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Building a Straight Wall When Working Up a Slope

Use this helpful information if your project requires a wall to be built up a slope and you would like to keep the wall parallel to an existing feature such as a driveway, road, or sidewalk.

Take for example the picture shown on the right. This wall is an AB Ashlar Blend™ pattern wall from the AB Collection®, with an approximate setback of 6 degrees. The entire finished wall needed to be the same distance from the curb so the contractor could place the continuous 4 ft. (1.2 m) sidewalk parallel to both the curb and wall. If the wall was built without accounting for the block's setback, the wall would move away from the road approximately 0.8 in. (20 mm) per step-up as it continued up the slope. Depending on the slope of the hill, the wall could be a considerable distance away from the driveway and sidewalk by the time it reached the top of the slope. See Figure 1 for an illustration of the effects of block setback. This tech sheet demonstrates two alternatives for creating a straight wall when building a retaining wall up a slope.

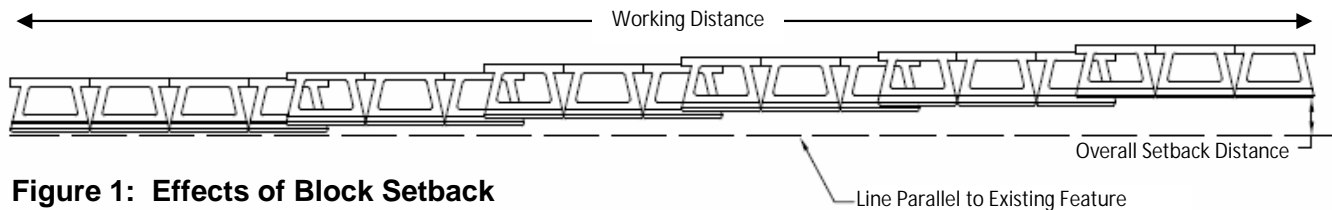


Figure 1: Effects of Block Setback

Table 1: Setback Chart

Setback by Collection	Change in Elevation (courses)				
	1	2	3	4	5
AB Stones (12°) only of the AB Collection	1 3/4 in	3 3/8 in	5 1/8 in	6 3/4 in	8 1/2 in
	43 mm	86 mm	130 mm	173 mm	216 mm
AB and AB Europa Collection (6°) (excluding AB Stones and AB Three)	0 7/8 in	1 5/8 in	2 1/2 in	3 3/8 in	4 1/4 in
	21 mm	43 mm	64 mm	85 mm	107 mm
AB Three (3°) only of the AB Collection	0 3/8 in	0 7/8 in	1 1/4 in	1 5/8 in	2 1/8 in
	11 mm	21 mm	32 mm	43 mm	53 mm

*Setback distance and setback angle are nominal dimensions. Stack 2 blocks onsite and measure the actual setback for your block.

Table 1 Example:

The example shown is an AB Ashlar Blend patterned wall using blocks from the AB Collection. For simplicity, define the working distance as a segment where the wall will change by 5 courses in elevation. (Actual site conditions will dictate the rise over a particular working distance.)

Using Table 1:

1. Find the row with AB Collection (6° block).
2. Find the column where the wall change by 5 courses in elevation.
3. Therefore, for every 5 courses of block, the wall will need to be adjusted to account for a setback of 4 1/4 in (107 mm).

Steps to build a straight wall from a series of angled wall segments:

1. Review the Gravity Wall Construction and/or the Reinforced Wall Construction sections of the *AB Commercial Retaining Wall Manual*.
2. Layout a line where you would like the wall. This will be referred to as the *Wall Line* and it should be parallel to the existing feature.
3. Establish your working distance and plan the number of step-ups that would occur within this area based on the grade change. The working distance can be defined as any convenient length of wall. For a wall being built on a steep hill, you may find a shorter working distance is easier, while a wall being built on a gentle slope can use a longer working distance. For every 8 in. (200 mm) of grade change, there will be a step up of 1 course of block.
4. Using Table 1, determine the overall setback that would occur based on your type of block and the number of step-ups within your working distance.

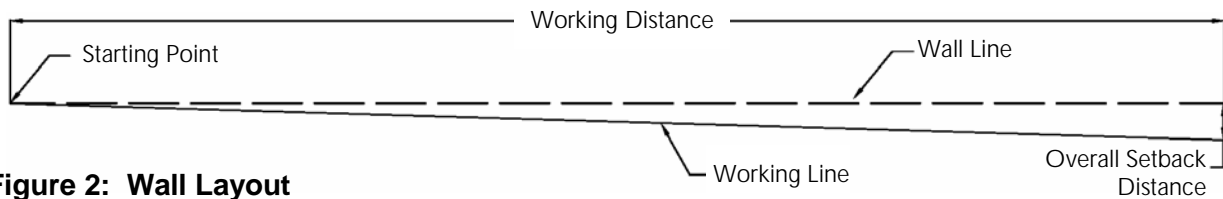


Figure 2: Wall Layout

5. At the end of your working distance measure from the *Wall Line* and mark the overall setback distance you determined in Step 3. Stretch a string line from the beginning of the working distance to the overall setback mark you just made. Figure 2 shows this line as your *Working Line*.
6. Start constructing your base course by measuring off the working line the distance shown in Table 1 for one block height. Figure 3 shows the base course construction. Going back to our example wall, using blocks from the AB Collection (6°), we would measure off the *working line* and place each block approximately 7/8 in. (21 mm) away from the *Working Line*.

