 - OUTSIDE CORNER: CUT UNIT DIAGRAM





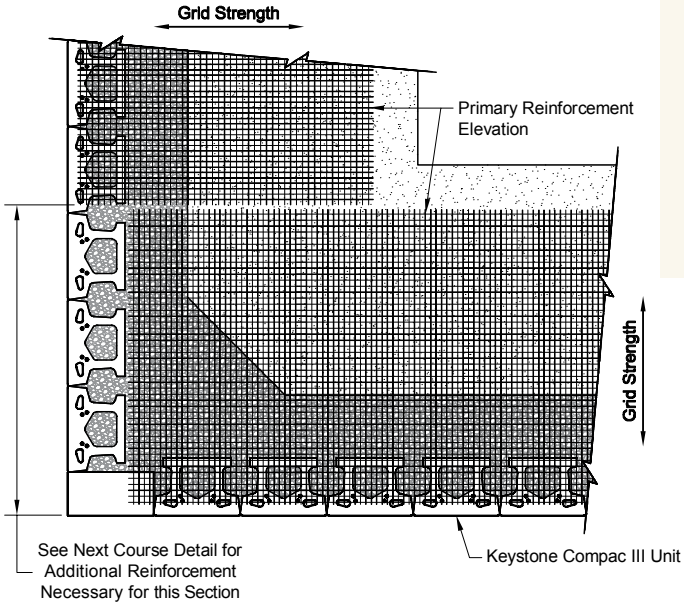


KEYSTONE COMPAC® STRAIGHT

The information contained herein has been compiled by Keystone Retaining Wall Systems® LLC and to the best of our knowledge, accurately represents the Keystone product used in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Design and analysis shall be performed by a qualified engineer.

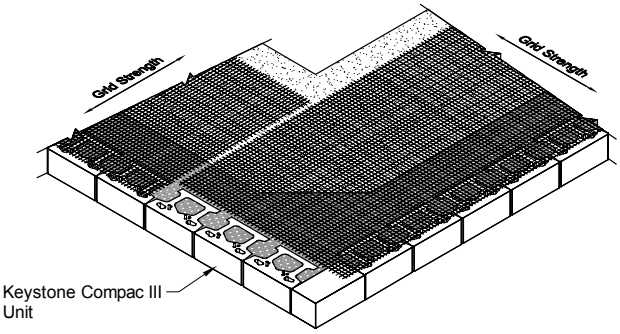
90° Outside Corner: Installation Details

C:5 - TYPICAL GEOGRID OUTSIDE CORNER INSTALLATION (PRIMARY ELEVATION)

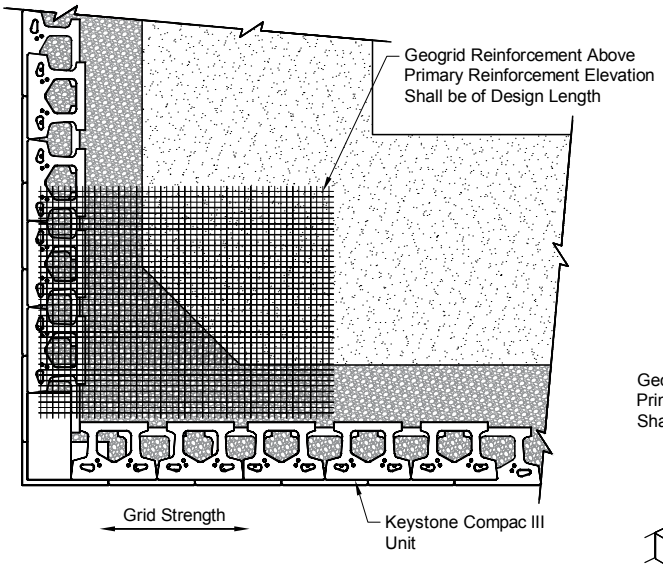


NOTES:

- The geogrid strength direction must be perpendicular to each wall *(see Figure C:9, page 38).*
- Geogrid layers cannot be placed immediately on top of each other. A minimum of 2-3-inches of soil must be placed between geogrid layers placed on the same course.
- Using the procedures outlined in drawings C:5 and C:6 will achieve the proper placement of geogrid in outside 90° corners.



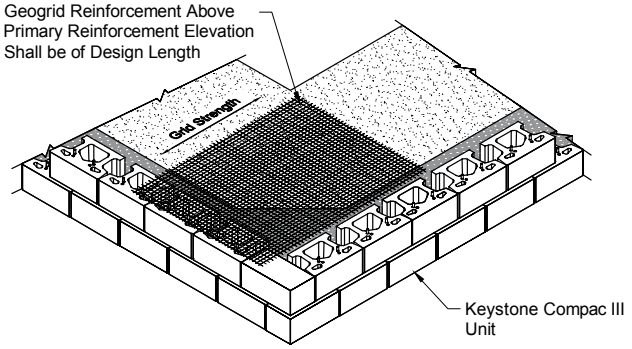
C:6 - TYPICAL GEOGRID OUTSIDE CORNER INSTALLATION (SECONDARY ELEVATION)



Note:
Unit drainage fill and reinforced backfill between Layers of geogrid not shown here for illustrative purposes.

