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 2 years from the date of install. For warranty service, contact Belgard at 1-800-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 helps 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.
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118 Basic Installation Instructions
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-BLEGARD

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
PROVIDE DREAMS ON DEMANDS

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 miscommunications 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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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>
</tr>
</thead>
<tbody>
<tr>
<td>Paver Joint Width</td>
<td>½₄-in to max. ¾₄-in</td>
</tr>
<tr>
<td>Paver Surface Flatness</td>
<td>±¾-in 10-ft (non cum.)</td>
</tr>
<tr>
<td>Lippage at Catch Basins/Drains</td>
<td>¼-in to ⅝-in (non ADA)</td>
</tr>
<tr>
<td>Lippage between individual pavers</td>
<td>max. ⅛-in for pedestrian access routes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>ICPI Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paver aspect ratio (l:t) (length divided by thickness)</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 lines¹</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 pavers²</td>
<td>No less than 1/3-in for vehicular application No less than 3/8-in for all other applications</td>
</tr>
<tr>
<td>Paver laying pattern²</td>
<td>Acceptable for application</td>
</tr>
<tr>
<td>Minimum paver thickness</td>
<td>31/8-in for street/parking 23/8-in for pedestrian &amp; driveways</td>
</tr>
<tr>
<td>Bedding layer thickness</td>
<td>1-in nominal</td>
</tr>
<tr>
<td>Joint sand gradation</td>
<td>ASTM C144 or C33 CSA A23.1 FA1 or CSA A179</td>
</tr>
<tr>
<td>Bedding sand gradation</td>
<td>ASTM C33 or CSA A23.1 FA1</td>
</tr>
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</table>

BASE AND SUBBASE LAYER

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top of base surface variation</td>
<td>± ⅛-in over 10-ft (non cum.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>ICPI Recommendation</th>
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<tbody>
<tr>
<td>Base thickness variation³</td>
<td>+ 3/4-in to -1/2-in</td>
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<tr>
<td>Compaction</td>
<td>min. 98% standard Proctor</td>
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<tr>
<td>Over-excavation (dense graded bases)</td>
<td>greater of 6-in or equal to base thickness</td>
</tr>
<tr>
<td>Geotextile</td>
<td>as needed</td>
</tr>
</tbody>
</table>

Minimum base thickness

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

Edge Restraint/Curb Edge

<table>
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<th>Attribute</th>
<th>Tolerance</th>
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</thead>
<tbody>
<tr>
<td>No Movement</td>
<td>Firmly in place</td>
</tr>
<tr>
<td>Proper Restraint</td>
<td>Acceptable for application (see “Guide References on next page)</td>
</tr>
</tbody>
</table>

NOTES:

¹This guide does not apply to permeable interlocking concrete pavements or tumbled pavers.
²Bond lines: Unless it is deemed that the pavement is not adequately restrained at the edges the bond line tolerance is considered cosmetic.
³Paving layer pattern: ICPI recommends herringbone laying pattern for all vehicular applications.
⁴Base thickness variation: An example of an acceptable variation is 7½-in to 8¾-in for an 8-in required total base thickness. The excavated cut should have the same slope and contouring as the final surface profile.
⁵Minimum base thickness: These are for well drained soils. Increase thickness in colder climates or weak soils.
⁶The 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.
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 A231.2 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 Restraint for Interlocking Concrete Pavements

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.

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.
INSTALL THE 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

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 piece of wood (an 8-foot 2 x 4) 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.

PLACE THE CONCRETE PAVERS

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. See pattern and border on pages 105-114 for reference.

Continue to screed bedding sand and place pavers on the sand while maintaining consistent joint widths. String lines will help keep pavers straight.

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

Helpful hint for Rinn™ and Texturgard™ pavers for optimal aesthetics leave joint space between cut pavers.

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.
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. Then compact back and forth like mowing grass. 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.

SPREAD DRY JOINT SAND OVER THE SURFACE

Sweep some sand into the joints, then vibrate and compact it into the joints, sweeping and compacting as you go. Filling the joints with sand will take several passes with the plate compactor. 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.

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 Rinn™ 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

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. Reinstate 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

PROJECT EXAMPLE:

15 (L) x 10 (W) = 150 SqFt
150 SqFt / 200 = .75 tons/inch of base
.75 x 6 inches of base = 4.5 tons
4.5 tons x 1.25 = 5.625 tons
5.625 Tons of Aggregate Needed

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.
### SHAPES & SIZES

#### 3-Piece Modular

<table>
<thead>
<tr>
<th>Shape</th>
<th>Dimension</th>
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</thead>
<tbody>
<tr>
<td>3 x 6 x 2⅞</td>
<td></td>
</tr>
<tr>
<td>6 x 6 x 2⅛</td>
<td></td>
</tr>
<tr>
<td>6 x 9 x 2⅜</td>
<td></td>
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</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>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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</thead>
<tbody>
<tr>
<td>3 X 6 X 2⅞</td>
<td>120</td>
<td>12</td>
<td>10</td>
<td>–</td>
<td>–</td>
<td>160</td>
<td>240</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>6 X 6 X 2⅛</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>9 X 6 X 2⅜</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</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.

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
NOTES:
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# NEW CATALINA GRANA® WITH TRUECOLOR

<table>
<thead>
<tr>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
<th>PERMEABLE</th>
<th>ADA</th>
<th>TRUECOLOR PROCESS</th>
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<td><img src="image" alt="ADA" /></td>
<td><img src="image" alt="Truecolor Process" /></td>
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</tbody>
</table>

## SHAPES & SIZES

3-Piece Large

- 6 x 12 x 2¾
- 9 x 12 x 2¾
- 12 x 12 x 2¾

## PALLET INFORMATION / ESTIMATING CHART

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

CATALINA GRANA® WITH TRUECOLOR

3-PIECE Pattern A

25%  6 x 12 Rectangles
25%  9 x 12 Squares
50%  12 x 12 Rectangles

Percentages are based on area by paver.

For more pattern options visit Belgard.com/products/pavers.
CATALINA GRANA® WITH TRUECOLOR

3-PIECE Pattern B

25% 6 x 12 Rectangles
25% 9 x 12 Squares
50% 12 x 12 Rectangles

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

NOTES:
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## CATALINA SLATE™ WITH TRUECOLOR

### SHAPES & SIZES

<table>
<thead>
<tr>
<th>3-Piece Modular</th>
<th>3-Piece Stone</th>
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<tbody>
<tr>
<td>3 x 6 x 2 3/8</td>
<td>6 x 12 x 2 3/8</td>
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### PALLET INFORMATION / ESTIMATING CHART

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<th>UNITS/LAYER</th>
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<th>LNFT PALLET (SAILOR)</th>
<th>UNITS/SQFT</th>
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#### 3-PIECE MODULAR

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<tr>
<td>6 X 9 X 2 3/8</td>
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#### 3-PIECE STONE

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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.
CATALINA GRANA® WITH TRUECOLOR

3-PIECE Running Bond Pattern

17% 6 x 3 Rectangles
33% 6 x 6 Squares
50% 6 x 9 Squares

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

NOTES:
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### SHAPES & SIZES

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<thead>
<tr>
<th>3-Piece Modular</th>
<th>Large Square</th>
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<td>9 X 6 X 2¾</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.

