LIFETIME TRANSFERABLE LIMITED WARRANTY

Oldcastle® Architectural, Inc. (“Belgard”) is proud to inform you that all of our interlocking concrete paver and retaining walls (“Products”) meet and/or exceed the requirements of ASTM C-936 and ASTM C-1372. Belgard® guarantees its Products against these standards for the lifetime of the Product defined by ICPI. This guarantee does not apply to splitting, chipping or other breakage that could be caused by impact, abrasion or overloading. This warranty is transferable. The original proof of purchase is required.

This warranty is only valid if the material is installed under the guidelines of the ICPI (www.ICPI.org), The NCMA (www.NCMA.org) or the Belgard Installation Guideline Manual. Improper installation voids this warranty. This warranty is for residential applications only and does not apply to commercial applications. It is recommended that the job be installed by a Belgard Authorized Contractor who guarantees their workmanship for a minimum of 3 years from the date of install. For warranty service, contact Belgard at 1-877-BELGARD. A service representative will investigate your claim within 10 business days. If the Belgard product fails to meet the specifications, Belgard will replace the defective product at no charge. Color matching cannot be guaranteed. Belgard will not be responsible for any replacement labor, consequential damages or incidental damages. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. SOME STATES DO NOT ALLOW FOR THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

For specific information regarding warranty coverage and exclusions in regards to the Elements and Porcelain Paver products, please visit: Belgard.com/Warranty

ABOUT US

At Belgard®, we take our role as industry leaders seriously. Our rigorous research and development program is centered on innovation and quality. We never take it for granted that our products are the best in the business and constantly strive to improve and take the industry to the next level. Our overarching goal is to continue to find new and exciting ways to create beautiful outdoor spaces while maintaining incredibly high standards for product quality and performance.

Since 1995, our locally made and nationally backed products have transformed thousands of residential and commercial properties across North America. With more shapes, styles and textures than any other brand, Belgard’s Outdoor Living paving and wall products aren’t just functional, they infuse outdoor spaces with distinctive atmosphere and style.

Every day, our network of Belgard Authorized Dealers and Contractors help customers realize their outdoor dreams. And every year, we strive to improve our product and service offerings by dedicating more than 20,000 hours to research and development. By staying ahead of design trends, we are able to provide design-forward products that homeowners envision for their backyard spaces.

All of our outdoor products—when installed by a Belgard Authorized Contractor—are covered by a transferable lifetime limited warranty. That’s just part of our commitment to lasting outdoor beauty.
HELP THEM DREAM BIGGER
with Belgard Preferred Payment®

With the **Belgard Preferred Payment** financing program, you can close jobs faster by offering homeowners a way to build their dream outdoor space now, instead of delaying construction or phasing it out over several months or years.

Available only through **Belgard Authorized Contractors or Dealers**, Preferred Payment offers flexible financing options including same-as-cash terms. You can even choose to include landscaping, furniture, appliances, grills and more! Optimize labor resources and increase sales by signing up today.

TO LEARN MORE, VISIT BELGARD.COM/BPP OR CALL 877-BELGARD

**BENEFITS OF BELGARD FINANCING INCLUDE:**
- Stand above competition
- Close jobs faster
- Increase scope of projects
- Improve labor allocation
- No paperwork
- Approval by phone
- Get paid faster
Help homeowners step into their dream backyard before construction begins with FREE Virtual Reality designs from the Belgard® Design Studio.

Simply supply the Design Studio with photos of the home and rough design sketches, and our expert designers will create lifelike imagery that will have them wanting to start building immediately. Virtual Reality designs help homeowners visualize the possibilities, eliminate costly miscommunication and significantly increase closure rates.

Belgard Design Studio services are FREE for Belgard Authorized Contractors.

TO VIEW SAMPLE DESIGNS OR REQUEST FREE CUSTOM DESIGNS VISIT BELGARD.COM/VR
PAVERS & SLABS
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PAVER LAYING GUIDE
TYPICAL COMPONENTS OF INTERLOCKING CONCRETE PAVEMENT

PAVER & BEDDING LAYER

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Tolerance</th>
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<tbody>
<tr>
<td>Paver Joint Width</td>
<td>1/16-in to max. 3/16-in</td>
</tr>
<tr>
<td>Paver Surface Flatness</td>
<td>±1/8-in 10-ft (non cum.)</td>
</tr>
<tr>
<td>Lippage at Catch Basins/Drains</td>
<td>1/8-in to 1/4-in (non ADA)</td>
</tr>
<tr>
<td>Lippage between individual pavers</td>
<td>max. 1/8-in for pedestrian access routes.</td>
</tr>
<tr>
<td>Paver aspect ratio (l:t)</td>
<td>max. 4:1 for pedestrian &amp; driveways max. 3:1 for street/parking</td>
</tr>
<tr>
<td>Joint fill depth</td>
<td>max. 1/2-in measured from top of pavement</td>
</tr>
<tr>
<td>Bond lines</td>
<td>±1/2-in max. over 50-ft</td>
</tr>
<tr>
<td>Slope for drainage</td>
<td>min. 2%</td>
</tr>
<tr>
<td>Cut pavers</td>
<td>No less than 1/3-in for vehicular application No less than 3/8-in for all other applications</td>
</tr>
</tbody>
</table>

ICPI Recommendation

PAVER LAYING PATTERN
Acceptable for application

Minimum paver thickness
31/8-in for street/parking 23/8-in for pedestrian & driveways

Bedding layer thickness
1-in nominal

Joint sand gradation
ASTM C144 or C33
CSA A23.1 FA1 or CSA A179

Bedding sand gradation
ASTM C33 or CSA A23.1 FA1

BASE AND SUBBASE LAYER

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Tolerance</th>
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</thead>
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<tr>
<td>Top of base surface variation</td>
<td>± 1/16-in over 10-ft (non cum.)</td>
</tr>
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ICPI Recommendation

Base thickness variation
+ 3/4-in to -1/2-in

Compaction
min. 98% standard Proctor

Over-excavation (dense graded bases)
greater of 6-in or equal to base thickness

Geotextile
as needed

Minimum base thickness
Sidewalks, patios, pedestrian 4-in
Residential driveways 6-in
Parking lot/residential street 8-in

Edge Restraint/Curb Edge

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Tolerance</th>
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<tbody>
<tr>
<td>No Movement</td>
<td>Firmly in place</td>
</tr>
<tr>
<td>Proper Restraint</td>
<td>Acceptable for application</td>
</tr>
</tbody>
</table>

(see *Guide References on next page)

NOTES:
1. This guide does not apply to permeable interlocking concrete pavements or tumbled pavers or paving slabs.
2. Bond lines: Unless it is deemed that the pavement is not adequately restrained at the edges the bond line tolerance is considered cosmetic
3. Paving layer pattern: ICPI recommends herringbone laying pattern for all vehicular applications
4. Base thickness variation: An example of an acceptable variation is 71/2 in. to 83/4-in for an 8-in required total base thickness. The excavated cut should have the same slope and contouring as the final surface profile.
5. Minimum base thickness: These are for well drained soils. Increase thickness in colder climates or weak soils.
6. The contractor should have the discretion on cuts no less than 1/3 paver size. Sometimes it is not possible to adjust the cuts to less than 1/3 paver size without adjusting laying pattern, and sometimes it is not possible to adjust laying pattern with certain shapes.
TOLERANCE MEASUREMENT GUIDANCE

Joint widths are measured with a ruler from inside edge of paver to inside edge paver between adjacent pavers.*

*Lippage is measured from the top of a paver to the top of the adjacent paver.

Joint widths are measured with a ruler from inside edge of paver to inside edge paver between adjacent pavers.*

*Lippage is measured from the top of a paver to the top of the adjacent paver.

Paver surface flatness and top of base surface variation are measured with a straight edge for simple slopes and with a transit for complex contours.

GUIDE REFERENCES

Specification and design references
- ASCE 58-10 Structural Design of Interlocking Concrete Pavements for Municipal Streets and Roadways
- ICPI Tech Spec 4—Structural Design of Interlocking Concrete Pavement for Roads and Parking Lots
- ICPI Tech Spec 9—Guide Specification for the Construction of Interlocking Concrete Pavement

Pavement system references
- ASTM C936 Standard Specification for Solid Interlocking Concrete Paving Units
- CSA A23.1.2 Precast Concrete Pavers
- ICPI Tech Spec 1—Glossary of Terms for Segmental Concrete Pavement
- ICPI Tech Spec 2—Construction of Interlocking Concrete Pavements
- ICPI Tech Spec 4—Structural Design of Interlocking Concrete Pavement for Roads and Parking Lots
- ICPI Tech Spec 5—Cleaning, Sealing and Joint Sand Stabilization of Interlocking Concrete Pavement

Bedding and joint sand references
- ASTM C33 Standard Specification for Concrete Aggregates
- CSA A23.1 Concrete Materials and Methods of Construction
- ASTM C144 Standard Specification for Aggregate for Masonry Mortar
- CSA A179 Mortar and Grout for Unit Masonry
- ICPI Tech Spec 17—Bedding Sand Selection for Interlocking Concrete Pavements in Vehicular Applications

Base, subbase and subgrade layer references
- ASTM D 2940 Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports
- ICPI Tech Spec 2—Construction of Interlocking Concrete Pavements
- ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

Edge restraint references
- ICPI Tech Spec 3—Edge Restraints for Interlocking Concrete Pavements

*Does not refer to antiqued, natural series or permeable pavers.
INSTALL THE EDGE RESTRAINTS

Install edge restraints.

Place edge restraint on one or two sides of the area to be paved to create a square area. If installing a circle or curve, edging can be installed after pavers are placed. Anchor the edging with fasteners, approximately one fastener every 12 inches (follow instructions per edge restraint manufacturers). Before compacting pavers into the sand bed, all edging should be installed. The edging goes on the base, not on top of the sand. Remove excess sand from the edge of the paved area before installing the edging.

INSTALL THE BEDDING SAND

Install bedding sand.

Place at least two pipes of 1-inch outside diameter directly on the base. Place them 6 to 8 feet apart and parallel to each other. Spread the sand between the pipes. Use a shovel and rake to smooth it out. The sand should be moist but not wet or saturated.

Use a straight screed board to screed the sand smooth. Pull the wood across the pipes several times until the area of sand is perfectly smooth. Remove the pipes and fill the voids with sand. Level these areas with a trowel. Don’t walk on or disturb the screeded and leveled sand. Do not compact the screeded sand.

PLACE THE CONCRETE PAVERS

Install the remaining edge restraints.

Start in the corner, if you have one in your design, and check to see that it is a 90-degree corner. Place a border course around the entire edge, then place the pavers in the desired pattern.

Continue to screed bedding sand and place pavers on the sand while maintaining consistent joint widths. String lines will help keep pavers straight. Avoid screeding more sand than can be covered with pavers on the same day; exposed sand must be covered overnight.

Cut pavers as needed to fill in at the edges next to the border course. Use a diamond blade to cut the pavers.

PLACEBEDDING SAND

INSTALL REMAINING EDGE RESTRAINTS

Installing edge restraints after pavers have been installed allows for adjustments in size of paved area to help reduce pavers needing to be cut. Based on the shape and pattern we are using our 10 x 20-foot area may come to just under or over without having to cut pavers. When installing remainder of edging remember to remove sand from edge of pavers so edging sits on the base.
HELPFUL HINT FOR PAVER PROTECTION

Manufacturers of plate compactors recommend the use of mats or membranes between the compactor and pavers to protect the pavers from surface damage. Most plate compactor manufacturers sell accessories for this purpose.

Pavers with profiled tops, non-tumbled pavers and Texturgard™ paver surfaces are more susceptible to damage from plate compactors. We recommend that you always protect the pavers with any of the following materials between the paver and the plate compactor.

- Cardboard
- Thin carpeting
- Luan plywood
- Urethane rubber mat

COMPACT THE PAVERS USING A PLATE COMPACTOR

Make at least two passes over all pavers, starting at the outside of the pavement, working around the edges toward the inside. Remove and replace any pavers that crack from the compaction equipment. Adjust joints so they are consistent. A large screwdriver is effective for aligning paver joints. Avoid compacting within 6’ of the edge of an unrestrained pavement.

SPREAD DRY JOINT SAND OVER THE SURFACE

Place some sand into the joints, then vibrate and compact it into the joints, sweeping into place with broom and compacting as you go. Filling the joints with sand will take several passes with the plate compactor. Check joints with a putty knife to make sure they are full. After compaction, the sand in the joints might settle, especially after rainstorms. Apply extra sand to fill these joints as needed.

NOTE: Many recommend using polymeric jointing sand to fill the joints between pavers, which helps to stabilize the sand in the joints and control ants and weeds. Belgard® carries Techniseal® products such as HP NextGel Jointing sand. Make sure to follow all manufacturer recommendations in using and applying these products.

Find additional resources and technical specifications available online at www.icpi.org
PEAK PERFORMANCE FROM CONCRETE PAVERS

Quality concrete pavers create a surface that can last for generations when placed on a well-prepared base. They need practically no maintenance when installed to ICPI guidelines. This guide will help you get the most value from your concrete paver installation.

JOINT SAND

During the course of normal use, the sand-filled joints receive dust from traffic on the pavement. This dust settles into the top of the joints, helping to hold the sand in place. Installations exposed to driving winds or runoff, however, may lose some joint sand that can be simply replenished with dry sand. Stabilized sand can be used instead of mason sand to reduce joint sand loss. Sealers can also help hold the sand in the joints. These are applied over the entire paver surface as a liquid and allowed to soak and cure in the joints. Ask your concrete paver manufacturer or distributor about these products and their application.

PREVENTING WEEDS AND ANTS

Weeds can germinate between pavers from windblown seeds lodged in the joints. They don’t grow from the bedding sand, base or soil. Weeds can be removed by hand or with herbicides. Take care in using herbicides to not damage adjacent vegetated areas. Use biodegradable products that won’t damage other vegetation or pollute water supplies when washed from the pavement surface. Besides stabilizing the joint sand, sealers can prevent seeds from germinating and discourage ants from entering.

SNOW AND ICE REMOVAL

Concrete pavers offer outstanding freeze-thaw resistance. They can resist damage from de-icing salts better than most pavement surfaces. Snow and ice are removed with shovels or plows like any other pavement. Electric or liquid snow-melting systems work well under concrete pavers, eliminating plowing and reducing slip hazards.

EFFLORESCENCE

Efflorescence is a white haze that may appear on the surface of pavers sometime after installation. It forms as a result of a natural chemical reaction that occurs when the lime or water soluble calcium oxide, produced by the cement contained in the pavers, reacts with water. When the water enters the microscopic capillaries in the pavers, calcium hydroxide is formed. The calcium hydroxide rises to the surface of the paver, reacts with the carbon dioxide in the air, and forms a white haze of calcium carbonate when the moisture evaporates from the surface. The appearance of efflorescence stops when there isn’t any more calcium hydroxide available to move to the surface. This process sometimes can take several months.

Efflorescence does not damage pavers. However, it can be unappealing. The white haze may give the impression that the paver color is fading but this is not the case.

Efflorescence may occur randomly or be concentrated in certain areas. Dark colored pavers show efflorescence more than lighter-colored ones. If efflorescence does
occur, it can be removed with cleaners specially made for concrete pavers. Careless or improper cleaning can result in damage and discoloration to the concrete paver surfaces. Contact your Belgard sales representative for further information on efflorescence cleaners.

COLOR AND WEAR
Color in concrete pavers is achieved by adding pigment to the concrete mix during production. The cement in the concrete mix holds the pigments in place. They are very stable, showing little change in their properties over time. As the paver wears from traffic or weather, the cement and pigment particles gradually erode causing a color change over time. Like all pavements, concrete pavers receive dirt from foot or tire traffic which also changes the surface color. One way to moderate the rate of color change is by cleaning and sealing the surface of the concrete pavers. Besides enhancing their color, sealers can prevent dirt from lodging in the surface.

SETTLEMENT AND UTILITY REPAIRS
Settlement is often caused by inadequate soil or base compaction. Other factors can be water in the base or soil, too thick a layer of bedding sand, or washed out bedding and joint sand. Loose or inadequate edge restraints cause pavers to move apart and can also contribute to settlement. If the base or soil has settled and is stable, remove the pavers and bedding sand, place and compact additional base material to the correct level, then add bedding sand. The removed pavers can then be reinstated with no wasted paving materials or unsightly patches. Concrete pavers can be removed for access to underground utilities, and reinstated after repairs. When utility repairs are complete, fill the trench with base material and compact it. Remove about 18 in. (0.5 m) of pavers on either side of the opening, level the bedding sand and replenish as necessary. Reinstall the pavers, compact, fill the joints with sand and compact the surface again, filling joints as needed.

REMOVING OIL STAINS
Concrete pavers aren’t damaged by oil leaking from cars, but the stains can be difficult to remove. Stains should be treated as soon as possible since the longer they remain on the surface, the deeper they penetrate making removal harder. Wipe excess oil from the surface as soon as possible and apply liquid detergent. Allow it to soak for several minutes. Then scrub and wash the pavers with hot water. Several treatments may be necessary for particularly stubborn stains. Cleaners specially made for removing oil stains from concrete pavers are available and yield good results. In some cases, it may be simpler to replace the stained pavers with new ones. Cleaning and sealing concrete pavers early in their life can make removing stains easier since sealers prevent stains from soaking into the surface.
PAVER ESTIMATING FORMULA

AGGREGATE BASE ESTIMATING FORMULA
For this example we are using a 10’ x 15’ Rectangular patio with a 6” base.
1. Calculate the square footage of the job.
2. Divide the square footage by 200.
   (1 ton of loose aggregate covers 200 SqFt at 1” thick)
3. Multiply by the thickness of the base in inches.
4. Multiply by 1.25 to account for the compaction.
5. This gives you the number of tons of aggregate needed.

BEDDING SAND ESTIMATING FORMULA
For this example we are using a 10’ x 15’ Rectangular patio with a 6” base.
1. Calculate the square footage of the job.
2. Divide the square footage by 200.
   (1 ton of loose aggregate covers 200 SqFt at 1” thick)
3. Multiply by the thickness of the base in inches.
4. Multiply by 1.25 to account for the compaction.
5. This gives you the number of tons of bedding sand needed.

SOLDIER COURSE ESTIMATING FORMULA
For this example we are using a 10’ x 15’ Rectangular patio with Holland Stone for the Soldier course.
1. Add up the linear footage of the job.
2. Multiply the linear footage by 12 to convert to inches.
3. Divide by the width of the paving stone being used for the soldier course to get the number of stones needed.
4. Multiply the number of stones by the SqFt/Unit.
5. This gives you the amount of square footage needed.

SAILOR COURSE ESTIMATING FORMULA
For this example we are using a 10’ x 15’ Rectangular patio with Holland Stone for the Sailor course.
1. Add up the linear footage of the job.
2. Multiply the linear footage by 12 to convert to inches.
3. Divide by the length of the paving stone being used for the sailor course to get the number of stones needed.
4. Multiply the number of stones by the SqFt/Unit.
5. This gives you the amount of square footage needed.
INTERLOCKING CONCRETE PAVEMENT

Interlocking concrete pavements (ICP) are flexible pavements designed to spread loads imposed on a small area of the pavement surface through a base layer (or series of layers or sub-bases) to a large enough area of the soil subgrade that the soil subgrade can support the load without rutting.

A 1,000 lb. wheel with a footprint of 40-SQIN exerts a load on the pavement surface of 3,600 lbs./SQFT. With proper design and construction, a flexible pavement can expand the footprint to 8-SQFT on the soil subgrade, thus reducing the load on the subgrade to only 125 lbs./SQFT. In a flexible pavement, the pavement surface and base have the ability to move slightly or flex under load then recover when the load is removed.

The unique aspect of interlocking concrete pavements is that the pavers interlock to help spread the imposed loads. There are three kinds of interlock: vertical, rotational and horizontal.

**VERTICAL INTERLOCK**
This is achieved by the shear transfer of loads to surrounding units through the sand in the joints. This shear transfer also prevents one paver from moving vertically in relationship to its neighbor(s).

**ROTATIONAL INTERLOCK**
This is achieved through use of the proper paver thickness in relationship to load and use and by a perimeter edge restraint. A slight crown constructed into the pavement will increase rotational interlock and the load bearing capacity of the pavement.

**HORIZONTAL INTERLOCK**
This is achieved through the use of laying patterns that minimize the length of uninterrupted joint lines and disperse forces from braking, turning and accelerating vehicles. Certain geometrically interlocking paver shapes enhance horizontal interlock. Herringbone laying patterns provide the most effective horizontal interlock and should always be used in vehicular applications.

In summary, the contractor achieves vertical, rotational and horizontal interlock by the interaction of these factors:

**JOINT WIDTHS** - consistent joint widths of approximately 1/8-in
**JOINT SAND** - properly selected joint sand
**PAVER THICKNESS** - 60mm (2 3/8-in) for pedestrian and some residential driveways
80mm (3 1/8-in) for heavy and industrial vehicle applications
**EDGE RESTRAINT** - non-moving fixed edge restraint
**LAYING PATTERN** - minimize length of uninterrupted joint lines in all directions. The most commonly used pattern is Herringbone.
See product pages for other acceptable pattern options.
**PAVER SHAPE** - shapes which allow Herringbone type laying patterns and which geometrically interlock on two or more sides with each other
**CROWN** - slight crown in pavement cross section
OTHER PAVEMENT SYSTEMS

Other flexible pavement systems include asphalt (bituminous) pavements. These pavements are designed and function in a similar manner to ICP. Stamped asphalt is in this category.

Rigid pavements are designed to bridge or span soft areas in the soil subgrade. Rigid pavements include poured-in-place Portland cement concrete, regular poured concrete, exposed aggregate concrete, stamped or imprinted concrete and decorative pavements mortared or adhered to a concrete surface or a bituminous layer overlying concrete.

COMPARISON OF PAVEMENT SYSTEMS

Interlocking Concrete Pavements:
- Flex without cracking.
- Do not require expansion joints.
- Resistant to spilled fuel and oil.
- Resistant to freeze/thaw damage.
- Resistant to de-icing compounds.
- Virtually unlimited combination of solid and blended colors, shapes and laying patterns.
- May be used immediately upon completion of installation.
- May be disassembled to repair subgrade or underground services then reinstalled with no unsightly patch.
- Skid and slip resistant surface.
- Cooler surface.
- Easy to work to grade transitions.
- Long design life.
- Low life cycle costs.
- Virtually maintenance free.

Asphalt:
- Flexible, but more apt to crack than ICP.
- Cracks from evaporation of essential oils.
- Dissolved by spilled fuels or oil.
- Limited colors.
- Patches and repairs obvious.
- Relatively short design life.
- Must be sealed on a regular basis.
- Loses strength with increase in temperature.
- Installation requires special equipment.

Poured-in-Place Concrete:
- Cracks from load flexing and from thermal expansion and contraction.
- Difficult to effectively repair and repairs are obvious.
- Less resistant to de-icing compounds than ICP.
- Design life longer than asphalt, less than ICP.
- Must cure before use.
- Subject to environment during curing.
- Needs expansion joints.
- Stamped concrete typically colored only on the top.

COMPONENTS OF THE ICP SYSTEM

The eight components of the ICP system are:

SUBGRADE

The in-place soil on which the pavement will be constructed. The characteristics of the subgrade soil have a major effect on the design and performance of the pavement and can also impact construction time and cost. The gradation, or distribution of the various size particles making up the subgrade soil, greatly influences the ability of the subgrade to support loads. Soils range from coarse grained sands to silts and clays which contain the smallest particles. The smaller the particle size, the less strength the subgrade will have. Clay soils are, in general, the weakest. The three most common methods used to rate or classify soils are discussed in Appendix A.
It is recommended a soil sieve analysis, proctor density testing and nuclear density gauge or other compaction testing takes place for residential driveways and pavements intended to endure higher ESALs. This may not be monetarily practical for most residential projects. Therefore, a simple way to quickly classify soils in the field is by visual appearance and feel. If coarse grains can be seen and the soil feels gritty when rubbed between the fingers, then it is a sandy soil. If the grains cannot be seen with the naked eye and it feels smooth, then it is a silt or clay. Don't be fooled by the apparent solidity of clay soils, they shift under loads.

A primary factor in the performance of soil under pavement is its ability to hold water. The higher the water holding ability, the worse the soil generally performs as a foundation for pavement. Some easy ways for the contractor to make a quick field identification are described below.

**Patty Test - Evaluating the water holding capacity of a soil:**
- Mix the soil with enough water to make a putty-like consistency.
- Form the sample into a patty, let it dry completely.
- The greater the effort required to break the patty with fingers, the greater the plasticity, or ability to hold water. The more water the soil can hold, the less suitable it is under pavement.
- High dry-strength is a characteristic of clays. Silts and silty sands will break easily.

**Shake Test - The dilatancy test, or a test for reaction to shaking:**
- Mix a tablespoon (15 ml.) of water with the soil sample in the hand. The sample should be soft but not sticky.
- Shake or jolt the sample in a closed palm of the hand a few times.
- If water comes to the surface, the soil is fine sand.
- If none or a little comes to the surface, it is silt or clay.
- If squeezing the soil between the fingers causes the moisture to disappear, the soil is sandy.
- If moisture does not readily disappear, then the soil is silty.
- If moisture does not disappear at all, the soil is clay.

**Snake Test - Evaluating the thread toughness for clay content:**
- A small sample of soil is moistened to the point where it is soft but not muddy or sticky.
- It is rolled into a thread or “snake” between the hands.
- The longer the thread, and the more it can be rolled without breaking, the higher the clay content.
- The subgrade must be compacted to at least 98 percent of Standard Proctor Density before the base is installed.

**GEOTEXTILE**

Sometimes called filter cloth or soil separation fabric. A layer of woven or non-woven fabric placed between the subgrade and base to prevent the two layers from mixing under repetitive traffic loading. A Geotextile should be used if the subgrade is clay or is poorly drained and apt to stay wet for extended periods. Use of geotextile does not substitute for base thickness. Check with your Authorized Belgard Distributor for the proper Geotextile.

**SUB-BASE**

A compacted layer or layers of specified material placed on the subgrade to support the base. Sub-bases are used primarily in heavy duty pavements or in areas with poor subgrade material. Sub-base is an optional layer depending on soil and site conditions, and typically consists of a larger aggregate mixed with cementitious materials and/or lime. An engineer should be consulted on projects where a sub-base may be required.
BASE
A layer of specified material of a designed thickness placed on the subgrade (or sub-base) to support the pavement surface. In an ICP, the most common base material is a compacted layer of Dense Graded Aggregate (DGA). Do not use stone dust or screenings.
The chart at right serves as a guideline for base construction for driveways, patios, walks and pool decks. In very cold winter climates, or in soils that retain excess water, thickness may be increased by two to six inches.
Check with your Authorized Belgard Distributor for the proper DGA for your area.

EDGE RESTRAINT
A specially designed edging, curb, building or other stationary object that contains the bedding sand and pavers so they do not spread and lose interlock. There are many plastic, aluminum and steel edge restraints specifically designed for use with unit pavers.
In addition to the specially designed edge restraints, poured-in-place concrete structures and treated timbers may be used. Timbers are not recommended. Troweled concrete is not recommended in freeze-thaw areas. Pavements adjacent to asphalt should be restrained with a concrete header between the pavers and asphalt. A soldier course is recommended as a restraint within a pavement where there is a chance in pattern, shape or slope. Consult your Belgard representative when encountering these job site conditions.

SAND SETTING BED
A layer of coarse, clean sand loose screeded to a thickness of one (1) inch over the base layer for bedding the pavers. When the pavers are compacted into the sand bedding layer, some sand enters the joints between the pavers from the bottom and begins the process of vertical interlock. The sand layer also allows the compaction process to achieve a smooth pavement surface, compensating for any minor differences in paver thickness. Do not compact the sand setting bed before setting pavers.
The bedding sand may be natural or man made but should conform to the requirements of ASTM C33. Do not use mason or play sand, stone dust or screenings. The gradation of ASTM C33 is included in Appendix A.

INTERLOCKING CONCRETE PAVERS
A concrete paver unit meeting requirements of ASTM C936. The pavers shall be capable of being lifted and placed with one hand, and shall have an exposed face (top surface) area less than or equal to 100.75 sq. in. The aspect ratio (that is, overall length divided by thickness) shall be equal to or less than 4. A 12 in. x 12 in. paver does not qualify because it has a top surface area greater than 100.75 sq. in. Paving slabs do not interlock the same as pavers and there are slight installation differences between the two. Contact your Belgard representative for details.
Other requirements of concrete pavers are:
• Average compressive strength not less than 8,000 lbs. per sq. in.
• Laboratory resistance to freezing and thawing. Less than 5 percent absorption.
• Dimensional tolerance. No more than ±1/8” in height, ±1/16” on length and width.
• Optional abrasion resistance.

These requirements of ASTM C936 insure a uniform durable paver unit.
Concrete pavers are typically manufactured in two thicknesses. Pavers 2-3/8 in. (60mm.) thick are used for pedestrian applications such as walkways, patios, plazas and pool decks. They may also be used in residential driveways. Some pavers 3-1/8 in. (80mm.) thick are used in vehicular traffic and heavy duty applications.
JOINT SAND

The sand used to fill the joint spaces between pavers to achieve vertical interlock. This sand must be clean, sharp, durable and well graded. Generally, it is best to use the same washed concrete sand (ASTM C33) used for the bedding layer as the joint sand. This is especially important in vehicular trafficked ICP. The sand should be spread, allowed to dry, then placed into the joints. The process can be accelerated if after the initial placement, a plate compactor is run over the pavement while the placing is continued. Finer sand conforming to ASTM C144 specifications may be used in pedestrian and residential driveway applications. Do not use non-conforming masonry sand, box or play sand, stone dust or screenings. The recommended gradation for the joint sand may be found in Appendix A.

Be sure the joints are filled with sand using a putty knife. In some cases it may be necessary to re-sand the job in two - three weeks.

SUMMARY:
The components of a typical ICP are:

- Subgrade
- Geotextile (if needed)
- Sub-base (if needed)
- Base
- Bedding Sand
- Edge Restraint
- Interlocking Concrete Pavers
- Joint Sand

Detailed information on the materials used is contained in Appendix A.

The following best practices apply to most residential projects. Commercial, street, parking lot, permeable, industrial, mechanical installs, overlays, inlays and other paving applications may require other base, sub-base and setting bed materials and techniques as well as engineering design. Contact Belgard for details on these specialty applications.
TOOLS, SUPPLIES AND EQUIPMENT

Most of the tools, supplies and equipment needed to install ICP are common to contractors involved in residential site work. The heavier and more expensive equipment may be easily rented if the work volume justifies the purchase. Some tools have been designed especially to facilitate the installation of ICP and are available through your Authorized Belgard Distributor.

Some special tools designed specifically for the ICP industry:
- Paver Cart - to transport full straps of pavers
- Paver Extractor - to remove installed pavers
- Dead Blow Rubber Hammer - to help adjust pavers
- Paver Scribe - to mark pavers for cutting
- Paver Adjuster - to move installed pavers to straighten lines

Personal Safety and Comfort Supplies:
- Eye Protection
- Ear Protection (muffs or plugs)
- Dust Mask (disposable)
- Steel Toed Shoes
- Gloves
- Knee Pads
- Back Support
- Finger Tape (can use duct tape)
- First Aid Kit
- Water Cooler

Expendable Supplies:
- Mason String Line
- Chalk for Chalk Line
- Marking Crayon (keel)
- Flagging Tape
- 2 ft. Wood Stakes
- Diamond Saw Blades
- Fuel & Oil
- Spray Marking Paint
- Steel Garden Rake
- Shovel(s) Round Point
- Push Broom
- Slim Jim Pry Bar
- Contractor’s Wheel Barrow
- 36 in. Crow Bar
- Screed Board (Magnesium) or 10 ft.-12 ft. wood 2x4’s
- Large Flat Blade Screw Drivers
- Screed Rails 3/4 in. ID Steel Pipe or 1 in. Square Steel tubing approximately10 ft. long (a couple of 4 ft. pieces are handy)
- Hacksaw
- Carpenter’s Saw
- Plumb Bob
- Garden Hose (75 ft.-100 ft.)
- Chalk Line
- Hand Tamper

Equipment:
Installation equipment may be owned or rented. The most common equipment needed is:
- Builders level or transit level with tripod and rod. Laser levels are excellent.
- Vibratory plate compactor rated minimum 5000 ft. lbs.
- Masonry saw
- Table saw, wet or dry, or a hand held cut-off saw. Either should be gasoline powered. A hand held cut-off saw is the most flexible and productive.

Heavy Equipment:
- Skid-Steer Loader capable of lifting 5000 lbs. - equipped with interchangeable bucket, forks and rotary broom
- Vibratory Roller - used for subgrade and base compaction on larger jobs
- Jumping Jack Compactor - for compacting trenches
- Backhoe - for excavation (especially demolition)
- Dump Truck - to haul excavated materials and to deliver material to job site
CONSTRUCTING THE ICP

UTILITY LOCATION
Before beginning any phase of the construction process, make sure that all underground utilities, services and structures have been located and clearly marked on the ground surface in all areas involved in the construction process including access lanes. In many areas, a single number such as Miss Utilities may be called.

Items to be located are:
• Electrical
• Sanitary sewer
• Gas
• Septic tank
• Water supply
• Telephone
• Storm sewer
• Cable TV
• Drainfield
• Irrigation piping

Double check; there may be other items particular to the job site.

SITE ACCESS
Before any demolition, delivery or construction equipment is allowed on site, make sure that there are no hazardous conditions such as overhead electric lines in the way. Plan all activities so that no damage will occur to existing pavements, structures, trees, shrubbery, gardens or other site amenities.

LAYOUT
Identify the area to be excavated and mark it on the ground with spray paint. Make sure the area to be excavated is at least 12 in. wider on all outside edges than the size of the pavement.

Place grade stakes with string lines just outside the area to be excavated, making sure that the excavation is at least 12 in. wider than the edge of pavement. Mark the elevations on the stakes so that the depth of excavation can be checked as it progresses. Use nylon mason’s line and set it at the finished elevation of the pavement. Measure all excavations and base thickness from these lines. Set the initial elevations and check them at the beginning of each day with a builders level. The stakes can be moved at night by mischievous persons.

String lines set at final or finished elevations should be sloped. All lines (and final elevations of the pavement) should slope away from the house or building. The minimum recommended slope is 1.5 percent or a drop of 3/16 in. for every foot of pavement. Many pavements are sloped at 2 percent or 1/4 in. per every foot of pavement as this will better facilitate drainage. The maximum slope for comfortable walking is 7 degrees or about 12 percent. A builders level should be used to establish elevations using marks on stakes set around the area to be paved.
EXCAVATION / SUBGRADE

Make sure that the area to be excavated is at least 12 in. wider than the limits of the ICP. This provides a firm base to support the edge of the pavement and the edge restraint.

Make sure that the depth to be excavated is measured from finished pavement surface elevations and is marked on all grade stakes. The bottom of excavations, below finished pavement elevation, should equal the total thickness of the designed base, sand bed (after paver installation and compaction) and the paver being used.

Try not to disturb the subgrade below the planned excavation depth. Over excavation is costly and can cause future problems.

When all excavation is completed, compact the subgrade with a vibratory plate compactor. Make sure that compaction is thorough, uniform and complete. If soft spots are encountered, they should be removed and backfilled with the material to be used for the base. If the subgrade is too wet to compact, allow it to dry or try adding a few inches of dry base material before compacting. If the subgrade is too dry however, water should be added with a hose to help achieve its maximum density after compaction.

EXCAVATION CHART

Remove existing sod and soil

<table>
<thead>
<tr>
<th>PAVERS</th>
<th>WELL DRAINED AREA/UNDISTURBED SOIL</th>
<th>POORLY DRAINED AREA/DISTURBED SOIL</th>
<th>PAVER THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Granular base</td>
<td>Bedding course</td>
<td>Granular base</td>
</tr>
<tr>
<td>PEDESTRIAN TRAFFIC, PATIOS, WALKWAYS, POOL DECKS</td>
<td>4” (100 MM)</td>
<td>1” (25 MM)</td>
<td>6” (150 MM)</td>
</tr>
<tr>
<td>VEHICULAR TRAFFIC RESIDENTIAL DRIVEWAYS</td>
<td>8” (200 MM)</td>
<td>1” (25 MM)</td>
<td>12” (300 MM)</td>
</tr>
</tbody>
</table>

Total excavation = Granular base + bedding course + paver thickness - ½” (13 mm) for an uncompacted bedding thickness

BASE

The recommended DGA base material (see Appendix A) should be spread in layers of uniform thickness then compacted. The thickness of the layer depends on the method of compaction and the planned use of the pavement. While compaction of the subgrade and base layers is key to the performance of any pavement, it is absolutely essential to pavements trafficked by vehicles. The 4 in. 6 in. base for patios, walkways and pool decks may be placed in two or three layers and compacted with a vibratory plate compactor of 5,000 ft. lbs. of force or greater. Maximum efficiencies can be achieved using a 7600 pound plate compactor to compact 4-6” lifts. The base should be compacted to 98% proctor density.
Place and compact the base material as recommended, making sure to keep the material lightly dampened. If free water appears on the base surface during compaction, the material is too wet and should be allowed to dry (or add a layer of dryer base material) before continuing compaction.

Be sure to thoroughly compact along edges, in corners and around structures. These are the most difficult areas to treat and the most apt to cause future settlement problems.

Do not use frozen base material and do not place base material over a frozen subgrade.

Be sure that the outside limits are at least 12 in. wider than the outside limits of the pavement.

When proper compaction of DGA has been achieved, the surface should be smooth, leave no areas into which the bedding sand can migrate. It may be necessary to fill any such areas with a finer material then recompact. The finished base surface should be flat (no more than 3/8 in. plus or minus variation under a 10 ft. straight edge) and uniformly true to grade.