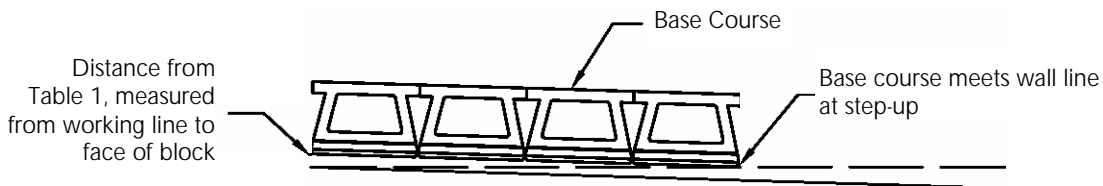


Figure 3: Base Course Construction

7. When your base course meets the *Wall Line*, it should be time for a step-up. Start constructing the second course as described in the *AB Commercial Retaining Wall Manual* on top of your compacted base. This course will be built using the setback shown for 2 block heights in Table 1. Referring to Figure 4, our example wall would be set back 1 5/8 inches (43 mm) from the *Working Line*.

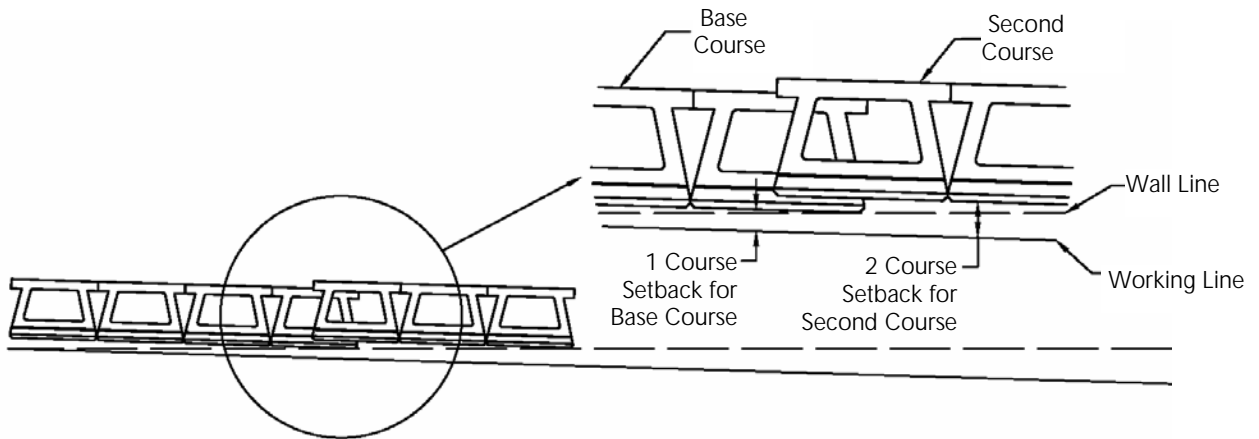


Figure 4: Installing the Second Course

8. Continue building the wall using Table 1 to determine each course's setback and using the *Working Line* for a reference until your wall is complete.

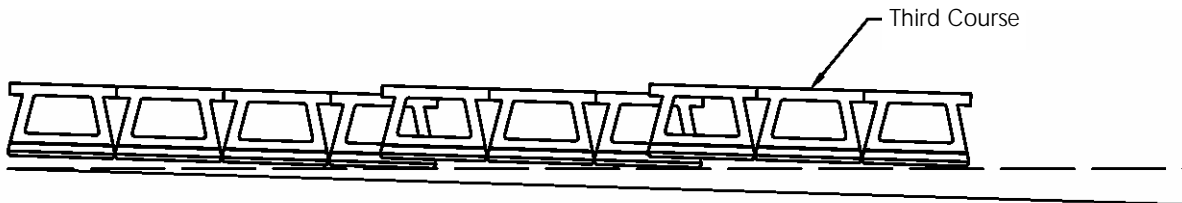


Figure 5: Installing the Third Course



Figure 6: Using Angled Segments to Build a Straight Wall

Building a Straight Wall When Working Up a Slope

Steps to build a straight wall by adding a kink to the wall:

1. Review the Gravity Wall Construction and/or the Reinforced Wall Construction sections of the *AB Commercial Retaining Wall Manual*.
2. Define your working line parallel to the existing feature you are following up the slope.
3. Construct the base course as shown in the *AB Commercial Retaining Wall Manual*.
4. Construct the second course as shown in the *AB Commercial Retaining Wall Manual*. When your second course reaches the end of the buried base course, add a kink in the wall as shown in Figure 7 to bring the wall back to the working line and parallel with your existing feature. Continue constructing the second course on top of the compacted base.
5. Construct the third course, softening the kink above the end of the base course, see Figure 8.
6. When your third course reaches the end of the buried second course, add another kink to bring the wall back to the working line and parallel with your existing feature.
7. Continue building the wall using this technique until the wall is complete.