NOTES:

- Place the next course of units over the primary reinforcement elevation course.
- Place and properly compact the needed core/drainage/ reinforced fill.
- Place the piece of reinforcement shown in drawing C:6 that is "missing" in drawing C:5.
- Make sure the geogrid strength direction is perpendicular to the wall face and the geogrid is not placed in the adjacent wall.

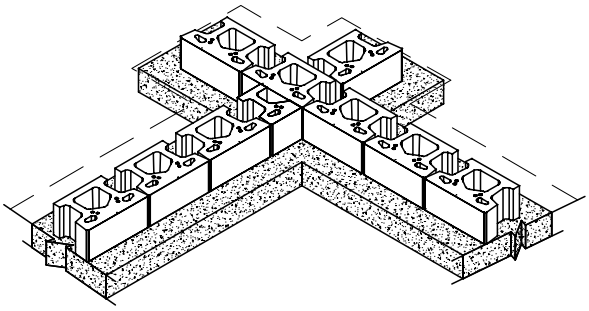


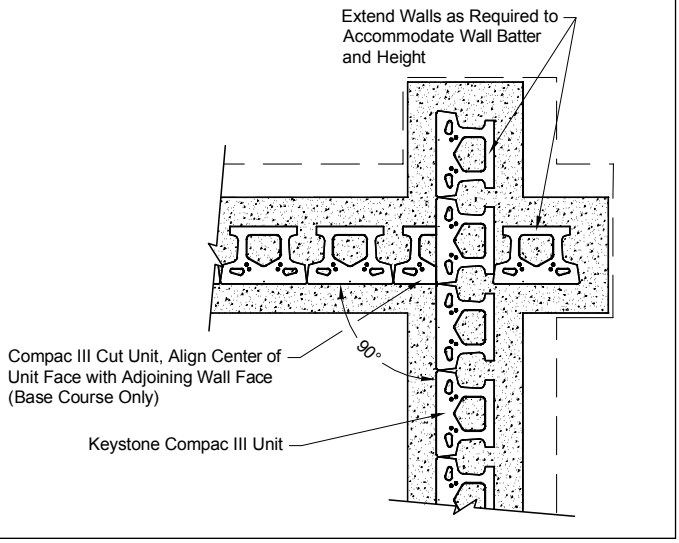
The information contained herein has been compiled by Keystone Retaining Wall Systems® LLC and to the best of our knowledge, accurately represents the Keystone product used in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Design and analysis shall be performed by a qualified engineer.

90° Inside Corner: Installation Details

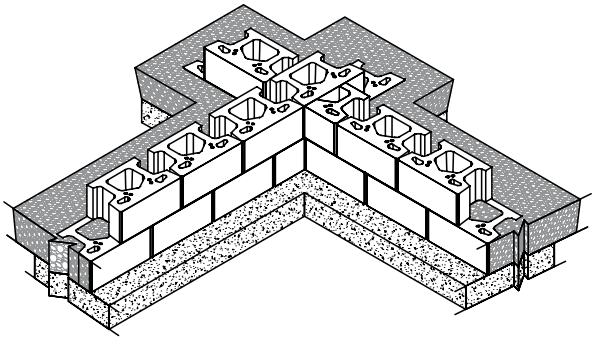
The construction of inside corners is relatively simple because no corner units are required. Construction of inside 90° corners should be accomplished by utilizing the interlocking method as shown below. Small side-to-side adjustments to the running bond pattern will be necessary as the wall rises vertically.

