

A vertical strip of a stone wall with a grid pattern, set against a light brown background. The wall is composed of large, rectangular stone blocks arranged in a regular grid. The background is a solid, light brown color. The text "QUESTIONS AND ANSWERS" is centered horizontally across the middle of the image.

# QUESTIONS AND ANSWERS

The following is a list of commonly ask questions relating to construction details.

QUESTION #1: How high can Keystone walls be built without the use of geogrid?

- ▶ Keystone walls can be constructed between 2' (.6m) and 6' (1.8m) high depending on the type of unit, soil conditions, amount of batter used, and surcharge on top of wall. The best way to determine if your wall will require the use of geogrid is to consult the Keystone Gravity Wall and Soil Reinforced Wall charts in this Design Manual.

QUESTION #2: Are concrete footings ever necessary or required?

- ▶ Most Keystone walls can be built directly on 4-6" (100-150mm) of well compacted granular base. However, there may be occasion to consider the use of a concrete leveling pad.

EXAMPLE: Applications in or near water, a taller wall built on soft sub-soils, or a wall that is very long and by using a concrete footing, the contractor can speed up the installation process.

QUESTION #3: Can I use sand to help level the units?

- ▶ Yes. After the road base material has been leveled and compacted, a 1/2" (13mm) to 1" (25mm) of sand may be used to help speed up the leveling process.

QUESTION #4: Can adjustments be made on a concrete leveling pad?

- ▶ Minor inconsistencies on a concrete leveling pad will not usually create much of a problem. However, if there are noticeable differences in block height as the units are placed due to low spots in the leveling pad, a thin layer of sand or mortar may be used to help the leveling process. High point inconsistencies may require some grinding. Make all adjustments as gradual as possible. Before you begin laying the base course, be sure to check that the leveling pad is level front to back. Make corrections as needed, especially if the back of the footing is higher than the front. It is important to note, that taking the time to accurately level and finish off the concrete leveling pad will allow for minimal adjustment time and greatly speed up the installation process.

QUESTION #5: How many Keystone units should be buried?

- ▶ Typically, 1" (25mm) is buried for every 8" (200mm) of wall height with a minimum of 6" (150mm) below finished grade. In most cases, other than where the grade slopes away from the wall at the base, 3 to 4 units are the maximum to be buried on tall walls. More than that does not create an added benefit. Unit burial is not a function of building below frost depth in cold climate areas like rigid wall systems, but is meant to provide resistance to base exposure from erosion to grade in front of the wall.

QUESTION #6: Is there a way to figure how much setback there will be per course before construction of the wall begins?

- ▶ Yes. Level three units side by side and install the pins in the preferred set of pin holes. Set the next course of Keystone units on the three you just leveled and slide them forward toward the wall face so they are in full contact with he pins. Measure the distance the second course tails are overhanging the units below. This will give you your true setback per course.

QUESTION #7: Should I always begin construction at one end of the wall or is it o.k. to start in the middle?

- ▶ Construction of the wall should begin at your lowest point whenever possible. If the wall is going to tie into a building or structure, measure the distance from the corner of the Keystone unit to the edge of the building and make sure the distance is in an increment of 18" (457mm). (Full unit width.)

QUESTION #8: What size rock is best suited for filling in and around the Keystone units in the drainage zone?

- ▶ A clean, angular 3/4" (20mm) rock is best for corefill if available. Otherwise, use a clean rock material that is 1/2-1-1/2" (15-40mm) in diameter. Avoid aggregates that are round in nature. Angular material will provide the best interlocking strength. Also avoid material that contains a lot of fine grains in that these fines can flow with water through the wall and possibly stain the wall face.

QUESTION #9: How much rock do I need to use?

- ▶ Adequately fill all open cores and 12" (305mm) behind the unit when using a Keystone Compac unit. The additional rock behind the unit provides better drainage and eliminates the need for compaction equipment directly behind the wall. For Keystone Standard units, core filling needs only to be placed in all open cores to the back of the tail. (See the section on Keystone Units in this Design Manual)

QUESTION #10: What advantages are there to using a pinned system?

- ▶ Unlike other retaining wall products, Keystone's pinned system offers the choice of near vertical or one inch setback options. It allows you to achieve tight corners and radii automatically without having to cut units while maintaining the running bond pattern. The Keystone fiberglass pins also provide additional shear strength at the wall face and positive connection with geogrid which allows proper pre-tensioning and resistance to bulging during construction.

QUESTION #11: How high can Keystone units be stacked before placing unit corefill and backfill?

- ▶ Keystone recommends adding corefill and backfill after each consecutive course for the Compac units. This insures that all voids are properly filled with rock providing maximum interlocking strength. It also aids in keeping the wall straight and reduces the amount of wasted rock.

