BASIC INSTALLATION

This section will take you through the step-by-step process of installing your retaining wall. Covered in this section is a basic gravity wall installation and also installation procedures for geogrid reinforced walls. While this section may not cover every construction issue you may encounter on your project, it gives a basic overview and helpful hints for the installation of a Keystone retaining wall.

Tools and materials that will be required:

- 12-inch, 48-inch, 72-inch levels
- Tape measure
- Shovel
- Excavating equipment
- Personal protective equipment (PPE)
- 5-lb dead blow hammer
- Heavy hammer and masonry cold chisel
- Stringline
- Compaction equipment (determined by size and scope of wall)
- Concrete saw
- Block splitter
- Keystone structural units and caps
- Structural geogrid, if required
- Unit drainage fill
- Backfill material
- Leveling pad material
- Exterior grade concrete adhesive
- Geotextile fabric
- 4-inch drainage pipe

Installation: Step-by-Step

STEP 1

1. Site Examination / Permitting

Select the location and length for the retaining wall. Call before you dig! In the United States, calling 811 before every digging job gets your underground utility lines marked for free and helps prevent undesired consequences. Digging without calling can disrupt service to an entire neighborhood, harm you and those around you and potentially result in fines and repair costs. Take the necessary measurements, prepare plans, research zoning requirements for your area and obtain proper building permits for your project. Local permitting may require a soils investigation and/or engineered documentation and drawings.

811 Know what's **below.** **Call** before you dig.

STEP 2

2. Excavation / Embedment

Verify that the layout dimensions are correct and excavate to the lines and grades shown on the construction drawings or to field dimensions. Remove all surface vegetation, organic soils and debris, and verify that the foundation subgrade is in proper condition prior to leveling pad installation. Do not proceed with installation until soft soils or any other unsatisfactory conditions have been corrected.

Embedment Recommendations

For small Keystone gravity walls, a minimum of 6-inches embedment is required.

For reinforced soil Keystone walls, the minimum depth of embedment as a ratio to wall height may be determined in the provided table *(page 11).*

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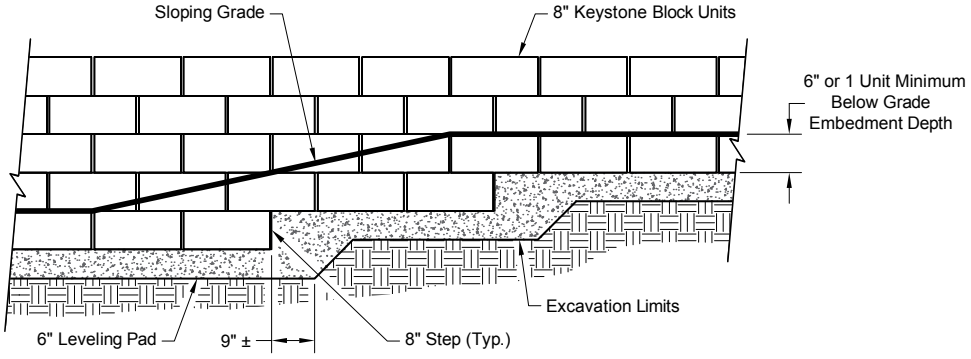
Installation: Step-by-Step

A:1 - ELEVATION



Elevation

NOTES:

- Project plans, specifications, and design codes may require minimum embedments that exceed the minimums shown here.
- The required embedment depth for Keystone walls may become a controversial issue. The International Building Code (IBC) recommends a 1-foot minimum or below prevailing frost depth, whichever is greater for foundations. AASHTO recommends a 2-foot minimum or below prevailing frost depth, whichever is greater for retaining structures. These minimum recommended depths are based on rigid foundation systems and are not totally applicable to SRWs, which can function properly with significantly less embedment. The proper embedment depth is a function of the structure size and type, the underlying soils, and the site geometry, especially toe slopes. It is important to properly inspect the foundation area when excavated, determine the limits of removal and replacement of unsuitable materials, and then confirm the final embedment depth for stability and bearing given the site conditions.