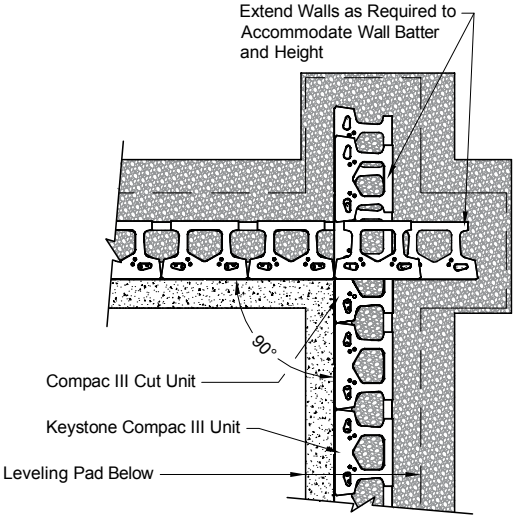
C:7 - TYPICAL BASE: ODD COURSE





C:8 - TYPICAL SECOND: EVEN COURSE





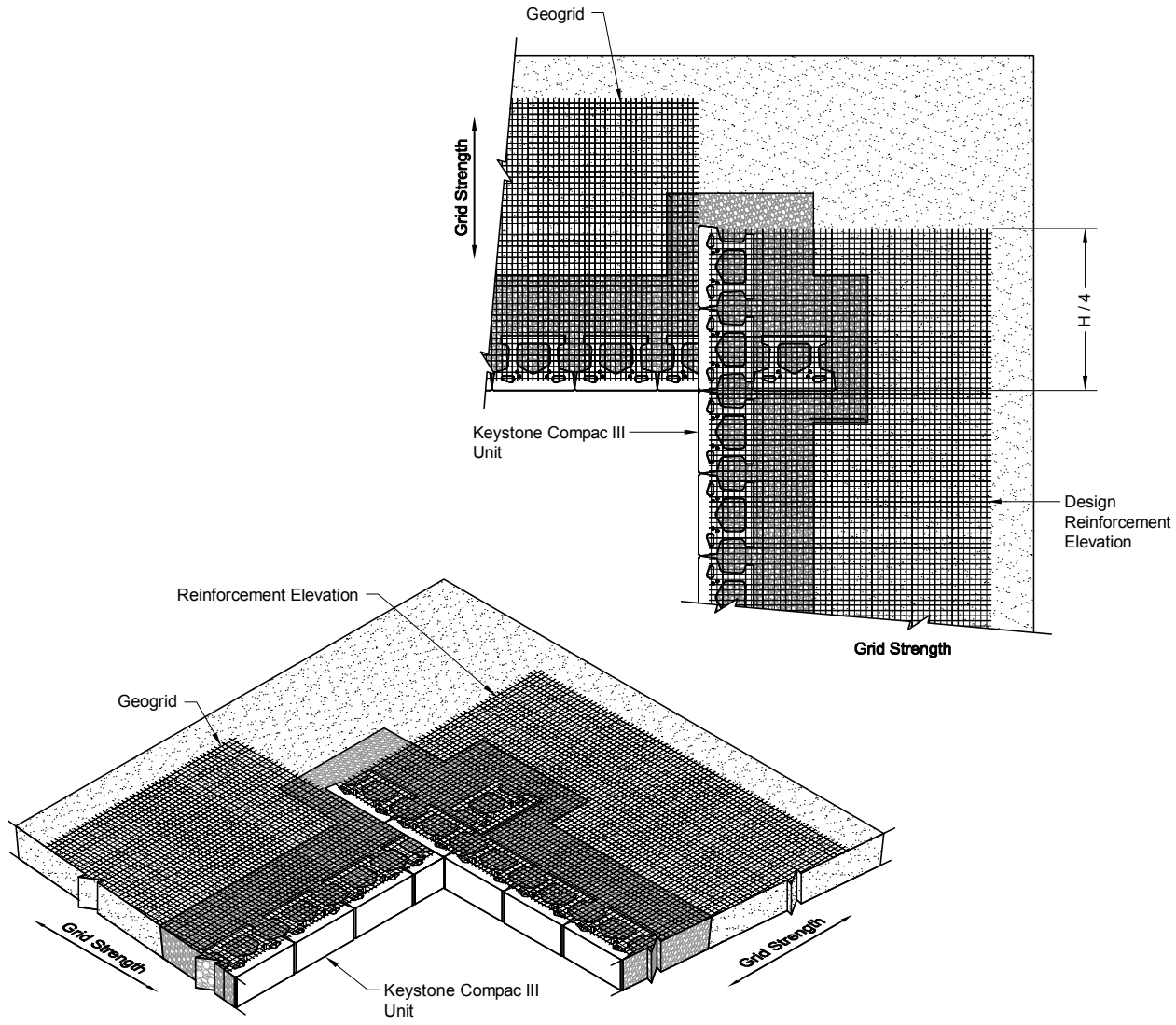
NOTES:

- Due to corner perpendicular wall setback per course, to maintain running bond course alignment, cut the adjoining unit to the perpendicular wall face as needed in both directions for proper wall joint alignment. Glue in place. This detail is similar for Keystone Standard units.
- Alternate cut units on odd and even courses.
- Placement of cut wall block less than 6-inches wide is not allowed. For example, assume the "gap" to be covered is 5-inches. Remove the adjacent unit and measure the gap distance of 23-inches (5-inches + 18-inches = 23-inches). Cut two units, 23/2 = 11.5 inches wide, and place them in the wall.

The information contained herein has been compiled by Keystone Retaining Wall Systems® LLC and to the best of our knowledge, accurately represents the Keystone product used in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Design and analysis shall be performed by a qualified engineer.