Summary:
• Base must be 12 in. wider than pavement on all sides.
• Use proper base material.
• Do not place frozen base material.
• Do not place base material over frozen subgrade.
• Place and fully compact base in layers.

EDGE RESTRAINT

Edge restraints must be installed on that part of the pavement edge which is not restrained by an existing structure such as a building, concrete curb or concrete slab.

Edge restraints are typically placed before installing the bedding sand and pavers. Some edge restraints can be installed after placement of the pavers and before compaction.

A detailed description of the various types of edge restraints is contained in Appendix A. Consult your Authorized Belgard Distributor for the edge restraint(s) recommended for your area. Also refer to ICPI Tech Spec 3 “Edge Restraints for Interlocking Concrete Pavements”.

Be sure that any area where bedding or joint sand can escape through or under the edge restraint is lined with a strip of Geotextile. Loss of sand will cause eventual settlement of the pavers. This also applies to any concrete or hardscape structure that abuts the pavers.

Back fill outside of edge restraint as soon as possible to prevent sand from escaping under the edge restraint.

SAND SETTING BED

Loose screed the washed concrete sand (see Appendix A) to an uniform thickness of 1 in. over the compacted base course. In no case should the sand be greater than 1-1/2 in. thick.

If the edge restraint has already been installed, the screed board may be notched to ride on the edge restraint on one or both ends. The notch should be cut to allow for the screeding of a 1 in. thick sand layer.

If the edge restraint cannot be used to carry the screed board, screed rails must be used. Screed rails may be wood, plastic or iron pipe or square steel tubing. The rails should be sized to allow for a 1 in. thick sand bed. For example, a 3/4 in. iron pipe (3/4 in. is the inside pipe diameter) has an outside diameter of approximately 1 in.

Place the screed rails parallel to each other and close enough together to enable the screed board to be pulled along the rails without falling off. Set the top of the rails to the desired elevation below grade lines and stabilize by hand packing sand along both sides of the rail.

Place the washed concrete sand between the screed rails and rough screed with a shovel, steel rake or lute. Excess sand makes the screed board difficult to pull. Place screed board on the rails and draw forward leaving a smooth surface. Fill in and rescrew any open streaks.

When a screed rail is no longer needed, it should be carefully removed and the void filled with sand and hand floated. Do not compact the sand setting bed before laying pavers.
PAVERS

In most ICP projects, the pavers, regardless of paver shape, are laid in patterns where two sets of joints run perpendicular to each other. Radii or curves are cut into the pavement after the field pavers have been laid but not compacted. Straight joint lines not only make the finished pavement look clean and sharp but make installation much easier. If pavers shaped to geometrically interlock with each other are not laid in straight lines, they will not fit together.

To keep joint lines straight, parallel string lines or chalk lines snapped on the sand setting bed should be used. The lines should be spaced five to ten feet apart with the spacing equal to the laying modulus of the paver shape being installed. This can be determined by laying a course of pavers in the proper pattern with 1/8 in. joints and measuring the distance between at the desired line separation distance.

Procedure:
• Snap a string line on the screeded sand in the center of the area(s) to be placed.
• The line should be perpendicular to the laying face.
• Place pavers in the given laying pattern on both sides of the line.
• If additional lines are snapped, they should be parallel to each other. Check this by measuring the distances at the opposite ends of each line. They should be equal.
• If they are not parallel, they can be erased and snapped again. Parallel chalk lines snapped in bedding sand or string lines pulled above sand and pavers. Parallel string lines are also used to pave around openings in the pavement such as manholes or swimming pools.

Procedure:
• Pull perpendicular string or snap chalk lines on all four sides of the opening.
• Lay pavers on one side, then the other.
• Count the courses needed to surround the openings on each side. They should be equal in number on both sides.
• Then fill around the remaining side of the opening.
• Cut pavers to fit and fill against the edge restraint around the opening.

Plan your installation to begin along a straight line and preferably in a corner which is easily accessible. Make absolutely certain that the beginning corner is a true 90 degree angle. If the intersection of 2 sides is not a true 90 degree angle, you must establish a 90 degree starting point.
A quick way to establish a line perpendicular to an edge (no corner walls) is with the following procedure:

- Measure and mark the length of the edge, or line, from which paving will begin. The line can be 10-20 ft. (3-7m.) long. This line is where an edge restraint will be placed, or where one is already placed.
- Mark exactly the half way point on the line that was just measured. In other words, divide the line in half.
- Take one tape measure and extend it from the other end of the line at an angle toward the center. Be sure the tape extends past the middle of the line by a foot or two (0.2m.-0.6m.).
- Take a second tape measure and extend it from the other end of the line at an angle toward the center.
- Overlap one tape on the other and match the length of both tapes. The same marked dimensions on each tape should be touching each other.
- Snap a line from the point where the two tape measures cross to the center of the line.
- This line is perpendicular to the line from which paving will begin.

3:4:5 Triangle may be used to establish a 90 degree angle or to check existing corners:
STARTING LAYING PATTERNS

Starting the first few rows of the pavement requires attention to the order of placing the pavers. The proper order for beginning herringbone patterns with a rectangular paver is illustrated below. The installation begins at a 90 degree corner.

When placing the pavers, it is important to maintain consistent joint spacing of 1/16 in. to 3/16 in. Consistent joint width of approximately 1/8 in. will spread loads (vertical interlock) better than wider joints. Consistent joint spacing will result in a neat and orderly appearance of the finished pavement.

The 1/16 in. spacer ribs molded into the sides of pavers are to ensure a minimal joint and that at least some sand can enter the joints between pavers. They are not intended to be the spacing mechanism. The best way to maintain joint consistency during paving is by the “click and drop” method.

Click and Drop Procedure:
- While holding a paver, the bottom 1/4 in. to 1/2 in. should “click” firmly against the top portion of the side of the pavers already placed.
- Do not hit the previously placed pavers so hard that they move.
- Release grip, dropping the paver an inch or so directly downward. A slight pressure with fingers will ensure that the paver does not move away from those already placed.

CUTTING PAVERS

Pavers may be cut with any one of three basic pieces of equipment. They are:
- Mechanical or guillotine splitter
- Masonry saw
- Hand held cut-off saw

Mechanical or guillotine cutters are relatively inexpensive to buy but produce the least desirable results. Masonry saws may be either gasoline engine or electric motor driven. They may be hand held or mounted on a stand. Hand held cut-off saws are the most convenient and produce the best overall combination of quality and productivity.

Visit OSHA.GOV for the most up to date regulations.
EDGE PAVERS AND PAVER CUTTING

Especially manufactured edge units are available for some paver shapes. Check with your Authorized Belgard Dealer for availability of these units.

In most cases, pavers along the pavement edges will need to be cut. The four types of cutting equipment generally available are:

- **Mechanical cutter or guillotine splitter.** This equipment cuts pavers between two steel blades through hydraulic or mechanical pressure. The cutting process is quick but the cut edge tends to be rough. The equipment is relatively inexpensive.

- **Gasoline or electric powered saws mounted on a stand.** These saws are generally set up to be run wet but can be run with a dry diamond blade. Very accurate cuts can be made but in most cases the pavers must be marked, brought to the saw, cut, then returned to the edge and installed. The process is labor intensive. Gasoline powered saws may be mounted on a coxet to facilitate the process.

- **Walk behind diamond saw.** Powered in most cases by a gasoline engine, the units roll on wheels while cutting. They are usually set up to run wet but can use a dry diamond blade. The advantage is that the pavers may be cut in place. The quality of cut is excellent but the saws are awkward to maneuver.

- **Gasoline powered cut-off or quick saws.** These hand held saws are similar to chain saws with the diamond saw blade replacing the chain. While some cut-off saws can be run wet, most are used with dry blades. These units provide good output and, in the hands of an experienced operator, excellent quality of cut. Cut-off saws have become the most used equipment for cutting pavers.

**Tips**

Diamond saw blades come in wet or dry versions. Dry blades may be run wet but wet blades should never be run dry. Use of water with either type blade extends blade life.

Care must be taken to make sure that the slurry (mixture of water and cutting dust) from wet saws or dust from dry saws is washed off installed pavers immediately before it dries. Surrounding structures, vegetation and automobiles should be protected from the dust. Cut-off saws with dust collection capability have recently become available. Check with your Authorized Belgard Dealer for the proper cutting equipment.

**Marking Procedure**

Mark lines to be cut with lumber pencil or crayon, chalk, welders soapstone or water-base liquid market. Do not use a marker which will not eventually come off. It is best to use a color which is easily visible against the color of the paver. Curved lines may be marked by using a garden hose as a guide.

No dimension of the final cut piece may be smaller than 3/8”. Pavers for vehicular use cannot be smaller than 1/3 the original size. Placing 1/2 pieces in the field may also allow for larger cut pieces at the edges. A border or header course of whole pavers between the field pavers and the edge restraint tends to keep the cut field pavers in place better than the edge restraint alone. The border pavers also add a neat finished appearance to the pavement.

Cut and place all edger pieces before compacting the pavers and applying joint sand.

**Summary:**

- Use proper hand, eye, ear and respiratory protection equipment.
- Mark lines to be cut.
- Maximize size of cut pieces to remain in pavement.
- Make clean neat cuts.
- Make all cuts before compacting pavement.
- Clean all cut residue from pavement immediately.
- Use paver border or header course as often as possible

Visit OSHA.GOV for the most up to date regulations.
PAVEMENT COMPACTION AND JOINT SANDING

Compaction of the ICP evens the tops of the pavers and begins the process of vertical interlock by forcing some of the bedding into the joints from the bottom.

On small jobs, compaction should take place after all pavers, including cut edges, are in place. On jobs lasting more than one day, all pavers placed should be compacted and the joints filled at the end of the workday. Do not compact or fill joints within 6 ft. of any unrestrained or incomplete edge. Do not spread joint sand before initial compaction of pavement.

Using a gasoline powered vibratory plate compactor with a minimum compaction force of 5000 ft. lbs. for 3-1/8 in. pavers, follow this procedure:

Compacting Procedure
- Start on one edge of the pavement and compact the perimeter.
- Compact in overlapping rows on the rest of pavement.
- Compact the pavement again but in the opposite direction. All pavers will need to be exposed to at least two passes of the compactor.
- Do not compact within 6 ft. of an unrestrained edge or the pavers will creep out.
- The operator looks for broken pavers just behind the plate compactor and marks them while compacting. The broken pavers are removed with a paver extractor and replaced with whole units.

JOINT SANDING

After compaction of pavement and replacement and re-compaction of replacement pavers, spread the joint sand. Refer to Section 2, Joint Sand for recommended sands. Dry sand works best, so if the sand is damp, allow it to dry. Place the dry sand into the joints. If necessary, dry bagged sand conforming to ASTM C144 may be used (see Appendix A). Do not use mason sand, play sand or sandbox sand or stonedust or screenings. After the initial setting, the filling of the joints can be expedited by alternating filling and passes of the vibratory plate compactor. Continue until all joints are filled. It is a good idea to reinspect a job two to three weeks after completion at which time it may be necessary to repeat the placement process.

Figure 3 Right

Compaction sequence working from the perimeter to the center of the pavement. All pavers should have two passes of the plate vibrator over them prior to filling the joints. After the joints are filled with sand, follow the same compaction sequence from the perimeter to the center.

Summary:
- Compact pavement after pavers are installed and before joint sand is spread.
- Replace broken pavers while compacting and before applying joint sand.
- Spread and dry joint sand.
- Place joint sand into joints and fill by alternating filling and vibrating.
- Check job in 2-3 weeks and re-sand if necessary.
COMPLETION OF PROJECT
When the installation has been completed, clean up the site. Some pavers of each shape and color used may be left with owner for possible future replacement. Store these pavers neatly where the owner directs. Walk the job with the owner and address any problems immediately. Review maintenance procedures with the owner and leave information regarding care and maintenance with him/her.

ESTIMATING MATERIALS

EXCAVATION
Calculate the area to be excavated. Remember to include the 12 in. outside the area to be paved. If an electronic digitizer is not available, break the area down into geometric shapes (squares, rectangles, triangles or circles), calculate the area of each, then add all together to arrive at total area in square feet.
Calculate volume of soil to be excavated by multiplying the total area in square feet by the depth to be excavated in feet. This will give the total cubic feet of soil to be excavated. In most residential projects, the depth to be excavated is uniform or easily averaged over the area to be paved. If the pavement is to be cut into a hill slope or will be built partially over an area to be filled, be sure to consider these conditions in your estimate. In the first case, more material will need to be excavated and disposed of. Some or all of that material may possibly be used as fill.
When soil is excavated it expands in volume. This expansion is called “swell” and ranges from 30 percent for clay to 15 percent for sand with “average” soil expanding about 25 percent. If the average soil expands 25 percent then the volume after excavation, or loose volume, is 125 percent greater than the volume of the soil in place. Thus, if the calculated in place volume of the soil to be excavated is 100 cubic yards, the volume to be hauled is approximately 125 cu. yds. (100 x 1.25).
Since the volume of soil increases when excavated, the weight per unit of volume must decrease.
The average soil weighs approximately 3250 lbs. (1.625 tons) per cubic yard in place and approximately 2600 lbs. (1.3 tons) per cu. yds. after excavation. Thus, the 125 cu. yds. to be hauled in the last example would weigh 162.5 tons (125 x 1.3).
Knowing the volume and weight of soil to be excavated, hauled and disposed of is absolutely necessary to accurately estimate time and cost. More detailed information is contained in Appendix A-Materials.

BASE
Calculate the base material by multiplying the area excavated in square feet by the design depth of the base in feet after compaction. Divide the result by 27 to obtain the cubic yards of base material needed in the compacted state.
Since the base material will usually be purchased by the ton, the volume needed after compaction must be converted from cubic yards to tons. This conversion can be made accurately if the bulk density of the base material is known. If the bulk density is not known, multiply the calculated volume needed by 1.6 to get tons needed. See Appendix A for calculations.

BEDDING SAND
The quantity of bedding sand will vary with the thickness of the loose screeded sand bed, 1 in. to 1-1/2 in., and with the moisture content of the sand being delivered. A good rule of thumb, however, is to order 1/2 ton of ASTM C33, washed concrete sand for every 100 sq. ft. of installed pavement. This should suffice for both the bedding and joint filling.

PAVERS
In simple straightforward projects requiring no cutting loss, the quantity of pavers to be ordered is equal to the area of the pavement, plus a 2 percent cull factor rounded up to the next highest package unit. In some cases it may be possible to order pavers in straps or section quantities while in others it may be necessary to order full cubes.
An additional quantity must be added for portions of pavers lost on edges which must be cut. A good rule of thumb is to add 30 sq. ft. of pavers for each 100 linear ft. of cut edge.
Edge pavers must be calculated separately for each paver shape. This information is available in the Product Guide available from your Authorized Belgard Dealer. Remember, edge pavers are only available for a limited number of paver shapes and may only be used on straight edges parallel to the laying pattern.
Border pavers, such as a header course, must be calculated based on the paver shape being used and the border pattern to be installed. In the common soldier course border using a 4 in. x 8 in. rectangular paver, 3 pavers are needed per 1 ft. of border or 0.67 sq. ft. of 4 in. x 8 in. pavers. The ordered quantity would be 0.67 x the lineal feet of border plus 2 percent rounded up to the next package unit.

If bands are to be inset into the paver field, it is usually best to lay the entire field then saw cut and remove field pavers to install the band pavers. In this case, do not deduct the quantity of band pavers from the gross field pavers required.

**JOINT SAND**

If the same sand used to fill the joints is used for the sand setting bed, the quantity will be included in the bedding sand estimate.

In non-vehicular residential projects, such as patios, dry bagged sand may be used. Use an all purpose or construction sand. Do not use play sand or sandbox sand. All purpose sand is generally packaged in 60 lb. bags. Use the table below to estimate quantity needed:

<table>
<thead>
<tr>
<th>Lbs./100 sq. ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 cm. (2 3/8 in.) pavers w/ 1/8 in. joint</td>
</tr>
<tr>
<td>8 cm. (3 1/8 in.) pavers w/ 1/8 in. joint</td>
</tr>
<tr>
<td>6 cm. (2 3/8 in.) pavers w/ rounded corners</td>
</tr>
<tr>
<td>8 cm. (3 1/8 in.) pavers w/ rounded corners</td>
</tr>
</tbody>
</table>

If the sand used for the sand setting bed is not used for filling the joints, the sand used should meet the gradation requirements of ASTM C144.

**ASTM C144 - Gradation of Joint Sand**

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>100</td>
</tr>
<tr>
<td>No. 8</td>
<td>95-100</td>
</tr>
<tr>
<td>No. 16</td>
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<tr>
<td>No. 30</td>
<td>40-75</td>
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<tr>
<td>No. 50</td>
<td>20-40</td>
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<tr>
<td>No. 100</td>
<td>10-25</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-10</td>
</tr>
</tbody>
</table>

**NOTE:**
- Do not use sandbox or play sand.
- Do not use stone dust.
- Do not use Mason sand.

**EDGE RESTRAINT**

The lineal feet of edge restraint required is simply the total feet of pavement edge which must be restrained by the specified edge restraint system. In many cases, both straight and curved restraints must be installed. Total quantities of each should be estimated.

If the edge restraint to be used requires stakes or spikes, this quantity must also be estimated. Space stakes or spikes as recommended by the manufacturer of the edge restraint system used. This information may be obtained from your Authorized Belgard Dealer.

Restraints hold the pavers tightly together, enabling consistent interlock of the units across the entire pavement. They prevent pavers from spreading due to horizontal forces from tires and minor settlement. Edge restraints are designed to remain stationary while receiving occasional impacts from tires.

When a compacted aggregate base supports the paver and bedding sand, the base should extend beyond the restraint. The rule of thumb is that the base should extend beyond the restraint the same dimension as the thickness of the base material. For example, if the base is 6 in. thick, then it should extend at least 6 in. beyond the outside edge of the restraints. This contributes stability to the restraint and pavement edge especially in soils subject to heaving. Soil backfield is never a suitable edge restraint and should never be installed on top of the bedding sand.

If there is a possibility of sand loss from beneath the pavers, or between the joints of the edge restraint, Geotextile (filter cloth) is recommended to prevent its migration. A 12 in. (0.3m.) wide strip can be applied along the base and...
turned up along the sides of the restraints. Filter cloth generally is not required across the entire surface of the base, nor should it be placed on top of the bedding sand.

There are two general types of edge restraints. Those made elsewhere and installed at the site include precast concrete, plastic, cut stone, aluminum, steel and timber. Restraints formed on-site are made of poured-in-place concrete.

Full depth precast concrete or cut stone edging generally extends the depth of the base material. They can be compacted soil (not subject to heaving), compacted aggregate or concrete backfield. The preferred method of installation with vehicular pavements is for the curb to rest on the compacted aggregate road base.

Partial depth precast concrete edge restraints may be used for residential and light duty commercial applications. These precast units are anchored on a compacted aggregate base with steel spikes. The spikes are typically 3/8 in. diameter. Depending on the design, the top on the concrete edge can be hidden or exposed.

Aluminum and steel edging should be selected to provide a smooth vertical surface against the pavers. L-shaped edging provides additional stability. Stakes fastened to the edging should be below the pavers or on the outside of the restraints. Steel should be painted or galvanized so that rust does not stain the pavers. Spikes to secure steel and aluminum edging should extend well into the base course. Consult manufacturer’s literature for recommended spacing of the spikes. Aluminum and steel edgings are manufactured in different thickness. The thickest edging is recommended when pavers are subjected to vehicular traffic.

Troweled concrete should not be used in freeze-thaw climates. Timber should not be used. A concrete header is recommended between asphalt and pavers.

Plastic edging installs quickly and will not rust or rot. Plastic edging should be specifically designed for use with pavers. It can be used with light duty residential, commercial or on some heavy duty, industrial applications, depending on the design. It should be firmly anchored into the compacted aggregate base course with steel spikes. Consult the manufacturer’s literature for the recommended spacing of the spikes. Edging for planting beds and lower gardens is not an acceptable restraint for interlocking concrete pavements.

Elevations should be set accurately for restraints that rest on the base. For example, 2 3/8 in. thick pavers with 1 1/4 in. of bedding sand would have a base elevation set 3 in. below that of the finish elevation of the pavers. This allows 1/4 in. settlement from compaction and 1/8 in. for minor settling over time.

Restraints formed on-site, poured-in-place concrete curbs, or combination curb and gutters required by municipalities make suitable restraints for pavers. Exposed concrete edges should have a 1/8 in. radius edge to reduce the likelihood of chipping. As with precast, the side of the curbs should extend well below the sand bedding course.

Troweled concrete curbs are not recommended in freezing climates as they may crack and be an on-going maintenance problem. The second letter describes a secondary soil type, the gradation or the ability of the soil to retain water. Gradation (variation in particle sizes)

W = well-graded (high variation - good for pavements)
P = poorly graded (low variation - not good for pavements)

Liquid Limit Symbols (Liquid limit is the ability of the soil to hold water)

H = high (can hold water, does not drain well - not good for pavements)
L = low (does not hold water, drains well - good for pavements)
APPENDIX A

MATERIALS

GENERAL
Gradation of subgrade soil, base material and bedding and joint sands is an important property of these materials. The size and distribution of their particle sizes greatly influence their performance under interlocking concrete pavements and therefore the performance of the pavement. Gradation is determined by placing a known weight of dry material in the uppermost of a stack of sieves or screens. Each sieve going down the stack has smaller openings than the one above it with the bottom unit a pan to catch the finest particles. After the sieves are shaken for a specified amount of time, the material retained on each sieve is weighed and the percentage of material passing each sieve is calculated. There are standardized ASTM tests for determining the gradations of soils, base materials, bedding and joint sands.

SUBGRADE SOILS
Subgrade soils range in particle size from coarse grained sands to fine grained silts and the finest grained clays. Most soils are a combination of the three particle size categories. In general, the soils containing a high percentage of clay particles are less suitable for good subgrade support of a pavement. Of the several systems used to classify soils with respect to their ability to support a pavement system, the Unified Soil Classification System (USCS) used by the Army Corps of Engineers is probably the easiest to use. This system is also described as ASTM D 2487, Standard Classification of Soils for engineering purposes. In this system, soils are separated into 15 groups which are each designated by a two letter code.

The first letter describes the predominate soil type:
G = gravels or gravelly soils
S = sand or sandy soils
M = silt - non-plastic (non putty-like when wet), or very slightly plastic, and having little or no strength when air dry
C = clay - plastic (putty-like when wet), and having considerable strength when wet.
Pt = peat - vegetation in various stages of decomposition usually black or dark brown in color
BASE MATERIAL
The specification for aggregate base materials for use under flexible asphalt pavement are suitable for use as base material under ICP. If no municipal, county or state specifications are available, use material meeting the specifications of ASTM D 2940 as shown below.

Sieve Size | Percent Passing
--- | ---
2 in. | 100
1-1/2 in. | 95-100
3/4 in. | 70-89
3/8 in. | 50-70
No. 4 | 35-55
No. 30 | 12-55
No. 200 | 0-8

The material meeting this specification is suitable for bases more than 4 in. thick. For bases less than 4 in. thick, the material should have 100 percent passing the 1-1/2 in. sieve and 95-100 percent passing the 3/4 in. sieve. In either case, the material passing the No. 200 sieve must not be greater than 10 percent.

SAND SETTING BED
The setting bed materials must be a coarse, sharp, washed sand. It may be a processed natural sand or a man made sand. It must meet the gradation specifications of ASTM C33. The most common term for the proper sand is "Washed Concrete Sand".

ASTM C33 - Gradation to Bedding Sand.

NOTE:
1. Do not use stone dust or unwashed screenings.
2. Do not use mason or bank sand.

JOINT SAND
If the sand used for the sand setting bed is not used for filling the joints, the sand used should meet the gradation requirements of ASTM C144.

ASTM C144 - Gradation of Joint Sand

Sieve Size | Percent Passing
--- | ---
No. 4 | 100
No. 8 | 95-100
No. 16 | 70-100
No. 30 | 40-75
No. 50 | 20-40
No. 100 | 10-25
No. 200 | 0-10

NOTE: Do not use sandbox or play sand. Do not use stone dust. Do not use Mason sand.
THE 14 USCS SOIL GROUPS AND THEIR RESPECTIVE SUITABILITY FOR USE AS A SUBGRADE FOR A PAVEMENT SYSTEM ARE:

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<th>SYMBOL</th>
<th>SOIL DESCRIPTION</th>
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<tr>
<td>GW</td>
<td>Well-graded gravels and gravel sand mixtures, little or no fines</td>
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</tr>
<tr>
<td>GP</td>
<td>Poorly graded gravels and gravel sand mixtures, little or no fines</td>
<td>X (1)</td>
</tr>
<tr>
<td>GM</td>
<td>Silty gravels, gravel-silt-clay mixtures</td>
<td>X (1)</td>
</tr>
<tr>
<td>GC</td>
<td>Clay gravels, gravel-sand-clay mixtures</td>
<td>X (1)</td>
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<tr>
<td>SW</td>
<td>Well-graded sand and gravely sands, little or no fines</td>
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<td>SP</td>
<td>Poorly graded sands and gravely sands, little or no fines</td>
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<tr>
<td>SM</td>
<td>Silty sands, sand-silt mixtures</td>
<td>X (1)</td>
</tr>
<tr>
<td>SC</td>
<td>Clay sands, sand-silt mixtures</td>
<td>X (1)</td>
</tr>
<tr>
<td>ML</td>
<td>Inorganic silts, very fine sands, rock flour, silty or clayish fine sands</td>
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<tr>
<td>CL</td>
<td>Inorganic clays of low to medium plasticity, gravely clays, silty clays, lean clays</td>
<td>X (2)</td>
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<tr>
<td>MH</td>
<td>Inorganic silts, micaceous or diatomaceous fine sands or silts, plastic silts</td>
<td>X (3)</td>
</tr>
<tr>
<td>CH</td>
<td>Inorganic clays or high plasticity fat clays</td>
<td>X (3)</td>
</tr>
<tr>
<td>OH</td>
<td>Organic clays of medium to high plasticity</td>
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</tr>
<tr>
<td>Pt</td>
<td>Peat</td>
<td>X (3)</td>
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</tbody>
</table>

(1) Use 6 in. compacted base in driveways.
(2) Use Geotextile between subgrade and base and thickness base to 8-in in driveways.
(3) Use Geotextile between subgrade and base and thickness base to 8-in in driveways and thicken driveway base to 10-in.
ALUMINIUM AND STEEL EDGING

POURED-IN-PLACE CONCRETE CURBS
PARTIAL DEPTH PRECAST CONCRETE EDGE

- Partial depth precast concrete (hidden)
- Stake
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Compacted soil subgrade

PRECAST CONCRETE/CUT STONE

- Precast concrete or cut stone
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Compacted soil subgrade
- Compacted aggregate or concrete backfill

UTILITY MANHOLE

- Cover
- String course around collar
- Rebar

- Concrete collar min. 6” (150 mm.)
- ¼” (7 mm.) below pavers
- Rebar
- Filter fabric
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Filter fabric
- Compacted soil
CROSSWALK IN EXISTING ASPHALT PAVEMENT

Existing asphalt pavement (min 4" (200 mm. thick)
Saw cut pavement
Seal joint
Filter fabric
Concrete pavers
Bedding sand
Compacted aggregate base
Compacted soil subgrade

CROSSWALK WITH CONCRETE BASE

Existing pavement – saw cut
Concrete curb min. 8" (200 mm.) wide
Filter cloth over drain hole
Concrete pavers
Bedding sand
Concrete base
Compacted aggregate base 2" (50 mm.) dia. drain
Hole filled with open graded aggregate
Compacted soil subgrade

CONCRETE BEAM

Curb
Concrete beam min. 8" (200 mm.) wide
Adjacent street
Street in pavers
AGILINA™ PLANK
PAVERS WITH TRUECOLOR™

<table>
<thead>
<tr>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
<th>PERMEABLE</th>
<th>ADA</th>
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<th>SATURA™ PROCESS</th>
<th>TRUECOLOR™ PROCESS</th>
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SHAPES & SIZES

3-Piece - 5” 80mm

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<th>Layer</th>
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<td><strong>Total</strong></td>
<td>91.62</td>
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3-Piece - 7\(\frac{1}{2}“\) 80mm

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<tr>
<td><strong>Total</strong></td>
<td>78.53</td>
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PALLET INFORMATION / ESTIMATING CHART

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AGILINA PLANK 3-PIECE - 5” 80MM

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<th>Dimensions</th>
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<th>Pallet</th>
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AGILINA PLANK 3-PIECE - 7\(\frac{1}{2}“\) 80MM

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AGILINA™ PLANK
SMALL/LARGE Running Bond

15%  5 x 11 11/16
20%  5 x 15 13/16
25%  5 x 19 11/16
10%  7 1/2 x 11 11/16
13%  7 1/2 x 15 3/4
17%  7 1/2 x 19 11/16

Percentages are based on area by paver.
For more pattern options visit
Belgard.com/products/pavers.

NOTES:
AutoCAD® hatch pattern files can be
downloaded from belgard.com for use in
architectural drawings
Some patterns may not necessarily reflect the
percentages of stone sizes within a particular
pallet. In some cases you may have extras
in one or more of the sizes. This must be
accounted for in your planning and design.
NOTES:
AutoCAD® hatch pattern files can be downloaded from belgard.com for use in architectural drawings.
Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
**NOTES:**

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Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

Percentages are based on area by paver.

For more pattern options visit Belgard.com/products/pavers.

### AGILINA™ PLANK

**LARGE Running Bond**

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<th>Percentage</th>
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<td>42%</td>
<td>7½ x 19(\frac{1}{16})</td>
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### CATALINA GRANA®
**PAVERS WITH TRUECOLOR™**

#### SHAPES & SIZES

3-Piece

<table>
<thead>
<tr>
<th>Size</th>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
<th>PERMEABLE</th>
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<th>TEXTURGARD® PROCESS</th>
<th>SATURA™ PROCESS</th>
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#### PALLET INFORMATION / ESTIMATING CHART

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**CATALINA GRANA 3-PIECE**

- Pedestrian
- Light Traffic
- Heavy Traffic
- Permeable
- ADA
- Texturgard® Process
- Satura™ Process
- Truecolor™ Process
# CATALINA™ SLATE

PAVERS WITH TRUECOLOR™

## Shapes & Sizes

3-Piece

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<td>-</td>
<td>-</td>
<td>60</td>
<td>6</td>
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<tr>
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<tr>
<td>12 x 12 x 2(\frac{3}{8})</td>
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</table>
NOTES:
AutoCAD® hatch pattern files can be downloaded from belgard.com for use in architectural drawings.
Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

Percentages are based on area by paver. For more pattern options visit Belgard.com/products/pavers.
NOTES:
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Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

Percentages are based on area by paver. For more pattern options visit Belgard.com/products/pavers.
### Country Manor® Pavers

<table>
<thead>
<tr>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
<th>PERMEABLE</th>
<th>ADA</th>
<th>TEXTURGARD® PROCESS</th>
<th>SATURA™ PROCESS</th>
<th>TRUECOLOR™ PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Shapes & Sizes

**Square**
6¼ x 6¼ x 2⅜

**Rectangle**
6¼ x 9¼ x 2⅜

### Pallet Information / Estimating Chart

<table>
<thead>
<tr>
<th>Unit</th>
<th>Square: 6¼ x 6¼ x 2⅜</th>
<th>Rectangle: 6¼ x 9¼ x 2⅜</th>
</tr>
</thead>
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<tr>
<td><strong>Unit</strong></td>
<td><strong>Unit</strong></td>
<td><strong>Unit</strong></td>
</tr>
<tr>
<td><strong>SOFT/Layer</strong></td>
<td><strong>SOFT/Layer</strong></td>
<td><strong>Layer/Layer</strong></td>
</tr>
<tr>
<td>116</td>
<td>11.6</td>
<td>10</td>
</tr>
</tbody>
</table>

**Country Manor Square**

| Country Manor Square        | 6¼ x 6¼ x 2⅜          | 116 | 11.6 | 10   | 420 | 42 | – | – | 3340 |

**Country Manor Rectangle**

| Country Manor Rectangle     | 6¼ x 9¼ x 2⅜          | 124 | 12.4 | 10   | 300 | 30 | – | – | 3460 |
NOTES:
AutoCAD® hatch pattern files can be downloaded from belgard.com for use in architectural drawings.
Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.
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For more pattern options visit Belgard.com/products/pavers.
NOTES:
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## SHAPES & SIZES

3-Piece Modular | 60mm

- 2\(\frac{1}{4}\)\(\times\) 5\(\frac{3}{4}\)\(\times\) 2\(\frac{3}{8}\)
- 5\(\frac{1}{4}\)\(\times\) 5\(\frac{3}{4}\)\(\times\) 2\(\frac{3}{8}\)
- 5\(\frac{1}{4}\)\(\times\) 8\(\frac{1}{8}\)\(\times\) 2\(\frac{3}{8}\)

### PALLET INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
<th>LNFT PALLET (SOLDIER)</th>
<th>LNFT PALLET (SAILOR)</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
<th>WEIGHT/PALLET LBS</th>
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<tr>
<td>3-PIECE MODULAR</td>
<td>60MM</td>
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</tr>
<tr>
<td>2(\frac{1}{4})(\times) 5(\frac{3}{4})(\times) 2(\frac{3}{8})</td>
<td>-</td>
<td>-</td>
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<td>5(\frac{1}{4})(\times) 5(\frac{3}{4})(\times) 2(\frac{3}{8})</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>5(\frac{1}{4})(\times) 8(\frac{1}{8})(\times) 2(\frac{3}{8})</td>
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<td>3440</td>
</tr>
</tbody>
</table>
NOTES:
AutoCAD® hatch pattern files can be downloaded from belgard.com for use in architectural drawings.
Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

DUBLIN COBBLE®
3-PIECE Pattern

17% 2 15/16 x 5 11/16 Rectangles
33% 5 7/16 x 5 11/16 Squares
50% 5 7/16 x 8 3/8 Rectangles

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
NOTES:
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Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
### Holland Stone Pavers

<table>
<thead>
<tr>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
<th>PERMEABLE</th>
<th>ADA</th>
<th>TEXTURGARD® PROCESS</th>
<th>SATURA™ PROCESS</th>
<th>TRUECOLOR™ PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>✔</td>
<td>80MM</td>
<td></td>
<td>✔</td>
<td>✔</td>
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</table>

*Select colors only.

### Shapes & Sizes

<table>
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<tr>
<th>60mm</th>
<th>80mm Special Order</th>
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<tr>
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<td>3(1\frac{1}{4}) x 7(\frac{7}{8}) x 3(\frac{1}{8})</td>
</tr>
</tbody>
</table>

### Pallet Information / Estimating Chart

<table>
<thead>
<tr>
<th>Unit</th>
<th>Sqft/ Pallet</th>
<th>Sqft/ Layer</th>
<th>Layer/ Pallet</th>
<th>Units/ Pallet</th>
<th>Units/ Layer</th>
<th>Units/ Sqft</th>
<th>Weight/ Unit Lbs</th>
<th>Weight/ Layer Lbs</th>
<th>Weight/ Pallet Lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>60mm (Easton)</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>3(1\frac{1}{4}) x 7(\frac{7}{8}) x 2(\frac{3}{8})</td>
<td>120</td>
<td>12</td>
<td>10</td>
<td>540</td>
<td>54</td>
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<td>3340</td>
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<tr>
<td><strong>60mm (Farmingdale)</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3(1\frac{1}{4}) x 7(\frac{7}{8}) x 2(\frac{3}{8})</td>
<td>120</td>
<td>20 Sqft per band</td>
<td>6 Bands</td>
<td>540</td>
<td>90 pieces per band</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3340</td>
</tr>
<tr>
<td><strong>80mm - Special Order</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3(1\frac{1}{4}) x 7(\frac{7}{8}) x 3(\frac{1}{8})</td>
<td>97</td>
<td>–</td>
<td>8</td>
<td>432</td>
<td>54</td>
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<td>–</td>
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<td>3188</td>
</tr>
</tbody>
</table>

Also available in a special order color for USGBC LEED® Credit.
Square foot varies depending on installation. All measurements are approximate.
**NOTES:**
AutoCAD® hatch pattern files can be downloaded from belgard.com for use in architectural drawings.

Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

**RUNNING BOND PATTERN**

100% Rectangles

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
NOTES:
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Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

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HOLLAND STONE
OLD YORK™
AQUA ROC™ I

BASKET WEAVE PATTERN
100% Rectangles

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
LAFITT® PAVER
PAVERS WITH TRUECOLOR™

PEDESTRIAN | LIGHT TRAFFIC | HEAVY TRAFFIC | PERMEABLE | ADA | TEXTURGARD® PROCESS | SATURA™ PROCESS | TRUECOLOR™ PROCESS
---|---|---|---|---|---|---|---
✅ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗

SHAPES & SIZES

3-Piece Modular

3\(\frac{3}{16}\) x 7\(\frac{3}{16}\) x 2\(\frac{3}{8}\)  7\(\frac{1}{16}\) x 7\(\frac{1}{16}\) x 2\(\frac{3}{8}\)  7\(\frac{1}{16}\) x 10\(\frac{5}{8}\) x 2\(\frac{3}{8}\)

PALLET INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SOFT/PALLET</th>
<th>SOFT LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS LAYER</th>
<th>UNITS SOFT</th>
<th>WEIGHT UNIT LBS</th>
<th>WEIGHT LAYER LBS</th>
<th>WEIGHT PALLET LBS</th>
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<tr>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>121</td>
<td>–</td>
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</tr>
<tr>
<td>7(\frac{1}{16}) x 10(\frac{5}{8}) x 2(\frac{3}{8})</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>121</td>
<td>–</td>
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</table>

3-PIECE MODULAR Sold as full pallet only
NOTES:
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Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

**LAFITT®**

3-PIECE Running Bond

17% Rectangles

33% Squares

50% Rectangles

Percentages are based on area by paver.