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DUBLIN COBBLE®
3-PIECE Running Bond Pattern

17% 6 x 3 Rectangles
33% 6 x 6 Squares
50% 6 x 9 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.

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DUBLIN COBBLE®
4-PIECE (3 pc & Large Square)

10% 6 x 3 Rectangles  29% 6 x 9 Rectangles
19% 6 x 6 Squares  43% 9 x 9 Squares

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

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<th>PERMEABLE</th>
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SHAPES & SIZES

60mm

4 x 8 x 2½"  

PALLET INFORMATION / ESTIMATING CHART

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<th>UNIT</th>
<th>SQFT/PALLET</th>
<th>SQFT/LAYER</th>
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<th>UNITS/LAYER</th>
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<th>LNFT PALLETS (SAILOR)</th>
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</table>
HOLLAND STONE
1-PIECE Herringbone Pattern

100% 4 x 8 Rectangles

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

1-PIECE Basket Weave Pattern

100% 4 x 8 Rectangles

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

LAFITT® GRANA SLAB

<table>
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<tr>
<th>PEDESTRIAN</th>
<th>LIGHT TRAFFIC</th>
<th>HEAVY TRAFFIC</th>
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SHAPES & SIZES

3-Piece Modular

14¾ x 7¾ x 2  18 x 18 x 2¾  14¾ x 22¾ x 2

PALLET INFORMATION / ESTIMATING CHART

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<tr>
<th>UNIT</th>
<th>SQFT/ PALLETT</th>
<th>SQFT/ LAYER</th>
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<th>UNITS/ PALLET</th>
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<td>–</td>
</tr>
<tr>
<td></td>
<td>18 X 18 X 2¾</td>
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<td>–</td>
<td>–</td>
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<tr>
<td></td>
<td>14¾ X 22¾ X 2</td>
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<td>3673</td>
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LAFITT GRANA SLAB 3-PC LAYING GUIDE

Belgard packages multiple sized paving stones on 1 pallet to aid in the ease of ordering and installation by the contractor. Belgard recommends that the products be laid “randomly” allowing no single joint line to expand longer than 3–3.5 ft in length. Random installation will ensure full use of all the different sized pieces on a pallet.

If you choose to follow one of the patterns below, please be aware that you may have left over pieces of a certain size(s) when finished with the project. Please be sure to properly calculate the percentages required in the pattern compared to how the product is sold on the pallet. Belgard will not be responsible for any shortages or overages with your project.
NOTES:
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LAFITT® GRANA SLAB
1-PIECE Running Bond Pattern

17% $14\frac{7}{8} \times 7\frac{3}{8}$ Rectangles
33% $14\frac{7}{8} \times 14\frac{7}{8}$ Squares
50% $14\frac{7}{8} \times 22\frac{5}{16}$ Rectangles

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
LAFITT® GRANA SLAB
3-PIECE Basket Weave Pattern

17% 147/8 x 73/8 Rectangles
33% 147/8 x 147/8 Squares
50% 147/8 x 225/16 Rectangles

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

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LAFTIT® GRANA SLAB
3-PIECE Pattern

17% 14\(\frac{7}{8}\) x 7\(\frac{3}{8}\) Rectangles
33% 14\(\frac{7}{8}\) x 14\(\frac{7}{8}\) Squares
50% 14\(\frac{7}{8}\) x 22\(\frac{5}{16}\) Rectangles

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

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### SHAPES & SIZES

**3-Piece Modular**

- 14¼ x 7⅛ x 2
- 18 x 18 x 2½
- 14½ x 22⅜ x 2

### PALLET INFORMATION / ESTIMATING CHART

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<tr>
<th>UNIT</th>
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<th>SQFT/ LAYER</th>
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<tr>
<td>14½ X 22⅜ X 2</td>
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<td>3673</td>
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**3-PIECE MODULAR**

- 14¼ x 7⅛ x 2
- 18 x 18 x 2½
- 14½ x 22⅜ x 2

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*BELGARD® RESOURCE GUIDE*
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LAFITT® RUSTIC SLAB
3-PIECE Running Bond Pattern

17% 147/8 x 73/8 Rectangles
33% 147/8 x 147/8 Squares
50% 147/8 x 225/16 Rectangles

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
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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® RUSTIC SLAB
3-PIECE Basket Weave Pattern

17% 14 7/8" x 7 3/8" 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.
NOTES:
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LAFFIT® RUSTIC SLAB
3-PIECE Pattern

17% 147/8 x 73/8 Rectangles
33% 147/8 x 147/8 Squares
50% 147/8 x 225/16 Rectangles

Percentages are based on area by paver.

For more pattern options visit Belgard.com/products/pavers.
### MEGA-ARBEL®

#### SHAPES & SIZES

Mega-Arbel 60mm

15¾ x 21 x 2¾

#### PALLET INFORMATION / ESTIMATING CHART

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<th>UNIT</th>
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<th>SQFT/LAYER</th>
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<th>UNITS/PALLET</th>
<th>UNITS/LAYER</th>
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<th>LNFT PALLET (SAILOR)</th>
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MEGA-ARBEL®
1-PIECE Cloverleaf Pattern

100% 15¾ x 21 Pavers

NOTES:
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Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
## NEW MELVILLE™ PLANK

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## SHAPES & SIZES

### 3-Piece Slim
- 5 x 11\(\frac{3}{16}\) x 2\(\frac{3}{8}\)
- 5 x 15\(\frac{3}{4}\) x 2\(\frac{3}{8}\)
- 5 x 19\(\frac{1}{16}\) x 2\(\frac{3}{8}\)

### 3-Piece Large
- 7\(\frac{1}{2}\) x 11\(\frac{3}{16}\) x 2\(\frac{3}{8}\)
- 7\(\frac{1}{2}\) x 15\(\frac{3}{4}\) x 2\(\frac{3}{8}\)
- 7\(\frac{1}{2}\) x 19\(\frac{1}{16}\) x 2\(\frac{3}{8}\)

## PALLET INFORMATION / ESTIMATING CHART

### 3-PIECE SLIM

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**MELVILLE™ PLANK**

3-PIECE Slim Linear Pattern

- 25% 5 x 11 13/16 Rectangles
- 33% 5 x 15 3/4 Rectangles
- 42% 5 x 19 11/16 Rectangles

Percentages are based on area by paver. For more pattern options visit Belgard.com/products/pavers.
MELVILLE™ PLANK
3-PIECE Large Linear Pattern