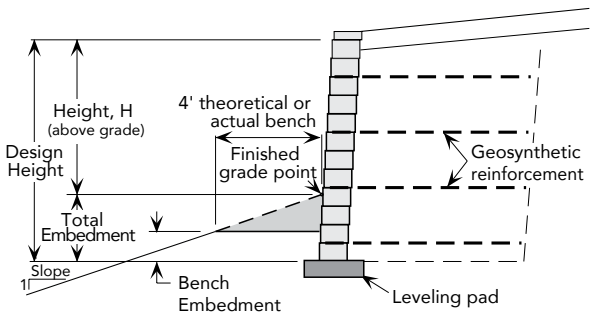
Sloping Toe

The minimum embedment required with a 3:1 or steeper slope in front of the wall should be based on the establishment of a minimum 4-foot horizontal bench in front of the wall and establishing a minimum embedment from that point. Fill slopes usually have poor compaction near the edge of slope, and all slopes are subject to erosion and superficial instability *(see Figure A:2, right).*

The depth of embedment should be increased when any of the following conditions occur:

- Weak bearing soils
- Potential scour of wall toe
- Submerged wall applications
- Significant shrink/swell/frost properties of foundation soils
- Global stability concerns

A:2 - EMBEDMENT CROSS SECTION



Slope in front of wall	Minimum embedment
Minimum requirement	0.5'
Horizontal (walls)	H/20
Horizontal (abutments)	H/10
3H:1V	H/10 + 1.33'
2H:1V	H/10 + 2'

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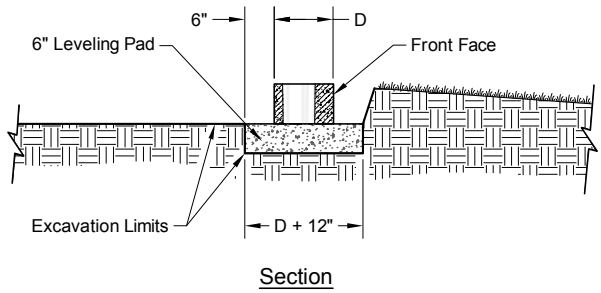
Installation: Step-by-Step

STEP 3

3. Prepare the Base Leveling Pad

Start the leveling pad at the lowest elevation along the wall alignment *(see Figure A:3, below).* The minimum leveling pad width shall be unit depth plus 12 inches. The leveling pad shall be level front-to-back and side-to-side and consist of 6 inches of well-compacted (95% standard proctor or greater) angular granular fill (road base or ½-inch to ¾-inch crushed stone). Lean unreinforced concrete (2,000 psi minimum) is also acceptable to use as a leveling pad. Step the leveling pad up in 8-inch increments at the appropriate elevation change in the foundation. Do not use rounded material (i.e. PEA GRAVEL or SAND) for leveling pad material.

A:3 - BASE LEVELING PAD



NOTES:

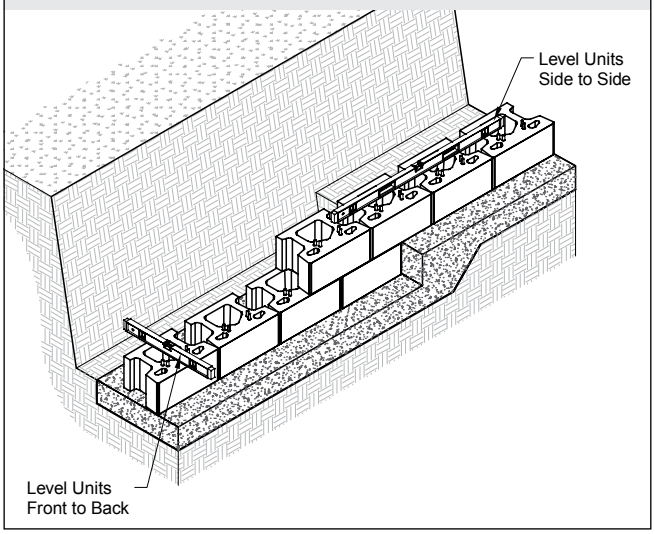
- Construct leveling pad with crushed stone or 2,000 psi ± unreinforced concrete.
- The leveling pad foundation is to be approved by the site geotechnical engineer prior to leveling pad placement.