For more pattern options visit Belgard.com/products/pavers.
NOTES:
AutoCAD® hatch pattern files can be downloaded from belgard.com for use in architectural drawings

Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

LAFITT®
3-PIECE Basket Weave
17% Rectangles
33% Squares
50% Rectangles

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
LaFitt®
3-PIECE Pattern A
17% Rectangles
33% Squares
50% Rectangles

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.

NOTES:
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## LAFITT® 6X9

PAVERS WITH TRUECOLOR™

<table>
<thead>
<tr>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
<th>PERMEABLE</th>
<th>ADA</th>
<th>TEXTURGARD® PROCESS</th>
<th>SATURA™ PROCESS</th>
<th>TRUECOLOR™ PROCESS</th>
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</table>

**SHAPES & SIZES**

6 x 9

6 x 9 x 23⁄8

**PALLETS INFORMATION / ESTIMATING CHART**

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
<th>WEIGHT/PALLET LBS</th>
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<tr>
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<td></td>
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</tr>
<tr>
<td>6 x 9 x 23⁄8</td>
<td>112</td>
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<td>10</td>
<td>300</td>
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<td>3080</td>
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</table>

LAFITT 6X9 LAYING PATTERN CAN BE FOUND ON PAGE 46-47
LAFITT® GRANA SLAB
PAVERS WITH TRUECOLOR™

<table>
<thead>
<tr>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
<th>PERMEABLE</th>
<th>ADA</th>
<th>TEXTURGARD® PROCESS</th>
<th>SATURA™ PROCESS</th>
<th>TRUECOLOR™ PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

3-Piece Modular

7⅜ x 14⅞ x 2⅛
14⅞ x 14⅞ x 2⅛
14⅞ x 22⅛ x 2⅛

PEDESTRIAN LIGHT TRAFFIC HEAVY TRAFFIC PERMEABLE ADA TEXTURGARD® PROCESS SATURA™ PROCESS TRUECOLOR™ PROCESS

SHAPES & SIZES

PALLETT INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SQFT/ PALLET</th>
<th>SQFT/ LAYER</th>
<th>LAYER/ PALLET</th>
<th>UNITS/ PALLET</th>
<th>UNITS/ LAYER</th>
<th>UNITS/ SQFT</th>
<th>WEIGHT/ UNIT LBS</th>
<th>WEIGHT/ LAYER LBS</th>
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<td>3-PIECE MODULAR</td>
<td>Sold as full pallet only</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 7⅜ x 14⅞ x 2⅛ | – | – | – | 30 | 3 | – | – | – | – |
| 14⅞ x 14⅞ x 2⅛ | – | – | – | 30 | 3 | – | – | – | – |
| 14⅞ x 22⅛ x 2⅛ | – | – | – | 20 | 2 | – | – | – | – |
| TOTAL | 116.57 | 11.66 | 10 | 80 | 8 | – | – | – | 2895 |
LAFITT® RUSTIC SLAB
PAVERS WITH TRUECOLOR™

<table>
<thead>
<tr>
<th>Shapes &amp; Sizes</th>
</tr>
</thead>
</table>

3-Piece Modular

- 7½ x 14½ x 2½
- 14½ x 14½ x 2½
- 14½ x 22½ x 2½

Pallet Information / Estimating Chart

<table>
<thead>
<tr>
<th>Unit</th>
<th>SQFT/Pallet</th>
<th>SOFT/Layer</th>
<th>Layer/Pallet</th>
<th>Units/Pallet</th>
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<th>Weight/Unit LBS</th>
<th>Weight/layer LBS</th>
<th>Weight/Pallet LBS</th>
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<td>–</td>
<td>–</td>
<td>30</td>
<td>3</td>
<td>–</td>
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</tr>
<tr>
<td></td>
<td>14½ x 14½ x 2½</td>
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<td>–</td>
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<td>3</td>
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<td></td>
<td>14½ x 22½ x 2½</td>
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<td>–</td>
<td>20</td>
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<tr>
<td>TOTAL</td>
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<td>11.66</td>
<td>10</td>
<td>80</td>
<td>8</td>
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<td>2895</td>
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</table>
NOTES:
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Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

LAFITT® GRANA SLAB & LAFITT® RUSTIC SLAB

3-PIECE Running Bond
17% 7¾ x 14¾ Rectangles
33% 14¾ x 14¾ Squares
50% 14¾ x 22½ Rectangles

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
**LAFITT® GRANA SLAB & LAFITT® RUSTIC SLAB**

3-PIECE Basket Weave

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>17%</td>
<td>Pavement A</td>
<td>7 3/8 x 14 7/8</td>
</tr>
<tr>
<td>33%</td>
<td>Pavement B</td>
<td>14 7/8 x 14 7/8</td>
</tr>
<tr>
<td>50%</td>
<td>Pavement C</td>
<td>14 7/8 x 22 5/16</td>
</tr>
</tbody>
</table>

Percentages are based on area by paver.

For more pattern options visit [Belgard.com/products/pavers](http://Belgard.com/products/pavers).

**NOTES:**

AutoCAD® hatch pattern files can be downloaded from belgard.com for use in architectural drawings.

Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.
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LAFFIT® GRANA SLAB & LAFFIT® RUSTIC SLAB

3-PIECE Pattern A

17% 7 3/8" x 14 7/8" Rectangles
33% 14 7/8" x 14 7/8" Squares
50% 14 7/8" x 22 5/16" Rectangles

Percentages are based on area by paver. For more pattern options visit Belgard.com/products/pavers.
LONDON COBBLE PAVERS

<table>
<thead>
<tr>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
<th>PERMEABLE</th>
<th>ADA</th>
<th>TEXTURGARD® PROCESS</th>
<th>SATURA™ PROCESS</th>
<th>TRUECOLOR™ PROCESS</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td>√*</td>
<td></td>
<td></td>
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</tbody>
</table>

*SELECT COLORS ONLY.

SHAPES & SIZES

Square

6 x 6 x 2¾

Rectangle

6 x 9 x 2¾

PALLER INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYERS/PALLET</th>
<th>UNITS/PALLET</th>
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<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
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<th>WEIGHT/PALLET LBS</th>
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</thead>
<tbody>
<tr>
<td>6 x 6 x 2¾</td>
<td>120</td>
<td>12</td>
<td>10</td>
<td>480</td>
<td>48</td>
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<td>–</td>
<td>3240</td>
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LONDON COBBLE SQUARE (FARMINGDALE)

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<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYERS/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
<th>WEIGHT/PALLET LBS</th>
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</thead>
<tbody>
<tr>
<td>6 x 6 x 2¾</td>
<td>120</td>
<td>15 sqft per band</td>
<td>8 bands</td>
<td>480</td>
<td>60 pieces per band</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3240</td>
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LONDON COBBLE RECTANGLE (EASTON)

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<th>SQFT/LAYER</th>
<th>LAYERS/PALLET</th>
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<th>UNITS/LAYER</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
<th>WEIGHT/PALLET LBS</th>
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<tr>
<td>6 x 9 x 2¾</td>
<td>112</td>
<td>11.2</td>
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LONDON COBBLE RECTANGLE (FARMINGDALE)

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<tr>
<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYERS/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
<th>WEIGHT/PALLET LBS</th>
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<tr>
<td>6 x 9 x 2¾</td>
<td>112</td>
<td>22.4 sqft per band</td>
<td>5 bands</td>
<td>300</td>
<td>60 pieces per band</td>
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<td>–</td>
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</table>

LONDON COBBLE LAYING PATTERNS CAN BE FOUND ON PAGES 45–48
## MADRIA®
SLABS WITH SATURA™

### SHAPES & SIZES

<table>
<thead>
<tr>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
<th>PERMEABLE</th>
<th>ADA</th>
<th>TEXTURGARD® PROCESS</th>
<th>SATURA™ PROCESS</th>
<th>TRUECOLOR™ PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
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<td></td>
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</tbody>
</table>

### PALLET INFORMATION / ESTIMATING CHART

<table>
<thead>
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<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
<th>WEIGHT/PALLET LBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LARGE SQUARE</td>
<td>83.88</td>
<td>–</td>
<td>6</td>
<td>24</td>
<td>4</td>
<td>–</td>
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<td>2434</td>
</tr>
<tr>
<td>22½ x 22½ x 2¾</td>
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<td></td>
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</tr>
<tr>
<td>LARGE RECTANGLE</td>
<td>83.97</td>
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<td>9</td>
<td>27</td>
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<tr>
<td>15 x 30 x 2¾</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
**MADRIA**

2-PIECE Pattern A

53% 15 x 30 Rectangles
47% 22½ x 22½ Squares

**NOTES:**
AutoCAD® hatch pattern files can be downloaded from belgard.com for use in architectural drawings. Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design. Percentages are based on area by paver. For more pattern options visit Belgard.com/products/pavers.
### SHAPES & SIZES

<table>
<thead>
<tr>
<th>60mm</th>
<th>SPECIAL ORDER</th>
<th>Driveway Slab 80mm</th>
</tr>
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<tbody>
<tr>
<td>15(\frac{1}{2}) x 21 x 2(\frac{3}{8})</td>
<td>15(\frac{1}{8}) x 21 x 3(\frac{1}{8})</td>
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### PALLET INFORMATION / ESTIMATING CHART

#### 60MM Sold as full pallet only

<table>
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<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
<th>WEIGHT/PALLET LBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>15(\frac{1}{2}) x 21 x 2(\frac{3}{8})</td>
<td>104.4</td>
<td>8.7</td>
<td>12</td>
<td>72</td>
<td>6</td>
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#### DRIVEWAY SLAB 80MM - SPECIAL ORDER Sold as full pallet only

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<thead>
<tr>
<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
<th>WEIGHT/PALLET LBS</th>
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</thead>
<tbody>
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<td>15(\frac{1}{8}) x 21 x 3(\frac{1}{8})</td>
<td>77.4</td>
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<td>9</td>
<td>54</td>
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<td>2930</td>
</tr>
</tbody>
</table>
NOTES:
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MEGA-ARBEL®
CLOVERLEAF PATTERN

100% 15 3/8 x 21 Pavers

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
Larger joints between pavers allow product to be installed as a permeable pavers.

### Shapes & Sizes

#### 3-Piece Modular

- 5⅝ x 7⅞ x 3⅜
- 5⅝ x 10⅛ x 3⅜
- 5⅝ x 12⅜ x 3⅜

### Pallet Information / Estimating Chart

#### 3-Piece Modular

<table>
<thead>
<tr>
<th>Unit</th>
<th>SQFT/Pallet</th>
<th>SQFT/Layer</th>
<th>Layer/Pallet</th>
<th>Units/Pallet</th>
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<th>Weight/Unit Lbs</th>
<th>Weight/Layer Lbs</th>
<th>Weight/Pallet Lbs</th>
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</thead>
<tbody>
<tr>
<td>5⅝ x 7⅞ x 3⅜</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>88</td>
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<td>5⅝ x 10⅛ x 3⅜</td>
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<td>–</td>
<td>96</td>
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</tr>
<tr>
<td>5⅝ x 12⅜ x 3⅜</td>
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<td>–</td>
<td>–</td>
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<td>–</td>
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<td>Total</td>
<td>90.27</td>
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<td>8</td>
<td>256</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3250</td>
</tr>
</tbody>
</table>
NOTES:
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 OL D Y OR K™
PAVERS WITH TRUECO L OR™

**PEDESTRIAN** | **LIGHT TRAFFIC** | **HEAVY TRAFFIC** | **PERMEABLE** | **ADA** | **TEXTURGARD® PROCESS** | **SATURA™ PROCESS** | **TRUECOLOR™ PROCESS**
---|---|---|---|---|---|---|---
✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓

Larger joints between pavers allow product to be installed as a permeable pavers.

### SHAPES & SIZES

**60mm**

3¾ x 7¾ x 2¾

### PALLET INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
<th>UNITS/SQFT</th>
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<th>WEIGHT/PALLET LBS</th>
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</thead>
<tbody>
<tr>
<td><strong>60mm</strong></td>
<td>120</td>
<td>12</td>
<td>10</td>
<td>540</td>
<td>54</td>
<td>–</td>
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<td>–</td>
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</table>

OLD YORK LAYING PATTERNS CAN BE FOUND ON PAGES 53–55
PROVENCE SLAB™
PAVERS WITH SATURA™

PEDESTRIAN | LIGHT TRAFFIC | HEAVY TRAFFIC | PERMEABLE | ADA | TEXTURGARD® PROCESS | SATURA™ PROCESS | TRUECOLOR™ PROCESS
---|---|---|---|---|---|---|---
✓ | | | | | | | 

SHAPES & SIZES

3-Piece Modular
- 7½ x 15 x 2½
- 15 x 15 x 2¼
- 15 x 22½ x 2½

SPECIAL ORDER
- Large Square
- 22½ x 22½ x 2½
- 15 x 30 x 2½

SPECIAL ORDER
- Large Rectangle

PALLET INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SQFT/ PALLET</th>
<th>SQFT/ LAYER</th>
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<th>UNITS/ LAYER</th>
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<td>–</td>
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<tr>
<td>15 x 22½ x 2½</td>
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<td>3722</td>
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<td>LARGE SQUARE - SPECIAL ORDER</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22½ x 22½ x 2½</td>
<td>83.88</td>
<td>–</td>
<td>6</td>
<td>24</td>
<td>4</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>2434</td>
</tr>
<tr>
<td>LARGE RECTANGLE - SPECIAL ORDER</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 x 30 x 2½</td>
<td>83.97</td>
<td>–</td>
<td>9</td>
<td>27</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>2436</td>
</tr>
</tbody>
</table>
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Percentages are based on area by paver. For more pattern options visit Belgard.com/products/pavers.
NOTES:
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PROVENCE SLAB™

4-PIECE Pattern A

15% 7½ x 15 Squares
30% 15 x 15 Squares
22% 15 x 22½ Squares
33% 22½ x 22½ Squares

Percentages are based on area by paver. For more pattern options visit Belgard.com/products/pavers.
NOTES:
AutoCAD® hatch pattern files can be downloaded from belgard.com for use in architectural drawings.
Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

PROVENCE SLAB™

5-PIECE Pattern A

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Paver Size</th>
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</thead>
<tbody>
<tr>
<td>9%</td>
<td>7½ x 15 Squares</td>
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<tr>
<td>24%</td>
<td>15 x 15 Squares</td>
</tr>
<tr>
<td>18%</td>
<td>15 x 22½ Squares</td>
</tr>
<tr>
<td>26%</td>
<td>22½ x 22½ Square</td>
</tr>
<tr>
<td>24%</td>
<td>15 x 30 Squares</td>
</tr>
</tbody>
</table>

Percentages are based on area by paver. For more pattern options visit Belgard.com/products/pavers.
PERMEABLE PAVERS
TABLE OF CONTENTS

PERMEABLE PAVERS

86  Aqua Roc™ I
87  Turfstone™
SITE EVALUATION

When evaluating a site, the following characteristics should be considered:

- Runoff from contributing at-grade impervious areas does not exceed five times the area of the PICP receiving the runoff.
- The estimated depth from the bottom of the pavement base, for full or partial exfiltrations systems, to the seasonal high level of the water table is greater than 2 feet (0.6 m). Greater depths may be required to obtain additional filtering of pollutants through the soil.
- PICP is down slope from building foundations and the foundations have piped drainage at the footers. Waterproofing such as an impermeable liner is recommended on basement walls against PICP.
- The slope of the permeable pavement surface is 1 percent.
- At least 100 feet (30 m) should be maintained between PICP and water supply wells. (Local jurisdictions may provide additional guidance or regulations.)

BASIC PICP SYSTEMS

PICP can be built with full, partial or no exfiltration of the open-graded stone base into the soil subgrade.

Full Exfiltration

Full exfiltration directs water through the base/subbase and exfiltrates it to the soil subgrade. This is the most common application over high infiltration soils such as gravels and sands. Overflows are managed via perimeter drains to swales, bioretention areas, or storm sewer inlets.

Partial Exfiltration

Partial exfiltration relies on drainage of the base/subbase into the subgrade soil and drainage pipes to direct excess water to a rain garden or storm sewer. This controls the amount of time the subgrade is saturated. This design is common to lower infiltration rate soils such as silts and clays.

Perforated drain pipes are typically raised some inches (cm) above the soil subgrade to allow some water capture and infiltration into the soil subgrade below them. When the water level rises to the pipes it drains away through them.

No Exfiltration

This is required when the soil has very low permeability or low strength, or there are other site limitations. The assembly performs like a detention pond with an outlet.

CONSTRUCTION OVERVIEW

Excavate to the proper depth as required based on engineered design. ICPI minimum would be 2 inches No. 8 bedding courses, 4 inches No. 57 base and a minimum of 6 inches No. 2 subbase. If equipment needs to traverse the bottom of the excavation, tracked vehicles can reduce the risk of soil compaction.

Compacted soil can be remedied by scarifying to increase its infiltration. This is done by back-dragging loader bucket teeth across the soil prior to placing the aggregate subbase. This loose layer will receive subbase or base aggregate compacted into it to reduce the risk of surface settlement.

Additional resources and technical specifications online at www.icpi.org.
Source: ICPI Tech Spec, issue number 18
INSTALL GEOTEXTILES, IMPERMEABLE LINERS AND DRAIN PIPES IF REQUIRED IN THE PLANS AND SPECIFICATIONS

The geotextile is placed between the subgrade soil and the subbase. Unless the entire edge of the cross section is bounded by a concrete structure, the geotextile is extended up the sides of the excavation and at least one foot past the extent of the excavation at the top and secured in place. A minimum 1-foot (0.3 m) overlap is recommended in stronger subgrade soils and 2-feet (0.6 m) overlap on poor-draining weaker soils (CBR<5%).

Drain pipes are installed according to plans and specifications and should be rigid PVC. Designs should have curb cut-outs or drain pipes from the PICP entering swales or storm sewer catch basins to handle overflow conditions.

Place and compact the aggregate subbase

Subbase material should be spread in minimum 6-inch (150 mm) lifts. Compaction is typically done with a 10 ton (9 T) steel vibratory roller or a 13,500 lbf (60 kN) plate compactor. Greater lift thicknesses are normal (e.g., 12 inch or 0.3 m) when using either of these compactors. When using a roller, the first two passes are in vibratory mode and the last two are in static mode. Compaction is completed when no visible movement can be seen in the base when rolled by the compactor.

INSTALL CURBS OR OTHER EDGE RESTRAINTS

For pedestrian areas and residential driveways, an edge restraint option is using compacted, dense-graded berms around PICP base perimeter with plastic or metal edging fastened to their surface. The dense-graded base is a foundation for metal or plastic edging secured with steel spikes. These edge restraints are installed on the dense-graded berms in a manner identical to those on interlocking concrete pavement driveways. The edge restraint contains some of the bedding layer such that at least the bottom half of the pavers is also contained by the edging. The DGA berms must be encased with geotextile to prevent contamination of the PICP aggregate materials.

Additional resources and technical specifications online at www.icpi.org. Source: ICPI Tech Spec, issue number 18.
Place and compact the aggregate base

The ASTM No. 57 base layer is spread and compacted as one 4-inch (100 mm) lift. Like the subbase aggregate, the initial passes with the roller can be with vibration to consolidate the base material or a plate compactor also can be used to compact the No. 57 base layer. Surface tolerance of the compacted No. 57 stone shall be ± 3/4-inch (19 mm) over a 10 feet (3 m) straightedge.

Place and screed the bedding layer

When subbase and base lifts are compacted the surface should then be topped with a 1 1/2- to 2-inch (50 mm) thick layer of No. 8 crushed stone bedding. This layer is screeded and leveled over the No. 57 base. Metal rails are placed on the compacted No. 57 layer and are used to guide screeding elevations. The surface tolerance of the screeded No. 8 bedding material should be ±3/8-inch over 10 feet (±10 mm over 3 m). Install the pavers manually or with mechanical installation equipment.

Geotextiles are used in some permeable pavement applications per the design engineer. If there are no concrete curbs and soil is restraining the sides of the base/subbase at its perimeter, then geotextile should be applied to prevent lateral migration of soil into the base/subbase aggregates. Geotextile is applied vertically against the soil with at least 1 foot (0.3 m) extending horizontally under the subbase and resting on the soil subgrade. A minimum 1-foot (0.3 m) overlap is recommended in stronger subgrade soils and 2-feet (0.6 m) overlap on poor-draining weaker soils (CBR<5%).

Drain pipes are installed according to plans and specifications and should be rigid PVC. Designs should have curb cut-outs or drain pipes from the PICP entering swales or storm sewer catch basins to handle overflow conditions.

Place and compact the aggregate subbase

Subbase material should be spread in minimum 6-inch (150 mm) lifts. Compaction is typically done with a 10 ton (9 T) steel vibratory roller or a 13,500 lbf (60 kN) plate compactor. Greater lift thicknesses are normal (e.g., 12 inch or 0.3 m) when using either of these compactors. When using a roller, the first two passes are in vibratory mode and the last two are in static mode. Compaction is completed when no visible movement can be seen in the base when rolled by the compactor.

After screeding the bedding material, the pavers are placed on this layer. Paver installation can be by hand or with mechanical equipment. Border courses consisting of mostly whole (uncut) pavers are typically used against curbs at PICP edges and at transitions to other pavement surfaces. Paving units abutting border courses should be cut to fill spaces prior to compaction. Cuts should provide gaps around the entire perimeter of the stone that are consistent with the typical joint size — this will allow for proper interlock between units and prevent direct paver-on-paver contact. Cut units should be no smaller than one-third of a whole unit if subject to vehicular traffic. Comply with OSHA Silica guidelines when cutting.
Fill the paver joints and sweep the surface clean

The paver joints are filled with ASTM No. 8, 9 or 89 stone. Depending on the PICP area, spreading and placing can be done with shovels and brooms, or larger areas with machines, moving into the paver joints with powered brooms. Once the joints are full (within 1/4-inch or 6 mm of the paver surface), remove loose stones on the surface as they can mar the pavers when in contact with a plate compactor.

Compact the pavers

After the PICP surface is swept clean, compact it with a plate compactor. Make a minimum of two passes with the second pass in a perpendicular direction from the first pass. The plate compactor should exert a minimum 5,000 lbf (22 kN) at 75-90 Hz.

Top up joints with joint filling stone as needed and sweep the surface clean

Compaction can cause some settlement of the aggregates inside the joints. If the aggregates are more than 1/4-inch (6 mm) from the paver surface, they should be topped up to this level with additional aggregates.
PRESERVING OUR DRINKING WATER SUPPLY

STORMWATER FILTRATION

The US Geological Survey reports that half of the drinking water in America comes from groundwater reserves, while the other half comes from lakes and rivers. Both of these sources are adversely impacted when impervious surfaces like buildings, parking lots and roads prevent rain from infiltrating back into the ground. Groundwater reserves are not being recharged and shallow groundwater flow systems, which maintain the base flow conditions between rainfall events in lakes and rivers, are reduced.

PERMEABLE INTERLOCKING CONCRETE PAVEMENTS (PICP)

Permeable Interlocking Concrete Pavements (PICP) are fundamentally large scale infiltration reservoirs with a drivable surface course over top. The open graded base and subbase aggregates have approximately 32% and 40% open space respectively, providing for temporary water storage. Being the same aggregates used for railway tracks, they are more than capable of supporting vehicular loads.

With FULL INFILTRATION systems, which are used on soils with high infiltration rates (Type A and B soils), it is expected that any precipitation that falls will drain almost as quickly as it is introduced; any excess rain can accumulate in the subbase for the short term.

With PARTIAL INFILTRATION systems, which are used on Type C and some D soils, the amount of excess rain that accumulates in the base/subbase is regulated by the elevation of the outlet control for the underdrain, which is set to only store as much water as can drain in 1 to 2 days post rainfall event.

It is a common misconception that a high soil infiltration rate is required for an infiltration system to work. The majority of 95th percentile design storms in the US range from one to two inches total precipitation. Even at infiltration rates as low as 0.05”/hour, it would only take 40 hours for full 2” of rain to drain out of the aggregate base/subbase storage zone.

<table>
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<th>TEXTURE CLASS</th>
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CONTROLLING RUNOFF

The goal of PICP is to mimic, if not improve upon a site’s predevelopment hydrology by detaining as much stormwater as possible in the base/subbase, so that it can infiltrate back into the ground. PICP is considered a Low Impact Development (LID) Best Management Practice (BMP) for stormwater management. As a distributive infiltration practice, PICP conserves space by providing a functional pavement and Stormwater Control Measure in one system. Various methods are used to model the site hydrology and calculate runoff flow rates and volumes. Depending on the hydrology model used, a curve number or a runoff coefficient is needed to represent the PICP site condition.

CURVE NUMBER FOR PICP SYSTEM

The Natural Resources Conservation Service (NRCS) method characterizes site runoff based on hydrologic soil type, land cover and amount of rainfall using a parameter known as a curve number (CN). Curve Numbers predict direct runoff from rainfall excess, and can range between 30 to 100, with lower numbers indicating lower runoff potential. Caution should be applied when using CNs for permeable pavement. Results can underestimate runoff in small watersheds (under 5 acres) for small storm events (below the 2-year storm), so for these cases, calculations should be verified by another method. Sample CNs per USDA Technical Release-55 are listed on this page. However, traditional hydrologic modelling requires CN modifications to properly model permeable pavement to account for reservoir storage. CNs for PICP systems can range anywhere between 45 for A soils to between 70-80 for D soils.

SURFACE RUNOFF COEFFICIENT FOR PICP SYSTEMS

A common question that is asked is “What is the runoff coefficient (C) of the PICP system? C represents the percentage of rainfall that becomes runoff based on the surface type and is used in the Rational Method to determine peak flow rates. It is overly simplistic and does not account for rainfall intensity, duration, or reservoir drainage. A C value of between 0.25 and 0.40 depending on subgrade permeability is appropriate for PICP systems when using the Rational Method.

CREDIT FOR PERVEROUS SURFACE

Correctly designed, installed, and maintained, PICP systems have surface infiltration rates higher than that of almost any natural soil, and several times greater than the maximum possible rainfall intensity. This is why a PICP surface should be given complete credit for “100% perviousness,” as would a meadow or forest.

WATER VOLUME CONTROL

PICPs can detain or retain water quality volume through storage in the aggregate base and subbase. Most design storm requirements are easily controlled in the underground reservoir created until the subgrade soils infiltrate the water or until underdrains release the volume at a controlled rate.

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<th>COVER DESCRIPTION</th>
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Source: USDA Technical Release 55
## AQUA ROC™ I
PERMEABLE PAVERS

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### SHAPE & SIZES

80mm

4½ x 9 x 3½

### PALLET INFORMATION / ESTIMATING CHART

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AQUA ROC I LAYING PATTERNS CAN BE FOUND ON PAGES 55-57
TURFSTONE™
PERMEABLE PAVERS

<table>
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SHAPES & SIZES

80mm

Turfstone is manufactured to a different ASTM standard than pavers and paving slabs. Vehicular applications are limited to residential driveway, overflow parking or emergency access lanes only.

15¾ x 23¾ x 3¾

PALLETT INFORMATION / ESTIMATING CHART

<table>
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<tr>
<th>TURFSTONE Sold as full pallet only</th>
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<tr>
<td>15¾ x 23¾ x 3¾</td>
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NOTES:
AutoCAD® hatch pattern files can be downloaded from belgard.com for use in architectural drawings.

Some patterns may not necessarily reflect the percentages of stone sizes within a particular pallet. In some cases you may have extras in one or more of the sizes. This must be accounted for in your planning and design.

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
PORCELAIN PAVERS
## TABLE OF CONTENTS

### PORCELAIN PAVERS

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<thead>
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<th>Page</th>
<th>Product</th>
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<tr>
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<tr>
<td>101</td>
<td>Porcelain Veneer</td>
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PORCELAIN PAVERS

Belgard Porcelain Pavers are formed by pressing, followed by vitrification: this process involves the total fusion into a single material made from natural raw materials (sand, quartz, feldspars, kaolin, clays and inorganic pigments) which, fired at temperatures above 1226.67 °C (2240 °F), are transformed into a product with exceptional hardness, ultra-low absorption rate and unmatchable mechanical characteristics. Belgard porcelain pavers are eco-compatible and ecolabel-certified. Each unit is 20mm (0.7874") standard thickness or ¾" nominal thickness and is durable enough to withstand use in exterior applications.

PORCELAIN PAVERS ADVANTAGES:

- **Freeze thaw resistant**—They are 100% frost-free and their properties remain unaltered at temperatures ranging from -51.1 °C to +60 °C (-60° F to +140°F).
- **Color durability**—Color is fused by vitrification, becomes an integral part of the porcelain surface and is not affected by elements.
- **Easy installation**—Perfect fit and for fast installs.
- **Low absorption rate**—Spills, salt and other materials will not seep into pours.
- **Easy to clean**—Household cleaners can be used to wipe down spills and dirt; can even be pressure washed with a low pressure washing device* (see pressure washing warning below).*
- **Stylish**—Matches what homeowners are currently doing inside the home.
- **Durable**—High breakage loads of up to 3,587 lbs (1,627 kg) per foot based on ASTM-C648.
- **Resistant**—High compressive strength and ultra-low absorption rate creates a dense surface that resists mold, moss, dirt and other staining.
- **Skid-resistant**—Structured paver top textures create slip resistant surfaces for safety; perfect for around pools/spas or in wet climates.
- **Modular Design**—Superior accuracy in dimensional sizing and linear sides, the slabs allow for perfectly executed installations with tight and accurate lines.
- **Light weight**—16.8 kg (37 lbs) for the 24”x24” paver permit for easy installation, removal and serviceability and even reusability (excluding adhered installations).
- **Available in colors that have an SRI that qualifies for a LEED certification. The SRI on some units ranges between 60-80. To receive LEED credit, the SRI must be at least 29.**
- **Impermeable**—Deicing salt and other deicing materials can be used without concern of damage.

* It is important that all pressure washing of your porcelain pavers be done with a low pressure washer with a maximum of 1600 psi and nothing more powerful. When pressure washing your installation, care should be taken to prevent damage to the grout (adhesive and grout installations) and some re-sanding will be necessary when power washing an installation with sand or polymeric sand joints.

SPECIALTY TOOLS FOR PORCELAIN PAVER CONSTRUCTION:

- Wet cut tile saw equipped with a diamond blade manufactured for wet cutting porcelain. The saw should be designed to safely cut a 24 inch length porcelain paver.
- A paver clamp for easy handling, which can be used to both install and remove pavers.
- The use of gloves is highly recommended while handling and installing porcelain slabs.
- Appropriate notched trowels and grout float tools for cementitious adhesive and grout installation. The appropriate tool selection would be based on the adhesive and grout manufacturer’s recommendation
- Pallets of porcelain pavers are manufactured and shipped with a Heavy Duty plastic protective pallet cover and the individual porcelain pavers are packaged in protective card board boxes. To prevent damage to your pavers, do not remove the protective card board boxes until you are ready to install them.
- Caution: Removing pavers from their protective packaging and handling multiple loose stones together creates the possibility for chipping.

Once the Heavy Duty plastic pallet covers have been removed from the pallet, the unused boxed pavers should be protected from the elements to insure the integrity of the protective cardboard boxes.
CLEANING & MAINTENANCE FOR PORCELAIN PRODUCTS

Post-laying cleaning is obligatory after on site works. Inadequate or late removal of the grouting used on the joints can leave marks difficult to remove and create, on the flooring, a cement film able to absorb all types of dirt, thus giving the impression that it is the material that has become dirty.

It is indispensable to dissolve and remove these residues completely using buffered acids diluted in water (follow the instructions on the packs of the products used), which must then be removed completely and quickly, rinsing the floor with plenty of water to avoid residues or drops on the floor which could damage the tiles.

Allow the product to act on the wet floor, without letting it dry and rubbing it with colorless rags. Next, rinse it thoroughly with water to ensure that the floor is free of detergent residues. If necessary, repeat the operation.

We suggest performing a preliminary wash on a sample surface of a few square meters; if the test is successful, extend clearing over the entire surface. When you have done the above wash, carry out a basic or alkaline wash using degreasing detergents. This is because acid can leave grease on the floor, which could contribute to retaining dirt.

PORCELAIN PAVER INSTALLATION

Each of the following option details will include specific information relative to the selected installation. Base thicknesses vary between different geographical and climatic locations and the contractor will be installing typical base thicknesses for paving installations in their location.

Installing porcelain pavers requires the bedding course sand to be pre-compacted and then struck off with a screed to the required thickness as shown in the detail drawings. The porcelain pavers are not compacted and therefore the sand layer beneath them requires pre-compaction. Do not compact dry sand, but insure the sand has a 5 to 6% moisture content so that it will compact cohesively and allow for a smooth strike off finish.

INSTALLATION INFORMATION THAT MUST BE FOLLOWED:

• NEVER compact porcelain pavers with a plate compactor.
• ALWAYS pre-compact and strike off your sand leveling course before installing your porcelain pavers in sand set installations.
• Porcelain pavers should only be wet cut with a tile saw equipped with a wet cut porcelain blade.
• NEVER install porcelain pavers without the required 4mm spacing between them. The porcelain pavers should never be installed with a porcelain to porcelain contact. Plastic 4mm spacers (shown at right) should be used on Sand Set and Permeable installations. The photo on the left illustrates the spacer installed in a perspective to support and space 4 paver corners and the photo on the right illustrates the installed spacer snapped apart (as designed) to form Space T that supports 2 paver corners. This versatility will permit your porcelain pavers to be installed in a stack bond pattern, a running bond patterns as well as a flush installation against another structure.
• For a 100 sf. project, approximately 34 spacers are needed; this allows for overages if needed.
PERIPHERAL RESTRAINT SYSTEM SPIKED TO 6–8-IN OVER BASE AREA MINIMUM 4MM (3/16-IN) SPACING BETWEEN PAVERS

20MM (3/4-IN) PORCELAIN PAVERS

MINIMUM 4MM (3/16-IN) SPACING BETWEEN PAVERS

20MM (3/4-IN) PORCELAIN PAVERS

INSTALLATION NOTES:
- Follow the detailed drawing above
- Base material is to be over based 6 to 8 inches beyond the edge of the pavement.
- Precompact the sand bedding course and screed to 1-in thickness with smooth surface.
- The required edge restraint system is a low profile edge restraint with a vertical height of 1½-in as shown in the drawing.
- Insure that pavement is constructed with a 1 ½ to 2% slope that it is pitched away from any building.
- Insure the plastic 4mm spacers are installed at all corners of the installed pavers.

Belgard porcelain pavers can also be installed as a permeable system. Replace sand with 2 inch thick bedding course or 3/8 inch crushed open grade aggregate. Replace 3/4 minus base with 3/4 crushed open grade aggregate.

SAND SET OVER CONCRETE OVERLAY INSTALLATION (PEDESTRIAN FOOT TRAFFIC)

INSTALLATION NOTES:
- The required edge restraint system is a low profile edge restraint with a vertical height of 1½ inches as shown in the drawing.
- Pre-compact the sand bedding course and screed to 1-in thickness with smooth surface.
- Mechanically anchor edge restraint into the concrete base.
- Insure geotextile is installed directly on top of the concrete to contain the bedding sand.
- Insure that pavement is constructed with a 1½ to 2 percent slope and that it is pitched away from any building.
- Insure the plastic 4mm spacers are installed at all corners of the installed pavers.
INSTALLATION NOTES:
- Insure that pavement is constructed with a 2% slope and that it is pitched away from any building.
- For Cementitious adhesive and grout installation, refer to the manufacturer’s technical instructions and specifically as they relate to outdoor installations.
- For concrete foundation slabs that are not large enough to require contraction / control joints, a minimum 4mm (1/8" to 3/16") grout joint is acceptable, but for larger concrete foundation slabs that do require contraction / control joints, the joint width should be a 3/8". It is absolutely imperative that all contraction / control joints be located in the joint line of installed porcelain pavers and not beneath a paver.
- Caution: If a Porcelain Paver is installed over a control joint, the paver will reflectively crack along the contraction / control joint beneath it.
ARDESIE
STONE FINISH PORCELAIN PAVERS

Spacers are recommended for all porcelain paver installations. PLEASE NOTE: For vehicular applications, must be a mortar install over a concrete slab. Please refer to the MIRAGE install guide for driveway install procedure.

<table>
<thead>
<tr>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
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*Porcelain must be laid on concrete and concrete must be designed by an engineer to support the traffic load that will be imposed.

### SHAPES & SIZES

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### PALLET INFORMATION / ESTIMATING CHART

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Spacers are recommended for all porcelain paver installations. PLEASE NOTE: For vehicular applications, must be a mortar install over a concrete slab. Please refer to the MIRAGE install guide for driveway install procedure.

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*Porcelain must be laid on concrete and concrete must be designed by an engineer to support the traffic load that will be imposed.

### SHAPES & SIZES

8 x 48

- 7.80 x 47.17 x 3/4

12 x 48 - SPECIAL ORDER

- 11.73 x 47.17 x 3/4

**Unico**

- 12.99 x 23.54 x 3/4

### PALLET INFORMATION / ESTIMATING CHART

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<td>6.37</td>
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QUARZITI 2.0
STONE FINISH PORCELAIN PAVERS

Spacers are recommended for all porcelain paver installations. PLEASE NOTE: For vehicular applications, must be a mortar install over a concrete slab. Please refer to the MIRAGE install guide for driveway install procedure.

PEDESTRIAN | LIGHT TRAFFIC | HEAVY TRAFFIC | PERMEABLE | ADA | TEXTURGARD® PROCESS | SATURA™ PROCESS | TRUECOLOR™ PROCESS
---|---|---|---|---|---|---|---
✓ | ✓ | | | | | |

*Porcelain must be laid on concrete and concrete must be designed by an engineer to support the traffic load that will be imposed.

SHAPES & SIZES

24 x 24

23.54 x 23.54 x ¾

11.73 x 23.54 x ¾ 23.54 x 35.35 x ¾

*Modular pieces sold as pair only.