25% 7\(\frac{1}{2}\) x 11\(\frac{13}{16}\) Rectangles
33% 7\(\frac{1}{2}\) x 15\(\frac{3}{4}\) Rectangles
42% 7\(\frac{1}{2}\) x 19\(\frac{11}{16}\) Rectangles

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
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MELVILLE™ PLANK
40% SLIM & 60% LARGE Pattern

10% 5 x 11\(\frac{3}{16}\) Rectangles
13% 5 x 15\(\frac{3}{4}\) Rectangles
17% 5 x 19\(\frac{11}{16}\) Rectangles
15% 7\(\frac{1}{2}\) x 11\(\frac{3}{16}\) Rectangles
20% 7\(\frac{1}{2}\) x 15\(\frac{3}{4}\) Rectangles
25% 7\(\frac{1}{2}\) x 19\(\frac{11}{16}\) Rectangles

Percentages are based on area by paver.
For more pattern options visit Belgard.com/products/pavers.
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For more in-depth information see page 118

PERMEABLE PAVERS

54 Aqua Roc™
58 Eco Dublin®
PERMEABLE INTERLOCKING CONCRETE PAVEMENT (PICP)

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 infiltrations 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 at least 1 percent and no greater than 12 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 infiltration of the open-graded stone base into the soil subgrade.

Full Infiltration
Full infiltration 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 Infiltration
Partial infiltration 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 Infiltration
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.

INSTALL GEOTEXTILES, IMPERMEABLE LINERS AND DRAIN PIPES IF REQUIRED IN THE PLANS
AND SPECIFICATIONS

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.

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.
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%).

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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.
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 sweeping can be done with shovels and brooms, or larger areas with machines, sweeping into the paver joints with powered brooms or sweepers. Once the joints are full (within 1/4-inch or 6 mm of the paver surface), the surface must be swept clean prior to compaction as loose stones on the surface 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.
**AQUA ROC™**

### SHAPES & SIZES

4½ x 9 x 3½

### PALLET INFORMATION / ESTIMATING CHART

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Machine lay, product will contain ½ pieces.
NOTES:
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Percentages are based on area by paver. For more pattern options visit Belgard.com/products/pavers.
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AQUA ROC™
1-PIECE Basket Weave Pattern

100% 4½ x 9 Rectangles
AQUA ROC™

1-PIECE Running Bond Pattern

100% 4½ x 9 Rectangles

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**SHAPES & SIZES**

**3-Piece Modular**

- 6½ x 3¼ x 3½
- 6½ x 6¾ x 3½
- 6½ x 10¼ x 3½

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ECO DUBLIN®
3-PIECE Basket Weave Pattern

17% 3\(\frac{7}{16}\) x 6\(\frac{7}{8}\) Rectangles
33% 6\(\frac{7}{8}\) x 6\(\frac{7}{8}\) Squares
50% 10\(\frac{1}{4}\) x 6\(\frac{7}{8}\) Rectangles

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PORCELAIN PAVERS

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70 Verona
71 Unico
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 unmatched 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° 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.

*S 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 (¾-in) Porcelain pavers

Sand Bedding Course

Compacted Road Base

¼-in minus road base material. Base thickness is determined by soil and climate conditions

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)

MINIMUM 4mm (3⁄16-in) spacing between pavers

20mm (¾-in) Porcelain pavers

Sand Bedding Course

Porcelain Paver

Concrete Base

Geotextile Fabric

Installed on top of concrete and folded up the front of the edging. This is required to prevent the unwanted migration of the sand bedding course material.

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.
• Precompact 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.
### SHAPES & SIZES

| 7.64 x 47.17 x 3/4 | 11.73 x 47.17 x 3/4 |

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.

### PALLETT 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.
SHAPES & SIZES

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.

24 x 24”

PALLETT INFORMATION / ESTIMATING CHART

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#### Shapes & Sizes

Unico

![Unico](image)

12.99 x 23.54 x ¾

#### Pallet Information / Estimating Chart

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WALLS
## WALL INSTALLATION GUIDE

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<tr>
<td>74</td>
<td>Wall Types</td>
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<tr>
<td>76</td>
<td>Before You Begin</td>
</tr>
<tr>
<td>77</td>
<td>Estimating Base Course Materials</td>
</tr>
<tr>
<td>88</td>
<td>Estimating Charts</td>
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## WALLS

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<td>Diamond Pro®</td>
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<td>Diamond Pro® Stone Cut</td>
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<td>Lafitt Tandem™</td>
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<td>Lamina Tandem™ Wall</td>
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<td>86</td>
<td>Landings™ Step Unit</td>
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<td>87</td>
<td>Weston Stone™ &amp; Universal</td>
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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, nonconventional 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.
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.
WALLS

Estimating Base Course Materials

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.
## DIAMOND® 9D

### 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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<td>![Wall Icon]</td>
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### SHAPES & SIZES

- **9D Multi-Piece**
  - 6 x 5¾ x 9
  - 6 x 11¾ x 9
  - 6 x 17¾ x 9
- **9D Block**
  - 6 x 17¾ x 9
- **Cap**
  - 3 x 16 x 9

### PALLET INFORMATION / ESTIMATING CHART

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<th>UNIT</th>
<th>SQFT / PALLET</th>
<th>SQFT / LAYER</th>
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# NEW DIAMOND® 9D 2.0

## FREESTANDING WALLS

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<th>KITCHEN</th>
<th>FREESTANDING WALL</th>
<th>RETAINING WALL</th>
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### SHAPES & SIZES

- **Small Block**: 6 x 6 x 5
- **Medium Block**: 6 x 12 x 5
- **Large Block**: 6 x 18 x 5
- **Column/Corner Unit**: 6 x 16 x 5
- **XL® Cap**: Front: 3 x 18 x 13, Back: 3 x 12 x 13
- **U Start Base Block**: 3 x 18 x 13

## PALLET INFORMATION / ESTIMATING CHART

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<th>WEIGHT/UNIT LBS</th>
<th>WEIGHT/LAYER LBS</th>
<th>WEIGHT/PALLET LBS</th>
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### 9D MULTI-PIECE

- **6 x 6 x 5**: 3 units, 30 layers, 10 LNFT, 10 units/sqft, no weight
- **6 x 12 x 5**: 3 units, 30 layers, 10 LNFT, 10 units/sqft, no weight
- **6 x 18 x 5**: 3 units, 30 layers, 10 LNFT, 10 units/sqft, no weight
- **TOTAL**: 22.5 units, 30 layers, no LNFT, 10 units/sqft, no weight

### COLUMN/CORNER UNIT

- **6 x 16 x 5**: 2 units, 24 layers, 12 LNFT, 1000 weight

### XL® CAP

- **3 x 18/12 x 13**: 9 units, 81 layers, 9 LNFT, 2800 weight

### U START BASE BLOCK

- **3 x 18 x 13**: 56 units, 4300 weight
# NEW DIAMOND® 9D 2.0
## ADAPTABLE COLUMN / CORNER KIT

### SHAPES & SIZES

- **Column/Corner Unit**: 6 x 16 x 5
- **XL® Cap**: Front: 3 x 18 x 13, Back: 3 x 12 x 13
- **U Start Base Block**: 3 x 18 x 13

### PALLET INFORMATION / ESTIMATING CHART

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## PALLET INFORMATION / ESTIMATING CHART

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# LAFITT TANDEM™
## FREESTANDING / RETAINING WALLS

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<th>COLUMNS</th>
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<th>KITCHEN</th>
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<th>RETAINING WALL</th>
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## SHAPES & SIZES

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<th>Unit 2</th>
<th>Unit 3</th>
<th>Cap Unit</th>
<th>U Start Base Block</th>
<th>8” Connecting Member</th>
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NOTE: Ashlar Tandem Units 1, 2, & 3 come mixed on one pallet.