STEP 4

4. Install the Base Course

Place the first course of Keystone units (Keystone Compac units shown for illustrative purposes) end-to-end, with face of wall corners touching (do not leave gaps between units) on the prepared base. Ensure that all units are in full contact with the base and properly seated by gently tapping each block corner with the dead blow hammer as required. Level the first course front-to-back, side-to-side, and unit-to-unit down the length of the wall. At base elevation changes, maintain a minimum embedment at step-up locations. A level base course is critical for accurate and acceptable results. *(See Figure A:4, below.)* Lay out corners and curves in accordance with the "Corners and Curves" section of this manual *(page 33).*

A:4 - LEVELING PAD



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STEP 5

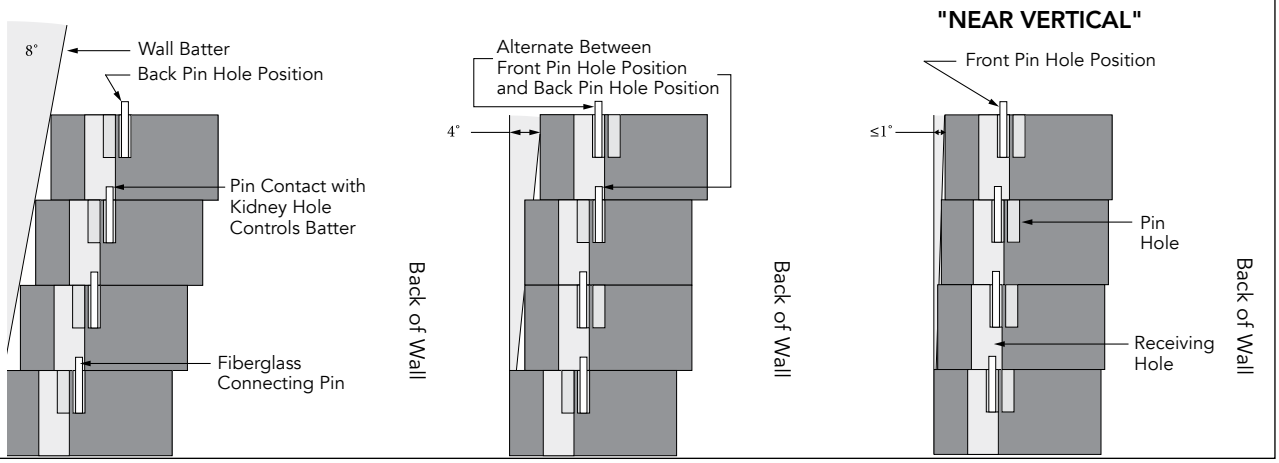
5. Insert the Fiberglass Pins/Drainage Pipe

Keystone units have various facing setback options depending on pinning arrangement used from course to course. Typically near vertical and 8° setback are most common *(See Figure A:5, below)*. For the near vertical option, place the pins in the front pin holes, or for the 8° setback, place the pins in the rear pin holes *(See Figure A:6, below)*. Once placed, the pins create an automatic setback and alignment for the additional courses *(See Figures A:5 - A:7, below)*.

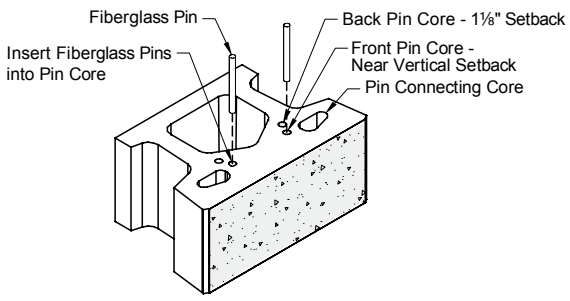
NOTE:

- Place pins prior to placing unit core fill.