Unico

12.99 x 23.54 x ¾

PORCELAIN COLLECTION

PALLET INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th>UNIT</th>
<th>GROSS WEIGHT / BOX</th>
<th>PIECES / BOX</th>
<th>SQ FT / BOX</th>
<th>BOXES / FULL PALLET</th>
<th>SQ FT / PALLET</th>
<th>PALLET GROSS WEIGHT</th>
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NEW
VERONA
STONE FINISH PORCELAIN PAVERS

Spacers are recommended for all porcelain paver installations. PLEASE NOTE: For vehicular applications, must be a mortar install over a concrete slab. Please refer to the MIRAGE install guide for driveway install procedure.

<table>
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<tr>
<th>PEDESTRIAN</th>
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<th>HEAVY TRAFFIC</th>
<th>PERMEABLE</th>
<th>ADA</th>
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<th>SATURA™ PROCESS</th>
<th>TRUECOLOR™ PROCESS</th>
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*Porcelain must be laid on concrete and concrete must be designed by an engineer to support the traffic load that will be imposed.

### SHAPES & SIZES

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23.54 x 23.54 x ¾

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<td>232.5</td>
<td>2160</td>
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</table>
Two installation needs, a single solution. UNICO, size 12.99” x 23.51” x 3⁄4”, is processed on both sides, on one side it has a rounded edge and on the other a square edge. An extremely versatile special piece, which can be used both as a step and as a special piece for swimming pools, with bullnose edge or straight edge, both colored along the side.
Belgard’s Porcelain Veneer is a porcelain stoneware special piece: a squared, rectified three-dimensional decorative piece ideal to outdoor tiling for creating walls and wall coverings. The veneer must be laid staggered, with no gaps, to create a balanced, harmonious visual effect. A cover element should be laid at the top of the tiling to prevent water from infiltrating between the tiles and the wall.

**Installation Recommendations**
- Apply the adhesive using the double-buttering technique in order to increase the adhesion of the modules on the wall.
- Select tiles from different boxes in order to ensure the typical shaded effect and install the tiles in a staggered pattern.
- For installation of tiles close to column, ceiling, floor, lateral walls, etc., it is necessary to allow for adequate gap between the tiles and said fixed obstacles. Do not cover expansion joints. Once the installation is completed, it is possible to make the wall uniform by filling the spaces with grout or silicone.
- For installation of corners, start the procedure with the spaccatella corners as shown in the chart and proceed with the spaccatella on the wall.
- In order to clad walls which will come into contact with water (for example walls in a shower), apply a water-proofing agent on the substrate, use specifics adhesives and grouts.
- If, during installation, the tiles become dirty with adhesive, mortar and grout, immediately proceed with their cleaning.
FREESTANDING & RETAINING WALLS
# TABLE OF CONTENTS

## FREESTANDING & RETAINING WALLS

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<td>Brookshire™</td>
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<td>Diamond Pro® PS Quarried Face</td>
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<td>Ashlar Tandem™ Wall</td>
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<td>Lafitt Tandem™ Wall</td>
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<td>164</td>
<td>Tandem® Column Kit</td>
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<td>168</td>
<td>Tandem® Modular Grid</td>
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<tr>
<td>173</td>
<td>U Start Base Block®</td>
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<td>174</td>
<td>Weston Stone™</td>
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</table>
BEFORE YOU BEGIN

Advance planning and careful layout at the job site help ensure a successful retaining and freestanding wall project.

- Review the site plan to confirm lot lines, wall location, length and elevations.
- Understand on-site soils. Ideal soils are sand and gravel. For walls built in clay or poor soils, work with a local engineer to confirm the wall design and the required soil reinforcement. Black or organic soils should not be used as backfill.
- Confirm the location of underground utilities. Call 811.
- Seek all necessary building permits.
- Prepare a drawing of the site with the wall location, lengths and elevations.
- Plan drainage to avoid erosion or buildup of water behind the wall. Consider where the water will drain through the wall, where downspouts will expel and whether there’s an underground sprinkler. For walls greater than three feet in height, a perforated drainpipe is recommended at the base of the aggregate to quickly remove large amounts of water.
- A best practice is to divert water away from the wall before it has an opportunity to enter the reinforced soil and gravel fill zone.
- Check the block delivered to ensure it is the correct product and color. Check the geosynthetic reinforcement to confirm that it’s the strength and weight specified in the engineering plans.
- Be sure to use the right tools. Hand tools include a shovel, 4-foot level, dead-blow hammer, 2- or 3-pound hammer, chisel, hand tamper, hydraulic splitter and string line. Power tools may include a circular saw with a diamond blade and a plate compactor.
- Always wear protective eye wear.

For additional wall installation references go to Belgard.com.
1. **HOW DO I ESTIMATING LEVELING PAD AGGREGATE?**
   Leveling pad aggregate is a compactible base material of ¾-inch minus (with fines). The leveling pad extends at least 6 inches in front of and behind the wall units and is at least 6 inches deep after compaction.

   Wall length in feet (L) x width of trench in feet (W) ÷ 200 x depth of base in inches (D) x 1.25 = _______ tons.

2. **HOW DO I ESTIMATE DRAINAGE AGGREGATE?**
   Drainage aggregate gravel fill is clear 1-inch crushed stone (with no fines). The drainage column extends 12-inches behind the wall units. Wall length (L) in feet x total wall height (H) in feet = sq. ft. ÷ 27 x 1.1 = cubic yards (cu. yd.). cu. yd. x 1.6 = tons.

   sq. ft. ÷ 27 x 1.1 = _______ cu. yd.

   cu. yd. x 1.6 x 1.25 = _______ tons of aggregate with compensation for compaction.
SEGMENTAL RETAINING WALL TYPES

Segmental retaining walls typically fall into one of three categories.

GRAVITY RETAINING WALL

The first category — a gravity wall — is a retaining wall that does not use soil reinforcement. A gravity wall has height limitations specific to each product. An advantage of this type of retaining wall is that it requires a smaller work area behind the wall. A gravity wall relies on the weight and setback of the block to resist the soil forces being exerted on the wall.

GEOSYNTHETIC-REINFORCED RETAINING WALL

The second category is a geosynthetic-reinforced wall, which needs to be designed by a qualified engineer. There are (theoretically) no height limitations with reinforced retaining walls, and they are used in larger applications. It requires more work area behind the structure.

The block of soil is stabilized by introducing reinforcement layers into the soil mass behind the facing units. The larger the stabilized soil mass, the more soil can be retained or held back. The geogrid in the soil extends past the theoretical failure plane and serves to create a large, rectangular mass of block and soil, restraining the retained soil.

ANCHORPLEX® SYSTEM

The third category is the Anchorplex system, which offers a unique, non-conventional solution to problematic wall construction sites. It is a retaining wall built with Anchor™ products and structural backfill specified by Anchor Wall Systems, and backed by engineering support tools developed by Anchor.

Use of the Anchorplex system completely eliminates the need for the construction of a mechanically stabilized earth zone behind the wall facing and requires substantially less excavation than is usually necessary in geosynthetic-reinforced wall construction.

Contact Anchor Wall Systems at 1-877-295-5415 for more information about designing and building with the Anchorplex system.
OTHER SEGMENTAL WALL APPLICATIONS

INDEPENDENT TERRACED WALLS

For each wall to be independent of others, they must be built using 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 also 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 above, below or between wall locations. For example, if the lower terrace is 4 feet tall, the distance between the terraces must be at least 8 feet and the upper wall must not be higher than 4 feet.

Proper drainage is vital to maintaining stable, long-lasting terraced walls. A drainpipe must be installed so that the water is directed around or under the lower wall. Never place the drainpipe outlet for the upper wall above or behind the lower wall.

DEPENDENT TERRACED WALLS

When the distance between the lower and upper walls is less than twice the height of the lower wall, the walls become structurally dependent on each other. In this situation, it is important to take global stability into account, incorporating additional reinforcement — and longer layers — into the wall plan. In addition, structurally dependent walls require even more excavation, backfill and time. So plan ahead and be sure to check the wall plan for specific requirements. For structurally dependent walls, consult with a qualified engineer.
STAKE OUT THE WALL
• Have a surveyor stake out the wall’s placement. Verify the locations with the project supervisor.

EXCAVATION
• Excavate for the leveling pad according to the lines and grades shown on the approved plans and excavate enough soil behind the wall for the geosynthetic reinforcement material, if needed.
• The trench for the leveling pad should be at least 12 inches wider than the block you are installing and 6 inches deeper than the height of the block. See Diagram 1.

LEVELING PAD
• An aggregate leveling pad is made of compactable base material of ¾-inch minus (with fines).
• The pad must extend at least 6 inches in front of and behind the first course of block and be at least 6 inches deep after compaction.
• If the planned grade along the wall front will change elevation, the leveling pad may be stepped up in 6-inch increments to match the grade change. Start at the lowest level and work upward whenever possible.
• Compact the aggregate and make sure it’s level front to back and side to side. Mist lightly with water before compaction. See Diagram 2.

BASE COURSE
• This is the most important step in the installation process. Bury the base course of block.
• Begin laying block at the lowest elevation of the wall. Remove the rear lip (if applicable) of the block by hitting from the back so that it will lie flat on the leveling pad. See Diagram 3.
• Place first block and level, front to back and side to side; lay subsequent blocks in the same manner.
• Place the blocks side by side, flush against each other, and make sure they are in full contact with the leveling pad.
• If the wall is on an incline, don’t slope the blocks; step them up so they remain consistently level.
• Use string line along the back edge of block to check for proper alignment.
• For multi-piece products, use the largest unit, 18 inches wide, for the base course.
• Fill cores (if applicable) and voids between blocks with 3/4-inch free-draining aggregate prior to laying the next course of block. Clean any debris off the top of the blocks. See Diagram 4.
CONSTRUCTION OF SUBSEQUENT COURSES

• Clean any debris off the top of the blocks.
• Place the second course of blocks on top of the base course. Maintain running bond. Pull each block forward as far as possible to ensure the correct setback. See Diagram 5.
• Fill cores (if applicable) and voids between blocks with 1-inch free-draining aggregate prior to laying the next course of block. Clean any debris off the top of the blocks.
• For best results, use a filter fabric, which should be placed directly behind the wall extending from the bottom of the base course to the middle of the top course. This will minimize material coming through the rough-hewn face texture of these products. We recommend a non-woven, 4- to 6-ounce fabric.
• Backfill with ¾-inch free-draining aggregate directly behind the block, adding 6 inches at a time followed by proper compaction.
• Add retained soil behind the aggregate. Compact before the next course is laid.
• Don’t drive heavy equipment near the wall. Self-propelled compaction equipment should not be used within 4 feet of the wall.
• Keep the wall bond by placing units in a staggered relationship to the course beneath.
• You may need partial units to stay on bond. A saw with a diamond blade is recommended for cutting partial units. Use safety glasses and other protective equipment when cutting.

DRAINAGE DESIGN

• Each project is unique. The grades on your site will determine at what level to install the drainpipe.
• Place the drainpipe 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. See Diagram 6.
• Fill in the area behind the blocks with ¾-inch free-draining aggregate, at least 12 inches from the wall.
• You may need to place and backfill several courses to achieve the proper drainage level. See Diagrams 7 and 8.
• Cover the drainpipe with a geotextile sock which acts as a filter. The drainpipe outlets should be spaced not more than every 50 feet and at low points of the wall. In order for the drainage aggregate to function properly, it must keep clear of regular soil fill. See below diagram of daylight drainage system.
LAYING PATTERN AND INSTALLATION GUIDE FOR MULTI-PIECE SEGMENTAL RETAINING WALLS

USING A PATTERN FOR SINGLE-HEIGHT RETAINING WALLS

When using a pattern, begin at one edge, laying the units as indicated. Install at least one repeat of the pattern to establish the pattern before proceeding to the next course. Stagger the patterns as shown to avoid vertical bonds.

One set of 6-inch-high retaining wall blocks consists of 2 large units, 1 medium unit and 1 small unit, and is 2 square feet.

6” Multipiece wall system, 18-inch by 4-foot pattern = 6 sq. ft.

STEPPING UP THE BASE AT LOWEST POINT

Walls built on a sloping grade require a stepped base. Begin excavation at the lowest point and dig a level trench into the slope until it is deep enough to accommodate the base material and height of one entire block.

STEP-UP

At this point, step up the height of one block and begin a new section of base trench. Continue to step up as needed to top of slope. Always bury at least one full unit at each step.

STEPPING UP THE BASE USING THE U START BASE BLOCK

Walls built on a sloping grade require a stepped base. Begin excavation at the lowest point and dig a level trench, 24 inches wide, into the slope until it is deep enough to accommodate the base material and one entire base block. See Diagram 9.
ABUTTING AN EXISTING STRUCTURE

FIRST COURSE

Begin with the first block next to the wall and place the first course. Place filter fabric behind the first two units and extend it 2 feet along the existing structure.

SECOND COURSE

Build second course with standard installation techniques. A split unit is shown but may not be necessary in every installation. Extend filter fabric to the top edge of the final course. See Diagram 10. A rubber membrane may be placed between the units and a non-concrete wall to prevent moisture damage to the structure.

Note: To split a block, use a hydraulic splitter or split manually by using a hammer and chisel to score the block on all sides. Pound the chisel on the same line until the block splits. If partial unit sides are not exposed, use a saw with a diamond blade to achieve a tighter fit.
OUTSIDE CURVES

CALCULATE THE RADIUS

When building an outside curve, begin by determining the desired radius of the top course. This will be the smallest radius in the wall and must not be less than the minimum radius for the wall system used.

To determine the approximate base course radius:

1) Add ¼-inch to the setback of the block used. Multiply that by the number of courses in the finished wall.

2) Add desired radius length of the top course to the result of step 1. This number equals the approximate radius length of the base course.

3) To determine the radius for the front edge of the trench, add 6 inches to the approximate radius length of the base course.

Example: Setback of the Highland Stone® product is 1¼ inch. The wall is 8 courses high. The desired radius of the wall measured to the front of the block on the top course is 6 feet.

1) Setback multiplied by number of courses
   
   1¼” + ¼” = 1½” x 8 courses = 11”

2) Desired radius plus setback
   
   6’ + 11” = 6’11”

3) Front of trench
   
   6’11” + 6” = 7’5”

TIP: Subtract the depth of the block if you prefer to mark the curve from the back of the block.

LAY OUT THE TRENCH

Drive a stake into the ground at the desired radius point of the curve. Attach a string and rotate it in an arc at the desired length to mark the curve in the soil. Dig the trench.

BASE COURSE

Using the existing radius point stake and string, mark the base course curve on the leveling pad. Align the front of the block with the marked curve and ensure level placement from side to side and front to back.

ADDITIONAL COURSES

On each course, some of the rear lip of each block must be in contact with the back of the units below to ensure structural stability. The setback 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 needed. Once a split or cut unit is cut to size, glue in place with a concrete adhesive.
INSIDE CURVES

CALCULATE THE RADIUS
Check the wall plan to determine the radius of the top course. This will be the biggest radius in the wall and you will need it to determine the radius at the base course, which will be the smallest radius of the wall and must not be less than the minimum for the block system used.

A QUICK WAY TO DETERMINE THE BASE COURSE RADIUS:
1) Add ¼-inch to the setback of the block used. Multiply that by the number of courses in the finished wall.
2) Subtract the result of step 1 from the radius of the top course. This number equals the approximate radius length of the base course.
3) To determine the radius for the front edge of the trench, subtract 6 inches from the approximate radius length of the base course.

Example: The setback of the Highland Stone® product is 1 1/8 inches. The wall is 8 courses high. The desired radius of the wall measured to the front of the block on the top course is 10 feet.

1) Setback multiplied by number of courses
   1 1/8" + ¼" = 1 3/8" x 8 courses = 11"

2) Desired radius minus setback
   10' - 11" = 9'1"

3) Front of trench
   9'1" - 6" = 8'7"

TIP: Add the depth of the block if you prefer to mark the curve from the back of the block.

LAY OUT THE TRENCH
Drive a stake into the ground at the desired radius point of the curve. Attach a string and rotate it in an arc at the desired length to mark the curve in the soil. Dig the trench.

BASE COURSE
Using existing radius point stake and string, mark the base course curve on the leveling pad. Align the front of the block with the marked curve and ensure level placement from side to side and front to back.

ADDITIONAL COURSES
On each course, some of the lips of each block must be in contact with the back of the units below to ensure structural stability. If not, use construction adhesive to adhere blocks together. To maintain proper running bond, use partial units as needed. Once a split unit is cut to size, glue in place with a concrete adhesive.
OUTSIDE 90-DEGREE CORNERS
FOR SYSTEMS WITHOUT A CORNER UNIT

BASE COURSE
To build an outside 90-degree corner, begin by splitting a unit in half. Place this unit with both split faces out at the
corner. If needed, remove the rear lip so that the block lies flat. Then lay the rest of the base course working from the
corner block out.

ADDITIONAL COURSES
Begin the next course with the other half of the split unit faced in the opposite direction at the corner.
Place the second and third blocks on either side of the corner unit. Once the corner unit is in position, glue block in
place with a concrete adhesive. Continue to alternate the corner unit orientation with each course and always use a
cement adhesive on the corner units. Use cut or split units as necessary to maintain running bond.

OUTSIDE 90-DEGREE CORNERS
FOR SYSTEMS WITHOUT A CORNER UNIT
90-degree corners are built by alternating corner/column units so the long side is on different sides of the wall. Build
the pattern from the corner unit when possible. Install corner units level from front to back.
Depending on the wall layout, there may be a need to go off the pattern and randomly place wall blocks near the
corner. Set back corner units to reflect the batter of the wall block units and glue from bottom to top.

NOTE: To split a block, use a hydraulic splitter or split manually by using a hammer and chisel to score the block
on all sides. Pound the chisel on the same line until the block splits. If partial unit sides are not exposed, use a
saw with a diamond blade to achieve a tighter fit.
INSIDE 90-DEGREE CORNERS

BASE COURSE
To create an inside 90-degree corner, begin by placing a block at the corner. Then lay a second block perpendicular 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 standard site prep and installation procedures.

Additional Courses
On the second course, place all blocks on bond along one side of the corner. Once the second course of one wall is established, begin the second course of the adjacent wall. Split units or units of varying sizes may be required on this wall to maintain running bond. Continue to alternate the corner unit orientation with each course and always use a concrete adhesive on the corner units.

NOTE: To split a block, use a hydraulic splitter or split manually by using a hammer and chisel to score the block on all sides. Pound the chisel on the same line until the block splits. If partial unit sides are not exposed, use a saw with a diamond blade to achieve a tighter fit.
GEOSPHTHETIC REINFORCEMENT (IF REQUIRED)

- Geosynthetic reinforcement is recommended for walls taller than the gravity height of each product, or walls situated in poor soils, supporting a driveway, etc. Consult an engineer for design assistance.
- Check the wall construction plan for which courses will need geosynthetic reinforcement.
- Clean any debris off the top layer of blocks.
- Measure and cut the geosynthetic reinforcement to the design length in the plans.
- The geosynthetic reinforcement has a design strength direction, which must be laid perpendicular to the wall.
- Place the front edge of the geosynthetic reinforcement on top of the block, making sure it’s within 1 inch of the face of the block. Correct placement ensures that you maximize the connection strength and keep the batter consistent.
- Apply the next course of blocks to secure it in place.
- A minimum of 6 inches of backfill is required prior to operating vehicles on the geosynthetic reinforcement. Avoid sudden turning or braking.

COMPACION

- Place the backfill soil behind the drainage aggregate and compact with a hand-operated compactor.
- Make sure the aggregate is level with or slightly below the top of the course.
- Place soil in front of the base course and compact. The base course should be buried.
- Continue to fill and compact.

FINISH GRADE AND SURFACE DRAINAGE

- Protect the wall with a finished grade at the top and bottom.
- To ensure proper water drainage away from the wall, use 6 inches of soil with low permeability. This will minimize water seeping into the soil and drainage aggregate behind the wall. See Drainage Swales.

SITE CLEANING AND RESTORATION

- Brush off the wall and pick up any debris left from the construction process.
- Notify the job superintendent in writing of the project’s completion and that it is ready for final inspection and acceptance.
- Planting vegetation in front and on top of the wall will help reduce the chance of erosion.
- Following the best practices for construction will ensure the successful installation of Anchor™ products.

DRAINAGE SWALES

- Design and performance of most retaining walls are based on keeping the reinforced zone relatively dry. Appropriate drainage swales to help control water should be designed into the wall construction plan.

SAFETY NOTE: Always use appropriate equipment, including safety glasses or goggles and respirators, when splitting, cutting or hammering units. Refer to the NCMA Segmental Retaining Wall Installation Guide at www.ncma.org.
ANCHORPLEX® SYSTEM CONSTRUCTION GUIDE

HOW TO USE THIS GUIDE
Use this information to gain a general understanding of the basics of building retaining walls with the Anchorplex system. Do not use this in lieu of construction drawings provided by a qualified engineer. Contact Anchor Wall Systems at 1-877-295-5415 for more information about designing and building with the Anchorplex system.

ABOUT THE ANCHORPLEX® SYSTEM
The Anchorplex system is a retaining wall built with Anchor products and self-compacting structural backfill, also known as no-fines concrete, which is a highly-porous mixture of clean stone, cement and water. The mixing ratios (by weight) of aggregate to cementitious material should be between 6:1 and 7:1. The mixing rate (by weight) of water to cementitious material should be no more than 1:2. The resulting material, upon curing, should have at least 25 percent voids and should exhibit a minimum compressive strength (f1c) of 1,500 psi.

RETAINING WALL CONSTRUCTION
Setting out the wall and excavation is no different for an Anchorplex system construction than for conventional construction, except that the amount of excavation will probably differ. Construction of the leveling pad, base course, subsequent courses and drainage is no different for an Anchorplex system construction than for conventional construction.

INSTALLATION OF STRUCTURAL BACKFILL
After completion of the leveling pad, base course, drainpipe installation and stacking block 2 feet above grade, the first lift of structural backfill that meets Anchor Wall Systems’ specifications can be installed. Do not exceed 2 feet vertical stacking of block before placing a lift of structural backfill.

The structural backfill can be placed directly from delivery vehicle or with skid-type loader or other equipment. It should be placed behind the blocks and worked into all voids and cores of the blocks (if applicable). When properly formulated, the structural backfill will not leak through the face of the wall.

After installation of the first lift of structural backfill, install additional courses and repeat the process. Place additional lifts every 8 to 24 inches depending on site conditions and project scale. Subsequent pours can be made as soon as the structural backfill in the previous lift has set — usually within 2 to 3 hours.

INSTALLATION OF FILTER FABRIC
Place a layer of filter fabric over the structural backfill and up the back of the top course and the cap. Then fill behind the top course and cap with low-permeability soil.

CAPPING & FINISHING
Follow standard practice when capping the wall. Protect the wall with a finish grade at the top and bottom.
**STEPS IN A CURVED WALL**

These drawings show Highland Stone®, Diamond® and Diamond Stone Cut® step units. Caps or pavers can be used for treads. Check local building codes for any tread depth standards.

**BASE COURSE**

Thoroughly compact the leveling pad. Lay out the base course according to the wall design. Place step units first, working from the center to each side. Remember, it is very important to backfill and compact behind and along the sides of each course of step units.

**FIRST STEP COURSE**

Place the first course of step units directly on top of the base course so there is no setback. Stagger them from the previous course and glue in place.

**SECOND STEP COURSE**

Add the second course of steps, staggering them from the previous course to maintain running bond. Overlap the lower course by a minimum 2 inches and glue to lower course. Place and compact base material prior to installing next course.

**NEXT WALL COURSE**

Place a block near the second course of steps, maintaining running bond with the base course. Measure and cut a block to fit the space remaining between the step unit and the next course of the wall. Place the unit in the wall, making sure that both vertical edges fit tight against both the step and standard unit. Remove the rear lip on the blocks when necessary, and angle the blocks flush with the face of the previous course. Glue in place with a concrete adhesive. Repeat these steps until the wall is finished.

**ADDITIONAL COURSES**

Beginning in the center, add the third course of steps, lining up the units with the first course. Overlap a minimum 2 inches and glue in place. Repeat until the steps are finished.

**DRAINAGE TIP:** Drain pipe can be placed behind the lowest step units at grade or behind each wall adjacent to the steps.
STEPS IN A 90-DEGREE WALL
These drawings show Highland Stone®, Diamond® and Diamond Stone Cut® step units. Caps or pavers can be used for treads. Check local building codes for any tread depth standards.

BASE COURSE
Thoroughly compact the leveling pad. Lay out the base course according to the wall design. Place step units first, working from the center to each side. Remember, it is very important to backfill and compact behind and along the sides of each course of step units.

FIRST STEP COURSE
Place the first course of step units directly on top of the base course so there is no setback. Stagger them from the previous course and glue in place.

SECOND STEP COURSE
Add the second course of steps, staggering them from the previous course to maintain running bond. Overlap the lower course by a minimum 2 inches and glue to lower course. Place and compact base material prior to installing next course.

SECOND WALL COURSE
Build the second course of the wall. Corner units are used at the end of steps tied into wall and glued in place. Alternate long and short direction of corner unit every other row.

THIRD STEP COURSE
Beginning in the center, add the third course of steps, lining up the units with the first course. Overlap the lower course by 2 inches and glue to lower course.

ADDITIONAL COURSES
Build the third course of the wall. Repeat these steps until the wall is finished.
STRAIGHT WALL

The XL™ cap must be laid alternately, short and long faces for a straight line. Always start capping from the lowest elevation. Once caps are aligned, caps should be glued in place using a concrete adhesive.

CURVES

Lay out the cap units side by side with the same face facing out (long faces for outside curves; short face to inside curves). If there’s a need to adjust for project’s radius, make cuts at least every other cap as needed for the most pleasing aesthetic.

• Minimum radius with XL™ cap: 2 feet 2 inches

90-DEGREE CORNERS

Saw-cut two caps to achieve a 45-degree mitered corner.

STEPPING UP CAPS WITH XL™ CAP

If the wall elevation changes, caps can be stacked where the wall steps up. Begin laying caps at the lowest elevation change and work your way toward the next step up. Split* a cap unit to fit. Place the split unit directly on top of the capped portion of the wall with all three split faces exposed.

FINISHING WITH XL™ CAP

After layout is complete and caps are saw-cut or split to size, carefully place concrete adhesive on wall top course and then place caps.

*NOTE: To split a block, use a hydraulic splitter or split manually by using a hammer and chisel to score the block on all sides. Pound the chisel on the same line until the block splits. If partial unit sides are not exposed, use a saw with a diamond blade to achieve a tighter fit.
LAYING PATTERN AND INSTALLATION GUIDE FOR MULTI-PIECE FREESTANDING WALL

WHEN TO USE A PATTERN FOR FREESTANDING WALLS

One set of 6-inch-high blocks consists of 2 large units, 1 medium unit and 1 small unit, and is 1 square foot of two sided wall.

NOTE: These freestanding wall installation patterns show only one side of the freestanding wall. The same number of blocks are needed to build the other side of a freestanding wall when using a back-to-back freestanding wall systems. Freestanding wall installation patterns are measured in length by height of one side of the wall, and are expressed in square feet. Sets of blocks required include the number of blocks needed to build both sides of the wall.

ENDING A WALL WITH WALL ENDS

Start pattern next to a wall end unit if the wall does not end with a column. Using a column unit, every other unit is cut in half to stagger bond. Glue all pieces in place using concrete adhesive.
LAYING PATTERN GUIDE FOR MULTI-PIECE RETAINING WALLS

USING A PATTERN FOR SINGLE-HEIGHT RETAINING WALLS

When using a pattern, begin at one edge, laying the units as indicated. Install at least one repeat of the pattern to establish the pattern before proceeding to the next course. Stagger the patterns as shown to avoid vertical bonds.

One set of 6-inch-high retaining wall blocks consists of 2 large units, 1 medium unit and 1 small unit, and is 2 square feet.

6” Multipiece wall system, 18-inch by 4-foot pattern = 6 sq. ft.

STEP-UP THE BASE AT LOWEST POINT

Walls built on a sloping grade require a stepped base. Begin excavation at the lowest point and dig a level trench into the slope until it is deep enough to accommodate the base material and height of one entire block.

STEP-UP

At this point, step up the height of one block and begin a new section of base trench. Continue to step up as needed to top of slope. Always bury at least one full unit at each step.
STEP CONSTRUCTION
When constructing steps, you must consider whether it is a fill or a cut-grade situation. Construction is similar, but varies in the amount of dummy units required.

A fill step will have a base course of dummy units in the entire footprint of the steps. For each additional step, add dummy units behind the facing units for stability. There are two methods for creating the step facing. Use sets of either 6-inch-high or 3-inch-high units. A cut-grade set of steps will use one layer of dummy blocks under each step, effectively stepping up the grade.

All applications will require some sort of tread to cover the facing units.

USING FILL SCENARIO

USING CUT SCENARIO

RETAINING WALL SQUARE FIRE PIT CONSTRUCTION
Inside of fire pit must be lined with a heat-resistant material. Affix all units with construction-grade adhesive.

These blocks are not fireproof and could start to crack under extreme heat. These blocks are intended for landscape applications and are not fire-rated. Over time the blocks may crack. A possible solution is to use heavy fire-rated bricks or a steel liner on the interior of an above or below ground fire ring/pit with the blocks outside the perimeter. Again, the heat may adversely affect landscape products, even with an interior heat-resistant barrier in place.
WHEN TO USE A PATTERN FOR FREESTANDING WALLS

One set of 6-inch-high blocks consists of 2 large units, 1 medium unit and 1 small unit, and is 1 square foot of two sided wall.

NOTE: These freestanding wall installation patterns show only one side of the freestanding wall. The same number of blocks are needed to build the other side of a freestanding wall when using Belair Wall 2.0 and Brisa freestanding wall systems. Freestanding wall installation patterns are measured in length by height of one side of the wall, and are expressed in square feet. Sets of blocks required include the number of blocks needed to build both sides of the wall.

ENDING A WALL WITH WALL ENDS

Start pattern next to a wall end unit if the wall does not end with a column. Every other wall end is cut in half. Glue all pieces in place using concrete adhesive.

COLUMN CONSTRUCTION

Course A

Course B

6” Minimum Compacted Granular-Base Leveling Pad

Stager Corner/Column Units to Maintain Bond
**TRAPEZOID DOUBLE-SIDED CAP**

The double-sided cap has a right-angle side and an offset-angle side. The caps can be used in any of four directions since there is no specific top or bottom.

**STRAIGHT WALL**

The cap must be laid alternately, narrow (N) and wide (W) faces, for a straight line. Always start capping from the lowest elevation.

**CURVES**

Lay out the cap units side by side with same face facing out (wide faces for outside curves; narrow faces for inside curves). Occasional cutting of some pieces may be necessary.

Minimum radius: 7'6”

**STEPPING UP CAPS WITH CAP ENDS**

If a wall elevation changes, caps can be stacked where the wall steps up. Begin laying caps at the lowest elevation and work your way toward the next step-up. Cut a cap unit to fit. Place the cut unit directly on top of the capped portion of the wall with the cut side hidden from view. If not using a Cap End, place the trapezoid double-sided cap so that the side with the arrow is hidden.

**90-DEGREE CORNERS WITH CAP END**

Using a Cap End unit

**FINISH WITH A CAP END**

Do not cut the cap end, cut an interior cap if needed.

**NOTE:** To split a block, use a hydraulic splitter or split manually by using a hammer and chisel to score the block on all sides. Pound the chisel on the same line until the block splits. If partial unit sides are not exposed, use a saw with a diamond blade to achieve a tighter fit.
## ASPEN STONE®
### RETAINING WALLS

### SHAPES & SIZES

**Block**

Use 3” Universal Cap as a coping.

4 x 11½ x 7

### PALLET INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th>Unit</th>
<th>SQFT/Pallet</th>
<th>LAYER/Pallet</th>
<th>UNITS/Pallet</th>
<th>UNITS/Layer</th>
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ANCHOR ASPEN STONE ESTIMATING GUIDE

To use:
1. Locate wall length and wall height to determine block quantities needed for a wall.
2. Add cap block quantities.
3. For planter rings, locate diameter of top ring and wall height to determine block quantities needed.

### 1. TOTAL WALL BLOCK QUANTITIES*

<table>
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<tr>
<th>HEIGHT</th>
<th>NUMBER OF COURSES</th>
<th>5'</th>
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<th>20'</th>
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*If the section is one, two or three courses high, bury one-half of the first course for any size wall. If the section is four courses or higher, the full first course must be buried.
**BELAIR WALL®**
FREESTANDING WALLS

<table>
<thead>
<tr>
<th>RESIDENTIAL</th>
<th>COMMERCIAL</th>
<th>STEPS</th>
<th>COLUMNS</th>
<th>FIRE PITS</th>
<th>KITCHEN</th>
<th>FREESTANDING WALL</th>
<th>RETAINING WALL</th>
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**SHAPES & SIZES**

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<th>6&quot; Freestanding Wall</th>
<th>Corner/Column</th>
<th>Cap</th>
<th>Cap End</th>
<th>Wall End</th>
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**PALLETS INFORMATION / ESTIMATING CHART**

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**COLUMN/CORNER**

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**WALL END UNIT**

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### SHAPES & SIZES

**6” Retaining Wall**

- 6 x 8 x 8
- 6 x 16 x 8
- 6 x 16 x 8 w/ microjoint

**Corner/Column**

- 6 x 16 x 8

**Cap**

- 3 x 7 / 8 x 13½

**Cap End**

- 3 x 8 x 13½

**Wall End**

- 6 x 8 x 11

### PALLET INFORMATION / ESTIMATING CHART

#### BELAIR 6” RETAINING WALL

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<td>2420</td>
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</tbody>
</table>

**COLUMN/CORNER**

- 6 x 16 x 8

| 6 x 16 x 8 | - | - | 2 | 20 | 10 | - | - | - | - | 1400 |

**CAP**

- 3 x 7 / 8 x 13½

| 3 x 7 / 8 x 13½ | - | - | 8 | 144 | 18 | - | - | - | - | 3420 |

**CAP END**

- 3 x 8 x 13½

| 3 x 8 x 13½ | - | - | 2 | 36 | - | - | - | - | - | 882 |

**WALL END UNIT**

- 6 x 8 x 11

| 6 x 8 x 11 | - | - | 2 | 42 | - | - | - | - | - | 1550 |
**BROOKSHIRE™**

**FREESTANDING / RETAINING WALLS**

<table>
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<tr>
<th>RESIDENTIAL</th>
<th>COMMERCIAL</th>
<th>STEPS</th>
<th>COLUMNS</th>
<th>FIRE PITS</th>
<th>KITCHEN</th>
<th>FREESTANDING WALL</th>
<th>RETAINING WALL</th>
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**SHAPES & SIZES**

**Brookshire Wall - 3”**

- 3 x 6 / 4 x 9
- 3 x 12 / 10 x 9
- 3 x 16 / 14 x 9

**Brookshire Wall - 6”**

- 6 x 6 / 4 x 9
- 6 x 12 / 10 x 9
- 6 x 16 / 14 x 9

**3” Corner / Column**

- 3 x 15 / 14 x 9

**6” Corner / Column**

- 6 x 15 / 14 x 9

**Cap**

- 3 x 18 / 12 x 13

**Anchor™ Pins**

- 5” L x .05” dia.
- Sold Separately

28” x 28” Cap

Please contact Belgard Rep for more information.
## PALLET INFORMATION / ESTIMATING CHART

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<thead>
<tr>
<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
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<th>LNFT PALLET (SAILOR)</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
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<td>3 x 16 / 14 x 9</td>
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<td>–</td>
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</tbody>
</table>

| **BROOKSHIRE WALL - 6"** | | | | | | | | | | | |
| 6 x 6 / 4 x 9 | – | – | – | – | – | – | – | – | – | – | – |
| 6 x 12 / 10 x 9 | – | – | – | – | – | – | – | – | – | – | – |
| 6 x 16 / 14 x 9 | – | – | – | – | – | – | – | – | – | – | – |
| TOTAL | 32 | – | 5 | – | – | – | – | – | – | – | 3300 |

| **3" CORNER/COLUMN** | | | | | | | | | | | |
| 3 x 15 / 14 x 9 | – | – | 8 | 80 | 10 | – | – | – | – | – | 2480 |

| **6" CORNER/COLUMN** | | | | | | | | | | | |
| 6 x 15 / 14 x 9 | – | – | 4 | 40 | 10 | – | – | – | – | – | 3250 |

| **CAP** | | | | | | | | | | | |
| 3 x 18 / 12 x 13 | – | – | 6 | 54 | 9 | – | – | – | – | – | 3132 |
BASE COURSE
- This is the most important step in the installation process.
- Begin laying block at the lowest elevation of the wall, whenever possible.
- Place first block with the wide side to the front and level, front to back and side to side; lay subsequent blocks in the same manner. When using the center pin channel, units should be pitched back $\frac{1}{16}$ inch for each foot of wall height.
- Align string line with the center channel to check for proper alignment. See Diagram 1.
- Place the blocks side by side, with wide side to the front and make sure the blocks are in full contact with the leveling pad. Level front to back and side to side. See Diagram 2.
- If the wall is on an incline, don’t slope the blocks. Step them up so they remain consistently level.
- Place soil in front of the base course and compact. Base course should be buried. Continue to fill and compact after each course is laid.
- Clean any debris off the top of the blocks.

CONSTRUCTION OF NEXT COURSE AND PIN PLACEMENT
- For a battered wall, place the next course of blocks and align the pin hole with the battered channel of the block on the course below. See Diagram 3.
- For a vertical wall, place the next course of blocks and align with the vertical channel of the block on the below course.
- Insert pins into the pin core of the block. See Diagram 4.
- Maintain running bond with the course below.
- Place 12 inches (minimum) of backfill aggregate behind the wall units and fill voids between the wall units. Place backfill soil and compact. Only lightweight hand operated compaction equipment is allowed within 3 feet from the back of the wall.
- Clean any debris off the top of the blocks before placement of the next course.