90° Inside Corner: Installation Details

C:9 - TYPICAL GEOGRID INSTALLATION FOR INSIDE CORNERS



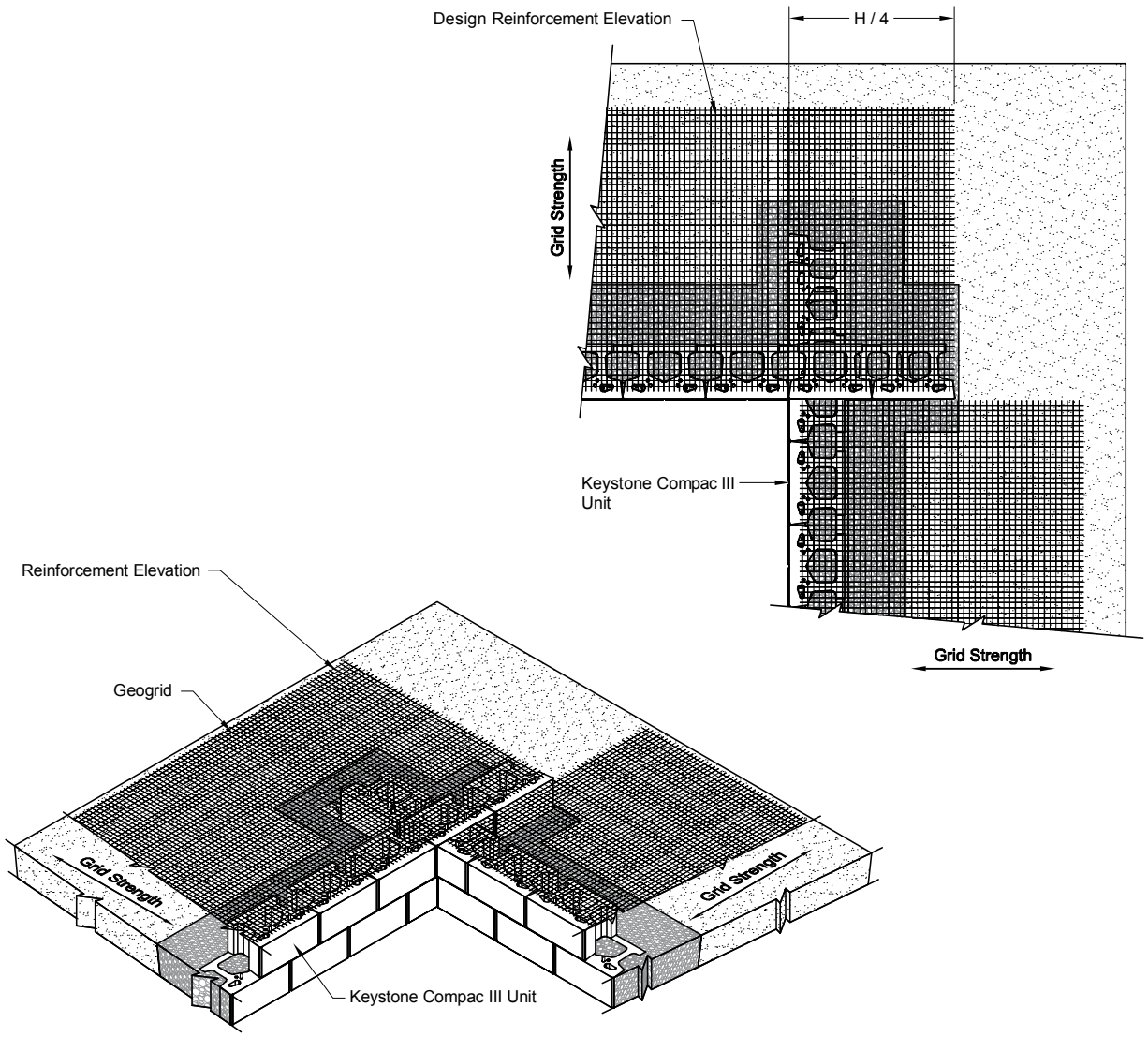
NOTES:

- Drainage zone and backfill materials should be placed and compacted up to the geogrid elevation prior to geogrid installation.
- Measure, cut and orient the geogrid, as per the engineer's design, in the correct strength direction.
- Place the geogrid over the Keystone unit within 1-inch of the front block face, then place next course units over grid to hold grid in place. Next, tension the geogrid by pulling it back away from the wall. Place a stake through the geogrid at the back to tension the geogrid in place.
- Extend geogrid layer into the corner from the continuous woven course side equal to H/4 (25%) of the total wall height.

The information contained herein has been compiled by Keystone Retaining Wall Systems® LLC and to the best of our knowledge, accurately represents the Keystone product used in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Design and analysis shall be performed by a qualified engineer.

90° Inside Corner: Installation Details

C:10 - TYPICAL ALTERNATING GEOGRID INSTALLATION FOR INSIDE CORNERS (ELEVATION)



NOTES:

- Proceed with placement of additional Keystone units and unit drainage fill. Start backfilling nearest the Keystone units and then move away from the wall placing backfill materials over the geogrid.
- Compact the backfill materials in 8-inch lifts up to the next reinforcement elevation.
- Extend geogrid layer into the corner from the continuous woven course side equal to H/4 (25%) of the total wall height.
- Alternate placement of reinforcement extension on specified reinforcement elevations.

The information contained herein has been compiled by Keystone Retaining Wall Systems® LLC and to the best of our knowledge, accurately represents the Keystone product used in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Design and analysis shall be performed by a qualified engineer.