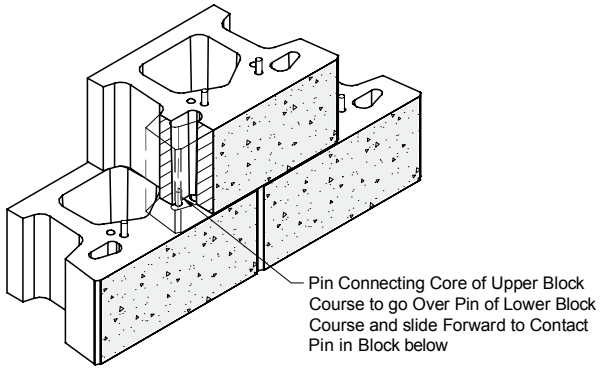
A:5 - SETBACK OPTIONS



A:6 - PIN INSTALLATION DIAGRAM



A:7 - CONNECTION DIAGRAM



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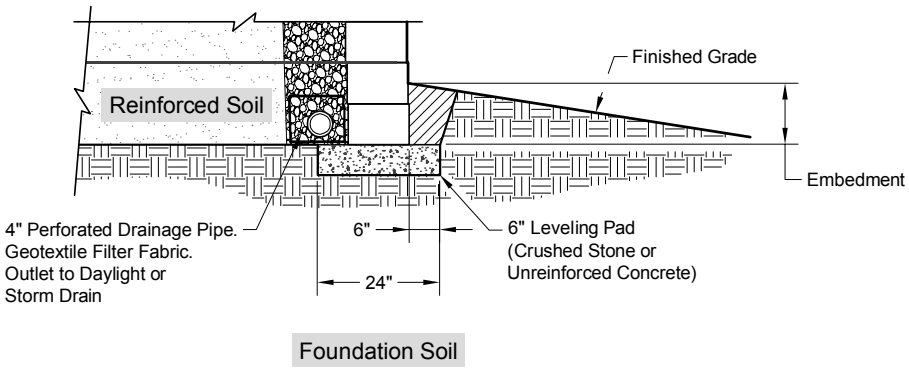
Installation: Step-by-Step

STEP 6

6. Install Unit Drainage Fill, Drainage Pipe, Backfill and Compaction

Install drainage pipe behind wall unit and outlet drain to storm system or daylight. See drainage section for additional details *(page 54).* Once the pins have been installed, provide ½-¾ inch (13-19mm) crushed stone unit drainage material to a minimum total distance of 24 inches (610mm) from wall face. Fill all open spaces between units and open cavities/cores with the same unit drainage material. Place the wall backfill behind the unit drainage fill in maximum 8 inch (203mm) lifts and compact to 95% Standard Proctor Density or 92% Modified Proctor Density with the appropriate compaction equipment. Use only hand-operated equipment within 3 feet (1m) of the retaining wall face.

A:8 - DRAINAGE PIPE DETAIL



NOTE:

- Drainage pipe should maintain positive drainage to daylight; outlet the drainpipe at low points every 30 to 50-feet on center at ends of wall, if appropriate. Alternatively, a raised drain may be utilized per the detail on *page 55* of this manual.

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STEP 7

7. Install Additional Courses

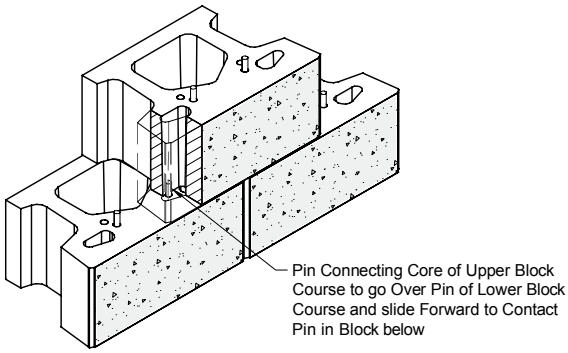
Remove all excess unit drainage material from the top surface of all the units. Hold the unit so the pin connecting cores of the upper block insert directly over the pin of the lower block course, and push the unit forward to contact the pins of the lower unit. *(See Figure A:9, below.)* Check level front-to-back and side-to-side, shim the units or grind as necessary. It is important to check level front-to-back and side-to-side on every course to maintain proper wall batter and alignment. Proper shimming materials can be any non-degradable material, including but not limited to, asphalt shingles, scrap pieces of geogrid, etc. Shimming of block is not allowed on courses with geogrid reinforcement.

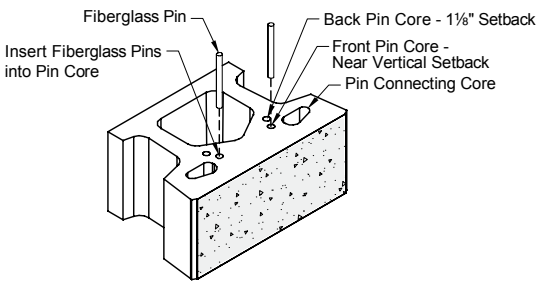
Continue backfilling, installing additional units and checking level to the desired top elevation. Follow wall unit and unit drainage fill installation closely with backfill. Maximum stacked vertical height of wall units prior to unit drainage fill, backfill placement and compaction shall not exceed 2 courses.