DRAINAGE DESIGN (PER DESIGN)
- Each project is unique. The grades on the site will determine at what level to install the drainpipe. Place the drainpipe (4-inch perforated piping) so water drains down and away from the wall into a storm drain, or daylight just above grade.
- Fill in the area behind the blocks with clean drainage aggregate, at least 1 foot from the wall. You may need to place and backfill several courses to achieve the proper drainage level. See Diagram 5.
- The outlet pipes should be spaced not more than every 50 feet and at low points of the wall. In order for the drainage aggregate to function properly, it must keep clear of regular soil fill.
REINFORCED BACKFILL PLACEMENT AND COMPACTION (PER PLAN)

- Place reinforced backfill in 6 to 8 inch loose lifts and compact to the densities specified on the approved wall constructions plans.
- Only hand operated compaction equipment is allowed within 3 feet from the back of the wall.
- If the compaction equipment is too small to achieve the required compaction, thinner lifts should be used.
- Install each subsequent course in a similar manner. Repeat procedure to the extent of the wall height.

REINFORCEMENT PLACEMENT (PER PLAN)

- Refer to the approved wall construction plans for the reinforcement type, strength, and placement location. Measure and cut the reinforcement to the lengths shown on the plans.
- Ensure the reinforced backfill is placed and compacted flush with the top of the units and is graded reasonably flat prior to reinforcement placement. Clean any debris off the top layer of blocks prior to reinforcement placement.
- The reinforcement has a primary strength direction, which must be laid perpendicular to the wall face.
- Place the reinforcement within 1 inch of the front of the units. See Diagram 6.
- Apply the next course of blocks to secure the reinforcement in place. Insert pins through the pin core. Pull the reinforcement hand taut and place staples, stakes, or fill at the back of the reinforcement tension during placement of drainage aggregate and reinforced backfill.
- Place a minimum of 6 inches of reinforced backfill prior to operating equipment above the reinforcement. Avoid sudden braking or turning on fill placed over the reinforcement.

FINISH GRADE AND SURFACE DRAINAGE

- Protect the wall with a finished grade at the top and bottom. To ensure proper water drainage away from the wall, use 6 inches of soil with low permeability and seed or plant to stabilize the surface.
- Consult the wall design engineer if water may be directed behind the wall. If needed, create a swale to divert water away from the wall. This will minimize water seeping into the soil and drainage aggregate behind the wall.

SITE CLEANING AND RESTORATION

- Brush off the wall and pick up any debris left from the construction process. Notify the job superintendent in writing of the completion and that it is ready for final inspection and acceptance.
- Planting vegetation in front and on top of the wall will help reduce the chance of erosion.
- Following these best practices for construction will ensure the success of your retaining wall system. These instructions are meant as general guidelines. Site-specific conditions may warrant additional installation requirements.
LAYING PATTERN GUIDE FOR MULTI HEIGHT RETAINING WALLS

WHEN TO USE A PATTERN
You can install the multipiece retaining wall system in a random pattern using any combination of units. Just avoid vertical lines that span more than 1 foot in height. If you are building a wall without geosynthetic reinforcement, use a pattern for inspiration or follow the pattern exactly. Pleasing random patterns can be built using an equal number of 6- and 3-inch high blocks or using an equal square footage of blocks in each size. These patterns are based on using an equal number of blocks of each size in each height.

When building a wall that includes geosynthetic reinforcement, using a pattern at the appropriate spacing eliminates the need to cut the geogrid. When using a pattern, begin at one edge laying the blocks as indicated. Install at least one repeat of the pattern to establish the pattern before proceeding to the next course.

SEQUENT™ PANEL INSTALLATION PATTERN
9-inch by 5-foot 8-inch Installation Pattern. This 9-inch high by 34-inch long installation pattern uses an equal number of units of each face size to make the panel. This installation pattern is one of many possible options. Others can be used for different appearances.

![Diagram of 9-inch by 5-foot 8-inch Installation Pattern]

STEPPING UP THE BASE

LOWEST POINT
Walls built on a sloping grade require a stepped base. Begin excavation at the lowest point and dig a level trench into the slope until it is deep enough to accommodate the base material and one entire block.

STEP-UP
At this point, step up the height of one block and begin a new section of base trench. Continue to step-up as needed to top of slope. Always bury at least one full unit at each step.
BASE COURSE
Once the pad is compact and level, begin placing the units. Center the units on the pad and alternate the short and long faces. The ends of the units should be in contact. Level the blocks front to back and side to side. Lay subsequent blocks in the same manner. The base course must be buried below grade and should be included when calculating total wall height. See Diagram 7.

CONSTRUCTION OF THE NEXT COURSE AND PIN PLACEMENT
• Clean any debris off the top of the blocks
• Place the next course of blocks and align the pin core with the vertical channel of the block on the course below and maintain running bond.
• Insert pins through the pin cores. See Diagram 8.
• Repeat this process to complete the wall. Glue top two courses and caps in place with a concrete adhesive.

STRUCTURAL DESIGN ELEMENTS
Structural design elements must be used if a freestanding wall is more than 10 feet long. Structural design elements include:
• Curves
• 90-Degree Corners
• Columns

ENDING A WALL WITHOUT A COLUMN
To end a wall without a column, split the unit down the center using the split line as a guide. Alternate courses as shown until the desired height of wall is reached. Cut wall units to maintain running bond. Glue all corner pieces with a concrete adhesive. See Diagram 9.
COLUMNS

When used with a freestanding wall, a column increases wall stability. The column leveling pad should extend 6 inches beyond each column edge and be at least 6 inches deep after compaction. To build a column, place the first column unit and level front to back and side to side. Place the second perpendicular to the first. Use a square as a guide. Place the third and fourth units in a similar fashion. Make sure all units are level with each other.

Alternate the position of the column units on each course and continue placing units in this manner. Glue every course. Continue building until you’ve reached the desired height. Cap the column with a cap unit of your choice and glue in place.

Frequently, a 90° turn is made at a column. To build this column, cut one column unit per course. Stack column units in a rotating pattern for each course. Glue each course of column units with a concrete adhesive.
## PALLET INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th></th>
<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
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<td>5</td>
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<tr>
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<td>–</td>
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<tr>
<td><strong>3&quot; UNIVERSAL CAP</strong></td>
<td>3 x 17¾ / 12 x 10¾</td>
<td>–</td>
<td>–</td>
<td>4</td>
<td>48</td>
<td>12</td>
<td>–</td>
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</table>

**SHAPES & SIZES**

- **Block**: 6 x 17¾ x 9
- **6" Corner**: 6 x 18 x 8
- **3" Universal Cap**: 3 x 17¾ / 12 ¾ x 10¼
DIAMOND PRO® PS
RETAINING WALLS

<table>
<thead>
<tr>
<th>RESIDENTIAL</th>
<th>COMMERCIAL</th>
<th>STEPS</th>
<th>COLUMNS</th>
<th>FIRE PITS</th>
<th>KITCHEN</th>
<th>FREESTANDING WALL</th>
<th>RETAINING WALL</th>
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</table>

SHAPES & SIZES

- **Block**: 8 x 18 x 12
- **Corner**: 8 x 18 x 9
- **4” Universal Cap**: 4 x 17¼ x 12 x 10¾
- **Anchor™ Fiberglass Pins**: 5” L x .5” dia. Sold Separately

†Select colors available in Straight Face and Victorian Face.
2 pins per block, sold separately.

PALLET INFORMATION / ESTIMATING CHART

<table>
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<tr>
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<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
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<td>8 x 18 x 12</td>
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<td><strong>CORNER</strong></td>
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<td>8 x 18 x 9</td>
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<tr>
<td>4 x 17¼ / 12 x 10¾</td>
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<td>72</td>
<td>8</td>
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AVAILABLE IN STRAIGHT AND VICTORIAN FACE STYLES

![Straight Face Style](image1)
![Victorian Face Style](image2)
# DIAMOND PRO® PS QUARRIED FACE

## RETAINING WALLS

<table>
<thead>
<tr>
<th>RESIDENTIAL</th>
<th>COMMERCIAL</th>
<th>STEPS</th>
<th>COLUMNS</th>
<th>FIRE PITS</th>
<th>KITCHEN</th>
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<td><img src="image4.png" alt="Columns Icon" /></td>
<td><img src="image5.png" alt="Fire Pits Icon" /></td>
<td><img src="image6.png" alt="Kitchen Icon" /></td>
<td><img src="image7.png" alt="Freestanding Wall Icon" /></td>
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</tbody>
</table>

## SHAPES & SIZES

- **Block**: 8 x 18 x 12
- **Corner**: 8 x 18 x 9
- **4” Universal Cap**: 4 x 17¼ / 12 x 10¾
- **Anchor™ Fiberglass Pins¹**: 5” L x .05” dia.

¹2 Pins per block, sold separately

## PALLET INFORMATION / ESTIMATING CHART

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<td><strong>4” Universal Cap</strong></td>
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## Pin Aligning Cores

- **Pin Core**: Near Vertical
- **Pin Core 1” / 7.1”**: Cores
- **Pin Aligning Cores**: [Image]
DIAMOND PRO PS INSTALLATION INSTRUCTIONS

STAKE OUT THE WALL
• A surveyor shall locate the proposed base of wall location. Verify the wall location with the project supervisor.

EXCAVATION
• Excavate for the leveling pad to the lines and grades shown on the approved plans and excavate enough soil behind the wall for the geosynthetic reinforcement material (if required).
• The trench for the leveling pad should be at least 2 feet wide and a minimum of 1 foot (minimum) deep, enough to bury the first course below grade, plus 6 inches for the leveling pad. Ensure that a minimum of 8 inches or 10 percent of the total wall height (whichever is greater) is below grade. See Diagram 1.

LEVELING PAD
• An aggregate leveling pad is made of compactible base material of 3/4-inch minus with fines.
• If the planned grade along the wall front will change elevation, the leveling pad may be stepped up by the height of the block (typically 8-inch increments) to match the grade change. Always start at the lowest level and work upward.
• Compact the 6 inch (minimum thickness) aggregate leveling pad, using ordinary compaction methods, to provide a level, hard surface on which to place the base course. Mist lightly with water before compaction, if needed. See Diagram 2.
• For walls with step-ups in the base course, extra care should be given to properly compact the aggregate leveling pad at the step-up locations.

BASE COURSE This is the most important step in the installation process.
• Begin laying block at the lowest elevation of the wall, whenever possible.
• Use string along back edge of the block to check for proper alignment.
  See Diagram 3.
• Place the blocks side by side, flush against each other, and make sure the blocks are in full contact with the leveling pad. Level front to back and side to side.
  See Diagram 4.
• If the wall is on an incline, don’t slope the blocks. Step them up so they remain consistently level.
• Place soil in front of the base course and compact. Continue to fill the rest of the trench, including cores, with gravel. Compact after each course is laid.

PIN PLACEMENT
• Each unit has two sets of pin cores. The pin cores closest to the face of the block will create a near vertical system. The pin cores closest to the back of the block will create a 1-inch setback with a 7.1° system batter. Additional system batters can be created by alternating pin placement on each course of wall.
• Install pins prior to filling the cores and voids between the blocks. See Diagram 5.

CONSTRUCTION OF THE NEXT COURSE
• Place 12 inches (minimum) of drainage aggregate between, and directly behind the wall units. Fill voids in wall units with free draining aggregate. Place backfill soil and compact. Only lightweight hand operated compaction equipment is allowed within 3 feet from the back of the wall. See Diagram 6.
• Remove excess fill from top of units before placement of the next course.
• Place the next course of blocks over the pins using the pin alignment cores. Align pins into the core of the unit. Pull each block forward as far as possible to engage the pins. Maintain running bond with row below.
• On curves, use partial units to stay on bond. A circular saw with a masonry blade is recommended for cutting partial units. Use safety glasses and other protective equipment when cutting.
DRAINAGE DESIGN (PER DESIGN)
- Each project is unique. The grades on the site will determine at what level to install the drainpipe. Place the drainpipe (4-inch perforated piping) so water drains down and away from the wall into a storm drain, or daylight just above grade.
- Fill in the area behind the blocks with clean drainage aggregate, at least 1 foot from the wall. You may need to place and backfill several courses to achieve the proper drainage level.
- The outlet pipes should be spaced not more than every 50 feet and at low points of the wall. In order for the drainage aggregate to function properly, it must keep clear of regular soil fill.

REINFORCED BACKFILL PLACEMENT AND COMPACTION (PER PLAN)
- Place reinforced backfill in 6 to 8 inch loose lifts and compact to the densities specified on the approved wall construction plans.
- Only hand operated compaction equipment is allowed within 3 feet from the back of the wall.
- If the compaction equipment is too small to achieve the required compaction, thinner lifts should be used.
- Install each subsequent course in a similar manner. Repeat procedure to the extent of wall height.

REINFORCEMENT PLACEMENT (PER PLAN)
- Refer to the approved wall construction plans for the reinforcement type, strength, and placement location. Measure and cut the reinforcement to the lengths shown on the plans.
- Ensure the reinforced backfill is placed and compacted flush with the top of the units and is graded reasonably flat prior to reinforcement placement. Clean any debris off the top layer of blocks prior to reinforcement placement.
- The reinforcement has a primary strength direction, which must be laid perpendicular to the wall face.
- Place the reinforcement within 1 inch of the front of the units and connect with the pins of the units. See Diagram 7.
- Place the next course of units. Pull the reinforcement hand taut and place staples, stakes, or fill at the back of the reinforcement to maintain reinforcement tension during placement of drainage aggregate and reinforced backfill.
- Place a minimum of 6 inches of reinforced backfill prior to operating equipment above the reinforcement. Avoid sudden braking or turning on fill placed over the reinforcement.

CAPPING A WALL
- Always start capping from the lowest elevation. If the wall elevation changes, caps can be stacked where the wall steps up.
- Lay caps at the elevation change and work back toward the previous step up. Cut caps with a diamond-blade saw to fit, as needed.
- Carefully glue with a high-strength concrete adhesive.

FINISH GRADE AND SURFACE DRAINAGE
- Protect the wall with a finished grade at the top and bottom. To ensure proper water drainage away from the wall, use 6 inches of soil with low permeability and seed or plant to stabilize the surface.
- Consult the wall design engineer if water may be directed behind the wall. If needed, create a swale to divert water away from the wall. This will minimize water seeping into the soil and drainage aggregate behind the wall.

SITE CLEANING AND RESTORATION
- Brush off the wall and pick up any debris left from the construction process. Notify the job superintendent in writing of the completion and that it is ready for final inspection and acceptance.
- Planting vegetation in front and on top of the wall will help reduce the chance of erosion.
- Following these best practices for construction will ensure the success of your retaining wall. These instructions are meant as general guidelines. Site-specific conditions may warrant additional installation requirements.
- It's recommended that you consult a professional engineer to design walls over 4 feet high, and have compaction tested by a qualified Geotechnical Engineer.
ASHLAR TANDEM™
FREESTANDING / RETAINING WALLS

**SHAPES & SIZES**

<table>
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<tr>
<th>Unit  1</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Solid Units 1, 2 &amp; 3</th>
<th>Tandem® Cap</th>
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<th>8” Connecting Member</th>
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Ashlar 1-6 come mixed on one pallet.

**PALLET INFORMATION / ESTIMATING CHART**

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**ASHLAR TANDEM**

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**TANDEM CAP**
## Lafitt Tandem™
### Freestanding / Retaining Walls

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<th>Residential</th>
<th>Commercial</th>
<th>Steps</th>
<th>Columns</th>
<th>Fire Pits</th>
<th>Kitchen</th>
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### Shapes & Sizes

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<th>Unit 3</th>
<th>Tandem Cap</th>
<th>Tandem Modular Block</th>
<th>8” Connecting Member</th>
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Lafitt Tandem Units 1, 2, & 3 come mixed on one pallet.

### Pallet Information / Estimating Chart

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| Tandem Cap |            |           |     |     |    |    |    |    |    |    |                   |
| 15 x 24 x 3\(\frac{1}{4}\) | – | – | 8 | 32 | 4 | – | – | – | – | – | 3136 |
**TANDEM SEGMENTAL RETAINING WALL GUIDE**

**NOTE:**
1. The base shall be a minimum of starter units.
2. Center tandem starter units on starter units.
3. The base slab shall be designed by the structural engineer prior to placement of the starter units.
4. Earth fill is typically placed in 10-in. lifts unless otherwise shown on the plans.

**TYPICAL BASE PAD ISOMETRIC VIEW**

**TYPICAL CURVED RETAINING WALL WITH SETBACK**
* 6' minimum OD radius

**TANDEM SEGMENTAL RETAINING SECTION VIEWS**

**NOTE:**
1. Base material shall be constructed of crushed stone. Center tandem units on base pad or foundation stops at 1,000 psi compression base condition is necessary.
2. The base slab shall be designed by the structural engineer prior to placement of the base slab.
3. Slab level of wall units not showing wall material in order to show intersection.
4. Gravel fill is typically used as backfill unless otherwise shown on the plans.

**TYPICAL CROSS SECTION**

**TYPICAL SECTION WITH GEDGRID**

**TYPICAL DRAINAGE OUTLET THRU WALL FACE DETAIL**

**DRAWN TO SCALE 1/4" = 1'-0"**
SEGMENTAL RETAINING WALL TYPICAL DETAIL VIEWS

TYPICAL ELEVATION WALL WITH SLOPE

TYPICAL TOP OF WALL STEPS

TYPICAL ABUTMENT DETAIL

NOTE:
1. Steel-filled fabric shall be placed where the retaining wall abuts to a site footing as shown on the retaining wall site plans. Overlay all abutment joints 22" with minimum 36" ties.

STEP DETAIL VIEWS

NOTE:
1. The base shall be made of concrete blocks.
2. Segment Tandem face units are planting units.
3. The back face of the segment shall be approved by the site geotechnical engineer prior to placement of the segmental blocks.
4. Bars are typically as site requirements otherwise shown on the plans.
TYPICAL GEOGRID INSTALLATION WITH CORNERS

NOTE:
1. Geogrid shall be placed on level backfill and extended over perimeter and up to the face of the wall, well and fault as shown or as required.
2. Backfill is typically an in-place type aggregate shown on the plans.
3. A minimum of 3’ of soil is required between overlapping geogrid for proper anchorage.

TYPICAL GEOGRID INSTALLATION IN CORNERS

NOTE:
1. Geogrid shall be placed on level backfill and extended over perimeter and up to the face of the wall, well and fault as shown or as required.
2. Backfill is typically an in-place type aggregate shown on the plans.
3. A minimum of 3’ of soil is required between overlapping geogrid for proper anchorage.
TYPICAL WALL TREE PLANTING DETAILS

NOTE:
1. All planting efforts shall be a minimum of 2 feet + 3 the opening diameter as measured from face of wall.
2. Vertical spacing between openings shall be a minimum of 3 times the opening diameter.
3. Soil excavation shall be carefully cut to avoid disturbance of adjacent reinforcement.
4. Only top two layers of reinforcement may be cut to allow planting of trees and shrubs.
5. Extreme care shall be taken if installing irrigation systems to avoid damage to reinforcement.
6. Investigators or homeowners are the sole legal entity.

PLAN VIEW

SECTION VIEW

BROKEN VENEER REPLACEMENT

REPLACEMENT OF A BROKEN VENEER

BEFORE REPLACING THE BROKEN VENEER, REMOVE ALL THE VENEERS AND COPINGS FROM TOP OF IT IN A "V" SHAPE. ONCE THE AGREGATES ARE DRAIN FROM THAT SPACE, REPLACE THE BROKEN VENEER AND PUT BACK THE OTHER VENEERS BEFORE REFILLING THE WALL.
RETAINING WALL INSTALLATION BEST PRACTICES

STAKE OUT THE WALL
- A surveyor shall locate the proposed base of wall location. Verify the wall location with the project supervisor.

LEVELING PAD
- Excavate for the leveling pad to the lines and grades shown on the approved plans and excavate enough soil behind the wall for geosynthetic reinforcement material, if needed.
- The trench should be approximately 24 inches wide. See Diagram 1.
- Create a leveling pad of compacted base materials that extends a minimum of 6 inches in front of and 6 inches behind the base units. This leveling pad should be at least 6 inches deep after compaction. See Diagram 2.

BASE COURSE
- Install the U Start Base Block with the hand holds down. Place the blocks so the outside curve of one block fits into the curve of the block next to it. Blocks should touch.
- Level blocks front to back and side to side with a dead-blow hammer. See Diagram 3.
- The base course and 2 inches of the wall will be buried.

SYSTEM ASSEMBLY
- Assemble a retaining wall unit by applying the veneer unit to the modular blocks.
- Each modular block has a vertical tenon and each veneer has multiple mortises. The veneer units are joined to the modular blocks by simply sliding the tenon into the mortise to form a retaining wall block.
- Assembly of the retaining wall units always requires the use of two modular blocks for every veneer unit. See Diagram 4.
CONSTRUCTION OF 1ST WALL COURSE
• Clean any debris off the top of the U Start base course unit.
• Place the assembled retaining wall unit on top of the U Start Base Block making sure that the first course of wall is centered on the base block.
• For best results, refer to the laying patterns on page 5.
• Check to make sure units are level front to back and side to side on each course.
• Fill cores and voids with ¾-inch free draining aggregate prior to laying the next course of block. See Diagram 5.
• After filling the cores of the units add additional free draining aggregate behind the units extending at least 12 inches behind the blocks. Compact aggregate after each course of block is laid.

CONSTRUCTION OF SUBSEQUENT COURSES AND UNIVERSAL CLIP PLACEMENT
• Clean any debris off the top of the 1st course of wall units.
• Assemble and place the next course of wall units, maintaining a running bond.
• Insert a universal connector in each modular unit with the knuckle towards the soil. Push the connector down until it extends below the bottom of the block to create a 3/8” setback. You need one connector per modular unit.
• Push the retaining unit forward until it locks in place. See Diagram 6.
• Level unit front to back and side to side with a dead-blow hammer.
• Fill cores and voids with ¾-inch free draining aggregate prior to laying the next course of block.
• Backfill with ¾-inch free draining aggregate directly behind the block, adding 6 inches at a time followed by proper compaction. Only lightweight hand operated compaction equipment is allowed within 3 feet from the back of the wall.
• Continue each course until the project is complete.
RETAINING WALL INSTALLATION BEST PRACTICES

STEPPING UP THE BASE
- Walls built on a sloping grade require a stepped base.
- Begin excavation at the lowest point and dig a level trench into the slope until it is deep enough to accommodate the base material and one entire block.
- At this point, step up the height of one block and begin a new section of base trench. Continue to step-up as needed to top of slope. Always bury at least one full unit at each step. See Diagram 7.

DRAINAGE (PER PLAN)
- Each project is unique. The grades on the site will determine at what level to install the drainpipe. Place the drainpipe (4-inch perforated piping) so water drains down and away from the wall into a storm drain, or daylight just above grade. See Diagram 8.
- Fill in the area behind the blocks with clean drainage aggregate, at least 1 foot from the wall. You may need to place and backfill several courses to achieve the proper drainage level.
- The outlet pipes should be spaced not more than every 50 feet and at low points of the wall. In order for the drainage aggregate to function properly, it must keep clear of regular soil fill.

REINFORCED BACKFILL PLACEMENT AND COMPACTION (PER PLAN)
- Place reinforced backfill in 6 to 8 inch loose lifts and compact to the densities specified on the approved wall constructions plans. See Diagram 9.
- Only hand operated compaction equipment is allowed within 3 feet of the back of the wall.
- If the compaction equipment is too small to achieve the required compaction, thinner lifts should be used.
- Install each subsequent course in a similar manner. Repeat procedure to the extent of the wall height.
GEOSYNTHETIC REINFORCEMENT PLACEMENT (PER PLAN)
BATTERED WALL INSTALLATION ONLY

- Refer to the approved wall construction plans for the reinforcement type, strength, and placement location. Measure and cut the reinforcement to the lengths shown on the plans.
- Ensure the reinforced backfill is placed and compacted flush with the top of the units and is graded reasonably flat prior to reinforcement placement. Clean any debris off the top layer of blocks prior to reinforcement placement.
- The reinforcement has a primary strength direction, which must be laid perpendicular to the wall face.
- Place the reinforcement within 1 inch of the front of the units. See Diagram 9.
- Apply the next course of blocks to secure the reinforcement in place. Insert Universal Connector into one of the mortise on the back of the modular block to create the proper setback. Pull the reinforcement hand taut and place staples, stakes, or fill at the back of the reinforcement to keep tension during placement of drainage aggregate and reinforced backfill.
- Place a minimum of 6 inches of reinforced backfill prior to operating equipment above the reinforcement. Avoid sudden braking or turning on fill placed over the reinforcement.

FINISH GRADE AND SURFACE DRAINAGE

- Protect the wall with a finished grade at the top and bottom. To ensure proper water drainage away from the wall, use 6 inches of soil with low permeability and seed or plant to stabilize the surface. See Diagram 10.
- Consult the wall design engineer if water may be directed behind the wall. If needed, create a swale to divert water away from the wall. This will minimize water seeping into the soil and drainage aggregate behind the wall.

SITE CLEANING AND RESTORATION

- Brush off the wall and pick up any debris left from the construction process. Notify the job superintendent in writing of the completion and that it is ready for final inspection and acceptance.
- Planting vegetation in front and on top of the wall will help reduce the chance of erosion.
- Following these best practices for construction will ensure the success of your retaining wall system. These instructions are meant as general guidelines. Site-specific conditions may warrant additional installation requirements.
- Oldcastle® recommends you consult a professional engineer to design walls over 4 feet high, and have compaction tested by a qualified geotechnical engineer.
CAPPING A WALL

CAPPING WALL
Always start capping from the lowest elevation. Once caps are aligned, caps should be glued in place using a concrete adhesive.

CURVES
Lay out the cap units side by side with the same face facing out. If there's a need to adjust for project’s radius, make cuts at least every other cap as needed for the most pleasing aesthetic.

90-DEGREE CORNERS
Saw-cut two caps to achieve a 45-degree mitered corner. See Diagram 11.

STEPPING THE CAP
Saw-cut caps to size depending on ending sized block. Allow at least a 2 inch overhang of the cap on each end. Keep cut end facing inward toward wall.
STEPS

- Steps can be constructed by creating layers of step landings.
- The base landing is created by connecting multiple modular block together.
- The size of the landing varies based on the number of risers to be constructed.
- Once the Modular Blocks are laid, the veneer to be used as the riser are joined to the modular block by sliding the tenon into the mortise. If you want to have veneer on the side, use the Universal Clips to attached the veneer to the modular block.
- A second course of steps are constructed above the first course and glued with a concrete adhesive.
- Construction continues until desired number of risers is reached.
- Cap the risers with a cap of choice.
- Clean stone must be installed behind the structural units. It is also recommended to install clean stone in the empty spaces of the modular block.

TYPICAL CROSS-SECTION: FILL SCENARIO
OUTSIDE CURVES & INSIDE CURVES

CURVES
- Building a 6 foot radius curved wall is possible by using full and partial modular block.
- To achieve a tighter radius only use the small and medium veneers.
- To create a partial Modular Block, split the block at the break line using a dead blow hammer. See illustration to the right.
- The minimum radius of an outside curved wall is 6 feet; 8 feet (Lamina).
- Note: the Lamina veneer is not recommended for curved retaining walls.

GEOSYNTHETIC REINFORCEMENT PLACEMENT - 1ST COURSE

GEOSYNTHETIC REINFORCEMENT PLACEMENT - 2ND COURSE
INSIDE 90-DEGREE CORNERS

CORNERS
- The veneer units are reversible to form inside or outside corners
- Corner veneers have finished end. See pallet layout below.
- The corner unit is formed by applying the veneer to the Modular Block using the Universal Connector. See Diagram 12.
- The position of the corner unit is alternated 90° from course to course
- Once corner units are in position, glue with a concrete adhesive
- Additional Modular Blocks can be installed to reinforce the corner

TOP VIEW OF PALLET LAYOUT.
Corner units identified in orange triangle

GEOSYNTHETIC REINFORCEMENT PLACEMENT

Fill area inside backing units with free-draining aggregate
Overlap veneer

Inside 90-Degree Corner

Reinforcement H/4 beyond corner at the specified reinforcement elevations
OUTSIDE 90-DEGREE CORNERS

CORNERS
• The veneer units are reversible to form inside or outside corners
• Corner veneers have a finished end and a unfinished end.
  See pallet layout below.
• The corner unit is formed by applying the veneer to the Modular Block using the Universal Connector.
• The position of the corner unit is alternated 90⁰ from course to course
• Once corner units are in position, glue with a concrete adhesive.
• Additional Modular Blocks can be installed to reinforce the corner.
  See Diagram 13.

TOP VIEW OF PALLET LAYOUT.
Corner units identified in orange triangle

NOTE: In the “cross-over area” of the reinforcement, one of the layers of reinforcement should be lowered or raised one course to allow placement of the reinforcement strength direction properly oriented. The reinforcement should not extend into the segmental retaining wall units on the return leg of the 90-degree corner.
MULTI STACK WALLS AND TERRACED WALLS

MULTI STACK WALL

The maximum gravity wall height for a retaining wall constructed with the Tandem Modular Block is 3 feet. The flexibility of the Tandem Modular Block allows you to connect the blocks to increase the depth of the retaining wall unit which allows a wall to be constructed higher than 3 feet without the need for geosynthetic reinforcement. Connect the blocks by sliding the vertical tenon into the mortise at the back of the modular block. See Diagram 14, 15 & 16.

DEPENDENT TERRACED WALLS

When the distance between the lower wall and the upper wall is less than twice the height of the lower wall, the walls become structurally dependent on each other. In this situation, it is important to take global stability into account, incorporating geogrid – and longer layers – into the wall plan. In addition, structurally dependent walls require even more excavation, backfill and time. Be sure to check the wall plan for specific requirements. For structurally dependent walls, consult with a qualified engineer.
FREESTANDING WALL INSTALLATION BEST PRACTICES

STAKE OUT THE WALL
• A surveyor shall locate the proposed base of wall location. Verify the wall location with the project supervisor.

LEVELING PAD
• Excavate for the leveling pad to the lines and grades shown on the approved plans and excavate enough soil behind the wall for geosynthetic reinforcement material, if needed.
• The trench should be approximately 24 inches wide. See Diagram 17.
• Create a leveling pad of compacted base materials that extends a minimum of 6 inches in front of and 6 inches behind the base units. This leveling pad should be at least 6 inches deep after compaction. See Diagram 18.

BASE COURSE
• Install the U Start Base Block with the hand holds down. Place the blocks so the outside curve of one block fits into the curve of the block next to it. Blocks should touch.
• Level blocks front to back and side to side with a dead-blow hammer. See Diagram 19.
• The base course and 2 inches of the wall will be buried.

SYSTEM ASSEMBLY
• Assemble a freestanding wall unit by applying the veneer units to both sides of the modular blocks. See Diagram 20.
• Each modular block has a vertical tenon and each veneer has multiple mortises. The veneer units are joined to the modular blocks by simply sliding the tenon into the mortise to form a retaining wall block.
• Assembly of the freestanding wall units always requires the use of two modular blocks for every veneer unit.
CONSTRUCTION OF WALL COURSES

To continue with additional courses, assemble units in the same manner as the previous step. Place the assembled units on the course below ensuring that the veneer units are staggered over the bond below. Glue each modular unit to the course below. See Diagram 21.

ENDING A WALL WITHOUT A COLUMN

When finishing a wall end without a column build the wall to the desired length. Install the veneers on one side of the modular units flush to the end. Install the veneer on the other side extending past the modular unit by the thickness of one veneer. Make sure the exposed end of the veneer is the natural edge and not the manufactured edge. Line up and mark a unit to be cut to finish the end of the wall. See illustration below. Make sure to cut off the manufactured edge leaving the natural edge exposed. Install this cut unit inserting two universal connectors into the grooves in both the modular unit and the veneer. See Diagram 22.

ENDING A WALL WITH A COLUMN

To end a free-standing wall with a column, start by constructing the first course of the column. Using four Modular units, interlock them with the tongue and groove See Diagram 24 on the next page. Add four large veneer units to this assembly utilizing to universal connectors for each veneer. Start building the wall flush to, and centered on the assembled column units. Add the veneer units to the wall and build to length. See Diagram 25. Add the second course of column in a similar fashion rotating the bond at the corners. Continue with the second course of wall. Continue in this fashion until you reach the desired height of column and wall.
To build a column you start by excavating 12 inches below grade and installing an aggregate leveling pad 6 inches thick after compaction and extends at least 6 inches on each side beyond the column dimension. Install 4 U-Start base blocks on the aggregate pad leveling front to back and side to side. Using four Modular units, create your first course of column by interlocking the tongue and groove system together forming an approximate 16-inch by 16-inch square formation. See Diagram 24. Attach a large veneer to each side of your column using 2 universal connectors on each veneer. Make sure the one end of the veneer that protrudes beyond the edge has the natural edge exposed and not the manufactured edge. Using 4 more Modular units build the second course in the same manner using Structurebond between the course to secure them in place. Attach 4 veneers to this course making sure to stagger the bonds at the corners and ensure that all exposed ends are the natural ends and not the manufactured ends. See Diagram 25. Continue to build your column to the desired height.
To build a 90 degree corner at a column start by constructing the first course of the column. Using four Modular units, interlock them with the tongue and groove. See Diagram 24 on previous page. Add four large veneer units to this assembly utilizing two universal connectors for each veneer. Start building one of the walls flush to, and centered on the assembled column units. Add the veneer units to the wall and build to length. Build the second wall flush to and centered on the column perpendicular to the first wall. Add the veneers this wall and build to length. Add the second course of column in a similar fashion rotating the bond at the corners. Continue with the second course on each of the two walls. Continue in this fashion until you reach the desired height of column and walls.

Frequently, a 90° turn is made at a column. Stack modular blocks and veneers in a rotating pattern for each course. Glue each course of column units with a concrete adhesive.

Place connectors in channels to secure veneer to modular block, two per veneer.

Place connectors in channels to secure veneer to modular block, two per veneer.
**TANDEM® COLUMN KIT**

**COLUMNS**

<table>
<thead>
<tr>
<th>RESIDENTIAL</th>
<th>COMMERCIAL</th>
<th>STEPS</th>
<th>COLUMNS</th>
<th>FIRE PITS</th>
<th>KITCHEN</th>
<th>FREESTANDING WALL</th>
<th>RETAINING WALL</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Residential" /></td>
<td><img src="image2.png" alt="Commercial" /></td>
<td><img src="image3.png" alt="Steps" /></td>
<td><img src="image4.png" alt="Columns" /></td>
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<td><img src="image7.png" alt="Freestanding Wall" /></td>
<td><img src="image8.png" alt="Retaining Wall" /></td>
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</tbody>
</table>

**SHAPES & SIZES**

Tandem Column Kit includes 2 Steel Cages, 2 Bags of clips, & Ashlar Tandem Units

- **Ashlar Tandem™**
- **Lafitt Tandem™**
- **Column Grid**
- **Height 42”**
- **Connector**
- **Tandem Cap**
  - 24 x 24 x 3¼
  - (SOLD SEPARATELY)
- **U Start Base Block™**
  - 12 x 18¼ x 3½
  - (SOLD SEPARATELY)

Tandem Veneer Units available in three sizes.
Ashlar Tandem unit sizes come mixed on a pallet.
Lafitt Tandem unit sizes also come mixed on a pallet.

See the installation video at Belgard.com/Tandem
TANDEM COLUMN INSTALLATION GUIDE

TANDEM® COLUMN COMPONENTS

1 Column grid
Final height: 42”
(Shown with U Start Base Block®)

Connectors:
50 connectors per bag
(Enough for 1-42” column)

Pallet of panels
21.8 square feet needed per column.
Use modules G only (Lg Unit 18.5”w)
24 of the long pieces are needed (21.6 sf)

24” x 24”
Tandem Wall Cap
(Sold Separately)

STEP 1
Install Base Block

STEP 2
Place the grid on a prepared surface. Make sure the outside perimeter of the grid is clear

STEP 3
Take a panel and slide the supplied connectors into the dovetails until they snap onto the horizontal rod of the grid.

STEP 4
Take another stone and repeat the same process. Make sure you have a corner stone to finish the corner. Once installed, slide the stone along the horizontal axis to adjust the corner.
**STEP 5**

Once you have completed the first two rows, use a square to make sure the column is square and then fill the space with 3/4" clear aggregate. Fill the empty space with aggregates at every row.

**STEP 6**

To integrate a wall into the column set the first course up against the column.

**STEP 7**

Every other row will require a grooved veneer.

**STEP 7: GROOVED VENEER DETAIL**

At the second row the long veneer on the column needs to be grooved. Set wall block into grooved veneer.

Note: You must groove a panel every other row.

**STEP 8**

When starting row 3 place full veneer panel across the top of grooved panel. The wall block in row 3 will butt up against column similar to row 1.

If you have to cut the grid before installation on the base, you must cut the vertical rod at mid distance between two horizontal rods as shown below.

**OPTIONAL**

If you have to cut the grid before installation on the base, you must cut the vertical rod at mid distance between two horizontal rods as shown below.
**STEP 9**

**IMPORTANT**

When you are starting the second row, make sure the base of the top panel hits the top portion of the connector.

**STEP 10**

When you have reached the last row, cut the top portion of the connectors with pliers snippers or just by twisting the top portion with your hands.

**STEP 11**

Apply glue on the top of the panels before putting on the capping. IMPORTANT: The capping must lay on the panels, not on the grid.

**FINISHED WALL DETAIL**

- 24" x 24" Capping
- 15" x 24" Tandem Wall Cap
- Row 4 Grooved Veneer Course
- Row 2 Grooved Veneer Course
TANDEM® MODULAR GRID

Tandem Veneer units available in three sizes.
Units only available in 7” height.
Ashlar Tandem unit sizes come mixed on a pallet.
Lafitt Tandem unit sizes also come mixed on a pallet.