## PALLET INFORMATION / ESTIMATING CHART

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*Recommended for use with all available wall block units. (Sold Separately)

NOTE: U Start Base Block actual coverage length is 16\frac{1}{4}”
### SHAPES & SIZES

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<th>Unit</th>
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### PALLET INFORMATION / ESTIMATING CHART

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# LANDINGS™ STEP UNIT

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<th>COLUMNS</th>
<th>FIRE PITS</th>
<th>KITCHEN</th>
<th>FREESTANDING WALL</th>
<th>RETAINING WALL</th>
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<td><img src="image4" alt="Columns" /></td>
<td><img src="image5" alt="Fire Pits" /></td>
<td><img src="image6" alt="Kitchen" /></td>
<td><img src="image7" alt="Freestanding Wall" /></td>
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## SHAPES & SIZES

**Landings Step**

6 x 48 x 18

## PALLET INFORMATION / ESTIMATING CHART

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<th>SQFT/ Pallet</th>
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<th>Units/ Layer</th>
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<th>Lnft Pallet (Sailor)</th>
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## Weston Stone™ & Universal

### Freestanding / Retaining Walls

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<th>COLUMNS</th>
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<th>KITCHEN</th>
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<th>Retaining Wall</th>
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<td>![Stairs Icon]</td>
<td>![Stairs Icon]</td>
<td>![Stove Icon]</td>
<td>![Kitchen Icon]</td>
<td>![Wall Icon]</td>
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### Shapes & Sizes

**3-Piece Modular**
- Weston Stone: 4 x 8 x 8
- Universal: 4 x 8 x 8

**Universal**
- Weston Stone: 4 x 12 x 8
- Universal: 4 x 12 x 8

### Pallet Information / Estimating Chart

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<th>Sqft/ Pallet</th>
<th>Sqft/ Layer</th>
<th>Units/ Pallet</th>
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<th>Lnft Pallet (Sailor)</th>
<th>Units/ Sqft</th>
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Estimating Chart for Geosynthetic Reinforcement with Diamond Series, Highland Stone & Sterling Wall Retaining Wall Systems
No Slopes & No Surcharges

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<td>Y = 120 psf (1960 kN/m²)</td>
<td>Y = 130 psf (1960 kN/m²)</td>
<td>Y = 130 psf (1960 kN/m²)</td>
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<table>
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<tr>
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<th>9'-6&quot; (2.90 m)</th>
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<th>Height (ft)</th>
<th>6'-6&quot; (2.00 m)</th>
<th>9'-6&quot; (2.90 m)</th>
<th>12'-6&quot; (3.80 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6'-6&quot;</td>
<td>7.5-PT (2290 mm)</td>
<td>7.5-PT (2290 mm)</td>
<td>7.5-PT (2290 mm)</td>
</tr>
<tr>
<td>9'-6&quot;</td>
<td>7.5-PT (2290 mm)</td>
<td>7.5-PT (2290 mm)</td>
<td>7.5-PT (2290 mm)</td>
</tr>
<tr>
<td>12'-6&quot;</td>
<td>7.5-PT (2290 mm)</td>
<td>7.5-PT (2290 mm)</td>
<td>7.5-PT (2290 mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Height (ft)</th>
<th>6'-6&quot; (2.00 m)</th>
<th>9'-6&quot; (2.90 m)</th>
<th>12'-6&quot; (3.80 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6'-6&quot;</td>
<td>8.5-PT (2550 mm)</td>
<td>8.5-PT (2550 mm)</td>
<td>8.5-PT (2550 mm)</td>
</tr>
<tr>
<td>9'-6&quot;</td>
<td>8.5-PT (2550 mm)</td>
<td>8.5-PT (2550 mm)</td>
<td>8.5-PT (2550 mm)</td>
</tr>
<tr>
<td>12'-6&quot;</td>
<td>8.5-PT (2550 mm)</td>
<td>8.5-PT (2550 mm)</td>
<td>8.5-PT (2550 mm)</td>
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</tbody>
</table>

WALL DESIGN TO BE PERFORMED BY A PROFESSIONAL ENGINEER
Estimating Chart for Geosynthetic Reinforcement with Diamond® Series, Highland Stone® & Sterling® Wall Retaining Wall Systems

250 PSF Surcharge

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Clay &amp; Silt Soils (φ=35° γ=140 psf (1.0 kN/m²))</th>
<th>Silty/Claey Sand Soil (φ=35° γ=130 psf (1.0 kN/m²))</th>
<th>Clean Sand and Gravel Soil (φ=35° γ=130 psf (1.0 kN/m²))</th>
</tr>
</thead>
<tbody>
<tr>
<td>6'</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
</tr>
<tr>
<td>12'</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
</tr>
<tr>
<td>18'</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
</tr>
<tr>
<td>24'</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
<td>6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm) 6.0-FT (1800mm)</td>
</tr>
</tbody>
</table>

WALL DESIGN TO BE PERFORMED BY A PROFESSIONAL ENGINEER

BELGARD.COM  | 877-235-4273
Estimating Chart for Geosynthetic Reinforcement
with Diamond Series, Highland Stone & Sterling Wall Retaining Wall Systems
3:1 Crest Slope

<table>
<thead>
<tr>
<th>CLAY &amp; SILT SOILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \phi = 15^\circ )</td>
</tr>
<tr>
<td>( g = 18 )</td>
</tr>
<tr>
<td>( y = 18 )</td>
</tr>
<tr>
<td>( 5.5'-PT (1650mm) )</td>
</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILTY/CLAYEY SAND SOIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \phi = 15^\circ )</td>
</tr>
<tr>
<td>( g = 18 )</td>
</tr>
<tr>
<td>( y = 18 )</td>
</tr>
<tr>
<td>( 5.5'-PT (1650mm) )</td>
</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLEAN SAND AND GRAVEL SOIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \phi = 15^\circ )</td>
</tr>
<tr>
<td>( g = 18 )</td>
</tr>
<tr>
<td>( y = 18 )</td>
</tr>
<tr>
<td>( 5.5'-PT (1650mm) )</td>
</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
<tr>
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</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
<tr>
<td>( 6.5'-PT (1950mm) )</td>
</tr>
</tbody>
</table>
## Estimating Chart for Structural Backfill Using Grid with Diamond® Series (6") Retaining Wall Systems