Note: Because of the depth and size of open core areas on the Keystone Standard units, Keystone recommends that the standard units can be stacked up to a maximum of 3 units before placing unit corefill and backfill.

QUESTION #12: What type of material should be used to backfill?

- ▶ Granular materials such as rock and sand are best if available. These types of materials compact fairly easy and won't hold moisture that can increase the weight of the soil behind the wall. Keystone walls can be effectively built with silty material and lean clays, but these types of soils require more compaction and care should be taken not to place these materials when they are wet. High clay soils that shrink and swell rapidly as well as organic soils should be avoided.

QUESTION #13: How often do I need to compact the fill soils?

- ▶ Compacting backfill material in 8" to 12" (200mm-300mm) lifts allows you to effectively compact the entire area behind the wall without putting unnecessary pressure on the units. Thick lifts of soil require more compaction effort and create a greater force at the back of the wall which may cause potential alignment and rotation problems. Consult with a geotechnical engineer for further compaction criteria based on specific site soil.

QUESTION #14: How often should the wall's alignment be checked?

- ▶ Wall alignment should be checked at least every third course by visually looking down the wall or using a string line along the pin holes or tail positions. The wall should also be checked every 15-20' (4.6m-6.1m) to make sure the units are level from front to back. If the bubble on the level is high to the back, this means the wall is building to negative batter (leaning forward) and needs corrective measures.

QUESTION #15: How can I fix units that are out of level?

- ▶ If the units are leaning back towards the embankment, due to geogrid thickness or units being thicker in front than back, this is generally not a problem in that the batter is increased. However, if space is limited on top of the wall, this could be a problem because the wall is setting back faster than expected. To correct this problem, you may uniformly insert shims under the tails to bring the units back to level. The best material for this would be excess geogrid, pieces of asphalt shingles or other appropriate non-deteriorating materials. Avoid using wood or materials that will deteriorate over time. Care should be taken to make adjustment in small increments. If the units are rotating outward and higher toward the back of the unit, the problem should be addressed immediately. If the tails are higher than the fronts by more than 3/4" (20mm), disassembling and portion of the wall should be considered. The same guidelines and materials for shimming the back of units may be used for the fronts as well. For minor adjustment, tapping down the back of the units with a maul or dead blow hammer may also help.

QUESTION #16: How can units that are out of alignment be fixed?

- ▶ To determine which units are out of alignment, run a stringline across the pin holes before the pins are placed. Adjust the misaligned units by sliding back and forth until the pin holes are in alignment with the stringline. If when looking down at the kidney shaped holes you see that these units are not in full contact with the pins below due to the adjustment, don't be alarmed. The gravel fill should adequately fill in around this area to secure the unit against the pin. If the unit type you are using has the dual pin option, either position may be used if it helps the alignment process.

QUESTION #17: When building gravity walls with terraces, what is the recommended distance between the terraced walls where the upper wall does not affect the loading condition on the lower wall?

- ▶ The distance between terraces (face of wall to face of wall) should be greater than or equal to two times the lower wall height. Typically this can also work for lower height soil reinforced walls. With higher reinforced walls or walls built on a slope, the issue of global stability must be considered by a qualified engineer in analyzing the terrace situation.

QUESTION #18: What are the recommended methods to avoid settlement when building a wall that has terraces converging into a single wall?

- ▶ If at all possible, build on bench cut virgin soil conditions. If this is difficult to achieve, the next best solution is to build the base course of the terrace as it approaches the single wall, to a deeper elevation (either stepping down to the same level as the single wall or to virgin soil at a higher elevation). This provides for a deeper and

more stable base condition.

QUESTION #19: When building around a structure or culvert, how do I know if the courses will match on top?

- ▶ Make sure that your Keystone units on either side of the culvert are at the same elevation and in an increment of 18" (457mm) apart. Depending on the distance, you may want to allow a 1/4" (6mm) or more for adjustments. When you get to the top, you may need to use mortar or grout on top of the culvert structure to continue the course of units across at the proper elevation. Also, it is important to create a cold joint at each side of the culvert to allow for differential settlement possibilities from the culvert on a rigid foundation to the Keystone on a flexible foundation.

QUESTION #20: When cutting for a round culvert or multi-plate arch, is it necessary for the whole Keystone unit to remain intact, and what is the best way to secure the unit?

- ▶ On many cuts, it is nearly impossible to keep the whole unit intact (i.e. having small pieces of units). After the cut has been made, pin the unit if possible and apply a liberal amount of Keystone Kapseal adhesive to secure. It is also important to use additional clean rock fill behind these units to ease compaction efforts, provide additional drainage, and to prevent fine material from migrating through any existing gaps. An additional solution is to design in a collar for the front edge of the culvert or multi-plate in order to conceal visually the construction joint where the Keystone units are cut to fit the curved structure.