For gravity walls, continue this construction sequence to complete the wall and proceed to Step 10. For geogrid reinforced walls, continue with Step 8 and Step 9.

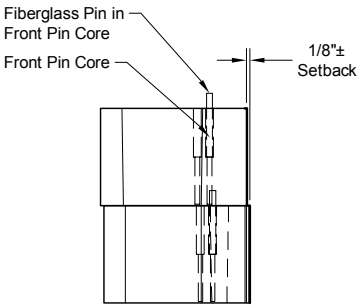
A:9 - BLOCK CONNECTION DETAIL

Note:
Place two Keystone fiberglass pins in each unit.

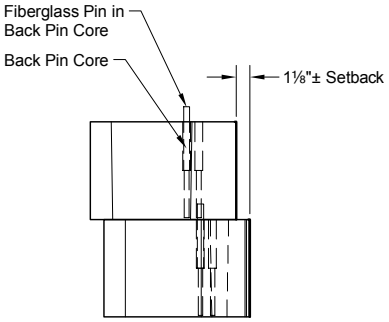




Compac III Block to Block Pin Connections Isometrics



Pin Connection - Near Vertical Setback Section



Pin Connection - 1 Inch Setback Section

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Installation: Step-by-Step

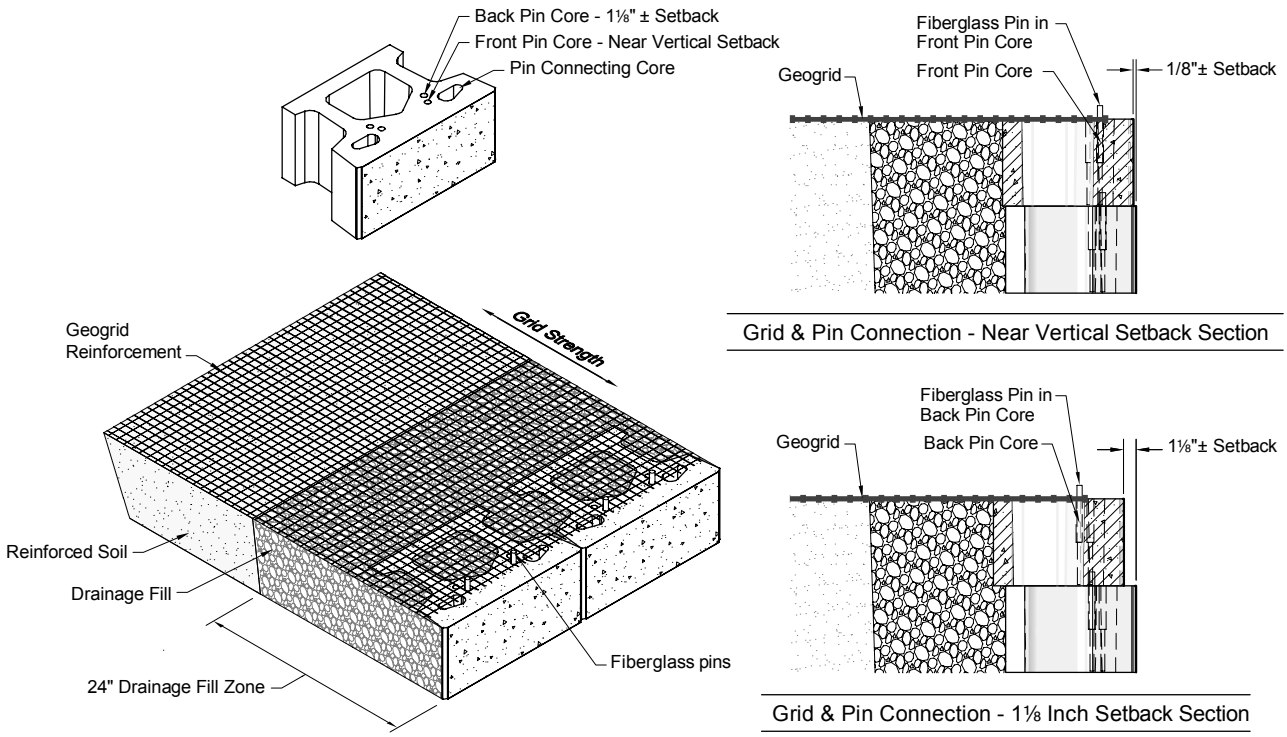
STEP 8

8. Structural Geogrid Installation

Start at the lowest wall elevation where a geogrid layer will be placed. The geogrid elevations, depths, and strength will be specified in the engineered design for the wall. Measure and cut the geogrid material to the specified length. Orient geogrid with highest strength axis perpendicular to the wall alignment. Lay geogrid horizontally on compacted backfill within 1-inch of the face of the lower block *(see Figure A:10, below)*. Ensure that the core fill and unit drainage fill is flush with the top of the lower unit prior to geogrid placement.