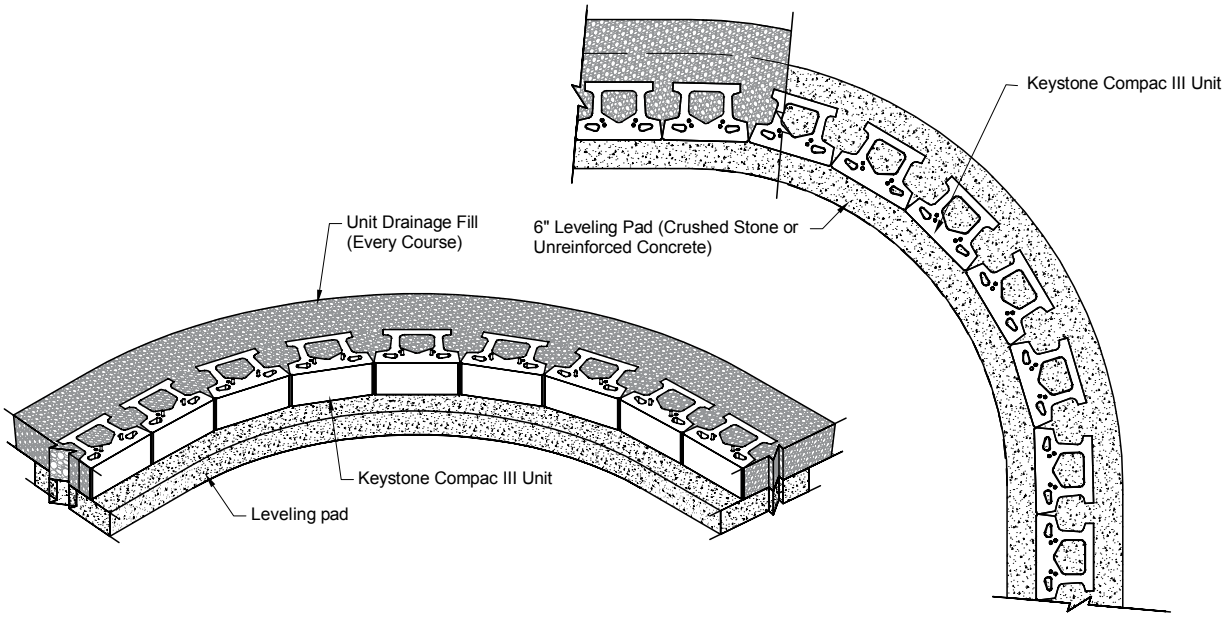
Concave (Inside) Curves: Installation Details

Inside curves for moderately tall Keystone walls are more difficult to construct than a straight wall due to the complex geometry resulting from a battered wall face in a curve. Inside curves allow good access for compaction and the wall face units tend to support each other like an arch when the soil strain associated with the active earth pressure condition develops. As the wall gets taller, inside curves will result in the top of the wall becoming longer than the base. For wall systems to maintain the desired running bond configuration, gaps between units tend to form.

The following is an outline to a process of constructing inside curves in taller walls. See the illustrations below.

1. Units can be moved laterally to remove gapping. Eventually, cutting partial units will be necessary to get the coursing back on the running bond pattern.
2. The minimum inside radius at the base of the wall course should not be less than 6 feet.

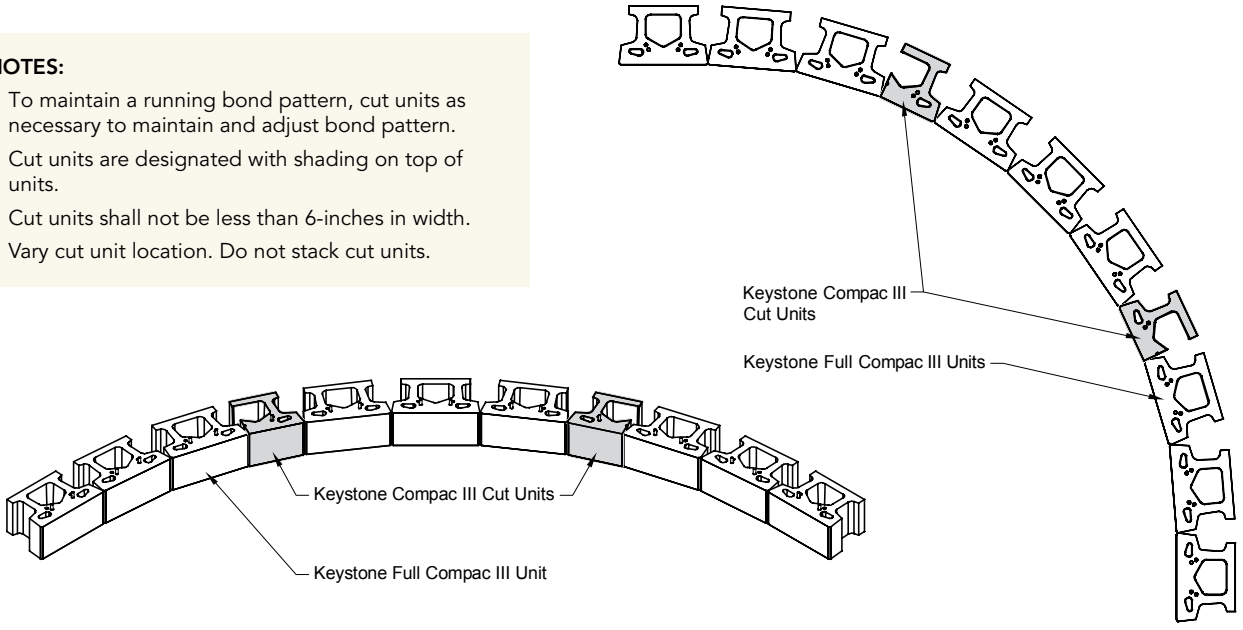
C:11 - TYPICAL UNIT INSTALLATION FOR INSIDE CURVE



