

EDITION 3.0



PAVERS | WALLS | STEPS
DESIGNER RESOURCE GUIDE

PLANNING | DESIGN | INSTALLATION | MAINTENANCE GUIDANCE FOR DESIGN PROFESSIONALS

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we're here to help you by understanding your needs...

At Oaks, our responsibility to design professionals goes beyond manufacturing quality products. Count on us to be your trusted resource during every phase of your project – from planning to design to construction to maintenance. Our goal is to help design professionals realize the potential benefits of using Oaks Landscape products by:

- 1) Offering specific tools and resources to help you with site solutions, including design software, costing tools and literature from ASCE, ASTM, ICPI and NCMA. See the *Applications and Solutions* section, pages 6 to 37.
- 2) Demonstrating how Oaks products can meet your aesthetic requirements and new regulatory criteria, while improving installation efficiencies.
- 3) Identifying which Oaks products are best suited for different applications: pedestrian plazas, parking lots, streetscapes, architectural features or retaining walls, and residential projects. See the *Product Solutions* section pages 38 to 57.

want help ensuring you're up to date with industry trends?

Sign up for our e-mailing list at www.oakspavers.com/subscribe to always be "in the know" or to request a consultation or arrange an in-office Lunch & Learn workshop.

we have the resources to help you every step of the way!

PLANNING

- Oaks Design Resource Guide
- Comprehensive library of supporting documentation
- Examples of existing LID BMP projects
- Environmental Product Declarations

DESIGN/ EVALUATION

- ASCE, ICPI and NCMA Manuals & Software
- Capital & Life Cycle Costing Software
- ASTM site inspection protocols
- VESPA design software for retaining walls

SPECIFICATION TENDER

- CSA and ASTM Standards
- Sample Specifications, Patterns, CAD details
- Direct design assistance complete with stamped drawings
- PAT paver pattern files for use in AutoCAD

CONSTRUCTION

- Oaks Inspection Checklists
- ICPI/NCMA Contractor Certification Training
- NCMA Inspector Certification Training

MAINTENANCE

- Oaks Maintenance Guides
- Warranty
- CSA/ASTM Quality Compliance Reports

product technology & quality

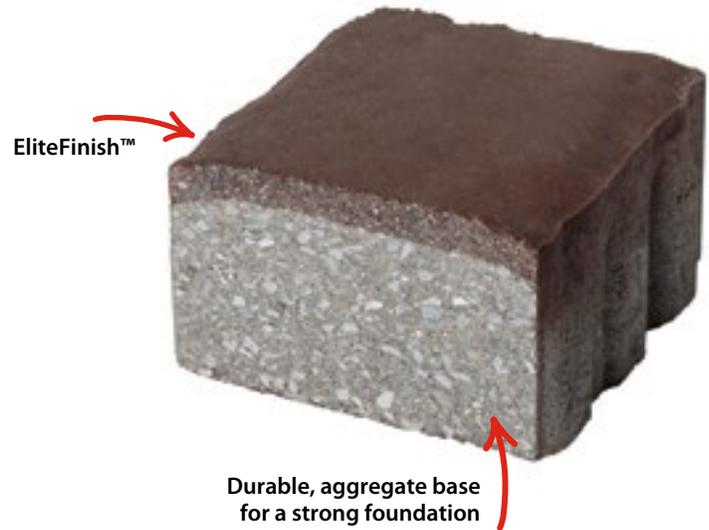
EliteFinish™

EliteFinish™ is an advanced manufacturing process that delivers richer, more vibrant color and a harder wearing, more durable and smoother textured surface.

The surface of our EliteFinish™ products is a specially engineered layer of finely-ground, durable aggregates combined with rich color and concentrated cement. The paver foundation uses coarser stone to ensure long term performance in application. The resulting product delivers an enhanced finish and greater structural integrity.

Products with EliteFinish™:

Eterna, Molina®, Market Paver, Enviro Passagio



ColorBold™

ColorBold™ is an integral treatment employed during manufacturing that provides a new level of color longevity and stain resistance.

ColorBold™ is a proprietary process where supplemental ingredients penetrate the surface of the product to become an integral part of the unit. Enhanced color depth, extended color durability, improved resistance to stains and acidic materials, as well as improved freeze-thaw capability due to decreased moisture absorption are all benefits delivered with products featuring ColorBold™.