See the installation video at Belgard.com/Tandem
TANDEM MODULAR GRID INSTALLATION GUIDE

**STEP 1**
Build your wooden frame

**STEP 2**
Attach your Modular Grid

**STEP 3**
Attach Lafitt Tandem Veneer with Connector

**STEP 4**
Finish with Lafitt Tandem Cap Unit
The Tandem® system allows you to install different outdoor living components such as outdoor kitchens (barbecue, fridge, bar), patio furniture (bench and table), flower box, outdoor gas fireplace, privacy wall, fencing and deck skirting.

You can easily build all these features if you use the new Tandem Modular Grid.

OUR SYSTEM HAS MULTIPLE BENEFITS:

• Provides a unified look for all the features of the landscaping design.
• Provides a durable, economical and maintenance-free solution.
• Offers great flexibility and unrestricted creativity regarding the configuration and size of components to be constructed.
• Offers a solution to difficult issues (e.g. deck skirting).
• Eliminates the use of cementitious products (mortar).
BASIC PRINCIPLES
A set of Tandem Modular Grids is attached to a treated wood structure. Tandem veneers are then attached to the grids. Since veneer units are manufactured in multiples of 2 5/8", the overall dimensions of outdoor units should always be a multiple of 2 5/8" in order to avoid cuts. The wooden structure should be built taking into account the modular design of Tandem veneers. The same applies to the height, which must be a multiple of 7 1/16". The item is finished off with an appropriate capping module. You can construct a range of outdoor units of various dimensions.

MAIN COMPONENTS OF THE SYSTEM
- Tandem Modular Grid, 28" × 42 1/2", including stainless steel screws and loop clamps for fastening. A modular grid covers a facing surface of 8.40 sq ft. Each modular grid includes a kit of 25 connectors, 10 × 1 1/4" screws and 10 loop clamps.
- Tandem veneer units.
- Galvanized shelf angle (for deck skirting, privacy walls and fences) 2 1/2" × 2 1/2" × 8' (min 10 gauge, Z275 G90 galvanized steel, ASTM A653 Grade 33).
- Concrete capping module (Sold Separately)

OTHER COMPONENTS (SOLD SEPARATELY)
- Treated Wood: 2x4, 2x6 and 2x8 boards, 4x4 or 6x6 posts, 4x8 plywood sheets (all wood should be treated against rot and must be category S-P-F #1 or better). Refer to the various suppliers' specific application sheets for details.
- Fiber cement panels 48" × 96" × 1/2.
- #10 screws of varying lengths, nuts, bolts and washers where required, all in stainless steel. It is not recommended to use treated wood screws (green ceramic) or metal plated screws (zinc, copper or other).
- Hilti Kwik Bolt®-type anchors (for concrete deck skirting).
- Simpson Strong-Tie-type hardware for construction of wood frame for deck.
- Custom countertops made of granite, quartz, marble and natural stone as alternatives to concrete tops.
- Cementitious adhesive for between each layer of veneers.
You must always take the modular design of Tandem® veneers into account when constructing wood framing. The overall dimensions of outdoor units must always be a multiple of 2⅝ in length and width and 7⅛ in height. When installing the framing, remember that grids need a ⅛ space between the veneer and the frame.

Bearing this in mind, the following tables show detailed measurements for the framing of units. These tables are very useful for quickly calculating the actual dimensions of the wood framing and the unit to be constructed to build the component without any veneers cut.

**NOTE:** When using a Dim A less than 15 13/16 cuts will be needed.

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<th>DIM B (IN)</th>
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U START BASE BLOCK®
WALL ACCESSORY

RESIDENTIAL  COMMERCIAL  STEPS  COLUMNS  FIRE PITS  KITCHEN  FREESTANDING WALL  RETAINING WALL

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</table>

SHAPES & SIZES

Base Block

18\(\frac{3}{4}\) x 12 x 3\(\frac{1}{2}\)

USE WITH:
Aspen Stone
Diamond® 9D
Diamond Pro® PS
Tandem® Wall

Base Block with Ashlar Tandem Wall

INSTALLATION INSTRUCTIONS

Prep Site
Install Base Course
Install the Wall

PALLET INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SQFT/ PALLET</th>
<th>SQFT/ LAYER</th>
<th>LAYER/ PALLET</th>
<th>UNITS/ PALLET</th>
<th>UNITS/ LAYER</th>
<th>LNFT PALLET (SOLDIER)</th>
<th>LNFT PALLET (SAILOR)</th>
<th>WEIGHT/ UNIT LBS</th>
<th>WEIGHT/ LAYER LBS</th>
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WESTON STONE™
FREESTANDING / RETAINING WALLS

SHAPES & SIZES

Universal

4 x 12 x 8

PALLET INFORMATION / ESTIMATING CHART

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WESTON STONE INSTALLATION INSTRUCTIONS

This is a pinless system. Maximum wall height is 2½ feet. Walls exceeding 2½ feet in height may require geogrid reinforcing and the consultation of a qualified engineer. Contact your Belgard sales representative or dealer for assistance.

Weston Stone wall units must be glued with a quality construction adhesive to develop the necessary mechanical bond. All measurements herein are approximate. Natural materials are used in the manufacturing of this product.

TYPICAL CROSS SECTION WITH WESTON STONE SEAT WALL
Estimating Chart for Geosynthetic Reinforcement
Diamond 9D® Retaining Walls
No Slopes / No Surcharges

<table>
<thead>
<tr>
<th>CLAY AND SILT SOIL</th>
<th>SILTY/CLAYEY SAND SOIL</th>
<th>CLEAN SAND AND GRAVEL SOIL</th>
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<td>$\phi = 30^\circ$</td>
<td>$\phi = 34^\circ$</td>
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<td>$\gamma = 120$ pcf (19 kN/m$^3$)</td>
<td>$\gamma = 120$ pcf (19 kN/m$^3$)</td>
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- **NO SLOPE OR SURCHARGE**

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Estimating Chart for Geosynthetic Reinforcement
Diamond 9D® Retaining Walls
100 PSF Surcharge

<table>
<thead>
<tr>
<th>CLAY AND SILT SOIL</th>
<th>SILTY/CLAYEY SAND SOIL</th>
<th>CLEAN SAND AND GRAVEL SOIL</th>
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<tbody>
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<td><strong>H</strong></td>
<td><strong>H</strong></td>
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<td>Total Height: 3'-0&quot; (900 mm)</td>
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<tr>
<td>4'-0&quot; (1200 mm)</td>
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<td>Total Height: 4'-0&quot; (1200 mm)</td>
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<tr>
<td>5'-0&quot; (1500 mm)</td>
<td>5'-0&quot; (1500 mm)</td>
<td>5'-0&quot; (1500 mm)</td>
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<td>Total Height: 5'-0&quot; (1500 mm)</td>
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<tr>
<td>6'-0&quot; (1800 mm)</td>
<td>6'-0&quot; (1800 mm)</td>
<td>6'-0&quot; (1800 mm)</td>
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</table>
Estimating Chart for Geosynthetic Reinforcement
Diamond 90° Retaining Walls
100 PSF Surcharge

<table>
<thead>
<tr>
<th>Clay and Silt Soil</th>
<th>Silty/Clayey Sand Soil</th>
<th>Clean Sand and Gravel Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \phi = 26° )</td>
<td>( \phi = 30° )</td>
<td>( \phi = 34° )</td>
</tr>
<tr>
<td>( \gamma = 120 \text{pcf} (19 \text{kN/m}^3) )</td>
<td>( \gamma = 120 \text{pcf} (19 \text{kN/m}^3) )</td>
<td>( \gamma = 120 \text{pcf} (19 \text{kN/m}^3) )</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Total Height:</th>
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<td>1'-0&quot; (360 mm)</td>
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<tr>
<td>100 PSF (5 KPA) Surcharge</td>
<td>100 PSF (5 KPA) Surcharge</td>
<td>50 PSF (3 KPA) Surcharge</td>
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<td>2'-0&quot; (600 mm)</td>
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<tr>
<td>4.0&quot; (120 mm)</td>
<td>4.0&quot; (120 mm)</td>
<td>4.0&quot; (120 mm)</td>
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<th>Total Height:</th>
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<td>4.0&quot; (120 mm)</td>
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<th>Total Height:</th>
<th>Total Height:</th>
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<tbody>
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<td>4'-0&quot; (1200 mm)</td>
<td>4'-0&quot; (1200 mm)</td>
<td>4'-0&quot; (1200 mm)</td>
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<tr>
<td>4.0&quot; (120 mm)</td>
<td>4.0&quot; (120 mm)</td>
<td>4.0&quot; (120 mm)</td>
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<td>NO REINFORCEMENT REQUIRED</td>
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<th>Total Height:</th>
<th>Total Height:</th>
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<tbody>
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<td>5'-0&quot; (1500 mm)</td>
<td>5'-0&quot; (1500 mm)</td>
<td>5'-0&quot; (1500 mm)</td>
</tr>
<tr>
<td>4.5&quot; (135 mm)</td>
<td>4.5&quot; (135 mm)</td>
<td>4.5&quot; (135 mm)</td>
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<th>Total Height:</th>
<th>Total Height:</th>
<th>Total Height:</th>
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</thead>
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<td>6'-0&quot; (1800 mm)</td>
<td>6'-0&quot; (1800 mm)</td>
<td>6'-0&quot; (1800 mm)</td>
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<td>4.5&quot; (135 mm)</td>
<td>4.5&quot; (135 mm)</td>
<td>4.5&quot; (135 mm)</td>
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<td>NO REINFORCEMENT REQUIRED</td>
<td>NO REINFORCEMENT REQUIRED</td>
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### Estimating Chart Geosynthetic Belair Wall® Retaining Walls No Slopes / No Surcharges

<table>
<thead>
<tr>
<th>Clay and Silt Soils</th>
<th>Silty / Clayey Sand Soil</th>
<th>Clean Sand and Gravel Soil</th>
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</thead>
<tbody>
<tr>
<td>( \varphi = 26^\circ )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \gamma = 120 \text{pcf (19 kN/m}^3) )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \varphi = 30^\circ )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \gamma = 120 \text{pcf (19 kN/m}^3) )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \varphi = 34^\circ )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \gamma = 120 \text{pcf (19 kN/m}^3) )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2'-0&quot; (600 mm)</th>
<th>3'-0&quot; (900 mm)</th>
<th>4'-0&quot; (1200 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4'-0&quot; (1200 mm)</td>
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<td></td>
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<tr>
<td>0'-0&quot; (1200 mm)</td>
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<tr>
<td>0'-0&quot; (1200 mm)</td>
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<table>
<thead>
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<th>6'-0&quot; (1800 mm)</th>
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<tbody>
<tr>
<td>4'-0&quot; (1200 mm)</td>
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</tr>
<tr>
<td>0'-0&quot; (1200 mm)</td>
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<tr>
<td>4'-5&quot; (1350 mm)</td>
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<tr>
<td>4'-5&quot; (1350 mm)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>5'-5&quot; (1650 mm)</th>
<th>6'-5&quot; (1800 mm)</th>
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</thead>
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<tr>
<td>5'-5&quot; (1650 mm)</td>
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<tr>
<td>5'-5&quot; (1650 mm)</td>
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<td>5'-5&quot; (1650 mm)</td>
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<td>5'-5&quot; (1650 mm)</td>
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<tr>
<td>5'-5&quot; (1650 mm)</td>
<td></td>
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</tbody>
</table>

| 6'-5" (1800 mm) |
|----------------|----------------|
| 6'-5" (1800 mm) |
| 6'-5" (1800 mm) |
| 6'-5" (1800 mm) |
| 6'-5" (1800 mm) |
| 6'-5" (1800 mm) |
| 6'-5" (1800 mm) |

**REINFORCEMENT REQUIRED**

**NO REINFORCEMENT REQUIRED**
### Estimating Chart Geosynthetic Reinforcement
#### Belair Wall® Retaining Walls
##### 250 PSF Surcharge

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Clay and Silt Soils</th>
<th>Silty / Clayey Sand Soil</th>
<th>Clean Sand and Gravel Soil</th>
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<tbody>
<tr>
<td>cp</td>
<td>26°</td>
<td>30°</td>
<td>34°</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>120 pcf (19 kN/m²)</td>
<td>120 pcf (19 kN/m²)</td>
<td>120 pcf (19 kN/m²)</td>
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</table>

<table>
<thead>
<tr>
<th>Height</th>
<th>2'-0&quot; (600 mm)</th>
<th>3'-0&quot; (900 mm)</th>
<th>4'-0&quot; (1200 mm)</th>
<th>5'-0&quot; (1500 mm)</th>
<th>6'-0&quot; (1800 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Courses</td>
<td>4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
</tr>
<tr>
<td>6 Courses</td>
<td>4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
</tr>
<tr>
<td>8 Courses</td>
<td>4.5' (1350 mm)</td>
<td>4.5' (1350 mm)</td>
<td>4.5' (1350 mm)</td>
<td>4.5' (1350 mm)</td>
<td>4.5' (1350 mm)</td>
</tr>
<tr>
<td>10 Courses</td>
<td>5.0' (1500 mm)</td>
<td>5.0' (1500 mm)</td>
<td>5.0' (1500 mm)</td>
<td>5.0' (1500 mm)</td>
<td>5.0' (1500 mm)</td>
</tr>
<tr>
<td>12 Courses</td>
<td>5.5' (1650 mm)</td>
<td>5.5' (1650 mm)</td>
<td>5.5' (1650 mm)</td>
<td>5.5' (1650 mm)</td>
<td>5.5' (1650 mm)</td>
</tr>
</tbody>
</table>

Reinforcement required for Silty / Clayey Sand Soil and Clean Sand and Gravel Soil.
## Estimating Chart Geosynthetic Reinforcement with Belair Wall® Retaining Wall Systems

### 3:1 Crest Slope

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Clay and Silt Soils</th>
<th>Silty / Clayey Sand Soil</th>
<th>Clean Sand and Gravel Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>2'0'' (600 mm)</td>
<td>4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
<td>NO REINFORCEMENT REQUIRED</td>
</tr>
<tr>
<td>3'0'' (900 mm)</td>
<td>4.0' (1200 mm); 4.0' (1200 mm)</td>
<td>4.0' (1200 mm); 4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
</tr>
<tr>
<td>4'0'' (1200 mm)</td>
<td>4.5' (1350 mm); 4.0' (1200 mm); 4.0' (1200 mm)</td>
<td>4.0' (1200 mm); 4.0' (1200 mm)</td>
<td>4.0' (1200 mm)</td>
</tr>
<tr>
<td>5'0'' (1500 mm)</td>
<td>5.5' (1650 mm); 5.0' (1500 mm); 5.0' (1500 mm); 5.0' (1500 mm)</td>
<td>5.0' (1500 mm); 5.0' (1500 mm); 5.0' (1500 mm); 5.0' (1500 mm)</td>
<td>4.5' (1350 mm); 4.5' (1350 mm); 4.5' (1350 mm); 4.5' (1350 mm)</td>
</tr>
<tr>
<td>6'0'' (1800 mm)</td>
<td>6.5' (1950 mm); 5.5' (1650 mm); 5.5' (1650 mm); 5.0' (1500 mm); 5.0' (1500 mm); 5.0' (1500 mm)</td>
<td>5.5' (1650 mm); 5.5' (1650 mm); 5.0' (1500 mm); 5.0' (1500 mm); 5.0' (1500 mm); 5.0' (1500 mm)</td>
<td>5.0' (1500 mm); 5.0' (1500 mm); 5.0' (1500 mm); 5.0' (1500 mm); 5.0' (1500 mm); 5.0' (1500 mm)</td>
</tr>
</tbody>
</table>

### Soil Properties
- **Clay and Silt Soils**
  - $\phi = 26^\circ$
  - $\gamma = 120\text{ pcf (19 kN/m}^3\text{)}$

- **Silty / Clayey Sand Soil**
  - $\phi = 30^\circ$
  - $\gamma = 120\text{ pcf (19 kN/m}^3\text{)}$

- **Clean Sand and Gravel Soil**
  - $\phi = 34^\circ$
  - $\gamma = 120\text{ pcf (19 kN/m}^3\text{)}$

**Notes:**
- REINFORCEMENT REQUIRED
- NO REINFORCEMENT REQUIRED
### Estimating Chart Structural Backfill Using AnchorPlex® System

**Belair Wall® Retaining Walls**  
**No Slope / No Surcharge**

| Height (in) | Clay and Silt Soils  
\( \varphi = 26^\circ \)  
\( \gamma = 120 \text{pcf (19 kN/m}^3) \) | Silty / Clayey Sand Soil  
\( \varphi = 30^\circ \)  
\( \gamma = 120 \text{pcf (19 kN/m}^3) \) | Clean Sand and Gravel Soil  
\( \varphi = 34^\circ \)  
\( \gamma = 120 \text{pcf (19 kN/m}^3) \) |
| --- | --- | --- | --- |
| 2'-0" (600 mm)  
4 Courses | 1'-0"  
[300 mm]  
0.08 x Wall Length = CY of Structural Backfill | | |
| 3'-0" (900 mm)  
6 Courses | 1'-0"  
[300 mm]  
0.12 x Wall Length = CY of Structural Backfill | 1'-0"  
[300 mm]  
0.12 x Wall Length = CY of Structural Backfill | |
| 4'-0" (1200 mm)  
8 Courses | 1'-0"  
[300 mm]  
0.16 x Wall Length = CY of Structural Backfill | 1'-0"  
[300 mm]  
0.16 x Wall Length = CY of Structural Backfill | 1'-0"  
[300 mm]  
0.16 x Wall Length = CY of Structural Backfill |
| 5'-0" (1500 mm)  
10 Courses | 1'-6"  
[450 mm]  
0.29 x Wall Length = CY of Structural Backfill | 1'-6"  
[450 mm]  
0.29 x Wall Length = CY of Structural Backfill | 1'-6"  
[450 mm]  
0.29 x Wall Length = CY of Structural Backfill |
| 6'-0" (1800 mm)  
12 Courses | 1'-6"  
[450 mm]  
0.35 x Wall Length = CY of Structural Backfill | 1'-6"  
[450 mm]  
0.35 x Wall Length = CY of Structural Backfill | 1'-6"  
[450 mm]  
0.35 x Wall Length = CY of Structural Backfill |
## Estimating Chart Structural Backfill Using AnchorPlex® System

**Belair Wall® Retaining Walls**

### 250 PSF Surcharge

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Estimating Chart</th>
<th>Formula</th>
</tr>
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<tbody>
<tr>
<td>Clay and Silt Soils</td>
<td>![Chart Image]</td>
<td>(0.08 \times \text{Wall Length} = \text{CY of Structural Backfill})</td>
</tr>
<tr>
<td>Silty / Clayey Sand Soil</td>
<td>![Chart Image]</td>
<td>(0.12 \times \text{Wall Length} = \text{CY of Structural Backfill})</td>
</tr>
<tr>
<td>Clean Sand and Gravel Soil</td>
<td>![Chart Image]</td>
<td>(0.12 \times \text{Wall Length} = \text{CY of Structural Backfill})</td>
</tr>
</tbody>
</table>

- **Clay and Silt Soils**
  - \(\phi = 26^\circ\)
  - \(\gamma = 120 \text{pcf} (19 \text{kN/m}^3)\)

- **Silty / Clayey Sand Soil**
  - \(\phi = 30^\circ\)
  - \(\gamma = 120 \text{pcf} (19 \text{kN/m}^3)\)

- **Clean Sand and Gravel Soil**
  - \(\phi = 34^\circ\)
  - \(\gamma = 120 \text{pcf} (19 \text{kN/m}^3)\)
## Estimating Chart Structural Backfill Using AnchorPlex® System
### Belair Wall® Retaining Walls
#### 3:1 Crest Slope

<table>
<thead>
<tr>
<th>Height (ft)</th>
<th>Clay and Silt Soils</th>
<th>Silty / Clayey Sand Soil</th>
<th>Clean Sand and Gravel Soil</th>
</tr>
</thead>
</table>
| 2'-0" (600 mm) | $\varphi = 26^\circ$  
$\gamma = 120$ pcf (19 kN/m³) | $\varphi = 30^\circ$  
$\gamma = 120$ pcf (19 kN/m³) | $\varphi = 34^\circ$  
$\gamma = 120$ pcf (19 kN/m³) |
| 3'-0" (900 mm) | 1'-0"  
[300 mm] | 1'-0"  
[300 mm] | 1'-0"  
[300 mm] |
| 4'-0" (1200 mm) | 1'-6"  
[450 mm] | 1'-0"  
[300 mm] | 1'-0"  
[300 mm] |
| 5'-0" (1500 mm) | 2'-0"  
[600 mm] | 2'-0"  
[600 mm] | 1'-6"  
[450 mm] |
| 6'-0" (1800 mm) | 3'-0"  
[900 mm] | 2'-0"  
[600 mm] | 1'-6"  
[450 mm] |

For each height, multiply the Wall Length by the specified CY of Structural Backfill:

- 2'-0" (600 mm): 0.08 x Wall Length
- 3'-0" (900 mm): 0.18 x Wall Length
- 4'-0" (1200 mm): 0.31 x Wall Length
- 5'-0" (1500 mm): 0.48 x Wall Length
- 6'-0" (1800 mm): 0.69 x Wall Length
COPING, EDGERS & STEPS
## COPING, EDGERS & STEPS

<table>
<thead>
<tr>
<th>Page</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>188</td>
<td>Anglia Edger®</td>
</tr>
<tr>
<td>189</td>
<td>Brookshire™ Curb</td>
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<tr>
<td>190</td>
<td>Country Manor® Curb</td>
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<tr>
<td>191</td>
<td>Laguna™ Coping</td>
</tr>
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<td>192</td>
<td>Landings™ Step Unit</td>
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<td>194</td>
<td>Marina™ Coping</td>
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ANGLIA EDGER®

EDGERS

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<th>STEPS</th>
<th>CAPS</th>
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SHAPES & SIZES

4-Piece

8 x 17 7/8 x 4 1/2 8 x 15 1/2 x 4 1/2 8 x 10 1/2 x 4 1/2 8 x 7 7/8 x 4 1/2

PALLET INFORMATION / ESTIMATING CHART

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>UNITS/LAYER</th>
<th>UNITS/PALLET</th>
<th>LNFT PALLET (SOLDIER)</th>
<th>LNFT PALLET (SAILOR)</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
<th>WEIGHT/PALLET LBS</th>
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<tr>
<td>8 x 15 1/2 x 4 1/2</td>
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<tr>
<td>8 x 10 1/2 x 4 1/2</td>
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<tr>
<td>8 x 7 7/8 x 4 1/2</td>
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### SHAPES & SIZES

Curb Units

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<td>3¾ x 9¾ x 3¾</td>
<td>3¾ x 10¾ x 3¾</td>
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### PALLET INFORMATION / ESTIMATING CHART

<table>
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<th>UNIT</th>
<th>LNFT/LAYER</th>
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<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
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<th>LNFT PALLETS (SAILOR)</th>
<th>UNITS/LNFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
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COUNTRY MANOR®
CURB

SHAPES & SIZES

Curb

4 x 8 x 12

PALLETS INFORMATION / ESTIMATING CHART

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<td>4 x 8 x 12</td>
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COUNTRY MANOR CURB INSTALLATION INSTRUCTIONS

- Laying bed 1” concrete sand
- Aggregate Base
- Pavers
- Concrete Backfill
- Minimum 12” excess width
- 4” minimum (6” for driveways)

PEDESTRIAN | DRIVEWAYS | STEPS | CAPS | POOLS | KITCHENS | FIRE PITS
<table>
<thead>
<tr>
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### SHAPES & SIZES

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14\(\frac{3}{16}\) x 23\(\frac{3}{8}\) x 2\(\frac{3}{8}\)

### PALLET INFORMATION / ESTIMATING CHART

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<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
<th>LNFT PALLET (SOLDIER)</th>
<th>LNFT PALLET (SAILOR)</th>
<th>UNITS/SQFT</th>
<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
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LANDINGS™ STEP UNIT

SHAPES & SIZES

Step Unit

6 x 48 x 18

PALLEI INFORMATION / ESTIMATING CHART

<table>
<thead>
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<th>SQFT/ PALLET</th>
<th>SQFT/ LAYER</th>
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<th>LNFT PALLET (SAILOR)</th>
<th>UNITS/ SQFT</th>
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</table>

INSTALLATION | LANDINGS STEP UNIT

Each Landings™ step unit is manufactured with two unique face patterns. The step units are palletized and packaged for easy skid-steer loader removal. Care needs to be taken in handling these units. If a blemish occurs on one side of unit, rotate 180° before setting unit into place.

BASE COURSE
Excavate an area 6 inches deep by 1 foot longer by 1 foot wider than the installed step(s) size. Add a minimum of 6 inches of compactable base material, 3/4-inch minus (with fines) aggregate. Compact and level. Set unit and, if desired, add a slight pitch of no more than 1/4 inch toward the front of the step to shed moisture. If installing step units next to a retaining wall, keep units level from front to back.

SINGLE STEP
Set step unit onto prepared base course. Level.

The textures on sides 1 and 2 are designed to nest with minimal gapping between the units.

Place units so they nest tightly together.
**STAIR TREAD**
For each consecutive step, follow base course instructions, making sure the top of the base is even with the top of the previously installed unit. Recommended tread depth is a minimum of 10 inches, but no more than 16 inches. When installing steps adjacent to a finished surface such as pavers, as illustrated, a 6-inch-tall dummy block needs to be installed below the first step.

**LANDING**
For landing(s) follow base course instructions. Each step unit is manufactured with two unique face patterns. The face patterns are manufactured to nest together, which will create a narrower joint, providing pleasing aesthetics.

**STEPS IN A 90-DEGREE WALL**
When building into a retaining wall, construct the steps first and build the walls adjacent to the steps.

**SKID-STEER LOADER**
Slide forks underneath the first step unit and lift off pallet. Set the step unit onto its desired location, using a spacer to ease in fork removal.

A helpful tip to protect the step unit is to wrap the fork of the skid-steer with corrugated plastic packaging from the pallet or other protective materials. Secure to the forks.

**CLAMP**
Using a materials clamp, center the clamp on the step unit. Attach clamp to skid-steer or mini-excavator and slowly lift the step unit off of the pallet and move it into place. Be sure to have a second person to help guide the unit into place as the machine sets the step unit down.

**STRAPS**
When using a heavy duty strap(s), start by wrapping the strap(s) around the center if using one or close to step unit ends if two straps are being used. Cinch the strap(s) tight and attach the looped ends of the strap(s) to skid-steer or mini-excavator. Slowly lift the step unit from the pallet and move it into place. Be sure to have a second person to help guide the unit into place as the machine sets the step unit down. Using a spacer will help to ease in the strap removal.

**CART**
When using a cart, place provided corrugated plastic from pallet or other protective material onto the cart to help protect the step unit. With help from a second person, slowly slide the step unit from the pallet onto the cart. Maneuver the unit carefully into place.

Videos can be found on our YouTube channel: www.youtube.com/anchorblockmn
Marina Coping

5½ x 11⅛ x 2⅜

### Installation Guide - Steps

**OPTION 1**

A. Marina Coping  
B. Wall Block  
C. Grey Block (4 in x 8 in x 16 in) or Wall Block  

Note: All elements must be glued together with the concrete adhesive.

**OPTION 2**

A. Marina Coping  
B. Wall Block  

Note: A & B elements must be glued together with the concrete adhesive.
FIRE FEATURES
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### FIRE FEATURES

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<td>Weston Stone™ Fire Pit</td>
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<td>205</td>
<td>Bristol™ Series</td>
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<td>209</td>
<td>Elements™ Installation Instructions</td>
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RESIDENTIAL | COMMERCIAL | STEPS | COLUMNS | FIRE PITS | KITCHEN | FREESTANDING WALL | RETAINING WALL
--- | --- | --- | --- | --- | --- | --- | ---
✓ | | | | | | | |

**SHAPES & SIZES**

Round Fire Pit

3 x 13 / 7 x 12

Ring and Grate sold separately.

5 courses high, 12 pieces to each course.

60 pieces required to complete fire pit.

**PALLETS INFORMATION / ESTIMATING CHART**

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
<th>LAYER/PALLET</th>
<th>UNITS/PALLET</th>
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<td>48</td>
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<td>1298 Without Insert</td>
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</table>
Square Fire Pit

4 x 8 x 12

Square Fire Pit:
Outside is 44”
Stacks up to 4 rows high,
12 pieces to each row.
48 pieces required to complete kit.
Metal insert sold separately.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>SQFT/ PALLET</th>
<th>SQFT/ LAYER</th>
<th>LAYER/ PALLET</th>
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<td>1298 Without Insert</td>
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</tbody>
</table>
BORDEAUX™ SERIES

ELEMENTS™

FIREPLACE
Rough Dimensions:
2’ 7”D x 4’ 3”W x 7’ 8”H

XL FIREPLACE
Rough Dimensions:
3’ 21/4”D x 5’ 6”W x 9’H

LINEAR FIREPLACE
Rough Dimensions:
2’ 11/4”D x 7’ 4”W x 4’ 2”H
Approximate Weight:
3,700 lbs

WOOD BOXES
Rough Dimensions:
2’ 1 1/4”D x 3’ 3”W x 3’ 1”H
FIREPLACE

70300791
Bordeaux Builder Wood Fireplace
Colors: Lamina Sienna/
   Cordova Stone Buff Base + Top

13070014
Bordeaux Builder Wood Fireplace
Colors: Lamina Solid Shelby Blend/
   Cordova Midnight
   Base + Top

13070014
Bordeaux Builder Wood Fireplace
Colors: Lamina Sienna/
   Cordova Stone Midnight
   Base + Top

Approximate Weight:
Bottom Unit-2850 lbs.
Top Unit-1320 lbs.

Rough Dimensions:
2’ 7”D x 4’ 3”W x 8’H

36” wood burning fireplace can be converted to a vented gas unit on-site.

WOOD BOXES

13140001
Bordeaux Wood Boxes (Pair)
Colors: Lamina Sienna/
   Cordova Stone Buff

13140020
Bordeaux Wood Boxes (Pair)
Colors: Lamina Sienna/
   Cordova Stone Midnight

13140505
Bordeaux Wood Boxes (Pair)
Colors: Lamina Solid Shelby Blend/
   Cordova Stone Midnight

Approximate Weight:
3070 lbs.

Rough Dimensions:
2’ 1 ¼”D x 3’ 3”W x 3’ 1”H
### Brick Oven

<table>
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<tr>
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<th>Width</th>
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<td>4'</td>
<td>4'</td>
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<td>70306097</td>
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</table>

13000012
Bordeaux Brick Oven
Colors: Lamina Sienna/
Cordova Stone Buff Base + Top

13000014
Bordeaux Brick Oven
Colors: Lamina Sienna/
Cordova Stone Midnight Base + Top

13000817
Bordeaux Brick Oven
Colors: Solid Shelby/
Cordova Stone Midnight Base + Top

Approximate Weight:
5252 lbs.

Rough Dimensions:
3’ 6”D x 4’ 5”W x 7’ 5”H

### Grill Island

GRILL ISLAND INCLUDES
- Napoleon 5-Burner Grill
- Porcelain Cast Iron Cooking Grids
- JETFIRE Ignition
- Rear Infrared Rotisserie Burner
- Up to 66,000 BTU
- Napoleon Stainless Steel Double Doors
* Hoses not included, recommended hard-piped installation.

GRILL ISLAND
Bordeaux Grill Island
Colors: Lamina Sienna/
Cordova Stone Buff + Stainless

Bordeaux Grill Island
Colors: Lamina Sienna/
Cordova Stone Midnight + Stainless

Bordeaux Grill Island
Colors: Lamina Solid Shelby Blend/
Cordova Stone Midnight + Stainless

Approximate Weight:
3055 lbs.

Rough Dimensions:
2’ 6”D x 5’ 11”W x 3’ 5”H
BRIGHTON™ SERIES

ELEMENTS™

FIREPLACE
Rough Dimensions:
3' 4"D x 4' 4"W x 8' 4"H

WOOD BOXES
Rough Dimensions:
2' 4"D x 2' 8"W x 2' 11"H

WOOD BOXES
70300046
Brighton Wood Boxes (Pair)
Colors: Weston Gascony Tan/Urbana
Ashbury Haze

70580291
Brighton Wood Boxes (Pair)
Colors: Weston Cotswold Mist/Urbana
Brookstone Slate

Approximate Weight Per Pair:
3200 lbs.

Rough Dimensions:
2' 4"D x 2' 8"W x 2' 11"H
**FIREPLACE**

70580007
Brighton Fireplace
Colors: Weston Gascony Tan/Urbana Ashbury Haze
Base + Top

70580378
Brighton Fireplace
Colors: Weston Cotswold Mist/Urbana Brookstone
Slate Base + Top

**Approximate Weight:**
Bottom Unit-4605 lbs.
Top Unit-1230 lbs.

**Rough Dimensions:**
3' 4"D x 4' 4"W x 8' 4"H

36” wood burning fireplace can be converted to a vented gas unit on-site.
BRISTOL™ SERIES

ELEMENTS™

FIREPLACE
Rough Dimensions:
3’D x 5’W x 9’ 3”H

WOOD BOXES
Rough Dimensions:
2’ 4”D x 3’W x 3’ 3”H

ARCHED HEARTH
Rough Dimensions:
2’D x 5’W x 11”H

WOOD BOXES
70580334
Bristol Wood Boxes (Pair)
Colors: Weston Gascony Tan/
Urbana Ashbury Haze

70580534
Bristol Wood Boxes (Pair)
Colors: Weston Cotswold Mist/
Urbana Brookstone Slate

Approximate Weight Per Pair:
3950 lbs.

Rough Dimensions:
2’ 4”D x 3’W x 3’ 3”H
FIREPLACE
70580261
Bristol Fireplace
Colors: Weston Gascony Tan/
       Arbel Ashbury Haze Base + Top

70580312
Bristol Fireplace
Colors: Weston Cotswold Mist/
       Arbel Brookstone Slate Base + Top

Approximate Weight:
Bottom Unit-4095 lbs.
Top Unit-3200 lbs.

Rough Dimensions:
3' D x 5' W x 9' 6" H

36" wood burning fireplace can be converted to a vented gas unit on-site.
**BRICK OVEN**

**70583280**
Bristol Brick Oven
Colors: Weston Gascony Tan/
   Urbana Ashbury Haze
   Base + Top

**70580205**
Bristol Brick Oven
Colors: Weston Cotswold Mist/
   Urbana Brookstone Slate
   Base + Top

**Approximate Weight:**
Bottom Unit-3125 lbs.
Top Unit-3800 lbs.

**Rough Dimensions:**
4’D x 4’W x 8’ 5”H

---

**ARCHED HEARTH**

**70580262**
Bristol Arched Hearth
Colors: Weston Gascony Tan/
   Arbel Ashbury Haze

**70580309**
Bristol Arched Hearth
Colors: Weston Cotswold Mist/
   Arbel Brookstone Slate

**Approximate Weight:**
1180 lbs.
**Rough Dimensions:**
2’D x 5’W x 11”H
GRILL ISLAND INCLUDES

- Napoleon 5 Burner Grill
- Stainless Steel Cooking Grids
- i-Glow Backlit Control Knobs
- Rear Infrared Rotisserie Burner
- 760 sq. in. of cooking surface
- Up to 66,000 BTU
- Requires 110v outlet
- Napoleon Stainless Steel Double Doors
* Hoses not included, recommended hard-piped installation.

GRILL ISLAND

Bristol Grill Island
Colors: Weston Gascony Tan/
       Arbel Ashbury Haze +
       Stainless

Bristol Grill Island
Colors: Weston Cotswold Mist/
       Arbel Brookstone Slate +
       Stainless

Approximate Weight: 3945 lbs.
Rough Dimensions: 3’D x 6’ 4”W x 4’ 4”H
Elements are very easy to install. Here are a couple cross section details to consider. Keep in mind, these are not engineered plans. Make sure you check with your local municipality for their requirements when installing Elements. Here are a few other key points to remember:

- Always place a piece of material (plywood or carpet work well) between your forks and the Elements to prevent chipping.
- Always transport the Element on the pallet it comes with until you are ready to place on the permanent location.
- Make sure to use a ratchet strap to secure the Element to the loader when transporting and placing.
- Handle Elements with care - they are concrete, but not indestructible.
- Make sure to size the machine to the Elements weight.
- All Elements are designed to be buried 4” below finish grade.
For areas not affected by freeze-thaw conditions please contact your local Belgard sales representative for further installation information.

**Typical Cross Section for Concrete Pad Installation**

*The following measurements are a suggestion. Always check your local building codes first.*

- Concrete Tube 8” Diameter
- Steel Reinforcement Rods

**Top View**

**Side View**

- Steel Reinforcement Rods
- Concrete Tube 9” Diameter
- 4 - 6” Concrete
- 6” Gravel Base
- 24” Native Soil
- 24” Maximum
- To frost line per local code

**3D View**
BASIC INSTALLATION INSTRUCTIONS
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## PAVERS & SLABS

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## WALLS

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INTERLOCKING CONCRETE PAVEMENT

Interlocking concrete pavements (ICP) are flexible pavements designed to spread loads imposed on a small area of the pavement surface through a base layer (or series of layers or sub-bases) to a large enough area of the soil subgrade that the soil subgrade can support the load without rutting.

A 1,000 lb. wheel with a footprint of 40-SQIN exerts a load on the pavement surface of 3,600 lbs./SQFT. With proper design and construction, a flexible pavement can expand the footprint to 8-SQFT on the soil subgrade, thus reducing the load on the subgrade to only 125 lbs./SQFT. In a flexible pavement, the pavement surface and base have the ability to move slightly or flex under load then recover when the load is removed.

The unique aspect of interlocking concrete pavements is that the pavers interlock to help spread the imposed loads. There are three kinds of interlock: vertical, rotational and horizontal.