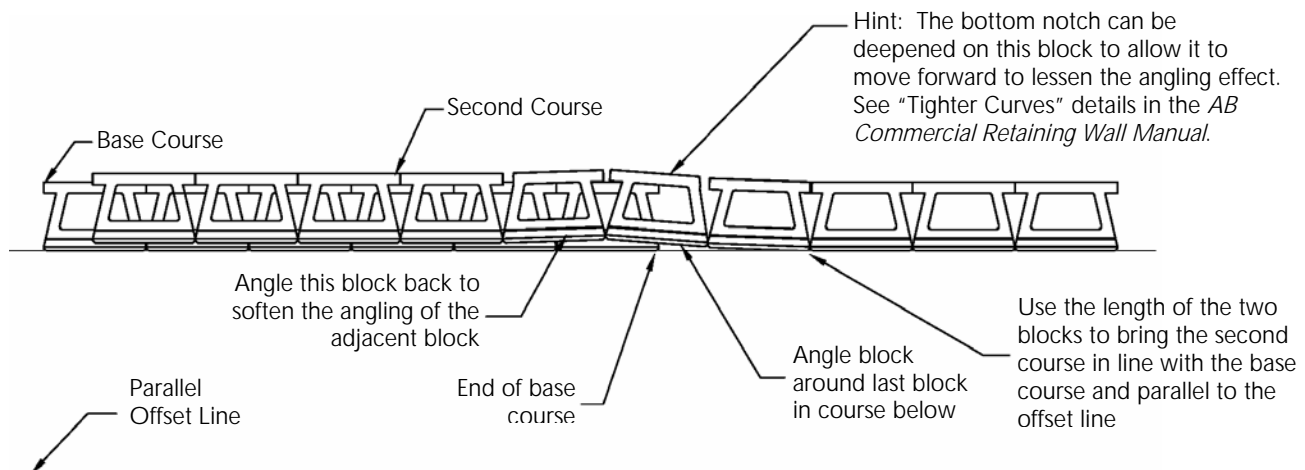


Figure 7: Using a Kink to Build a Straight Wall – Building the Second Course

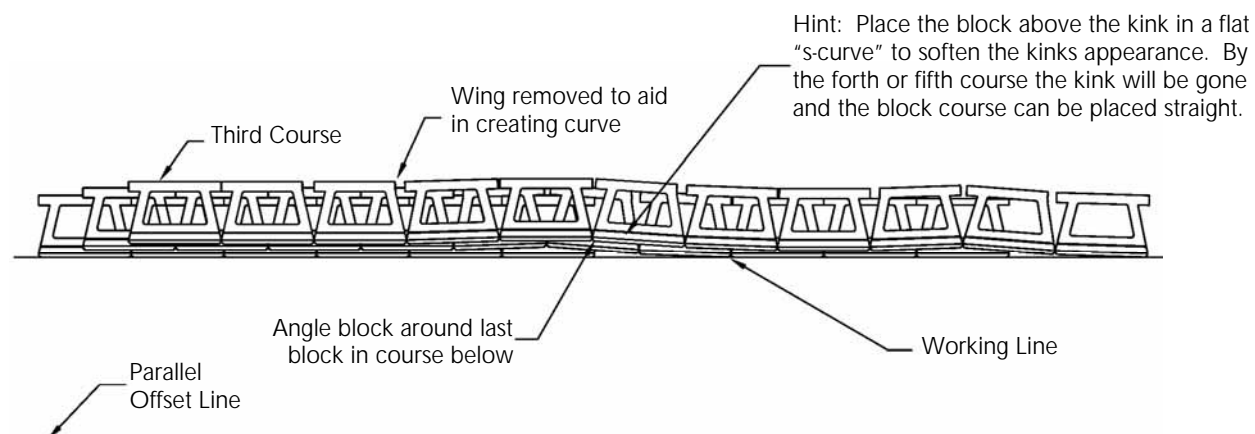


Figure 8: Using a Kink to Build a Straight Wall – Building the Third Course





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What Makes Allan Block The Best Designed Mortarless Retaining Wall Block On The Market?

When Bob Gravier invented the Allan Block Retaining Wall System no one, including Bob, realized how good his idea would work in the field. By 1997, after more than ten years of field performance, and approximately 30 million square feet (2.8 million square meters) of wall installed and performing well, it is time to summarize why Allan Block "Stands Above The Rest".

Allan Block's patented raised front lip is one of the key design features. The raised front lip and corresponding notch on the bottom of each block...