### No Slope / No Surcharge

<table>
<thead>
<tr>
<th>Depth (in)</th>
<th>Clay and Silt Soils $\varphi = 26^\circ$ $\gamma = 120$ pcf (19 kN/m$^3$)</th>
<th>Silty / Clayey Sand Soil $\varphi = 30^\circ$ $\gamma = 120$ pcf (19 kN/m$^3$)</th>
<th>Clean Sand and Gravel Soil $\varphi = 34^\circ$ $\gamma = 120$ pcf (19 kN/m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4'-0&quot; (1200 mm)</td>
<td>0.22 x Wall Length = CY of Structural Backfill</td>
<td>0.22 x Wall Length = CY of Structural Backfill</td>
<td>0.33 x Wall Length = CY of Structural Backfill</td>
</tr>
<tr>
<td>6'-0&quot; (1800 mm)</td>
<td>0.44 x Wall Length = CY of Structural Backfill</td>
<td>0.33 x Wall Length = CY of Structural Backfill</td>
<td>0.33 x Wall Length = CY of Structural Backfill</td>
</tr>
<tr>
<td>8'-0&quot; (2400 mm)</td>
<td>0.89 x Wall Length = CY of Structural Backfill</td>
<td>0.74 x Wall Length = CY of Structural Backfill</td>
<td>0.74 x Wall Length = CY of Structural Backfill</td>
</tr>
<tr>
<td>10'-0&quot; (3000 mm)</td>
<td>1.30 x Wall Length = CY of Structural Backfill</td>
<td>1.11 x Wall Length = CY of Structural Backfill</td>
<td>1.11 x Wall Length = CY of Structural Backfill</td>
</tr>
<tr>
<td>12'-0&quot; (3600 mm)</td>
<td>2.00 x Wall Length = CY of Structural Backfill</td>
<td>1.56 x Wall Length = CY of Structural Backfill</td>
<td>1.56 x Wall Length = CY of Structural Backfill</td>
</tr>
</tbody>
</table>
### Estimating Chart for Structural Backfill Using Grid with Diamond® Series (6"
Retaining Wall Systems
250 PSF Surcharge

<table>
<thead>
<tr>
<th>Depth (in ft)</th>
<th>250 PSF Surcharge</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>4'-0&quot; (1200 mm)</td>
<td>6 Courses</td>
<td>$2'6&quot;$ [750 mm]</td>
<td>$1'6&quot;$ [450 mm]</td>
<td>$1'0&quot;$ [300 mm]</td>
</tr>
<tr>
<td>0.44 x Wall Length = CY of Structural Backfill</td>
<td>0.30 x Wall Length = CY of Structural Backfill</td>
<td>0.22 x Wall Length = CY of Structural Backfill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6'-0&quot; (1800 mm)</td>
<td>9 Courses</td>
<td>$3'6&quot;$ [1050 mm]</td>
<td>$2'0&quot;$ [600 mm]</td>
<td>$1'0&quot;$ [300 mm]</td>
</tr>
<tr>
<td>0.89 x Wall Length = CY of Structural Backfill</td>
<td>0.56 x Wall Length = CY of Structural Backfill</td>
<td>0.33 x Wall Length = CY of Structural Backfill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8'-0&quot; (2400 mm)</td>
<td>12 Courses</td>
<td>$4'0&quot;$ [1200 mm]</td>
<td>$2'6&quot;$ [750 mm]</td>
<td>$2'0&quot;$ [600 mm]</td>
</tr>
<tr>
<td>1.35 x Wall Length = CY of Structural Backfill</td>
<td>0.89 x Wall Length = CY of Structural Backfill</td>
<td>0.74 x Wall Length = CY of Structural Backfill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10'-0&quot; (3000 mm)</td>
<td>15 Courses</td>
<td>$3'0&quot;$ [900 mm]</td>
<td>$2'6&quot;$ [750 mm]</td>
<td>$3'0&quot;$ [900 mm]</td>
</tr>
<tr>
<td>1.30 x Wall Length = CY of Structural Backfill</td>
<td>1.11 x Wall Length = CY of Structural Backfill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12'-0&quot; (3600 mm)</td>
<td>18 Courses</td>
<td>$3'6&quot;$ [1050 mm]</td>
<td>$3'0&quot;$ [900 mm]</td>
<td></td>
</tr>
<tr>
<td>1.78 x Wall Length = CY of Structural Backfill</td>
<td>1.56 x Wall Length = CY of Structural Backfill</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Wall design to be performed by a professional engineer.
Estimating Chart for Structural Backfill Using Anchorplex System with Diamond® Series (6") Retaining Wall Systems

3:1 Crest Slope

<table>
<thead>
<tr>
<th>Height (feet)</th>
<th>Courses</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>4'-0&quot; (1200 mm)</td>
<td>6 Courses</td>
<td>( \varphi = 26^\circ ) ( \gamma = 120 \text{ pcf} (19 \text{ kN/m}^3) )</td>
<td>( \varphi = 30^\circ ) ( \gamma = 120 \text{ pcf} (19 \text{ kN/m}^3) )</td>
<td>( \varphi = 34^\circ ) ( \gamma = 120 \text{ pcf} (19 \text{ kN/m}^3) )</td>
</tr>
<tr>
<td>6'-0&quot; (1800 mm)</td>
<td>9 Courses</td>
<td>2'-0&quot; [600 mm] 0.37 x Wall Length = CY of Structural Backfill</td>
<td>1'-0&quot; [300 mm] 0.22 x Wall Length = CY of Structural Backfill</td>
<td>1'-0&quot; [300 mm] 0.22 x Wall Length = CY of Structural Backfill</td>
</tr>
<tr>
<td>8'-0&quot; (2400 mm)</td>
<td>12 Courses</td>
<td>3'-6&quot; [1050 mm] 0.89 x Wall Length = CY of Structural Backfill</td>
<td>1'-6&quot; [450 mm] 0.44 x Wall Length = CY of Structural Backfill</td>
<td>1'-0&quot; [300 mm] 0.33 x Wall Length = CY of Structural Backfill</td>
</tr>
<tr>
<td>10'-0&quot; (3000 mm)</td>
<td>15 Courses</td>
<td>5'-0&quot; [1500 mm] 1.63 x Wall Length = CY of Structural Backfill</td>
<td>2'-6&quot; [750 mm] 0.89 x Wall Length = CY of Structural Backfill</td>
<td>0.74 x Wall Length = CY of Structural Backfill</td>
</tr>
<tr>
<td>12'-0&quot; (3600 mm)</td>
<td>18 Courses</td>
<td>Wall design to be performed by a professional engineer</td>
<td>3'-0&quot; [900 mm] 1.30 x Wall Length = CY of Structural Backfill</td>
<td>2'-6&quot; [750 mm] 1.11 x Wall Length = CY of Structural Backfill</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wall design to be performed by a professional engineer</td>
<td>4'-0&quot; [1200 mm] 2.00 x Wall Length = CY of Structural Backfill</td>
<td>1.56 x Wall Length = CY of Structural Backfill</td>
</tr>
</tbody>
</table>
Estimating Chart for Geosynthentic Reinforcement
Diamond 9D® Retaining Walls
No Slopes / No Surcharges
Estimating Chart for Geosynthetic Reinforcement
Diamond 9D® Retaining Walls
100 PSF Surcharge