VERTICAL INTERLOCK
This is achieved by the shear transfer of loads to surrounding units through the sand in the joints. This shear transfer also prevents one paver from moving vertically in relationship to its neighbor(s).

ROTATIONAL INTERLOCK
This is achieved through use of the proper paver thickness in relationship to load and use and by a perimeter edge restraint. A slight crown constructed into the pavement will increase rotational interlock and the load bearing capacity of the pavement.

HORIZONTAL INTERLOCK
This is achieved through the use of laying patterns that minimize the length of uninterrupted joint lines and disperse forces from braking, turning and accelerating vehicles. Certain geometrically interlocking paver shapes enhance horizontal interlock. Herringbone laying patterns provide the most effective horizontal interlock and should always be used in vehicular applications.

In summary, the contractor achieves vertical, rotational and horizontal interlock by the interaction of these factors:

JOINT WIDTHS - consistent joint widths of approximately 1/8-in

JOINT SAND - properly selected joint sand

PAVER THICKNESS - 60mm (2¾-in) for pedestrian and some residential driveways
80mm (3¼-in) for heavy and industrial vehicle applications

EDGE RESTRAINT - non-moving fixed edge restraint

LAYING PATTERN - minimize length of uninterrupted joint lines in all directions. The most commonly used pattern is Herringbone.
See product pages for other acceptable pattern options.

PAVER SHAPE - shapes which allow Herringbone type laying patterns and which geometrically interlock on two or more sides with each other

CROWN - slight crown in pavement cross section
OTHER PAVEMENT SYSTEMS

Other flexible pavement systems include asphalt (bituminous) pavements. These pavements are designed and function in a similar manner to ICP. Stamped asphalt is in this category.

Rigid pavements are designed to bridge or span soft areas in the soil subgrade. Rigid pavements include poured-in-place Portland cement concrete, regular poured concrete, exposed aggregate concrete, stamped or imprinted concrete and decorative pavements mortared or adhered to a concrete surface or a bituminous layer overlying concrete.

COMPARISON OF PAVEMENT SYSTEMS

Interlocking Concrete Pavements:
• Flex without cracking.
• Do not require expansion joints.
• Resistant to spilled fuel and oil.
• Resistant to freeze/thaw damage.
• Resistant to de-icing compounds.
• Virtually unlimited combination of solid and blended colors, shapes and laying patterns.
• May be used immediately upon completion of installation.
• May be disassembled to repair subgrade or underground services then reinstalled with no unsightly patch.
• Skid and slip resistant surface.
• Cooler surface.
• Easy to work to grade transitions.
• Long design life.
• Low life cycle costs.
• Virtually maintenance free.

Asphalt:
• Flexible, but more apt to crack than ICP.
• Cracks from evaporation of essential oils.
• Dissolved by spilled fuels or oil.
• Limited colors.
• Patches and repairs obvious.
• Relatively short design life.
• Must be sealed on a regular basis.
• Loses strength with increase in temperature.
• Installation requires special equipment.

Poured-in-Place Concrete:
• Cracks from load flexing and from thermal expansion and contraction.
• Difficult to effectively repair and repairs are obvious.
• Less resistant to de-icing compounds than ICP.
• Design life longer than asphalt, less than ICP.
• Must cure before use.
• Subject to environment during curing.
• Needs expansion joints.
• Stamped concrete typically colored only on the top.

COMPONENTS OF THE ICP SYSTEM

The eight components of the ICP system are:

SUBGRADE

The in-place soil on which the pavement will be constructed. The characteristics of the subgrade soil have a major effect on the design and performance of the pavement and can also impact construction time and cost. The gradation, or distribution of the various size particles making up the subgrade soil, greatly influences the ability of the subgrade to support loads. Soils range from coarse grained sands to silts and clays which contain the smallest particles. The smaller the particle size, the less strength the subgrade will have. Clay soils are, in general, the weakest. The three most common methods used to rate or classify soils are discussed in Appendix A.

A simple way to quickly classify soils in the field is by visual appearance and feel. If coarse grains can be seen and the soil feels gritty when rubbed between the fingers, then it is a sandy soil. If the grains cannot be seen with the naked eye and it feels smooth, then it is a silt or clay. Don’t be fooled by the apparent solidity of clay soils, they shift under loads.

A primary factor in the performance of soil under pavement is its ability to hold water. The higher the water holding ability, the worse the soil generally performs as a foundation for pavement. Some easy ways for the contractor to make a quick field identification are described below.
Patty Test - Evaluating the water holding capacity of a soil:
• Mix the soil with enough water to make a putty-like consistency.
• Form the sample into a patty, let it dry completely.
• The greater the effort required to break the patty with fingers, the greater the plasticity, or ability to hold water. In other words, the more water the soil can hold, the less suitable it is under pavement.
• High dry-strength is a characteristic of clays. Silts and silty sands will break easily.

Shake Test - The dilatancy test, or a test for reaction to shaking:
• Mix a tablespoon (15 ml.) of water with the soil sample in the hand. The sample should be soft but not sticky.
• Shake or jolt the sample in a closed palm of the hand a few times.
• If water comes to the surface, the soil is fine sand.
• If none or a little comes to the surface, it is silt or clay.
• If squeezing the soil between the fingers causes the moisture to disappear, the soil is sandy.
• If moisture does not readily disappear, then the soil is silty.
• If moisture does not disappear at all, the soil is clay.

Snake Test - Evaluating the thread toughness for clay content:
• A small sample of soil is moistened to the point where it is soft but not muddy or sticky.
• It is rolled into a thread or “snake” between the hands.
• The longer the thread, and the more it can be rolled without breaking, the higher the clay content.
• The subgrade must be compacted to at least 95 percent of Standard Proctor Density before the base is installed.

GEO TEXTILE
Sometimes called filter cloth or soil separation fabric. A layer of woven or non-woven fabric placed between the subgrade and base to prevent the two layers from mixing under repetitive traffic loading. A Geotextile should be used if the subgrade is clay or is poorly drained and apt to stay wet for extended periods. A greater amount of base does not substitute for a Geotextile fabric in poor soil conditions. Check with your Authorized Belgard Distributor for the proper Geotextile.

SUB- BASE
A compacted layer or layers of specified material placed on the subgrade to support the base. Sub-bases are used primarily in heavy duty pavements or in areas with poor subgrade material.

BASE
A layer of specified material of a designed thickness placed on the subgrade (or sub-base) to support the pavement surface. In an ICP, the most common base material is a compacted layer of Dense Graded Aggregate (DGA). Do not use stone dust or screenings.

The chart at right serves as a guideline for base construction for driveways, patios, walks and pool decks. In very cold winter climates, or in soils that retain excess water, thickness may be increased by two to six inches.

Check with your Authorized Belgard Distributor for the proper DGA for your area.

EDGE RESTRAINT
A specially designed edging, curb, building or other stationary object that contains the bedding sand and pavers so they do not spread and lose interlock. There are many plastic, aluminum and steel edge restraints specifically designed for use with unit pavers.

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>BASE THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driveways</td>
<td>6 in. - 8 in.*</td>
</tr>
<tr>
<td>Patios</td>
<td>4 in. - 6 in.</td>
</tr>
<tr>
<td>Walkways</td>
<td>4 in. - 6 in.</td>
</tr>
<tr>
<td>Pool Decks</td>
<td>4 in. - 6 in.</td>
</tr>
</tbody>
</table>

*Add 2 in. for low, wet, clay and silt soils.
In addition to the specially designed edge restraints, properly installed troweled concrete, poured-in-place concrete structures and treated timbers may be used. Troweled concrete is especially applicable in areas of sandy soil which does not allow spiked edge restraints to stay in place.

Check with your Authorized Belgard Distributor for a list of products available.

SAND SETTING BED

A layer of coarse, clean sand loose screeded to a thickness of one (1) inch over the base layer for bedding the pavers. When the pavers are compacted into the sand bedding layer, some sand enters the joints between the pavers from the bottom and begins the process of vertical interlock. The sand layer also allows the compaction process to achieve a smooth pavement surface, compensating for any minor differences in paver thickness. Do not compact the sand setting bed before setting pavers.

The bedding sand may be natural or man made but should conform to the requirements of ASTM C33. Do not use mason sand, stone dust or screenings. The gradation of ASTM C33 is included in Appendix A.

INTERLOCKING CONCRETE PAVERS

A concrete paver unit meeting requirements of ASTM C936-96. The pavers “shall be capable of being lifted and placed with one hand, and shall have an exposed face (top surface) area less than or equal to 100.75 sq. in. The aspect ratio (that is, overall length divided by thickness) shall be equal to or less than 4. A 12 in. x 12 in. paver does not qualify because it has a top surface area greater than 100.75 sq. in.

Other requirements of concrete pavers are:
- Average compressive strength not less than 8,000 lbs. per sq. in.
- Resistance to freezing and thawing. Less than 5 percent absorption
- Dimensional tolerance

These requirements of ASTM C936 insure a uniform durable paver unit.

Concrete pavers are manufactured in two thicknesses. Pavers 2-3/8 in. (60mm.) thick are used for pedestrian applications such as walkways, patios, plazas and pool decks. They may also be used in residential driveways. Pavers 3-1/8 in. (80mm.) thick are used in vehicular traffic and heavy duty applications.

JOINT SAND

The sand used to fill the joint spaces between pavers to achieve vertical interlock. This sand must be clean, sharp, durable and well graded. Generally, it is best to use the same washed concrete sand (ASTM C33) used for the bedding layer as the joint sand. This is especially important in vehicular trafficked ICP. The sand should be spread, allowed to dry, then swept into the joints. The process can be accelerated if after the initial sweeping, a plate compactor is run over the pavement while the sweeping is continued. Finer sand conforming to ASTM C144 specifications may be used in pedestrian and residential driveway applications. Bagged “all-purpose” sand may be used in pedestrian ICP but masonry sand, box or play sand as well as stone dust or screenings should not be used. The recommended gradation for the joint sand may be found in Appendix A.

Be sure the joints are filled with sand. In some cases it may be necessary to re-sand the job in two to three weeks.
SUMMARY:
The components of an ICP are:
- Subgrade
- Geotextile (if needed)
- Sub-Base (if needed)
- Base
- Bedding Sand
- Edge Restraint
- Interlocking Concrete Pavers
- Joint Sand

Detailed information on the materials used is contained in Appendix A.
TOOLS, SUPPLIES AND EQUIPMENT

Most of the tools, supplies and equipment needed to install ICP are common to contractors involved in residential site work. The heavier and more expensive equipment may be easily rented if the work volume justifies the purchase. Some tools have been designed especially to facilitate the installation of ICP and are available through your Authorized Belgard Distributor.

Some special tools designed specifically for the ICP industry are:

- Paver Cart - to transport full straps of pavers
- Paver Extractor - to remove installed pavers
- Dead Blow Rubber Hammer - to help adjust pavers
- Paver Scribe - to mark pavers for cutting
- Paver Adjuster - to move installed pavers to straighten lines

Personal Safety and Comfort Supplies:

- Eye Protection
- Ear Protection (muffs or plugs)
- Dust Mask (disposable)
- Steel Toed Shoes
- Gloves
- Knee Pads
- Back Support
- Finger Tape (can use duct tape)
- First Aid Kit
- Water Cooler

Expendable Supplies:

- Mason String Line
- Chalk for Chalk Line
- Marking Crayon (keel)
- Flagging Tape
- 2 ft. Wood Stakes
- Diamond Saw Blades
- Fuel & Oil
- Spray Marking Paint

Equipment:

Installation equipment may be owned or rented. The most common equipment needed is:

- Builders level or transit level with tripod and rod. Laser levels are excellent.
- Vibratory plate compactor rated minimum 5000 ft. lbs.
- Masonry saw
- Table saw, wet or dry, or a hand held cut-off saw. Either should be gasoline powered. A hand held cut-off saw is the most flexible and productive.

Heavy Equipment:

- Skid-Steer Loader capable of lifting 5000 lbs. - equipped with interchangeable bucket, forks and rotary broom
- Vibratory Roller - used for subgrade and base compaction on larger jobs
- Jumping Jack Compactor - for compacting trenches
- Backhoe - for excavation (especially demolition)
- Dump Truck - to haul excavated materials and to deliver material to job site
CONSTRUCTING THE ICP

UTILITY LOCATION

Before beginning any phase of the construction process, make sure that all underground utilities, services and structures have been located and clearly marked on the ground surface in all areas involved in the construction process including access lanes. In many areas, a single number such as Miss Utilities may be called.

Items to be located are:

- Electrical
- Sanitary sewer
- Gas
- Septic tank
- Water supply
- Telephone
- Storm sewer
- Cable TV
- Drainfield
- Irrigation piping

Double check; there may be other items particular to the job site.

SITE ACCESS

Before any demolition, delivery or construction equipment is allowed on site, make sure that there are no hazardous conditions such as overhead electric lines in the way. Plan all activities so that no damage will occur to existing pavements, structures, trees, shrubbery, gardens or other site amenities.

LAYOUT

Identify the area to be excavated and mark it on the ground with spray paint. Make sure the area to be excavated is at least 12 in. wider on all outside edges than the size of the pavement.

Place grade stakes with string lines just outside the area to be excavated, making sure that the excavation is at least 12 in. wider than the edge of pavement. Mark the elevations on the stakes so that the depth of excavation can be checked as it progresses. Use nylon mason's line and set it at the finished elevation of the pavement. Measure all excavations and base thickness from these lines. Set the initial elevations and check them at the beginning of each day with a builders level. The stakes can be moved at night by mischievous persons.

String lines set at final or finished elevations should be sloped. All lines (and final elevations of the pavement) should slope away from the house or building. The minimum recommended slope is 1.5 percent or a drop of 3/16 in. for every foot of pavement. Many pavements are sloped at 2 percent or 1/4 in. per every foot of pavement as this will better facilitate drainage. The maximum slope for comfortable walking is 7 degrees or about 12 percent. A builders level should be used to establish elevations using marks on stakes set around the area to be paved.
EXCAVATION / SUBGRADE

Make sure that the area to be excavated is at least 12 in. wider than the limits of the ICP. This provides a firm base to support the edge of the pavement and the edge restraint.

Make sure that the depth to be excavated is measured from finished pavement surface elevations and is marked on all grade stakes. The bottom of excavations, below finished pavement elevation, should equal the total thickness of the designed base, sand bed (after paver installation and compaction) and the paver being used.

Try not to disturb the subgrade below the planned excavation depth. Over excavation is costly and can cause future problems.

When all excavation is completed, compact the subgrade with a vibratory plate compactor. Make sure that compaction is thorough, uniform and complete. If soft spots are encountered, they should be removed and backfilled with the material to be used for the base. If the subgrade is too wet to compact, allow it to dry or try adding a few inches of dry base material before compacting.

BASE

EXCAVATION CHART

Remove existing sod and soil

<table>
<thead>
<tr>
<th>PAVERS</th>
<th>WELL DRAINED AREA/ UNDISTURBED SOIL</th>
<th>POORLY DRAINED AREA/ DISTURBED SOIL</th>
<th>PAVER THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Granular base</td>
<td>Bedding course</td>
<td>Granular base</td>
</tr>
<tr>
<td>PEDESTRIAN TRAFFIC, PATIOS, WALKWAYS, POOL DECKS</td>
<td>4” (100 MM)</td>
<td>1” (25 MM)</td>
<td>6” (150 MM)</td>
</tr>
<tr>
<td>VEHICULAR TRAFFIC RESIDENTIAL DRIVEWAYS</td>
<td>8” (200 MM)</td>
<td>1” (25 MM)</td>
<td>12” (300 MM)</td>
</tr>
</tbody>
</table>

Total excavation = Granular base + bedding course + paver thickness - ½” (13 mm) for an uncompacted bedding thickness

The recommended DGA base material (see Appendix A) should be spread in layers of uniform thickness then compacted. The thickness of the layer depends on the method of compaction and the planned use of the pavement. While compaction of the subgrade and base layers is key to the performance of any pavement, it is absolutely essential to pavements trafficked by vehicles. The 4 in. 6 in. base for patios, walkways and pool decks may be placed in two or three layers and compacted with a vibratory plate compactor of 5,000 ft. lbs. of force or greater. The 6 in. - 8 in. base for driveways may be placed in two lifts of 3 in. - 4 in. if a vibratory roller is used.

Place and compact the base material as recommended, making sure to keep the material lightly dampened. If free
water appears on the base surface during compaction, the material is too wet and should be allowed to dry (or add a layer of dryer base material) before continuing compaction.

Be sure to thoroughly compact along edges, in corners and around structures. These are the most difficult areas to treat and the most apt to cause future settlement problems.

Do not use frozen base material and do not place base material over a frozen subgrade.

Be sure that the outside limits are at least 12 in. wider than the outside limits of the pavement.

When proper compaction of DGA has been achieved, the surface should be smooth, leave no areas into which the bedding sand can migrate. It may be necessary to fill any such areas with a finer material then recompact. The finished base surface should be flat (no more than 3/8 in. plus or minus variation under a 10 ft. straight edge) and uniformly true to grade.

Summary:
- Base must be 12 in. wider than pavement on all sides.
- Use proper base material.
- Do not place frozen base material.
- Do not place base material over frozen subgrade.
- Place and fully compact base in layers.

EDGE RESTRAINT

Edge restraints must be installed on that part of the pavement edge which is not restrained by an existing structure such as a building, concrete curb or concrete slab.

Edge restraints are typically placed before installing the bedding sand and pavers. Some edge restraints can be installed after placement of the pavers and before compaction. Troweled concrete edge restraint is installed after the pavers have been placed.

A detailed description of the various types of edge restraints is contained in Appendix A. Consult your Authorized Belgard Distributor for the edge restraint(s) recommended for your area. Also refer to ICPI Tech Spec 3 “Edge Restraints for Interlocking Concrete Pavements”.

Be sure that any area where bedding or joint sand can escape through or under the edge restraint is lined with a strip of Geotextile. Loss of sand will cause eventual settlement of the pavers.

Back fill outside of edge restraint as soon as possible to prevent sand from escaping under the edge restraint.

SAND SETTING BED

Loose screed the washed concrete sand (see Appendix A) to an uniform thickness of 1 in. over the compacted base course. In no case should the sand be greater than 1-1/2 in. thick.

If the edge restraint has already been installed, the screed board may be notched to ride on the edge restraint on one or both ends. The notch should be cut to allow for the screeding of a 1 in. thick sand layer.

If the edge restraint cannot be used to carry the screed board, screed rails must be used. Screed rails may be wood, plastic or iron pipe or square steel tubing. The rails should be sized to allow for a 1 in. thick sand bed. For example, a 3/4 in. iron pipe (3/4 in. is the inside pipe diameter) has an outside diameter of approximately 1 in.

Place the screed rails parallel to each other and close enough together to enable the screed board to be pulled along the rails without falling off. Set the top of the rails to the desired elevation below grade lines and stabilize by hand packing sand along both sides of the rail.

Place the washed concrete sand between the screed rails and rough screed with a shovel, steel rake or lute. Excess sand makes the screed board difficult to pull. Place screed board on the rails and draw forward leaving a smooth surface. Fill in and rescrew any open streaks.

When a screed rail is no longer needed, it should be carefully removed and the void filled with sand and hand floated. Do not compact the sand setting bed before laying pavers.

PAVERS

In most ICP projects, the pavers, regardless of paver shape, are laid in patterns where two sets of joints run
perpendicular to each other. Radii or curves are cut into the pavement after the field pavers have been laid but not compacted. Straight joint lines not only make the finished pavement look clean and sharp but make installation much easier. If pavers shaped to geometrically interlock with each other are not laid in straight lines, they will not fit together.

To keep joint lines straight, parallel string lines or chalk lines snapped on the sand setting bed should be used. The lines should be spaced five to ten feet apart with the spacing equal to the laying modulus of the paver shape being installed. This can be determined by laying a course of pavers in the proper pattern with 1/8 in. joints and measuring the distance between at the desired line separation distance.

Procedure:
- Snap a string line on the screeded sand in the center of the area(s) to be placed.
- The line should be perpendicular to the laying face.
- Place pavers in the given laying pattern on both sides of the line.
- If additional lines are snapped, they should be parallel to each other. Check this by measuring the distances at the opposite ends of each line. They should be equal.
- If they are not parallel, they can be erased and snapped again. Parallel chalk lines snapped in bedding sand or string lines pulled above sand and pavers

Parallel string lines are also used to pave around openings in the pavement such as manholes or swimming pools.

Procedure:
- Pull perpendicular string or snap chalk lines on all four sides of the opening.
- Lay pavers on one side, then the other.
- Count the courses needed to surround the openings on each side. They should be equal in number on both sides.
- Then fill around the remaining side of the opening.
- Cut pavers to fit and fill against the edge restraint around the opening.

Plan your installation to begin along a straight line and preferably in a corner which is easily accessible. Make absolutely certain that the beginning corner is a true 90 degree angle. If the intersection of 2 sides is not a true 90 degree angle, you must establish a 90 degree starting point.
A quick way to establish a line perpendicular to an edge (no corner walls) is with the following procedure:

- Measure and mark the length of the edge, or line, from which paving will begin. The line can be 10-20 ft. (3-7m.) long. This line is where an edge restraint will be placed, or where one is already placed.
- Mark exactly the half way point on the line that was just measured. In other words, divide the line in half.
- Take one tape measure and extend it from the other end of the line at an angle toward the center. Be sure the tape extends past the middle of the line by a foot or two (0.2m.-0.6m.).
- Take a second tape measure and extend it from the other end of the line at an angle toward the center.
- Overlap one tape on the other and match the length of both tapes. The same marked dimensions on each tape should be touching each other.
- Snap a line from the point where the two tape measures cross to the center of the line.
- This line is perpendicular to the line from which paving will begin.
STARTING LAYING PATTERNS

Starting the first few rows of the pavement requires attention to the order of placing the pavers. The proper order for beginning herringbone patterns with a rectangular paver is illustrated below. The installation begins at a 90 degree corner.

When placing the pavers, it is important to maintain consistent joint spacing of 1/16 in. to 3/16 in. Consistent joint width of approximately 1/8 in. will spread loads (vertical interlock) better than wider joints. Consistent joint spacing will result in a neat and orderly appearance of the finished pavement.

The 1/16 in. spacer ribs molded into the sides of pavers are to ensure a minimal joint and that at least some sand can enter the joints between pavers. They are not intended to be the spacing mechanism. The best way to maintain joint consistency during paving is by the “click and drop” method.

Click and Drop Procedure:
• While holding a paver, the bottom 1/4 in. to 1/2 in. should “click” firmly against the top portion of the side of the pavers already placed.
• Do not hit the previously placed pavers so hard that they move.
• Release grip, dropping the paver an inch or so directly downward. A slight pressure with fingers will ensure that the paver does not move away from those already placed.

CUTTING PAVERS

Pavers may be cut with any one of three basic pieces of equipment. They are:
• Mechanical or guillotine splitter
• Masonry saw
• Hand held cut-off saw

Mechanical or guillotine cutters are relatively inexpensive to buy but produce the least desirable results. Masonry saws may be either gasoline engine or electric motor driven. They may be hand held or mounted on a stand. Hand held cut-off saws are the most convenient and produce the best overall combination of quality and productivity.

Visit OSHA.GOV for the most up to date regulations.
EDGE PAVERS AND PAVER CUTTING

Especially manufactured edge units are available for some paver shapes. Check with your Authorized Belgard Dealer for availability of these units.

In most cases, pavers along the pavement edges will need to be cut. The four types of cutting equipment generally available are:

- Mechanical cutter or guillotine splitter. This equipment cuts pavers between two steel blades through hydraulic or mechanical pressure. The cutting process is quick but the cut edge tends to be rough. The equipment is relatively inexpensive.
- Gasoline or electric powered saws mounted on a stand. These saws are generally set up to be run wet but can be run with a dry diamond blade. Very accurate cuts can be made but in most cases the pavers must be marked, brought to the saw, cut, then returned to the edge and installed. The process is labor intensive. Gasoline powered saws may be mounted on a coxet to facilitate the process.
- Walk behind diamond saw. Powered in most cases by a gasoline engine, the units roll on wheels while cutting. They are usually set up to run wet but can use a dry diamond blade. The advantage is that the pavers may be cut in place. The quality of cut is excellent but the saws are awkward to maneuver.
- Gasoline powered cut-off or quick saws. These hand held saws are similar to chain saws with the diamond saw blade replacing the chain. While some cut-off saws can be run wet, most are used with dry blades. These units provide good output and, in the hands of an experienced operator, excellent quality of cut. Cut-off saws have become the most used equipment for cutting pavers.

Tips

Diamond saw blades come in wet or dry versions. Dry blades may be run wet but wet blades should never be run dry. Use of water with either type blade extends blade life.

Care must be taken to make sure that the slurry (mixture of water and cutting dust) from wet saws or dust from dry saws is washed off installed pavers immediately before it dries. Surrounding structures, vegetation and automobiles should be protected from the dust. Cut-off saws with dust collection capability have recently become available. Check with your Authorized Belgard Dealer for the proper cutting equipment.

Cutting Procedure

Mark lines to be cut with lumber pencil or crayon, chalk, welders soapstone or water-base liquid market. Do not use a marker which will not eventually come off. It is best to use a color which is easily visible against the color of the paver. Curved lines may be marked by using a garden hose as a guide.

The pavement will perform best if the size of cut units left in the pavement is as large as possible. Thin pieces tend to break or displace with time and use. In most cases, the pattern may be adjusted at or near the edge to allow for larger cut pieces. A border or header course of whole pavers between the field pavers and the edge restraint tends to keep the cut field pavers in place better than the edge restraint alone. The border pavers also add a neat finished appearance to the pavement.

Cut and place all edger pieces before compacting the pavers and applying joint sand.

Summary:

- Use proper hand, eye, ear and respiratory protection equipment.
- Mark lines to be cut.
- Maximize size of cut pieces to remain in pavement.
- Make clean neat cuts.
- Make all cuts before compacting pavement.
- Clean all cut residue from pavement immediately.
- Use paver border or header course as often as possible.
PAVEMENT COMPACTION AND JOINT SANDING

Compaction of the ICP evens the tops of the pavers and begins the process of vertical interlock by forcing some of the bedding into the joints from the bottom.

On small jobs, compaction should take place after all pavers, including cut edges, are in place. On jobs lasting more than one day, all pavers placed should be compacted and the joints filled at the end of the workday. Do not compact or fill joints within 3 ft. of any unrestrained or incomplete edge. Do not spread joint sand before initial compaction of pavement.

Using a gasoline powered vibratory plate compactor with a minimum compaction force of 5000 ft. lbs. for 3-1/8 in. pavers, follow this procedure:

Compacting Procedure

• Start on one edge of the pavement and compact the perimeter.
• Compact in overlapping rows on the rest of pavement.
• Compact the pavement again but in the opposite direction. All pavers will need to be exposed to at least two passes of the compactor.
• Do not compact within 3 ft. of an unrestrained edge or the pavers will creep out.
• The operator looks for broken pavers just behind the plate compactor and marks them while compacting. The broken pavers are removed with a paver extractor and replaced with whole units.

JOINT SANDING

After compaction of pavement and replacement and recompaction of replacement pavers, spread the joint sand. Refer to Section 2, Joint Sand for recommended sands. Dry sand works best, so if the sand is damp, allow it to dry. Sweep the dry sand into the joints. If necessary, dry bagged sand conforming to ASTM C144 may be used (see Appendix A). Do not use mason sand, play sand or sandbox sand. After the initial sweeping, the filling of the joints can be expedited by alternating sweeping and passes of the vibratory plate compactor. Continue until all joints are filled. It is a good idea to reinspect a job two to three weeks after completion at which time it may be necessary to re-sweep sand into the joints.

Figure 3 Right

Compaction sequence working from the perimeter to the center of the pavement. All pavers should have two passes of the plate vibrator over them prior to filling the joints. After the joints are filled with sand, follow the same compaction sequence from the perimeter to the center.

Appendix A). Do not use mason sand, play sand or sandbox sand. After the initial sweeping, the filling of the joints can be expedited by alternating sweeping and passes of the vibratory plate compactor. Continue until all joints are filled. It is a good idea to reinspect a job two to three weeks after completion at which time it may be necessary to re-sweep sand into the joints.

Summary:

• Compact pavement after pavers are installed and before joint sand is spread.
• Replace broken pavers while compacting and before applying joint sand.
• Spread and dry joint sand.
• Sweep joint sand into joints and fill by
alternating sweeping and vibrating.

Check job in 2-3 weeks and re-sand if necessary.

Sweep off excess sand. On some commercial jobs, excess sand may be left on the pavement to help ensure joints are filled.

**COMPLETION OF PROJECT**

When the installation has been completed, clean up the site. Some pavers of each shape and color used may be left with owner for possible future replacement. Store these pavers neatly where the owner directs. Walk the job with the owner and address any problems immediately. Review maintenance procedures with the owner and leave information regarding care and maintenance with him/her.

**ESTIMATING MATERIALS**

**EXCAVATION**

Calculate the area to be excavated. Remember to include the 12 in. outside the area to be paved. If an electronic digitizer is not available, break the area down into geometric shapes (squares, rectangles, triangles or circles), calculate the area of each, then add all together to arrive at total area in square feet.

Calculate volume of soil to be excavated by multiplying the total area in square feet by the depth to be excavated in feet. This will give the total cubic feet of soil to be excavated. In most residential projects, the depth to be excavated is uniform or easily averaged over the area to be paved. If the pavement is to be cut into a hill slope or will be built partially over an area to be filled, be sure to consider these conditions in your estimate. In the first case, more material will need to be excavated and disposed of. Some or all of that material may possibly be used as fill.

When soil is excavated it expands in volume. This expansion is called “swell” and ranges from 30 percent for clay to 15 percent for sand with “average” soil expanding about 25 percent. If the average soil expands 25 percent then the volume after excavation, or loose volume, is 125 percent greater than the volume of the soil in place. Thus, if the calculated in place volume of the soil to be excavated is 100 cubic yards, the volume to be hauled is approximately 125 cu. yds. (100 x 1.25).

Since the volume of soil increases when excavated, the weight per unit of volume must decrease.

The average soil weighs approximately 3250 lbs. (1.625 tons) per cubic yard in place and approximately 2600 lbs. (1.3 tons) per cu. yds. after excavation. Thus, the 125 cu. yds. to be hauled in the last example would weigh 162.5 tons (125 x 1.3).

Knowing the volume and weight of soil to be excavated, hauled and disposed of is absolutely necessary to accurately estimate time and cost. More detailed information is contained in Appendix A-Materials.

**BASE**

Calculate the base material by multiplying the area excavated in square feet by the design depth of the base in feet after compaction. Divide the result by 27 to obtain the cubic yards of base material needed in the compacted state.

Since the base material will usually be purchased by the ton, the volume needed after compaction must be converted from cubic yards to tons. This conversion can be made accurately if the bulk density of the base material is known. If the bulk density is not known, multiply the calculated volume needed by 1.6 to get tons needed.

**EDGE RESTRAINT**

The lineal feet of edge restraint required is simply the total feet of pavement edge which must be restrained by the specified edge restraint system. In many cases, both straight and curved restraints must be installed. Total quantities of each should be estimated.

If the edge restraint to be used requires stakes or spikes, this quantity must also be estimated. Space stakes or spikes as recommended by the manufacturer of the edge restraint system used. This information may be obtained from your Authorized Belgard Dealer.
BEDDING SAND

The quantity of bedding sand will vary with the thickness of the loose screeded sand bed, 1 in. to 1-1/2 in., and with the moisture content of the sand being delivered. A good rule of thumb, however, is to order 1/2 ton of ASTM C33, washed concrete sand for every 100 sq. ft. of installed pavement. This should suffice for both the bedding and joint filling.

PAVERS

In simple straightforward projects requiring no cutting loss, the quantity of pavers to be ordered is equal to the area of the pavement, plus a 2 percent cull factor rounded up to the next highest package unit. In some cases it may be possible to order pavers in straps or section quantities while in others it may be necessary to order full cubes.

An additional quantity must be added for portions of pavers lost on edges which must be cut. A good rule of thumb is to add 30 sq. ft. of pavers for each 100 linear ft. of cut edge.

Edge pavers must be calculated separately for each paver shape. This information is available in the Product Guide available from your Authorized Belgard Dealer. Remember, edge pavers are only available for a limited number of paver shapes and may only be used on straight edges parallel to the laying pattern.

Border pavers, such as a header course, must be calculated based on the paver shape being used and the border pattern to be installed. In the common soldier course border using a 4 in. x 8 in. rectangular paver, 3 pavers are needed per 1 ft. of border or 0.67 sq. ft. of 4 in. x 8 in. pavers. The ordered quantity would be 0.67 x the lineal feet of border plus 2 percent rounded up to the next package unit.

If bands are to be inset into the paver field, it is usually best to lay the entire field then saw cut and remove field pavers to install the band pavers. In this case, do not deduct the quantity of band pavers from the gross field pavers required.

JOINT SAND

If the same sand used to fill the joints is used for the sand setting bed, the quantity will be included in the bedding sand estimate.

In non-vehicular residential projects, such as patios, dry bagged sand may be used. Use an all purpose or construction sand. Do not use play sand or sandbox sand. All purpose sand is generally packaged in 60 lb. bags. Use the table below to estimate quantity needed:

<table>
<thead>
<tr>
<th>Lbs./100 sq. ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 cm. (2 3/8 in.) pavers w/ 1/8 in. joint</td>
</tr>
<tr>
<td>8 cm. (3 1/8 in.) pavers w/ 1/8 in. joint</td>
</tr>
<tr>
<td>6 cm. (2 3/8 in.) pavers w/ rounded corners</td>
</tr>
<tr>
<td>8 cm. (3 1/8 in.) pavers w/ rounded corners</td>
</tr>
</tbody>
</table>

JOINT SAND

If the sand used for the sand setting bed is not used for filling the joints, the sand used should meet the gradation requirements of ASTM C144.

ASTM C144 - Gradation of Joint Sand

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>100</td>
</tr>
<tr>
<td>No. 8</td>
<td>95-100</td>
</tr>
<tr>
<td>No. 16</td>
<td>70-100</td>
</tr>
<tr>
<td>No. 30</td>
<td>40-75</td>
</tr>
<tr>
<td>No. 50</td>
<td>20-40</td>
</tr>
<tr>
<td>No. 100</td>
<td>10-25</td>
</tr>
</tbody>
</table>
NOTE:
- Do not use sandbox or play sand.
- Do not use stone dust.
- Do not use Mason sand.

EDGE RESTRAINTS

Restraints hold the pavers tightly together, enabling consistent interlock of the units across the entire pavement. They prevent pavers from spreading due to horizontal forces from tires and minor settlement. Edge restraints are designed to remain stationary while receiving occasional impacts from tires.

When a compacted aggregate base supports the paver and bedding sand, the base should extend beyond the restraint. The rule of thumb is that the base should extend beyond the restraint the same dimension as the thickness of the base material. For example, if the base is 6 in. thick, then it should extend at least 6 in. beyond the outside edge of the restraints. This contributes stability to the restraint and pavement edge especially in soils subject to heaving. Soil backfield is never a suitable edge restraint and should never be installed on top of the bedding sand.

If there is a possibility of sand loss from beneath the pavers, or between the joints of the edge restraint, Geotextile (filter cloth) is recommended to prevent its migration. A 12 in. (0.3m.) wide strip can be applied along the base and turned up along the sides of the restraints. Filter cloth generally is not required across the entire surface of the base, nor should it be placed on top of the bedding sand.

There are two general types of edge restraints. Those made elsewhere and installed at the site include precast concrete, plastic, cut stone, aluminum, steel and timber. Restraints formed on-site are made of poured-in-place concrete.

Full depth precast concrete or cut stone edging generally extends the depth of the base material. They can be compacted soil (not subject to heaving), compacted aggregate or concrete backfield. The preferred method of installation with vehicular pavements is for the curb to rest on the compacted aggregate road base.

Partial depth precast concrete edge restraints may be used for residential and light duty commercial applications. These precast units are anchored on a compacted aggregate base with steel spikes. The spikes are typically 3/8 in. diameter. Depending on the design, the top on the concrete edge can be hidden or exposed.

Aluminum and steel edging should be selected to provide a smooth vertical surface against the pavers. L-shaped edging provides additional stability. Stakes fastened to the edging should be below the pavers or on the outside of the restraints. Steel should be painted or galvanized so that rust does not stain the pavers. Spikes to secure steel and aluminum edging should extend well into the base course. Consult manufacturer’s literature for recommended spacing of the spikes. Aluminum and steel edgings are manufactured in different thickness. The thickest edging is recommended when pavers are subjected to vehicular traffic.

Timber should only be used to restrain residential patios and walks. It should be treated to resist insects and rot. A nominal 6 in. x 6 in. minimum dimension will restrain the bedding sand and 2 3/8 in. thick pavers. Smaller dimensioned lumber will likely warp. Stakes should be placed on the outside of the lumber, or below the pavers if placed on the inside. The stakes should extend into the base.

Plastic edging installs quickly and will not rust or rot. Plastic edging should be specifically designed for use with pavers. It can be used with light duty residential, commercial or on some heavy duty, industrial applications, depending on the design. It should be firmly anchored into the compacted aggregate base course with steel spikes. Consult the manufacturer’s literature for the recommended spacing of the spikes. Edging for planting beds and lower gardens is not an acceptable restraint for interlocking concrete pavements.

Elevations should be set accurately for restraints that rest on the base. For example, 2 3/8 in. thick pavers with 1 1/4 in. of bedding sand would have a base elevation set 3 in. below that of the finish elevation of the pavers. This allows 1/4 in. settlement from compaction and 1/8 in. for minor settling over time.

Restraints formed on-site, poured-in-place concrete curbs, or combination curb and gutters required by municipalities make suitable restraints for pavers. Exposed concrete edges should have a 1/8 in. radius edge to reduce the likelihood of chipping. As with precast, the side of the curbs should extend well below the sand bedding course.