- Allows for blocks to be molded with varied setbacks. The Allan Block is available in three, six or twelve degree batters. The twelve degree battered Allan Block dates back to the original design and still the most commonly used product. The twelve degree batter reduces active earth pressures, which act on a wall or reinforced mass by up to 30 percent. Consequently, lower pressures result in walls that are more economical to construct (Fig. A).
- Provide a continuous shear key that is molded into the block. This design feature produces an interlock between each course of block providing the best block to block shear in the marketplace because of its continuity and the ability it provides to inspect it's condition at any time during the life cycle of the wall (Fig. B).
- Resists the migration of fines carried by water through the horizontal joints. This minimizes staining that occurs in areas were native soils contain fine red clays (Fig. C).

Allan Block's Hollow Core Design and closed cell configuration provides many benefits which add to the working stability and success of the system. The following list contains the major positive characteristics of this hollow core design:

- Moving water away from any retained soil mass is critical to the success of any retaining wall. In addition to a drain field constructed 12 in. (30 cm) behind the wall, the hollow core provides an alternate path for water to flow and drain away from the retained soil (Fig. D).
- Due to the closed cell configuration the unit weight of the facing increases when water backs up behind the wall. This provides additional stability during the most critical stages of wall performance. Additionally, the full wing design on each side of the Allan Block creates a secondary cell which is also closed and captures all of the rock fill to add to the facing weight and stability (Fig. E).

Effects Of Batter

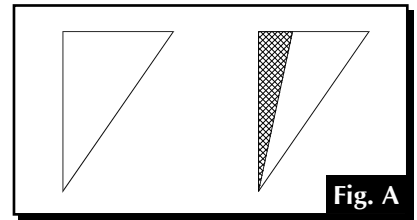


Fig. A

Shear Lock

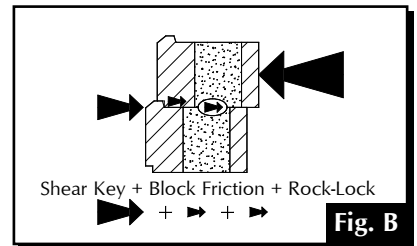


Fig. B

Filtration

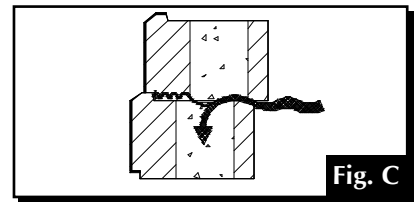


Fig. C

Closed Cell Configuration

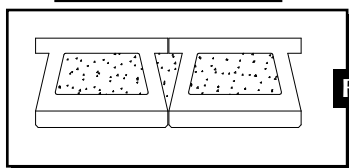
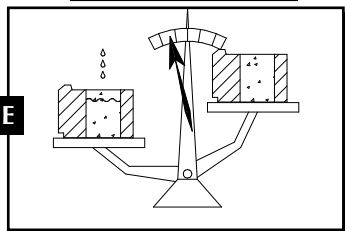


Fig. E

Water Weight



Self Draining

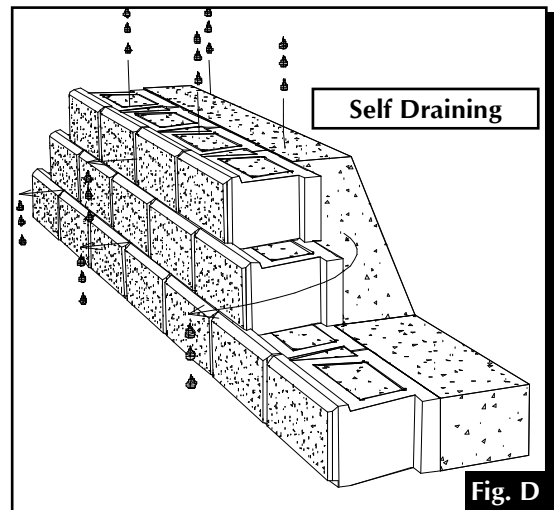
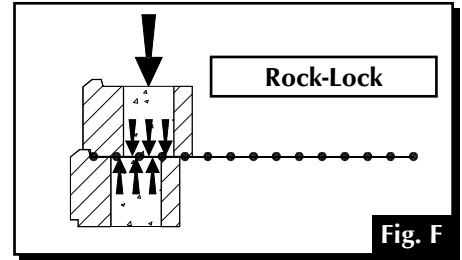