C:12 - IN CURVE CUT UNITS EXAMPLE COURSE

NOTES:

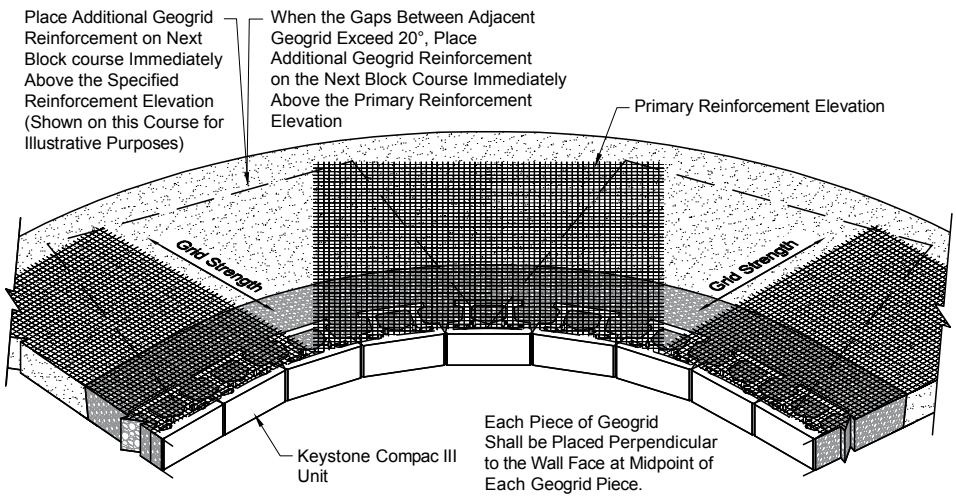
- To maintain a running bond pattern, cut units as necessary to maintain and adjust bond pattern.
- Cut units are designated with shading on top of units.
- Cut units shall not be less than 6-inches in width.
- Vary cut unit location. Do not stack cut units.



The information contained herein has been compiled by Keystone Retaining Wall Systems® LLC and to the best of our knowledge, accurately represents the Keystone product used in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Design and analysis shall be performed by a qualified engineer.

Concave (Inside) Curves: Installation Details

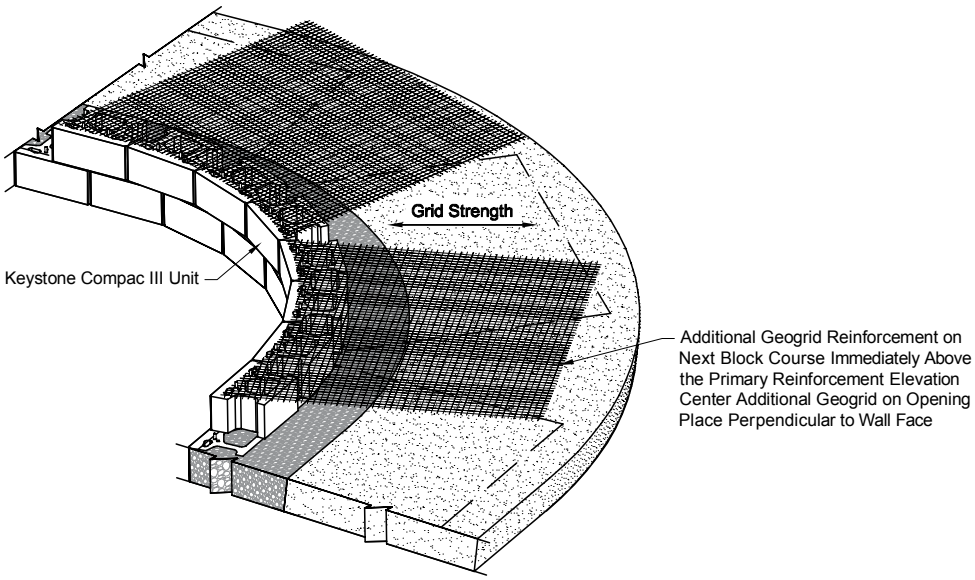
C:13 - INSIDE CURVE GEOGRID INSTALLATION (PRIMARY ELEVATION)



NOTES:

- Drainage zone and backfill materials should be placed and compacted up to the primary geogrid elevation prior to geogrid installation.
- Measure, cut and orient the geogrid, as per the engineer's design, in the correct strength direction.
- Place the geogrid over the Keystone units within 1-inch of the front block face, then place next course units over grid to hold grid in place. Next, tension the geogrid by pulling it back away from the wall. Place a stake through the geogrid at the back to tension the geogrid in place.