<table>
<thead>
<tr>
<th>Clay and Silt Soil</th>
<th>Eltta/Clayey Sand Soil</th>
<th>Clean Sand and Gravel Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Height:</td>
<td>Total Height:</td>
<td>Total Height:</td>
</tr>
<tr>
<td>1-4’ (300 mm)</td>
<td>2-4’ (600 mm)</td>
<td>3-0’ (900 mm)</td>
</tr>
<tr>
<td>2-0’ (600 mm)</td>
<td>3-0’ (900 mm)</td>
<td>3-0’ (900 mm)</td>
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<tr>
<td>3-0’ (900 mm)</td>
<td>3-0’ (900 mm)</td>
<td>3-0’ (900 mm)</td>
</tr>
<tr>
<td>4-0’ (1200 mm)</td>
<td>4-0’ (1200 mm)</td>
<td>5-0’ (1500 mm)</td>
</tr>
<tr>
<td>5-0’ (1500 mm)</td>
<td>5-0’ (1500 mm)</td>
<td>5-0’ (1500 mm)</td>
</tr>
<tr>
<td>6-0’ (1800 mm)</td>
<td>6-0’ (1800 mm)</td>
<td>6-0’ (1800 mm)</td>
</tr>
</tbody>
</table>

NO REINFORCEMENT REQUIRED
Estimating Chart for Geosynthetic Reinforcement
Diamond 9D® Retaining Walls
3:1 Crest Slope

<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><strong>Total Height:</strong></td>
<td><strong>Total Height:</strong></td>
<td><strong>Total Height:</strong></td>
</tr>
<tr>
<td>1'-0&quot; (300 mm)</td>
<td>1'-0&quot; (300 mm)</td>
<td>1'-0&quot; (300 mm)</td>
</tr>
<tr>
<td></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
</tr>
<tr>
<td>2'-0&quot; (600 mm)</td>
<td>2'-0&quot; (600 mm)</td>
<td>2'-0&quot; (600 mm)</td>
</tr>
<tr>
<td></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
</tr>
<tr>
<td>3'-0&quot; (900 mm)</td>
<td>3'-0&quot; (900 mm)</td>
<td>3'-0&quot; (900 mm)</td>
</tr>
<tr>
<td></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
</tr>
<tr>
<td>4'-0&quot; (1200 mm)</td>
<td>4'-0&quot; (1200 mm)</td>
<td>4'-0&quot; (1200 mm)</td>
</tr>
<tr>
<td></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
</tr>
<tr>
<td>5'-0&quot; (1500 mm)</td>
<td>5'-0&quot; (1500 mm)</td>
<td>5'-0&quot; (1500 mm)</td>
</tr>
<tr>
<td></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
</tr>
<tr>
<td>6'-0&quot; (1800 mm)</td>
<td>6'-0&quot; (1800 mm)</td>
<td>6'-0&quot; (1800 mm)</td>
</tr>
<tr>
<td></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
<td><strong>NO REINFORCEMENT REQUIRED</strong></td>
</tr>
</tbody>
</table>
## Estimating Chart for Multi-Stack Walls
### Diamond Pro® Retaining Walls
#### 3:1 Crest Slope

<table>
<thead>
<tr>
<th>Clay and Silts</th>
<th>Silt and Ayer Sand</th>
<th>Clay and Ayer Sand</th>
<th>Clay and Ayer Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Courses 2-4&quot; (100 mm)</td>
<td>4 Courses 2-4&quot; (100 mm)</td>
<td>4 Courses 2-4&quot; (100 mm)</td>
<td>6 Courses 4-4&quot; (120 mm)</td>
</tr>
<tr>
<td>4 Courses 2-4&quot; (100 mm)</td>
<td>6 Courses 4-4&quot; (120 mm)</td>
<td>6 Courses 4-4&quot; (120 mm)</td>
<td>6 Courses 4-4&quot; (120 mm)</td>
</tr>
<tr>
<td>6 Courses 4-4&quot; (120 mm)</td>
<td>8 Courses 5-4&quot; (160 mm)</td>
<td>8 Courses 5-4&quot; (160 mm)</td>
<td>8 Courses 5-4&quot; (160 mm)</td>
</tr>
<tr>
<td>16 Courses 6-4&quot; (200 mm)</td>
<td>16 Courses 6-4&quot; (200 mm)</td>
<td>12 Courses 6-4&quot; (240 mm)</td>
<td>N/A</td>
</tr>
<tr>
<td>10-9-7</td>
<td>10-7-5</td>
<td>10-7-3</td>
<td>N/A</td>
</tr>
<tr>
<td>12 Courses 6-4&quot; (240 mm)</td>
<td>12 Courses 6-4&quot; (240 mm)</td>
<td>12 Courses 6-4&quot; (240 mm)</td>
<td>N/A</td>
</tr>
<tr>
<td>12-11-9</td>
<td>12-9-7</td>
<td>12-9-7</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### Estimating Chart for Multi-Stack Walls

**Diamond Pro® Retaining Walls**

**No Slope / No Surcharges**

<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>$\phi = 25^\circ$</td>
<td>$\phi = 30^\circ$</td>
<td>$\phi = 35^\circ$</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>
</table>

**H**

<table>
<thead>
<tr>
<th>Courses</th>
<th>2'-8&quot; (800 mm)</th>
<th>2'-8&quot; (800 mm)</th>
<th>2'-8&quot; (800 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>6-2-0</td>
<td>6-1-0</td>
<td>6-1-0</td>
</tr>
<tr>
<td>6</td>
<td>4-0&quot; (1200 mm)</td>
<td>4-0&quot; (1200 mm)</td>
<td>4-0&quot; (1200 mm)</td>
</tr>
<tr>
<td>8</td>
<td>5-4&quot; (1600 mm)</td>
<td>5-4&quot; (1600 mm)</td>
<td>5-4&quot; (1600 mm)</td>
</tr>
<tr>
<td>10</td>
<td>6-8&quot; (2000 mm)</td>
<td>6-8&quot; (2000 mm)</td>
<td>6-8&quot; (2000 mm)</td>
</tr>
<tr>
<td>12</td>
<td>8-0&quot; (2400 mm)</td>
<td>8-0&quot; (2400 mm)</td>
<td>8-0&quot; (2400 mm)</td>
</tr>
</tbody>
</table>