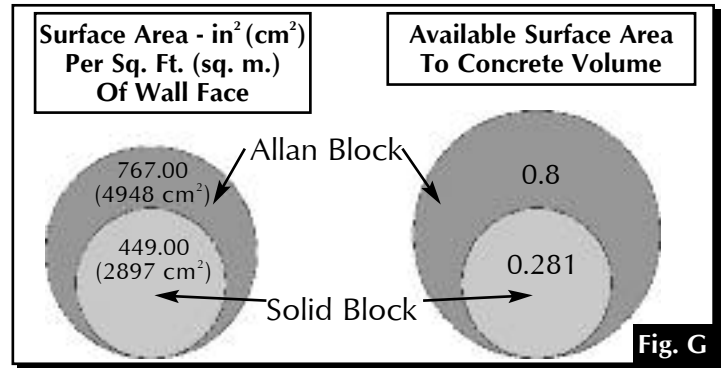
Fig. D

- Aggregate is not only used to fill the cores during construction. It is also compacted to provide an additional lock between the wall units. This positive continuous rock-lock connection adds greatly to the ability for the wall to lock on to the grid and allow the Allan Block, geogrid and reinforced soil to work as a composite mass. This continuous positive connection is superior to any point loaded pin system (Fig. F).
- The additional surface area on the inside of the core allows for faster drying of saturated block. This is critical to eliminate freeze thaw durability concerns. Without the presence of water, freeze thaw cycles have no affect on concrete (Fig. G).
- The hollow core design provides for efficiencies in production, transportation and installation. This translates into a better quality product and installation for the same price.



Allan Block has the best track record for structural stability of all modular block wall products.

- The built in design features of Allan Block allow for the safe and effective construction of taller gravity walls, when compared with other modular block systems. When reinforcement is required, the ability to include a built-in batter reduces the amount of reinforcement required providing a more cost effective solution for the site.
- Allan Block has zero documented wall failures attributed to product design.
- Allan Block is the product which most closely simulates how high shear strength soils interact and hold their form. High shear strength soils, sand and gravel, possess three important characteristics. First, when a soils mass is loaded the internal ability of the soils to resist shear is hard to overcome. Secondly, soils of this type drain very well. And last, the open space configuration within high shear strength soils allows paths for frost prism to form thereby reducing the pressure within the soil mass.



Don't take our word on these items, let us prove it to you on your next project.

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Taiwan Patent #NI-72269 • Int'l. & Other Patents Pending • Doc #R0538



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How Soils Can Work For You

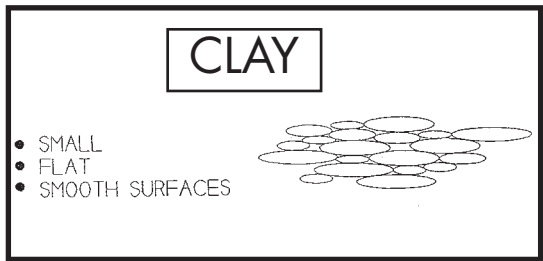
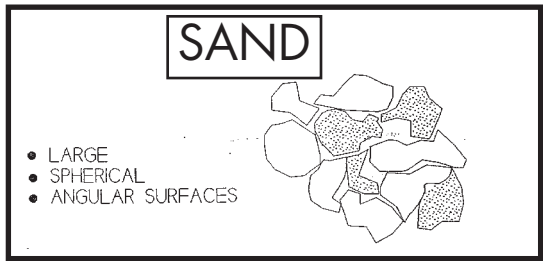
Q Why does the type of soil being retained make a difference?

Soil has two main properties that are used to determine how much reinforcement is required to stabilize a soil mass. The internal strength, *soil*

TYPICAL SOIL PROPERTIES			
Soil Groups	Cohesion (as compacted) PSF	Cohesion (saturated) PFS	Soil Friction Angle (degree)
Clean Gravel - Sand Mix	0	0	36
Sand - Silt Clay Mix	1050	300	32
Inorganic Clays	1800	270	27

friction angle or Phi angle, of different soils plays a major role in determining how well soils hold themselves up. This internal strength of the soil, not the retaining wall, performs most of the work of holding up any hillside. The friction angle of the soil is an indicator on how well the soil will support its own weight.

Soils also possess a second property which allows the soil to stick together, *cohesion*. Clay soils have lower internal strengths but higher cohesion values. Soils with high percentages of sand and gravel have higher internal strengths and lower cohesion values.



Q How does water affect the soil?

The major cause of landslides is moisture. Water changes the characteristics of soil in the same way that heat affects ice. As any soil becomes saturated, two things happen:

- The weight of the mass of soil increases. Once the weight of the soil increases beyond the internal strength of the soil, the mass slumps.
- The ability of soil particles to stick together is reduced.

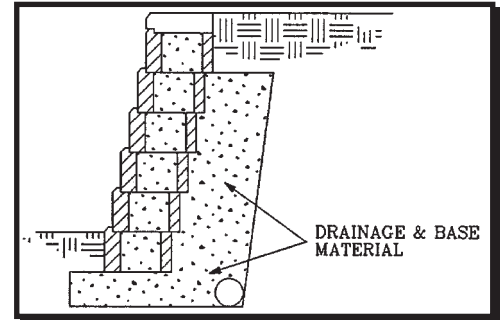
Clay soils are comprised of small flat particles that drain away water very slowly. Once a clay soil mass becomes saturated, cohesive properties become negligible.

Soils with high percentages of sand and gravel are comprised of larger more angular particles. This type of soil has lower cohesive properties but drains away water very rapidly. The ability of the soil to drain provides a more stable soil mass and reduces hydrostatic pressure present in saturated soil. The internal strength of sandy soil is also higher.