C:14 - INSIDE CURVE TYPICAL GEOGRID INSTALLATION (SECONDARY ELEVATION)



NOTES:

- Proceed with placement of additional Keystone units and unit drainage fill. Start backfilling nearest the Keystone units and then move away from the wall placing backfill materials over the geogrid.
- Compact the backfill materials in 8-inch lifts up to the next reinforcement elevation.
- If the radius of the wall creates a gap between adjacent primary elevation geogrid layers *(see Figure C:13, above)* of greater than 20 degrees, mark the wall units in the center of the gap, then place an additional secondary elevation on the course above the primary elevation geogrid, with the middle of the secondary elevation geogrid centered on the mark made in the center of the gapped geogrid below.
- The use of 12-foot wide rolls of geogrid will not be possible in walls with anything tighter than a gradual inside radius curve. Very tight inside radius curves may even require cutting the width of the roll to maintain the geogrid being as perpendicular as possible to the wall units.

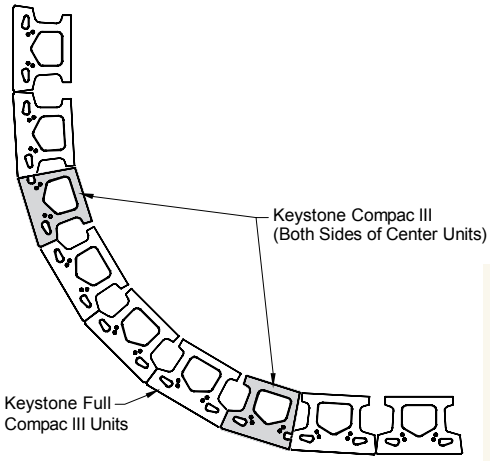
The information contained herein has been compiled by Keystone Retaining Wall Systems® LLC and to the best of our knowledge, accurately represents the Keystone product used in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Design and analysis shall be performed by a qualified engineer.

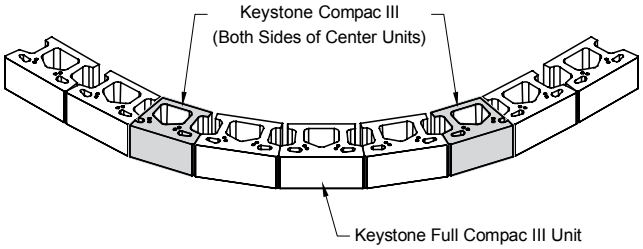
Convex (Outside) Curves: Installation Details

Keystone units can be easily integrated with multiple curves within the same wall. However, convex curves require attention to details during construction. Every wall system has a minimum radius that can be built before the tails of the units come into contact with each other. This minimum radius is unique to the shape of each individual block system. In convex curves, the tightest radius will always be the top course of the wall. This means that the radius at the base course of a convex curve wall will be larger than the desired radius at the top of the wall. Care should be taken when laying out a wall horizontal location in the field given these wall batter and radius relationships.

The minimum radius of an outside curve should not be less than 5-feet. When constructing an outside curve, we recommend performing the following steps to maintain running bond configuration. It is recommended to construct the wall into the curve, maintaining a running bond pattern in the straight sections of the wall on either side of the curve. ***(See Figure C:15, below.)*** Due to the unit setback, the radius change in a curved wall will cause the units to migrate off from running bond. When this occurs, it will be necessary to cut a block to maintain running bond; cut unit width shall be no smaller than 6-inches. Use exterior grade concrete adhesive to secure the partial unit. When coming out of the radius, do not stack cut units. Cutting of another block may be required to maintain a more precise running bond on the straight wall extending away from the curve.