**Notes:**
- Multistack not required for the given configurations.
- Zones of multistack are indicated in the diagram.
<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><strong>H</strong></td>
<td><strong>H</strong></td>
<td><strong>H</strong></td>
</tr>
<tr>
<td>$\gamma = 26'$</td>
<td>$\gamma = 30'$</td>
<td>$\gamma = 34'$</td>
</tr>
<tr>
<td>$\gamma = 220$ psf (19 kN/m$^2$)</td>
<td>$\gamma = 220$ psf (19 kN/m$^2$)</td>
<td>$\gamma = 220$ psf (19 kN/m$^2$)</td>
</tr>
<tr>
<td>250 PSF (12 kPA) SURCHARGE</td>
<td>250 PSF (12 kPA) SURCHARGE</td>
<td>250 PSF (12 kPA) SURCHARGE</td>
</tr>
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</table>

**Estimating Chart for Multi-Stack Walls**

**Diamond Pro® Retaining Walls**

**250 PSF Surcharge**

<table>
<thead>
<tr>
<th>4 Courses</th>
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Estimating Chart Structural Backfill Using AnchorPlex® System
Diamond Pro® Retaining Walls
3:1 Crest Slope

<table>
<thead>
<tr>
<th>Height</th>
<th>Clay and Silt Soils</th>
<th>Silty / Clayey Sand Soil</th>
<th>Clean Sand and Gravel Soil</th>
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<td>(1'\cdot0&quot;) [300 mm]</td>
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<td>(0.22 \times ) Wall Length = CY of Structural Backfill</td>
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<tr>
<td>6'-0&quot; (1800 mm)</td>
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<td>(1'-6&quot;) [450 mm]</td>
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<td>(2.00 \times ) Wall Length = CY of Structural Backfill</td>
<td>(1.56 \times ) Wall Length = CY of Structural Backfill</td>
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Wall design to be performed by a professional engineer.
Estimating Chart Structural Backfill Using AnchorPlex® System
Diamond Pro® Retaining Walls
No Slope / No Surcharges

<table>
<thead>
<tr>
<th>Courses</th>
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<th>Silty / Clayey Sand Soil</th>
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109  Bristol™ Series

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BORDEAUX™ SERIES

ELEMENTS™

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

WOOD BOXES
Rough Dimensions:
2’ 1 ¼”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
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
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

GRILL ISLAND INCLUDES
• Napoleon 5-Burner Grill
• Porcelanized Cast Iron Cooking Grids
• JETFIRE Ignition
• Rear Infrared Rotisserie Burner
• 760 sq. in. of cooking surface
• Up to 66,000 BTU
• Napoleon Stainless Steel Double Doors
* Hoses not included, recommend-
ed hard-piped installation.
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’ 1”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
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

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.
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.
FIRE PIT KITS INSTALLATION INSTRUCTIONS

- Always use in accordance with all applicable local and state fire codes
- Failure to follow these instructions could result in a hazardous fire causing property damage or physical injury
- Caution: For outdoor use only
- Use the fire ring on stone, dirt or sand surfaces
- For adult use only — do not allow children to use the fire ring
- Do not use on lawns, wooden decks, concrete or asphalt
- Do not use fire ring indoors or under a patio roof
- Do not use in windy conditions
- Do not leave fire unattended at any time
- Do not use under tree branches, trellis, or overhangs of any kind, including covered porches
- Do not use flammable liquids such as gasoline, alcohol, diesel fuel, kerosene, or charcoal lighter fluid to light or relight fires as this may also cause paint to flake off fire ring
- Care should be taken to make sure all combustible material is far enough away from the fire ring not to ignite it
- Avoid using softwoods such as pine or cedar because they are likely to throw sparks — hardwoods are recommended
- Keep children and pets away from the fire ring while it is in use
- Exercise the same precautions you would with any open fire
- Do not wear flammable or loose clothing when tending an open fire
- Avoid touching surfaces as they will be extremely hot
- Assure the fire is completely extinguished before leaving fire ring
- Any modifications to this appliance may be dangerous and are not permitted

ADDITIONAL MATERIALS NEEDED

- Tamper
- Level
- 2 Bags of Leveling Sand
- 2 Tubes of Concrete Adhesive
- Caulk Gun
- 3 Bags of Gravel or Lava Rock
- Shovel
- Optional Marking Paint or Chalk
For a lawn, mark a 58” diameter circle with marking paint then go to step 2. For a patio, use chalk instead of paint then skip to step 5.

Remove all sod, roots and dirt to a depth of 2 inches inside the circle.

Level the soil with a tamper and remove high spots as best possible. Tip: Use a level to check.

Add 1½”-2” of paver base (sand) and level. Moisten with water to aid compaction then use a tamper to pack the entire area firm. Add 1/2”-1” more of paver base and level again.

Place wall blocks on top of paver base, firmly touching each block creating a circle. Make sure each block is leveled front to back and side to side and even with adjacent blocks.

For the second layer of blocks, center the middle of each block over the joint made between the sides of the two blocks underneath it. Place blocks firmly together and level as before.

Attach the two layers of blocks together using concrete adhesive. Remove one top block and lay two liberal beads of adhesive near the center of the block. Place block back and press down firmly. Repeat for all 2nd layer blocks.

Lay the third layer the same way you laid the second. The third layer joints should line up with the first layer joints. Adhere the blocks with concrete adhesive as you did in step 7.

After all blocks are set, install the fire pit insert. The insert’s top lip should rest on the inside edge of the fire pit blocks.
BASIC INSTALLATION INSTRUCTIONS
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145 Controlling Runoff

WALLS

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148 Laying Pattern & Installation Guide for Multi-Piece Segmental Retaining Walls
149 Abutting an Existing Structure
150 Outside & Inside Curves
152 Outside & Inside 90-Degree Corners
155 Anchorplex® System Construction Guide
158 Laying Pattern Guide for Multi-Piece Walls
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 1/4-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.