Q What type of aggregate should be used when preparing the base, building the drain field behind the wall and in the cores of the block?

A well graded compatible aggregate provides the best base and drain field material. *Well graded* may be defined as having a wide range in grain sizes and substantial amounts of all intermediate particle sizes. Fines should be minimized as sufficient compaction can be obtained with the proper gradation of aggregates. It is not necessary to use different types of material for the base and drain field.

Crushed stone has several positive features as a backfill material for retaining walls. High internal shear strength, good compaction characteristics and excellent drainage and freeze/thaw resistance capabilities provide the key ingredients needed for trouble free retaining wall construction.

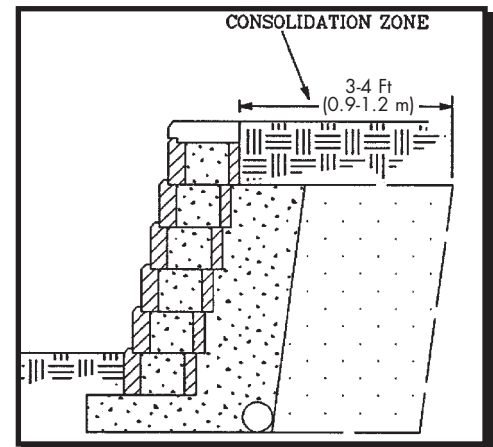


Q Can soil behind the wall be over compacted?

Yes! Excess compaction may result in the following situations:

- Forward rotation of the wall facing.
- Localized bulging of the wall facing.
- Damage to the reinforcement when sharp angular aggregate is used.

Retaining wall construction requires a certain amount of compaction to consolidate the soil and minimize settlement that occurs after walls have been constructed. Excessive compaction can cause forward rotation of the wall facing. Soil compaction within 3-4 ft (0.9-1.2 m) of the wall must be accomplished with hand operated equipment. Plate compactors provide the compaction required while minimizing the potential for pushing the wall forward. Large equipment operating too close to the wall is a common problem on commercial construction sites. Concentrated loading from heavy equipment may cause over compaction and result in a rotation of the wall facing or localized bulging. Over compaction may also damage geogrid reinforcement materials.



More compaction is not always better. Contact the AB Engineering Department for more information on the correct backfill material to use for the job and guidelines on proper compaction.

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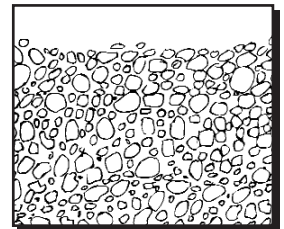
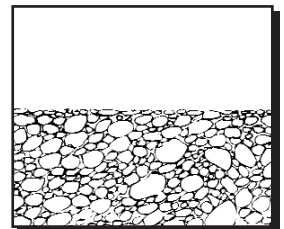


COMPACTION EXPLAINED

How to ensure your wall is compacted properly

Retaining wall specifications generally focus on features such as grid lengths, grid spacing, interblock shear strength, soil type, block to grid connection and other components that constitute a geogrid reinforced soil mass. Wall specifications also include compaction requirements (ie: 95% of Standard Proctor) but little else is mentioned on the importance of compaction. We will discuss what compaction is, how to measure it, how to achieve it, and why it is so important.

- Compaction is the process of rearranging soils to consolidate the space occupied by the soil particles while forcing out excess air and water. Compaction is accomplished by applying a force or vibration to the soil mass. The efficiency and success of any compaction effort will be dependent on the type of soil being worked, the moisture content present in the soil mass, and the technique used to compact the soil. In retaining wall design, cohesion is not considered when analyzing external and internal stability. Properly compacted soils help to strengthen the internal strength of the soil mass by aligning the soil particles together and increasing the coefficient of friction when a load is applied to the soil, and reducing undesirable settlement.
- Compaction is measured using an industry standard proctor test. The level of compaction in a soil mass is determined by comparing the density of the soil as measured at the site with the density of that soil type as defined in the Standard Proctor tests. For example, specifications often require compaction to be 95 percent of Standard Proctor. This means the on-site soil density must be equal to 95% of the maximum achievable compaction.
- Compaction is achieved by applying three basic types of force to the soil mass.