C:15 - OUTSIDE CURVE RUNNING BOND

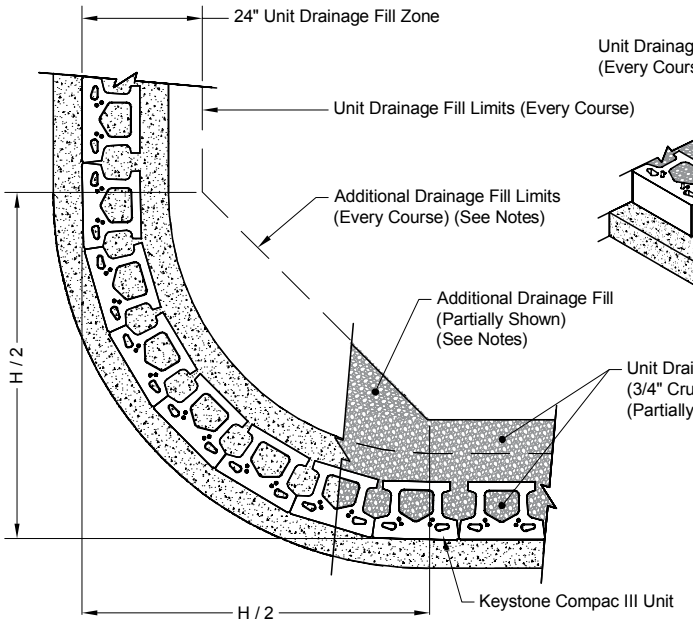


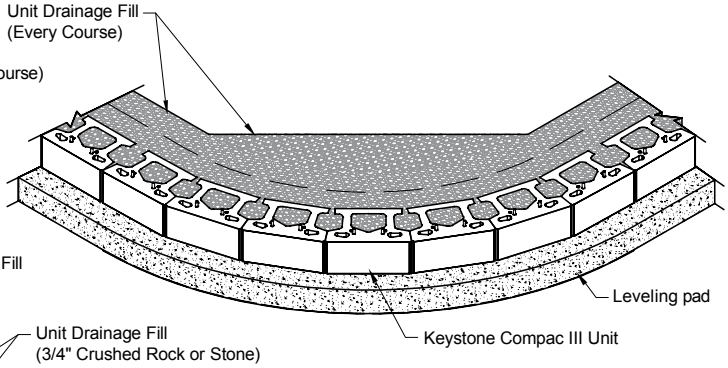


NOTES:

- Full uncut units to be used for the base course and as indicated in the details.
- Verify actual cut widths for each course as wall is constructed.
- Cut units shall not be less than 6-inches in width.
- Do not stack cut units.

C:16 - OUTSIDE CURVE ADDITIONAL DRAINAGE FILL





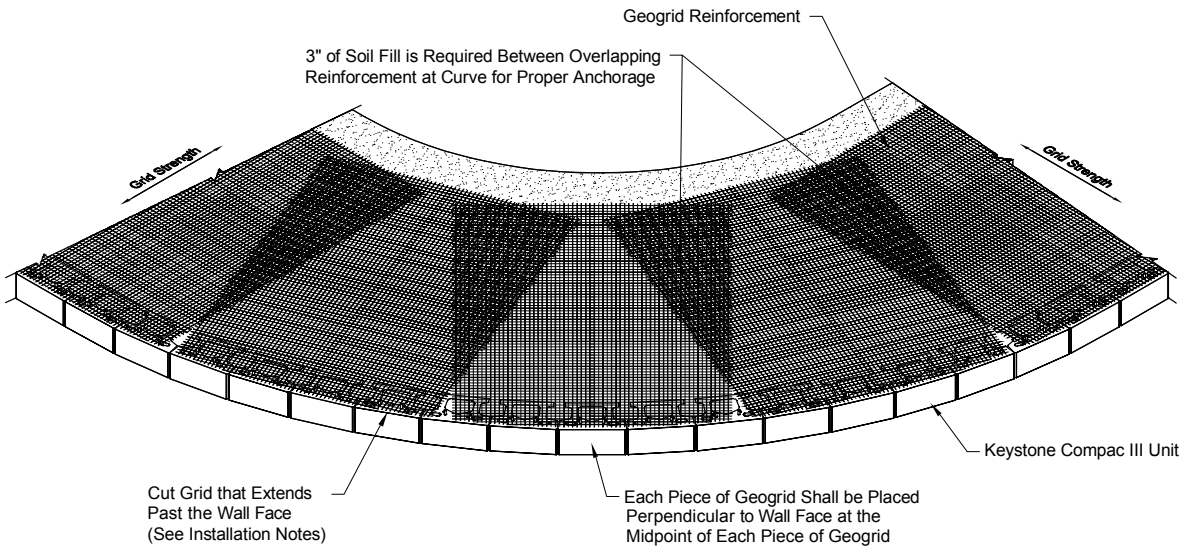
NOTE:

- Place additional drainage fill at outside wall curves to extend back from wall face each way a distance of the wall height / 2, (H/2).

The information contained herein has been compiled by Keystone Retaining Wall Systems® LLC and to the best of our knowledge, accurately represents the Keystone product used in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Design and analysis shall be performed by a qualified engineer.

Convex (Outside) Curves: Installation Details

C:17 - TYPICAL OUTSIDE CURVE GEOGRID PLAN



NOTES:

- Drainage zone and backfill materials should be placed and compacted up to the geogrid elevation prior to geogrid being installed at design elevation. Place geogrid in strength direction, perpendicular to wall face
- Measure, cut and orient the geogrid, as per the engineer's design, in the correct strength direction.
- Place the geogrid over the Keystone units within 1-inch of the front block face, then place next course units over grid to hold grid in place. Next, tension the geogrid by pulling it back away from the wall. Place a stake through the geogrid at the back to tension the geogrid in place.
- Proceed with placement of additional Keystone units, then drainage zone and backfill material. Starting at the wall and moving away from the wall, place the drainage zone and backfill materials over the geogrid to hold the geogrid in place under tension.
- Compact the backfill materials in 8-inch lifts up to the next reinforcement elevation.
- Cut grid that extends beyond curved wall face 1-inch back from wall face. The minimum geogrid length must match design length.
- Where geogrid tail overlap naturally occurs, place 3-inches of rock or soil between the overlapping layers.



KEYSTONE COMPAC® STRAIGHT

The information contained herein has been compiled by Keystone Retaining Wall Systems® LLC and to the best of our knowledge, accurately represents the Keystone product used in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Design and analysis shall be performed by a qualified engineer.