### Tools

<table>
<thead>
<tr>
<th>QTY</th>
<th>T:/Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Folding 6 ft. ruler</td>
</tr>
<tr>
<td>1</td>
<td>4 ft. Level</td>
</tr>
<tr>
<td>2</td>
<td>16 ft. Tapes</td>
</tr>
<tr>
<td>1</td>
<td>Torpedo Level</td>
</tr>
<tr>
<td>1</td>
<td>100 ft. Tape</td>
</tr>
<tr>
<td>1</td>
<td>Line Level</td>
</tr>
<tr>
<td>1</td>
<td>Steel or Aluminum Carpenter Square</td>
</tr>
<tr>
<td>1</td>
<td>Mason Trowel - Rectangular</td>
</tr>
<tr>
<td>1</td>
<td>Claw Hammer</td>
</tr>
<tr>
<td>1</td>
<td>Mason Trowel - Pointed</td>
</tr>
<tr>
<td>1</td>
<td>Mason Hammer</td>
</tr>
<tr>
<td>1</td>
<td>Mason Wood Float</td>
</tr>
<tr>
<td>1</td>
<td>3 lb. Maul</td>
</tr>
<tr>
<td>1</td>
<td>4 in. Brickset (Mason Chisel)</td>
</tr>
<tr>
<td>1</td>
<td>12 lb. Sledge Hammer</td>
</tr>
<tr>
<td>1</td>
<td>Pair Metal Snips</td>
</tr>
<tr>
<td>1</td>
<td>Rubber or Deadblow Hammer</td>
</tr>
<tr>
<td>1</td>
<td>Shovel(s) Square Point</td>
</tr>
<tr>
<td>1</td>
<td>Steel Garden Rake</td>
</tr>
<tr>
<td>1</td>
<td>Shovel(s) Round Point</td>
</tr>
<tr>
<td>1</td>
<td>Push Broom</td>
</tr>
<tr>
<td>1</td>
<td>Slim Jim Pry Bar</td>
</tr>
<tr>
<td>1</td>
<td>Contractor’s Wheel Barrow</td>
</tr>
<tr>
<td>1</td>
<td>36 in. Crow Bar</td>
</tr>
<tr>
<td>1</td>
<td>Screeed Board (Magnesium) or 10 ft.-12 ft. wood 2x4’s</td>
</tr>
<tr>
<td>2</td>
<td>Large Flat Blade Screw Drivers</td>
</tr>
<tr>
<td>6</td>
<td>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)</td>
</tr>
<tr>
<td>1</td>
<td>Hacksaw</td>
</tr>
<tr>
<td>1</td>
<td>Carpenter’s Saw</td>
</tr>
<tr>
<td>1</td>
<td>Plumb Bob</td>
</tr>
<tr>
<td>1</td>
<td>Garden Hose (75 ft.-100 ft.)</td>
</tr>
<tr>
<td>1</td>
<td>Chalk Line</td>
</tr>
<tr>
<td>1</td>
<td>Hand Tamper</td>
</tr>
</tbody>
</table>

### Special Tools

- 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&quot; (100 MM)</td>
<td>1&quot; (25 MM)</td>
<td>6&quot; (150 MM)</td>
</tr>
<tr>
<td></td>
<td>2¼&quot; (60 MM)</td>
<td>2¾&quot; (70 MM)</td>
<td></td>
</tr>
<tr>
<td>VEHICULAR TRAFFIC RESIDENTIAL DRIVEWAYS</td>
<td>8&quot; (200 MM)</td>
<td>1&quot; (25 MM)</td>
<td>12&quot; (300 MM)</td>
</tr>
<tr>
<td></td>
<td>2¼&quot; (60 MM)</td>
<td>2¾&quot; (70 MM)</td>
<td>3¼&quot; (80 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 rescreen 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.

EDGES 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 ARE:

<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, silt-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.
**Plastic Edge Restraint**

- Plastic edge restraint
- Stake
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Compacted soil subgrade

**Timber Edge Restraint**

- Timber edge restraint
- Stake
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Compacted soil subgrade

**Aluminium and Steel Edging**

- Edge restraint
- Stake
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Compacted soil subgrade

**Troweled Concrete and "Submerged Curb" Edges**

- Troweled concrete
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Compacted soil subgrade

- NOTE: Reinforcing steel is recommended in troweled concrete

**Poured-in-Place Concrete Curbs**

- Curb
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Compacted soil subgrade

- Curb
- Concrete pavers
- Bedding sand
- Compacted aggregate base
- Compacted soil subgrade
PARTIAL DEPTH PRECAST CONCRETE EDGE

PRECAST CONCRETE/CUT STONE

UTILITY MANHOLE
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 IN EXISTING ASPHALT PAVEMENT

CROSSWALK WITH CONCRETE BASE

Curb
Concrete beam min. 8” (200 mm.) wide
Adjacent street
Street in pavers

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>
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<tr>
<td>No. 8</td>
<td>95-100</td>
</tr>
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<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

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
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 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 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}" = 1\frac{3}{8}" \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 $\frac{1}{4}$-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 $1\frac{1}{8}$ 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
   
   $1\frac{1}{8} + \frac{1}{4} = 1\frac{3}{8} \times 8 \text{ courses} = 11''$

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

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

**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.

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 (f\textsubscript{1c}) 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**
COLUMN CONSTRUCTION

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.

```
N W N W N W N W N W N W
N W N W N W N W N W N W
```

**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"

```
N W W W N N N N
W N N N W W W W
```

**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.
THE ULTIMATE PROTECTION SYSTEM

Belgard's 3-step treatment system guarantees the best results. Remove dirt with a specially formulated Build Remover, prepare the surface with Power Prep, then apply a Protector that delivers the long-term seal.

1. PREP

STAIN REMOVERS

2. CLEAN

CLEANERS
- Melts greasy oil stains and dirt to diet
- Preps power prior to protector application
- Dilutes power water

3. PROTECT

SAME FINISHES, HIGHER STANDARDS

For maximum performance, Belgard power treated protectors are designed with special finishes.

ERA LiGHT TINTED PROTECTOR
- Future proof
- Unbreakable
- Water-based slip-resistant
DRiBOND™
CHANGING THE WAY YOU OVERLAY

In More Concrete Removal

- Ideal for thin layer overlay
- Dry application
- No textures - smooth as new
- Resists hairline cracks

COVERS EXISTING CRACKS AND JOINTS

BEFORE
AFTER
STRUCTURE BOND is an innovative super-strength foam adhesive that bonds a wide range of construction materials. Made for high-around sealed expansion joints, it offers a variety of applications. Use it to expand and seal a variety of materials, including joint sealants and waterproofing membranes.

Visit TECHSEAL.COM for more details.
1. PREP

**EZ BASE® PANEL BASE SYSTEM**
- Building block
- Designed for 12" x 12" paver installations
- Used for paver base

**PAVING ENHANCING WEED BARRIER & EMBOSSED TO PAPER INSTALLATION**
- HDPE 0-FT SHTS
- CIRL 40-FT COIL

2. SET

**STRUCTURE BOND® FOAM ADHESIVE**
- Hydrophobic and weather resistant

**BONDI-BOND® CEMENT MORTAR**
- Applied directly to backerboard
- Used for natural stone pavers

**BONDI-BOND® PORTION FOR BENEFIT 236 PASTES**
- Mixing required
- Interlayer bond strength of adhesive

3. SAND

**HP NEXTGEL® JOINTING SAND**
- High-performance grout
- For joints up to 1/2" wide
- Resists dust and air
- Faster hard setting
- Rapid set
- Prevents moisture and mold

**SMART SAND® POLYMER SAND WITH STABILIZATION**
- Blends for hardworking areas
- Joints up to 1/2" wide
- Easy to use, no less
- Fast setting
- Rapid set
- Prevents moisture and mold

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