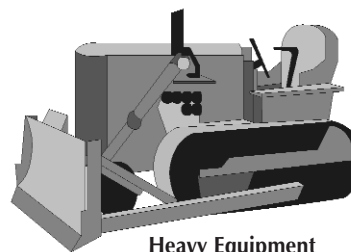
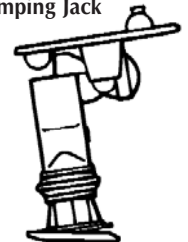


1. **Vibration** - Vibratory machines send waves of motion through the soil to reposition and consolidate the soil particles. Forces of this type do a good job of forcing out excess air within the uncompacted mass. Vibratory machines work well in noncohesive soils; soils comprised of at least 50 percent sand or gravel.
2. **Ramming** - Rammers such as jumping jacks and vibrating sheep foot rollers, simulate the action of someone striking the ground with a hammer. This type of force is a good choice with highly cohesive clay soils because it breaks down the soil masses and forces out excess moisture. This type of equipment can not be used within 3 feet (0.9 m) of the back of the wall.
3. **Static** - By simply using the weight of the machine being passed over the desired area, compaction can occur. Generally this will only yield compaction of a thin top layer where the load is applied. A heavy, walk-behind roller can develop good results when used in 8 in. (20.3 cm) lifts. Don't count on obtaining proper compaction by driving your construction equipment back and forth over soil. Heavy equipment can not be driven within 3 feet (0.3 m) of the back of the wall.

Vibratory Plate Compactor

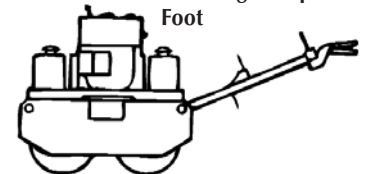


Jumping Jack



Heavy Equipment

Vibrating Sheeps Foot

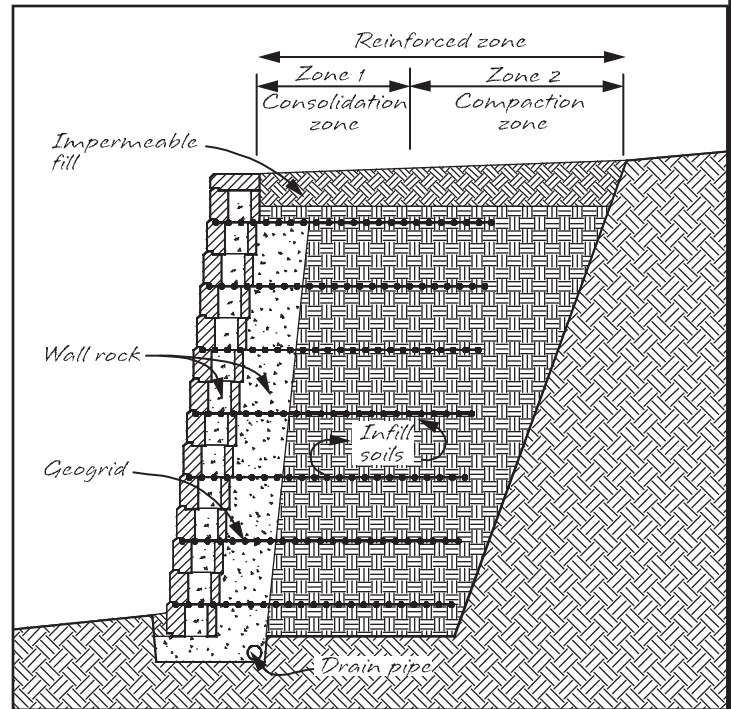


The compaction process will be helped by controlling the amount of moisture in the soil. When the proper amount of water is present, it acts as a lubricant to help consolidate the soils as they are being compacted. If there is too much water in the soil, the water will take up space between the particles and prevent them from bonding together. If the soils are too dry, water will be required as each new lift of soil is placed to reduce the friction between the soil particles to obtain proper compaction.

When an Allan Block wall is constructed there are two distinct zones for compaction.

- Zone One** is referred to as the consolidation zone. It's an area approximately 3 ft (0.9 m) wide behind your Allan Block wall. Compaction is required in 8 in. (20.3 cm) lifts utilizing a walk behind vibratory plate compactor. We have found that stackable block walls perform best when hand operated plate compactors are used to consolidate Zone One. Compacting the aggregate within the block cores locks the blocks together. Compacting the Zone One materials with the same plate compactor prevents overcompaction and unnecessary rotation of the wall face. **Do not use raming or heavy static equipment in Zone One.**
- Zone Two** is often referred to as the compaction zone, or the backfill zone.. It's the area that extends from the back of Zone One to the on-site slope or cut that you will fill to. Operating mechanized equipment in Zone Two is acceptable. Allan Block recommends that the soils in both zones be compacted in 8 in. (20.3 cm) lifts. The scope of the job and the type of soil will determine what type of compaction equipment should be used, and what degree of final compaction should be achieved.

Now let's move on to the bottom line. Properly built and properly compacted Allan Block wall structures will perform. Know the soils and their characteristics before you start your project. Stage the wall with the right type of equipment. Always build one row at a time, compacting in 8 in. (20.3 cm) lifts. Since the soils are part of the structure, they require and deserve a high quality installation. Don't build a mechanically stabilized earth structure without proper compaction. It's the best insurance you will ever buy, don't leave your job site without it.



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Taiwan Patent #NI-72269 • Int'l. & Other Patents Pending • Doc #R0539



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Caring For Your Retaining Walls

Retaining Walls, like everything else on your property, require care and maintenance. With any newly built retaining wall, there are maintenance aspects that are important to watch for after the wall is completed. ALLAN BLOCK walls will need far less care than other types of retaining wall products, but there are some key factors to watch for.