Geogrid will be placed in pieces side-by-side (100% coverage) with no gapping or overlapping in a continuous layer along the length of design geogrid elevation, unless a change in elevation is specified in the design.

A:10 - GRID CONNECTION



NOTES:

- Geogrid is to be placed on level backfill and extended within 1-inch of the front face of the block unit. Place next unit. Pull grid taut and backfill. Stake as required.
- The roll direction is the strength direction of the geogrid. Geogrid is rolled out perpendicular to wall face.

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STEP 9

9. Reinforced Backfill Placement

Install next course of units over the geogrid to secure in place. Tension the geogrid by pulling it towards the embankment. Place a stake through the end of the geogrid into the ground or place fill over the back edge of geogrid to hold it taut and in place. Do not excessively tension geogrid; this may pull units out of proper alignment.

Proceed with placement of the unit drainage fill and the backfill in the reinforced zone. Specifications for the material to be used as backfill in the reinforced zone should be defined in the engineered plans. Place this material nearest to the units, moving progressively toward the staked end of the geogrid. This procedure will keep the geogrid under tension. Compact the reinforced and drainage fill material to a minimum 95% standard proctor density (ASTM D698) or 92% modified proctor density (ASTM D1557). Or see compaction requirements stated in the engineered plans. Install additional courses as described in Step 7, until the next reinforcement elevation. Repeat Steps 8 and 9.

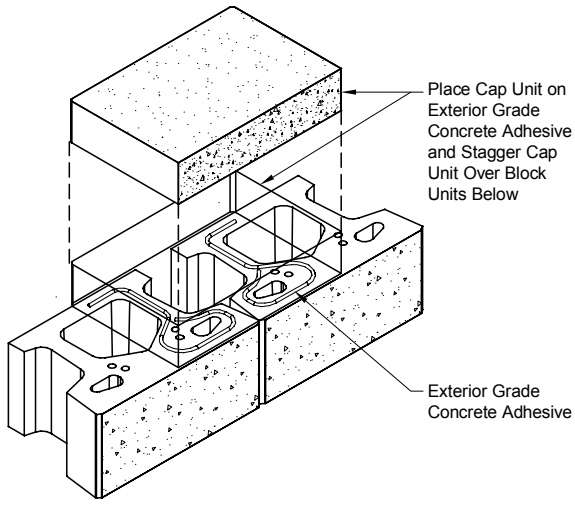
Only hand-operated compaction equipment can be allowed within 3-feet of the back surface of the units. At the end of each day's operation, grade the backfill away from the wall and direct runoff away from the wall face.

STEP 10

10. Capping the Wall

Complete your wall with the appropriate Keystone capping units. These units are available in a variety of sizes and shapes. Availability of these units will vary by region. For cap unit descriptions and placement variations see the section, "Wall Finishing" *(page 45)* of this manual. Sweep the lower units clean and make sure they are dry. Use exterior grade concrete adhesive on the top surface of the last course before applying cap units *(see Figure A:11, below)*.

A:11 - SECURE THE CAPS



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Installation: Step-by-Step

STEP 11

11. Finished Grade and Landscaping

The Keystone retaining wall is now complete. Final grading, planting or other surface material can now be put into place. Typically an 8-inch thick layer of low permeable soil is installed as the final layer of material. This is to help prevent water infiltration into the retained or reinforced zone of the retaining wall. Remember that finished grade conditions affect the wall's performance. Fill placed behind the wall should be graded to flush with the top back of the cap unit. Such conditions should not be altered from the original design.