Troweled concrete from a bag mix, or batched on-site, can be applied without forms against edge pavers and on the compacted base. If the top of the concrete edge is recessed and slopes away from the pavers, grass can grow next
to them. The depth below the surface of the pavers must be sufficient to prevent the concrete from becoming a heat sink that dries the grass and topsoil. This edge restraint is suitable for pavers subjected to pedestrian traffic and for residential driveways. Troweled edges should be at least 6 in. wide. Steel reinforcing such as DuraWall should be placed in the concrete to increase service life.

Troweled concrete curbs are not recommended in freezing climates as they may crack and be an on-going maintenance problem. The second letter describes a secondary soil type, the gradation or the ability of the soil to retain water. Gradation (variation in particle sizes)

W = well-graded (high variation - good for pavements)
P = poorly graded (low variation - not good for pavements)

Liquid Limit Symbols (Liquid limit is the ability of the soil to hold water)

H = high (can hold water, does not drain well - not good for pavements)
L = low (does not hold water, drains well - good for pavements)
### The 14 USCS Soil Groups and Their Respective Suitability for Use as a Subgrade for a Pavement System

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>Soil Description</th>
<th>Subgrade</th>
<th>Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW</td>
<td>Well-graded gravels and gravel sand mixtures, little or no fines</td>
<td></td>
<td>X (1)</td>
</tr>
<tr>
<td>GP</td>
<td>Poorly graded gravels and gravel sand mixtures, little or no fines</td>
<td></td>
<td>X (1)</td>
</tr>
<tr>
<td>GM</td>
<td>Silty gravels, gravel-silt-clay mixtures</td>
<td></td>
<td>X (1)</td>
</tr>
<tr>
<td>GC</td>
<td>Clay gravels, gravel-sand-clay mixtures</td>
<td></td>
<td>X (1)</td>
</tr>
<tr>
<td>SW</td>
<td>Well-graded sand and gravely sands, little or no fines</td>
<td></td>
<td>X (1)</td>
</tr>
<tr>
<td>SP</td>
<td>Poorly graded sands and gravely sands, little or no fines</td>
<td></td>
<td>X (1)</td>
</tr>
<tr>
<td>SM</td>
<td>Silty sands, sand-silt mixtures</td>
<td></td>
<td>X (1)</td>
</tr>
<tr>
<td>SC</td>
<td>Clay sands, sand-silt mixtures</td>
<td></td>
<td>X (1)</td>
</tr>
<tr>
<td>ML</td>
<td>Inorganic silts, very fine sands, rock flour, silty or clayish fine sands</td>
<td></td>
<td>X (2)</td>
</tr>
<tr>
<td>CL</td>
<td>Inorganic clays of low to medium plasticity, gravelly clays, silty clays, lean clays</td>
<td></td>
<td>X (2)</td>
</tr>
<tr>
<td>MH</td>
<td>Inorganic silts, micaceous or diatomaceous fine sands or silts, plastic silts</td>
<td></td>
<td>X (3)</td>
</tr>
<tr>
<td>CH</td>
<td>Inorganic clays or high plasticity fat clays</td>
<td></td>
<td>X (3)</td>
</tr>
<tr>
<td>OH</td>
<td>Organic clays of medium to high plasticity</td>
<td></td>
<td>X (3)</td>
</tr>
<tr>
<td>Pt</td>
<td>Peat</td>
<td></td>
<td>X (3)</td>
</tr>
</tbody>
</table>
BASE MATERIAL
The specification for aggregate base materials for use under flexible asphalt pavement are suitable for use as base material under ICP. If no municipal, county or state specifications are available, use material meeting the specifications of ASTM D 2940 as shown below.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 in</td>
<td>100</td>
</tr>
<tr>
<td>1-1/2 in</td>
<td>95-100</td>
</tr>
<tr>
<td>3/4 in</td>
<td>70-89</td>
</tr>
<tr>
<td>3/8 in</td>
<td>50-70</td>
</tr>
<tr>
<td>No. 4</td>
<td>35-55</td>
</tr>
<tr>
<td>No. 30</td>
<td>12-55</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-8</td>
</tr>
</tbody>
</table>

The material meeting this specification is suitable for bases more than 4 in. thick. For bases less than 4 in. thick, the material should have 100 percent passing the 1-1/2 in. sieve and 95-100 percent passing the 3/4 in. sieve. In either case, the material passing the No. 200 sieve must not be greater than 10 percent.

SAND SETTING BED
The setting bed materials must be a coarse, sharp, washed sand. It may be a processed natural sand or a man made sand. It must meet the gradation specifications of ASTM C33. The most common term for the proper sand is "Washed Concrete Sand".

ASTM C33 - Gradation to Bedding Sand.

NOTE:
1. Do not use stone dust or unwashed screenings.
2. Do not use mason or bank sand.
PARTIAL DEPTH PRECAST CONCRETE EDGE

- Partial depth precast concrete (hidden)
- Stake
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Compacted soil subgrade

PRECAST CONCRETE/CUT STONE

- Precast concrete or cut stone
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Compacted soil subgrade
- Compacted aggregate or concrete backfill

UTILITY MANHOLE

- Cover
- String course around collar
- Rebar
- Concrete collar min. 6" (150 mm.)
  ¼" (7 mm.) below pavers
- Rebar
- Filter fabric
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Filter fabric
- Compacted soil
JOINT SAND

If the sand used for the sand setting bed is not used for filling the joints, the sand used should meet the gradation requirements of ASTM C144.

ASTM C144 - Gradation of Joint Sand

<table>
<thead>
<tr>
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<td>40-75</td>
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<tr>
<td>No. 50</td>
<td>20-40</td>
</tr>
<tr>
<td>No. 100</td>
<td>10-25</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-10</td>
</tr>
</tbody>
</table>

NOTE: Do not use sandbox or play sand. Do not use stone dust. Do not use Mason sand.
APPENDIX A

MATERIALS

GENERAL
Graded of subgrade soil, base material and bedding and joint sands is an important property of these materials. The size and distribution of their particle sizes greatly influence their performance under interlocking concrete pavements and therefore the performance of the pavement. Gradation is determined by placing a known weight of dry material in the uppermost of a stack of sieves or screens. Each sieve going down the stack has smaller openings than the one above it with the bottom unit a pan to catch the finest particles. After the sieves are shaken for a specified amount of time, the material retained on each sieve is weighed and the percentage of material passing each sieve is calculated. There are standardized ASTM tests for determining the gradations of soils, base materials, bedding and joint sands.

SUBGRADE SOILS
Subgrade soils range in particle size from coarse grained sands to fine grained silts and the finest grained clays.
Most soils are a combination of the three particle size categories. In general, the soils containing a high percentage of clay particles are less suitable for good subgrade support of a pavement.
Of the several systems used to classify soils with respect to their ability to support a pavement system, the Unified Soil Classification System (USCS) used by the Army Corps of Engineers is probably the easiest to use. This system is also described as ASTM D 2487, Standard Classification of Soils for engineering purposes. In this system, soils are separated into 15 groups which are each designated by a two letter code.

The first letter describes the predominate soil type:
G = gravels or gravelly soils
S = sand or sandy soils
M = silt - non-plastic (non putty-like when wet), or very slightly plastic, and having little or no strength when air dry
C = clay - plastic (putty-like when wet), and having considerable strength when wet.
Pt = peat - vegetation in various stages of decomposition usually black or dark brown in color
PRESERVING OUR DRINKING WATER SUPPLY

STORMWATER FILTRATION

The US Geological Survey reports that half of the drinking water in America comes from groundwater reserves, while the other half comes from lakes and rivers. Both of these sources are adversely impacted when impervious surfaces like buildings, parking lots and roads prevent rain from infiltrating back into the ground. Groundwater reserves are not being recharged and shallow groundwater flow systems, which maintain the base flow conditions between rainfall events in lakes and rivers, are reduced.

PERMEABLE INTERLOCKING CONCRETE PAVEMENTS (PICP)

Permeable Interlocking Concrete Pavements (PICP) are fundamentally large scale infiltration reservoirs with a drivable surface course over top. The open graded base and subbase aggregates have approximately 32% and 40% open space respectively, providing for temporary water storage. Being the same aggregates used for railway tracks, they are more than capable of supporting vehicular loads.

With FULL INFILTRATION systems, which are used on soils with high infiltration rates (Type A and B soils), it is expected that any precipitation that falls will drain almost as quickly as it is introduced; any excess rain can accumulate in the subbase for the short term.

With PARTIAL INFILTRATION systems, which are used on Type C and some D soils, the amount of excess rain that accumulates in the base/subbase is regulated by the elevation of the outlet control for the underdrain, which is set to only store as much water as can drain in 1 to 2 days post rainfall event.

It is a common misconception that a high soil infiltration rate is required for an infiltration system to work. The majority of 95th percentile design storms in the US range from one to two inches total precipitation. Even at infiltration rates as low as 0.05”/hour, it would only take 40 hours for full 2” of rain to drain out of the aggregate base/subbase storage zone.

<table>
<thead>
<tr>
<th>TEXTURE CLASS</th>
<th>MINIMUM FILTRATION RATE (F) INCH PER HOUR</th>
<th>HYDROLOGIC SOIL GROUPING</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAND</td>
<td>8.27</td>
<td>A</td>
</tr>
<tr>
<td>LOAMY SAND</td>
<td>2.41</td>
<td>A</td>
</tr>
<tr>
<td>SANDY LOAM</td>
<td>1.02</td>
<td>B</td>
</tr>
<tr>
<td>LOAM</td>
<td>0.52</td>
<td>B</td>
</tr>
<tr>
<td>SILT LOAM</td>
<td>0.27</td>
<td>C</td>
</tr>
<tr>
<td>SANDY CLAY LOAM</td>
<td>0.17</td>
<td>C</td>
</tr>
<tr>
<td>CLAY LOAM</td>
<td>0.09</td>
<td>D</td>
</tr>
<tr>
<td>SILTY CLAY LOAM</td>
<td>0.06</td>
<td>D</td>
</tr>
<tr>
<td>SANDY CLAY</td>
<td>0.05</td>
<td>D</td>
</tr>
<tr>
<td>SILTY CLAY</td>
<td>0.04</td>
<td>D</td>
</tr>
<tr>
<td>CLAY</td>
<td>0.02</td>
<td>D</td>
</tr>
</tbody>
</table>

CONTROLLING RUNOFF

The goal of PICP is to mimic, if not improve upon a site’s predevelopment hydrology by detaining as much stormwater as possible in the base/subbase, so that it can infiltrate back into the ground. PICP is considered a Low Impact Development (LID) Best Management Practice (BMP) for stormwater management. As a distributive infiltration practice, PICP conserves space by providing a functional pavement and Stormwater Control Measure in one system. Various methods are used to model the site hydrology and calculate runoff flow rates and volumes. Depending on the hydrology model used, a curve number or a runoff coefficient is needed to represent the PICP site condition.

CURVE NUMBER FOR PICP SYSTEM

The Natural Resources Conservation Service (NRCS) method characterizes site runoff based on hydrologic soil type, land cover and amount of rainfall using a parameter known as a curve number (CN). Curve Numbers predict direct runoff from rainfall excess, and can range between 30 to 100, with lower numbers indicating lower runoff potential. Caution should be applied when using CNs for permeable pavement. Results can underestimating runoff in small watersheds (under 5 acres) for small storm events (below the 2-year storm), so for these cases, calculations should be verified by another method. Sample CNs per USDA Technical Release-55 are listed on this page. However, traditional hydrologic modelling requires CN modifications to properly model permeable pavement to account for reservoir storage. CNs for PICP systems can range anywhere between 45 for A soils to between 70-80 for D soils.

SURFACE RUNOFF COEFFICIENT FOR PICP SYSTEMS

A common question that is asked is “What is the runoff coefficient (C) of the PICP system? C represent the percentage of rainfall that becomes runoff based on the surface type and is used in the Rational Method to determine peak flow rates. It is overly simplistic and does not account for rainfall intensity, duration, or reservoir drainage. A C value of between 0.25 and 0.40 depending on subgrade permeability is appropriate for PICP systems when using the Rational Method.

CREDIT FOR PERVIOUS SURFACE

Correctly designed, installed, and maintained, PICP systems have surface infiltration rates higher than that of almost any natural soil, and several times greater than the maximum possible rainfall intensity. This is why a PICP surface should be given complete credit for “100% perviousness;” as would a meadow or forest.

WATER VOLUME CONTROL

PICPs can detain or retain water quality volume through storage in the aggregate base and subbase. Most design storm requirements are easily controlled in the underground reservoir created until the subgrade soils infiltrate the water or until underdrains release the volume at a controlled rate.

<table>
<thead>
<tr>
<th>COVER DESCRIPTION</th>
<th>CURVE NUMBER FOR HYDROLOGIC SOIL GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Condition</td>
<td></td>
</tr>
<tr>
<td>WOODS</td>
<td>30-35</td>
</tr>
<tr>
<td>PASTURE</td>
<td>39-68</td>
</tr>
<tr>
<td>ROW CROPS</td>
<td>61-72</td>
</tr>
<tr>
<td>LAWN, PARKS</td>
<td>39-68</td>
</tr>
<tr>
<td>COMMERCIAL &amp; BUSINESS</td>
<td>89</td>
</tr>
<tr>
<td>INDUSTRIAL</td>
<td>81</td>
</tr>
<tr>
<td>PAVED ROADS &amp; PARKING LOTS</td>
<td>98</td>
</tr>
<tr>
<td>ROOFS</td>
<td>98</td>
</tr>
</tbody>
</table>

Source: USDA Technical Release 55
STAKE OUT THE WALL
- Have a surveyor stake out the wall’s placement. Verify the locations with the project supervisor.

EXCAVATION
- Excavate for the leveling pad according to the lines and grades shown on the approved plans and excavate enough soil behind the wall for the geosynthetic reinforcement material, if needed.
- The trench for the leveling pad should be at least 12 inches wider than the block you are installing and 6 inches deeper than the height of the block. See Diagram 1.

LEVELING PAD
- An aggregate leveling pad is made of compactable base material of ¾-inch minus (with fines).
- The pad must extend at least 6 inches in front of and behind the first course of block and be at least 6 inches deep after compaction.
- If the planned grade along the wall front will change elevation, the leveling pad may be stepped up in 6-inch increments to match the grade change. Start at the lowest level and work upward whenever possible.
- Compact the aggregate and make sure it’s level front to back and side to side. Mist lightly with water before compaction. See Diagram 2.

BASE COURSE
- This is the most important step in the installation process. Bury the base course of block.
- Begin laying block at the lowest elevation of the wall. Remove the rear lip (if applicable) of the block by hitting from the back so that it will lie flat on the leveling pad. See Diagram 3.
- Place first block and level, front to back and side to side; lay subsequent blocks in the same manner.
- Place the blocks side by side, flush against each other, and make sure they are in full contact with the leveling pad.
- If the wall is on an incline, don’t slope the blocks; step them up so they remain consistently level.
- Use string line along the back edge of block to check for proper alignment.
- For multi-piece products, use the largest unit, 18 inches wide, for the base course.
- Fill cores (if applicable) and voids between blocks with 3/4-inch free-draining aggregate prior to laying the next course of block. Clean any debris off the top of the blocks. See Diagram 4.
CONSTRUCTION OF SUBSEQUENT COURSES

- Clean any debris off the top of the blocks.
- Place the second course of blocks on top of the base course. Maintain running bond. Pull each block forward as far as possible to ensure the correct setback. See Diagram 5.
- Fill cores (if applicable) and voids between blocks with 1-inch free-draining aggregate prior to laying the next course of block. Clean any debris off the top of the blocks.
- For best results, use a filter fabric, which should be placed directly behind the wall extending from the bottom of the base course to the middle of the top course. This will minimize material coming through the rough-hewn face texture of these products. We recommend a non-woven, 4- to 6-ounce fabric.
- Backfill with ¾-inch free-draining aggregate directly behind the block, adding 6 inches at a time followed by proper compaction.
- Add retained soil behind the aggregate. Compact before the next course is laid.
- Don’t drive heavy equipment near the wall. Self-propelled compaction equipment should not be used within 4 feet of the wall.
- Keep the wall bond by placing units in a staggered relationship to the course beneath.
- You may need partial units to stay on bond. A saw with a diamond blade is recommended for cutting partial units. Use safety glasses and other protective equipment when cutting.

DRAINAGE DESIGN

- Each project is unique. The grades on your site will determine at what level to install the drainpipe.
- Place the drainpipe 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. See Diagram 6.
- Fill in the area behind the blocks with ¾-inch free-draining aggregate, at least 12 inches from the wall.
- You may need to place and backfill several courses to achieve the proper drainage level. See Diagrams 7 and 8.
- Cover the drainpipe with a geotextile sock which acts as a filter. The drainpipe outlets should be spaced not more than every 50 feet and at low points of the wall. In order for the drainage aggregate to function properly, it must keep clear of regular soil fill. See below diagram of daylight drainage system.
LAYING PATTERN AND INSTALLATION GUIDE FOR MULTI-PIECE SEGMENTAL RETAINING WALLS

USING A PATTERN FOR SINGLE-HEIGHT RETAINING WALLS

When using a pattern, begin at one edge, laying the units as indicated. Install at least one repeat of the pattern to establish the pattern before proceeding to the next course. Stagger the patterns as shown to avoid vertical bonds.

One set of 6-inch-high retaining wall blocks consists of 2 large units, 1 medium unit and 1 small unit, and is 2 square feet.

6” Multipiece wall system, 18-inch by 4-foot pattern = 6 sq. ft.

STEPPING UP THE BASE AT LOWEST POINT

Walls built on a sloping grade require a stepped base. Begin excavation at the lowest point and dig a level trench into the slope until it is deep enough to accommodate the base material and height of one entire block.

STEP-UP

At this point, step up the height of one block and begin a new section of base trench. Continue to step up as needed to top of slope. Always bury at least one full unit at

STEPPING UP THE BASE USING THE U START BASE BLOCK

Walls built on a sloping grade require a stepped base. Begin excavation at the lowest point and dig a level trench, 24 inches wide, into the slope until it is deep enough to accommodate the base material and one entire base block.

See Diagram 9.
ABUTTING AN EXISTING STRUCTURE

FIRST COURSE

Begin with the first block next to the wall and place the first course. Place filter fabric behind the first two units and extend it 2 feet along the existing structure.

SECOND COURSE

Build second course with standard installation techniques. A split unit is shown but may not be necessary in every installation. Extend filter fabric to the top edge of the final course. See Diagram 10. A rubber membrane may be placed between the units and a non-concrete wall to prevent moisture damage to the structure.

Note: To split a block, use a hydraulic splitter or split manually by using a hammer and chisel to score the block on all sides. Pound the chisel on the same line until the block splits. If partial unit sides are not exposed, use a saw with a diamond blade to achieve a tighter fit.
OUTSIDE CURVES

CALCULATE THE RADIUS
When building an outside curve, begin by determining the desired radius of the top course. This will be the smallest radius in the wall and must not be less than the minimum radius for the wall system used.

To determine the approximate base course radius:

1) Add ¼-inch to the setback of the block used. Multiply that by the number of courses in the finished wall.
2) Add desired radius length of the top course to the result of step 1. This number equals the approximate radius length of the base course.
3) To determine the radius for the front edge of the trench, add 6 inches to the approximate radius length of the base course.

Example: Setback of the Highland Stone® product is 1½ inch. The wall is 8 courses high. The desired radius of the wall measured to the front of the block on the top course is 6 feet.

1) Setback multiplied by number of courses
   \[1\frac{1}{2}'' + \frac{1}{4}'' = \frac{3}{4}'' \times 8 \text{ courses} = 11''\]
2) Desired radius plus setback
   \[6' + 11'' = 6'11''\]
3) Front of trench
   \[6'11'' + 6'' = 7'5''\]

TIP: Subtract the depth of the block if you prefer to mark the curve from the back of the block.

LAY OUT THE TRENCH
Drive a stake into the ground at the desired radius point of the curve. Attach a string and rotate it in an arc at the desired length to mark the curve in the soil. Dig the trench.

BASE COURSE
Using the existing radius point stake and string, mark the base course curve on the leveling pad. Align the front of the block with the marked curve and ensure level placement from side to side and front to back.

ADDITIONAL COURSES
On each course, some of the rear lip of each block must be in contact with the back of the units below to ensure structural stability. The setback 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 needed. Once a split or cut unit is cut to size, glue in place with a concrete adhesive.
**INSIDE CURVES**

**CALCULATE THE RADIUS**
Check the wall plan to determine the radius of the top course. This will be the biggest radius in the wall and you will need it to determine the radius at the base course, which will be the smallest radius of the wall and must not be less than the minimum for the block system used.

**A QUICK WAY TO DETERMINE THE BASE COURSE RADIUS:**
1) Add ¼-inch to the setback of the block used. Multiply that by the number of courses in the finished wall.
2) Subtract the result of step 1 from the radius of the top course. This number equals the approximate radius length of the base course.
3) To determine the radius for the front edge of the trench, subtract 6 inches from the approximate radius length of the base course.

Example: The setback of the Highland Stone® product is 1 ½ inches. The wall is 8 courses high. The desired radius of the wall measured to the front of the block on the top course is 10 feet.

1) Setback multiplied by number of courses
   
   \[1\frac{1}{2}" + \frac{1}{4}" = 1\frac{3}{8}" \times 8 \text{ courses} = 11"

2) Desired radius minus setback
   
   \[10' - 11" = 9'1"

3) Front of trench
   
   \[9'1" - 6" = 8'7"

**TIP:** Add the depth of the block if you prefer to mark the curve from the back of the block.

**LAY OUT THE TRENCH**
Drive a stake into the ground at the desired radius point of the curve. Attach a string and rotate it in an arc at the desired length to mark the curve in the soil. Dig the trench.

**BASE COURSE**
Using existing radius point stake and string, mark the base course curve on the leveling pad. Align the front of the block with the marked curve and ensure level placement from side to side and front to back.

**ADDITIONAL COURSES**
On each course, some of the lips of each block must be in contact with the back of the units below to ensure structural stability. If not, use construction adhesive to adhere blocks together. To maintain proper running bond, use partial units as needed. Once a split unit is cut to size, glue in place with a concrete adhesive.
OUTSIDE 90-DEGREE CORNERS
FOR SYSTEMS WITHOUT A CORNER UNIT

BASE COURSE
To build an outside 90-degree corner, begin by splitting a unit in half. Place this unit with both split faces out at the corner. If needed, remove the rear lip so that the block lies flat. Then lay the rest of the base course working from the corner block out.

ADDITIONAL COURSES
Begin the next course with the other half of the split unit faced in the opposite direction at the corner. Place the second and third blocks on either side of the corner unit. Once the corner unit is in position, glue block in place with a concrete adhesive. Continue to alternate the corner unit orientation with each course and always use a concrete adhesive on the corner units. Use cut or split units as necessary to maintain running bond.

OUTSIDE 90-DEGREE CORNERS
FOR SYSTEMS WITHOUT A CORNER UNIT
90-degree corners are built by alternating corner/column units so the long side is on different sides of the wall. Build the pattern from the corner unit when possible. Install corner units level from front to back.
Depending on the wall layout, there may be a need to go off the pattern and randomly place wall blocks near the corner. Set back corner units to reflect the batter of the wall block units and glue from bottom to top.

NOTE: To split a block, use a hydraulic splitter or split manually by using a hammer and chisel to score the block on all sides. Pound the chisel on the same line until the block splits. If partial unit sides are not exposed, use a saw with a diamond blade to achieve a tighter fit.
INSIDE 90-DEGREE CORNERS

BASE COURSE
To create an inside 90-degree corner, begin by placing a block at the corner. Then lay a second block perpendicular 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 standard site prep and installation procedures.

Example Inside 90-Degree Corner

ADDITIONAL COURSES
On the second course, place all blocks on bond along one side of the corner. Once the second course of one wall is established, begin the second course of the adjacent wall. Split units or units of varying sizes may be required on this wall to maintain running bond. Continue to alternate the corner unit orientation with each course and always use a concrete adhesive on the corner units.

NOTE: To split a block, use a hydraulic splitter or split manually by using a hammer and chisel to score the block on all sides. Pound the chisel on the same line until the block splits. If partial unit sides are not exposed, use a saw with a diamond blade to achieve a tighter fit.
GEOSYNTHETIC REINFORCEMENT (IF REQUIRED)

- Geosynthetic reinforcement is recommended for walls taller than the gravity height of each product, or walls situated in poor soils, supporting a driveway, etc. Consult an engineer for design assistance.
- Check the wall construction plan for which courses will need geosynthetic reinforcement.
- Clean any debris off the top layer of blocks.
- Measure and cut the geosynthetic reinforcement to the design length in the plans.
- The geosynthetic reinforcement has a design strength direction, which must be laid perpendicular to the wall.
- Place the front edge of the geosynthetic reinforcement on top of the block, making sure it’s within 1 inch of the face of the block. Correct placement ensures that you maximize the connection strength and keep the batter consistent.
- Apply the next course of blocks to secure it in place.
- A minimum of 6 inches of backfill is required prior to operating vehicles on the geosynthetic reinforcement. Avoid sudden turning or braking.

COMPACtion

- Place the backfill soil behind the drainage aggregate and compact with a hand-operated compactor.
- Make sure the aggregate is level with or slightly below the top of the course.
- Place soil in front of the base course and compact. The base course should be buried.
- Continue to fill and compact.

FINISH GRADE AND SURFACE DRAINAGE

- Protect the wall with a finished grade at the top and bottom.
- To ensure proper water drainage away from the wall, use 6 inches of soil with low permeability. This will minimize water seeping into the soil and drainage aggregate behind the wall. See Drainage Swales.

SITE CLEANING AND RESTORATION

- Brush off the wall and pick up any debris left from the construction process.
- Notify the job superintendent in writing of the project’s completion and that it is ready for final inspection and acceptance.
- Planting vegetation in front and on top of the wall will help reduce the chance of erosion.
- Following the best practices for construction will ensure the successful installation of Anchor™ products.

DRAINAGE SWALES

- Design and performance of most retaining walls are based on keeping the reinforced zone relatively dry. Appropriate drainage swales to help control water should be designed into the wall construction plan.

SAFETY NOTE: Always use appropriate equipment, including safety glasses or goggles and respirators, when splitting, cutting or hammering units. Refer to the NCMA Segmental Retaining Wall Installation Guide at www.ncma.org.
ANCHORPLEX® SYSTEM CONSTRUCTION GUIDE

HOW TO USE THIS GUIDE
Use this information to gain a general understanding of the basics of building retaining walls with the Anchorplex system. Do not use this in lieu of construction drawings provided by a qualified engineer. Contact Anchor Wall Systems at 1-877-295-5415 for more information about designing and building with the Anchorplex system.

ABOUT THE ANCHORPLEX® SYSTEM
The Anchorplex system is a retaining wall built with Anchor products and self-compacting structural backfill, also known as “no-fines” concrete, which is a highly-porous mixture of clean stone, cement and water. The mixing ratios (by weight) of aggregate to cementitious material should be between 6:1 and 7:1. The mixing rate (by weight) of water to cementitious material should be no more than 1:2. The resulting material, upon curing, should have at least 25 percent voids and should exhibit a minimum compressive strength (f1c) of 1,500 psi.

RETAINING WALL CONSTRUCTION
Setting out the wall and excavation is no different for an Anchorplex system construction than for conventional construction, except that the amount of excavation will probably differ. Construction of the leveling pad, base course, subsequent courses and drainage is no different for an Anchorplex system construction than for conventional construction.

INSTALLATION OF STRUCTURAL BACKFILL
After completion of the leveling pad, base course, drainpipe installation and stacking block 2 feet above grade, the first lift of structural backfill that meets Anchor Wall Systems’ specifications can be installed. Do not exceed 2 feet vertical stacking of block before placing a lift of structural backfill.

The structural backfill can be placed directly from delivery vehicle or with skid-type loader or other equipment. It should be placed behind the blocks and worked into all voids and cores of the blocks (if applicable). When properly formulated, the structural backfill will not leak through the face of the wall.

After installation of the first lift of structural backfill, install additional courses and repeat the process. Place additional lifts every 8 to 24 inches depending on site conditions and project scale. Subsequent pours can be made as soon as the structural backfill in the previous lift has set — usually within 2 to 3 hours.

INSTALLATION OF FILTER FABRIC
Place a layer of filter fabric over the structural backfill and up the back of the top course and the cap. Then fill behind the top course and cap with low-permeability soil.

CAPPING & FINISHING
Follow standard practice when capping the wall. Protect the wall with a finish grade at the top and bottom.
**STEPS IN A CURVED WALL**

These drawings show Highland Stone®, Diamond® and Diamond Stone Cut® step units. Caps or pavers can be used for treads. Check local building codes for any tread depth standards.

**BASE COURSE**

Thoroughly compact the leveling pad. Lay out the base course according to the wall design. Place step units first, working from the center to each side. Remember, it is very important to backfill and compact behind and along the sides of each course of step units.

**FIRST STEP COURSE**

Place the first course of step units directly on top of the base course so there is no setback. Stagger them from the previous course and glue in place.

**SECOND STEP COURSE**

Add the second course of steps, staggering them from the previous course to maintain running bond. Overlap the lower course by a minimum 2 inches and glue to lower course. Place and compact base material prior to installing next course.

**NEXT WALL COURSE**

Place a block near the second course of steps, maintaining running bond with the base course. Measure and cut a block to fit the space remaining between the step unit and the next course of the wall. Place the unit in the wall, making sure that both vertical edges fit tight against both the step and standard unit. Remove the rear lip on the blocks when necessary, and angle the blocks flush with the face of the previous course. Glue in place with a concrete adhesive. Repeat these steps until the wall is finished.

**ADDITIONAL COURSES**

Beginning in the center, add the third course of steps, lining up the units with the first course. Overlap a minimum 2 inches and glue in place. Repeat until the steps are finished.

**DRAINAGE TIP:** Drainpipe can be placed behind the lowest step units at grade or behind each wall adjacent to the steps.
STEPS IN A 90-DEGREE WALL

These drawings show Highland Stone®, Diamond® and Diamond Stone Cut® step units. Caps or pavers can be used for treads. Check local building codes for any tread depth standards.

BASE COURSE

Thoroughly compact the leveling pad. Lay out the base course according to the wall design. Place step units first, working from the center to each side. Remember, it is very important to backfill and compact behind and along the sides of each course of step units.

FIRST STEP COURSE

Place the first course of step units directly on top of the base course so there is no setback. Stagger them from the previous course and glue in place.

SECOND STEP COURSE

Add the second course of steps, staggering them from the previous course to maintain running bond. Overlap the lower course by a minimum 2 inches and glue to lower course. Place and compact base material prior to installing next course.

SECOND WALL COURSE

Build the second course of the wall. Corner units are used at the end of steps tied into wall and glued in place. Alternate long and short direction of corner unit every other row.

THIRD STEP COURSE

Beginning in the center, add the third course of steps, lining up the units with the first course. Overlap the lower course by 2 inches and glue to lower course.

ADDITIONAL COURSES

Build the third course of the wall. Repeat these steps until the wall is finished.
LAYING PATTERN GUIDE FOR MULTI-PIECE WALLS

USING A PATTERN FOR SINGLE-HEIGHT RETAINING WALLS

When using a pattern, begin at one edge, laying the units as indicated. Install at least one repeat of the pattern to establish the pattern before proceeding to the next course. Stagger the patterns as shown to avoid vertical bonds.

One set of 6-inch-high retaining wall blocks consists of 2 large units, 1 medium unit and 1 small unit, and is 2 square feet.

6” Multipiece wall system, 18-inch by 4-foot pattern = 6 sq. ft.

WHEN TO USE A PATTERN FOR FREESTANDING WALLS

One set of 6-inch-high blocks consists of 2 large units, 1 medium unit and 1 small unit, and is 1 square foot of two sided wall.

Note: These freestanding wall installation patterns show only one side of the freestanding wall. The same number of blocks are needed to build the other side of a freestanding wall when using Belair Wall 2.0 and Brisa freestanding wall systems. Freestanding wall installation patterns are measured in length by height of one side of the wall, and are expressed in square feet. Sets of blocks required include the number of blocks needed to build both sides of the wall.

ENDING A WALL WITH WALL ENDS

Start pattern next to a wall end unit if the wall does not end with a column. Every other wall end is cut in half. Glue all pieces in place using concrete adhesive.

TYPICAL CROSS SECTION
STEPping up the base at lowest point

Walls built on a sloping grade require a stepped base. Begin excavation at the lowest point and dig a level trench into the slope until it is deep enough to accommodate the base material and height of one entire block.

step-up

At this point, step up the height of one block and begin a new section of base trench. Continue to step up as needed to top of slope. Always bury at least one full unit at each step.
TRAPEZOID DOUBLE-SIDED CAP

The double-sided cap has a right-angle side and an offset-angle side. The caps can be used in any of four directions since there is no specific top or bottom.

STRAIGHT WALL

The cap must be laid alternately, narrow (N) and wide (W) faces, for a straight line. Always start capping from the lowest elevation.

CURVES

Lay out the cap units side by side with same face facing out (wide faces for outside curves; narrow faces for inside curves). Occasional cutting of some pieces may be necessary.

Minimum radius: 7’6”

FINISH WITH A CAP END

Do not cut the cap end, cut an interior cap if needed.

STEPPING UP CAPS WITH CAP ENDS

If a wall elevation changes, caps can be stacked where the wall steps up. Begin laying caps at the lowest elevation and work your way toward the next step-up. Cut a cap unit to fit. Place the cut unit directly on top of the capped portion of the wall with the cut side hidden from view. If not using a Cap End, place the trapezoid double-sided cap so that the side with the arrow is hidden.

NOTE: To split a block, use a hydraulic splitter or split manually by using a hammer and chisel to score the block on all sides. Pound the chisel on the same line until the block splits. If partial unit sides are not exposed, use a saw with a diamond blade to achieve a tighter fit.
STEP CONSTRUCTION

When constructing steps, you must consider whether it is a fill or a cut-grade situation. Construction is similar, but varies in the amount of dummy units required.

A fill step will have a base course of dummy units in the entire footprint of the steps. For each additional step, add dummy units behind the facing units for stability. There are two methods for creating the step facing. Use sets of either 6-inch-high or 3-inch-high units. A cut-grade set of steps will use one layer of dummy blocks under each step, effectively stepping up the grade.

All applications will require some sort of tread to cover the facing units.

RETAINING WALL SQUARE FIRE PIT CONSTRUCTION

Inside of fire pit must be lined with a heat-resistant material.

Affix all units with construction-grade adhesive.

These blocks are not fireproof and could start to crack under extreme heat. These blocks are intended for landscape applications and are not fire-rated. Over time the blocks may crack. A possible solution is to use heavy fire-rated bricks or a steel liner on the interior of an above or below ground fire ring/pit with the blocks outside the perimeter. Again, the heat may adversely affect landscape products, even with an interior heat-resistant barrier in place.

USING FILL SCENARIO

USING CUT SCENARIO

RETAINING WALL SQUARE FIRE PIT CONSTRUCTION

Inside of fire pit must be lined with a heat-resistant material.

Affix all units with construction-grade adhesive.

These blocks are not fireproof and could start to crack under extreme heat. These blocks are intended for landscape applications and are not fire-rated. Over time the blocks may crack. A possible solution is to use heavy fire-rated bricks or a steel liner on the interior of an above or below ground fire ring/pit with the blocks outside the perimeter. Again, the heat may adversely affect landscape products, even with an interior heat-resistant barrier in place.
THE ULTIMATE PROTECTION SYSTEM

Techniseal’s 3-step treatment system guarantees the best results. Remove stains with a specially formulated Stain Remover, prepare the surface with Paver Prep, then apply a Protector that delivers the look you want.

1 PREP

STAIN REMOVERS

2 CLEAN

CLEANERS
- Distalges efflorescence and ground-in dirt
- Prepares pavers prior to protector application
- Brightens paver color

3 PROTECT

SAME FINISHES, HIGHER STANDARDS

Our versatile, new sealers have been formulated for easier product selection and application.

NULOOK® TINTED PROTECTOR
- Colors pavers
- Translucent
- Water-based stain guard
No More Concrete Removal!

With DriBond™, there is no need to remove the existing concrete substrate, which is a costly and time-consuming process. DriBond™ can be installed quickly and easily over most sound concrete surfaces.

- Ideal for thin paver overlays
- Dry application
- No mixing - ready to use
- Reduces installation time
**1. PREP**

**EZ BASE®**
**PANEL BASE SYSTEM**
- Saves up to 8 inches of excavation
- Each panel replaces up to 250 lbs of base aggregates
- Ideal for porcelain tile installation

**PAVER EDGING**
**PREVENTS MOVEMENT & DAMAGE TO PRODUCT**
- RIGID
  - 8-FT PANELS
- COIL
  - 40-FT COIL

**2. SET**

**STRUCTURE BOND™**
**FOAM ADHESIVE**

**DRIBOND™**
**DRY MUDSET**
- Applied directly to existing concrete slab
- Ideal for thin paver overlays installation

**BORDERBOND™**
**FORTIFIER FOR BORDER PAVERS**
- No mixing required
- Enhances the strength of DRIBond

**3. SAND**

**HP NEXTGEL™**
**JOINTING SAND**
- Heavy-sloped and high-traffic areas
- False or wide joints from 1/16" to 4"
- Haze and dust free

**SMARTSAND**
**POLYMERIC SAND**
- Designed for optimal jointing of interlocking paver installations
- For paver joints from 1/16" to 1"
- Deters insects and weed growth
- Eliminates joint erosion
STRUCTUREBOND™ IS AN INNOVATIVE SUPER-STRENGTH FOAM ADHESIVE THAT BONDS A WIDE RANGE OF CONSTRUCTION MATERIALS.

Made from high-quality modified polyurethanes, StructureBond’s adhesive strength is unmatched among all types of polyurethane adhesives. StructureBond’s Gun allows for a precise adhesive delivery with a single pull of the trigger. No pumping, cutting or puncturing of cartridge nozzles.

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