Let's cover the wall maintenance topic in these basic areas:

Site Grading, Surface Treatments, Wall Performance, Weed Growth, and Salt Spray.

Site Grading

Every newly built retaining wall has soils - backfills that are placed behind and sometimes below the wall and compacted during construction. It is quite common for some extra settling to take place after the wall is completed. If you inspect the wall each spring for any unusual or excessive settling, you can save your wall from a potentially large problem.

All retaining walls should be designed and built to route water around or over the wall face. Once an area behind the wall begins to settle, water goes to work to make that area deeper and bigger. If a low spot is neglected behind a wall, each new rainfall will collect water at that spot and work its way down behind the wall. If the area behind the wall is flat, this can have the effect of creating a "swimming pool" above the wall. And this pooling effect will also turn the soils soft and mushy. If the wall wasn't designed or engineered to hold up the added weight, a blow-out could occur.

Preventing this problem is easy. **Inspect your wall each spring. Look for low spots and areas that have settled.** Pull back the landscape mulch or sod on the surface and add enough new fill to bring the drainage back to its proper level. By keeping these trouble spots filled, you can ensure a lifetime of performance from your ALLAN BLOCK wall.

Surface Treatments

Another common maintenance problem with retaining walls is the lack of proper surface treatments. Once a new retaining wall is completed, the surface areas surrounding the wall that were disturbed during construction are typically finished with some type of landscape treatment. This might include paving, landscape plantings, mulch, sod or seed for turf, or some type of ground cover. Often overlooked as part of the total wall design, these surface treatments provide an important function for the wall. They capture, control and route the water from each rainfall.

These surface treatments will need to be checked each spring until they are completely established. Walk the site carefully, and look for areas that aren't in proper condition. Replace bad sod, re-seed bare areas, work with the ground covers to encourage growth and coverage. Look for areas of erosion, ruts and channels on the surface, and re-landscape as necessary. A little bit of work each spring with the areas surrounding your retaining wall will prevent major erosion from becoming a problem and will also enhance the landscape of your ALLAN BLOCK wall.



Weed Growth

Just like with concrete and asphalt pavement, stackable block retaining walls can find an occasional weed growing in the face. Allowed to stay in place, one weed can multiply into a veritable forest. It can happen any time. By plucking the odd weed that finds its way into your ALLAN BLOCK wall, you will keep the wall weed free for life. If pulling weeds isn't your preference, spray the wall once annually just like the lawn, to keep it clean and weed free.

Wall Performance

ALLAN BLOCK walls are made to last a lifetime. The high strength concrete units are designed and produced to handle tough winter weather, and long hot summers. They won't rot or decay. With over thirty million square feet (2.8 million square meters) of ALLAN BLOCK sold and installed, we can say they truly do last a lifetime. With all that, we still recommend a spring inspection of the actual wall itself. Take a few minutes to check out the wall, including the blocks and caps.

Begin by looking for any movement in the wall from the previous season. Properly built ALLAN BLOCK walls will remain in place forever. However, if a wall is not installed correctly, or if drainage or erosion problems are not corrected, some wall movement could occur.

If a soft spot was not properly compacted at the wall base, you could see some minor settling of the wall. Minor settling will not hurt the structural integrity of the wall. However, if it happens, you may wish to unstack the blocks in that area, raise the settled spot at the wall base, and restack the blocks.

Check your wall each spring for bulges or rotation. Again, this can only happen if the wall was not properly installed, but nonetheless, it is good to watch over the wall performance. If you see any significant forward movement or rotation in your ALLAN BLOCK wall, get a professional contractor or engineer to evaluate the movement, and determine the cause.

Salt Spray

In northern climates, ALLAN BLOCKS are produced with a concrete mix design that is resistant to the harsh effects of the freeze-thaw winter cycles. However, use of salts around an ALLAN BLOCK wall could cause surface damage to the blocks or capstones. Look for pock marks or spalling on the blocks in areas where salts are used for winter ice control.

Avoid using any salt deicers on or around your ALLAN BLOCKS. If you need to use deicers in areas around your wall, contact your local building materials outlet for a deicer that will not harm concrete. In cases where salt spray may exist, design the wall in such a manner that the snow melt and snow banks containing the salted snow are directed away from the ALLAN BLOCK WALL.

Maintenance Tips

Follow these simple maintenance steps to ensure a lifetime of performance from your ALLAN BLOCK wall:

- Make a thorough annual inspection of the wall.
- Correct any settling or grading problems around the wall.
- Maintain the landscape surfaces around the wall.
- Take notice of any wall movement - settling, bulging or rotation, and then take proper corrective measures.
- Control any random weed growth as necessary.
- Avoid use of salts as deicers around the wall.



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The information shown here is for use with Allan Block products only.



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Taiwan Patent #NI-72269 • Int'l. & Other Patents Pending • Doc #R0536