Loadings that include slopes, parking lots and buildings should be maintained as designed. Any changes to the top-of-wall finished grade must be evaluated prior to wall completion *(see Figures A:12-A:13, page 19).*

KEYSTONE COMPAC® STRAIGHT

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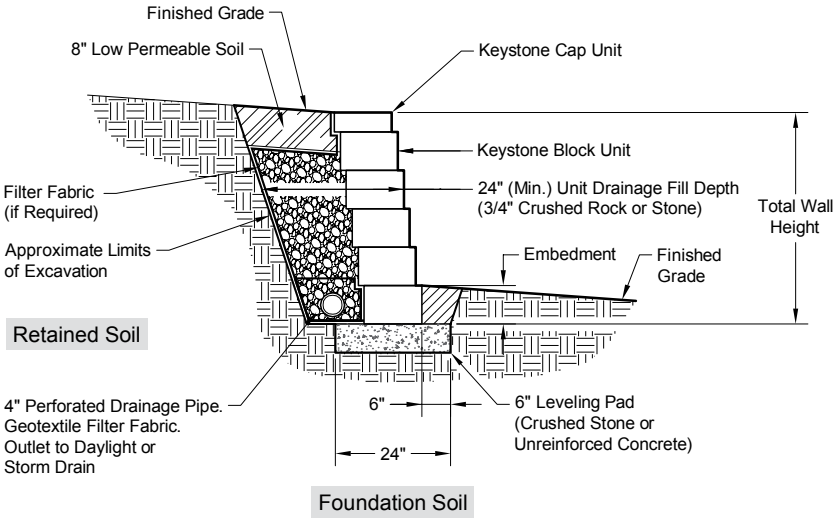
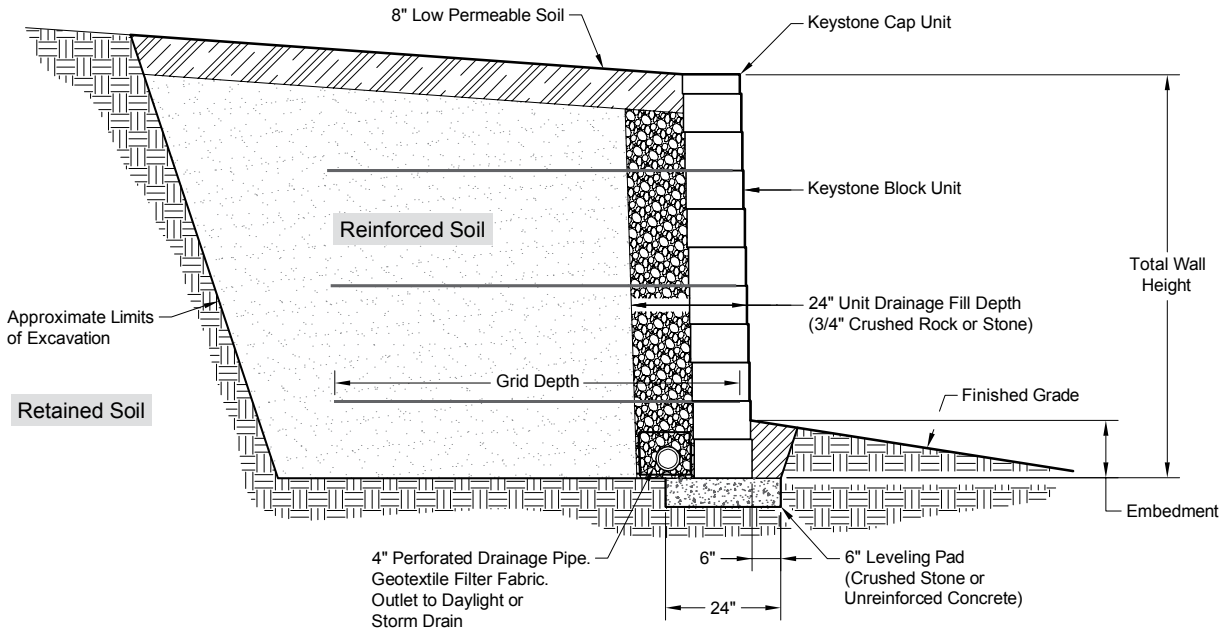
A:12 - GRAVITY WALL



NOTES:

- Drain should be at bottom of wall when possible. Utilize raised drain location when bottom of wall drainage is not possible.
- See Drainage Section *(page 55)* for additional details.

A:13 - REINFORCED WALL



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