Other color enhancement products are sealers applied post production, after the concrete has been thoroughly cured; the chemical can only penetrate whatever surface voids are present, with the balance being left as a film on the paver surface.

Products with ColorBold™:

Molina®, Market Paver, Enviro Passagio

PAVERS AFTER ONE YEAR'S EXPOSURE TO THE ELEMENTS



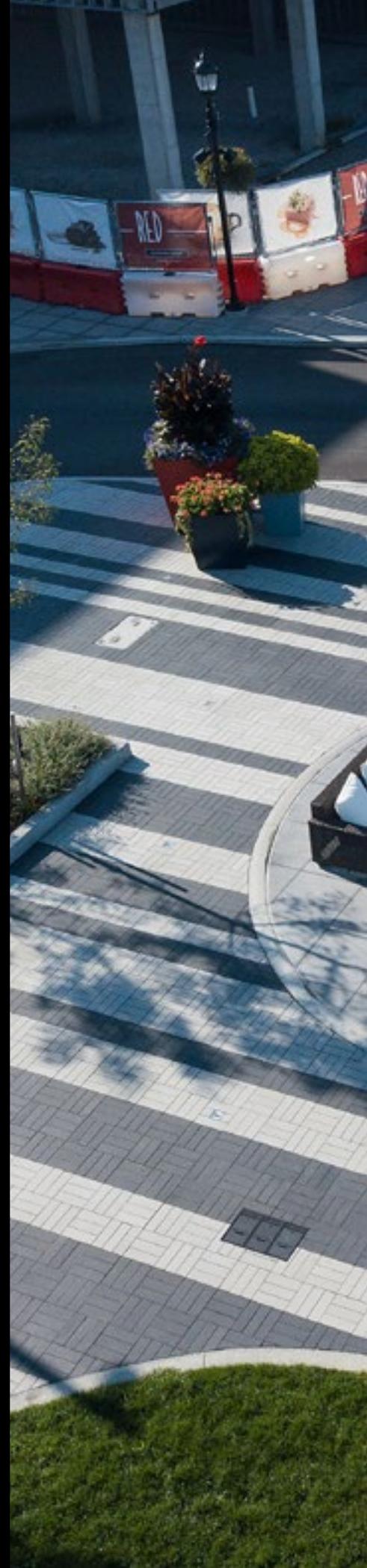
With ColorBold™



Without ColorBold™

applications & solutions

Oaks Segmental Pavement Systems are developed for various degrees of traffic, living street appeal, permeable pavement applications and northern climates, with consideration for pedestrian safety and wheelchair accessibility. Whether your intent is to enhance an entrance way, build a staircase or manage grades, Oaks Wall Products offer you design solutions for a variety of wall classifications. This section will guide you through making the right choices for your project, including detailed installation techniques, design tips, capital/life cycle costing and maintenance considerations.





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segmental concrete pavement systems

ALL OF THESE DETAILS ARE
AVAILABLE ONLINE!

There are several different locations pavers and slabs can be installed. Some of the most common are: at grade on native soil, over an existing concrete or asphalt road, or above grade on a concrete patio or roof deck. The following two pages provide guidance for each of these installation locations. CAD details, material specifications and testing requirements, and installation instructions for each option are available online or upon request.

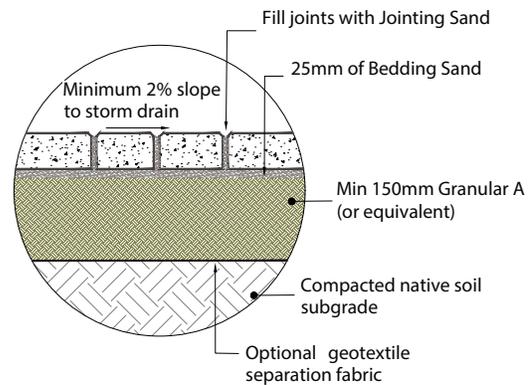
SAND SET ON SUBGRADE

SUITABLE APPLICATIONS: Most pedestrian and vehicular projects.

BENEFIT: Economical installation.

DESIGN NOTES: See ASCE 58-16 for recommended base thickness subject to traffic conditions and subgrade soil type. Need for separation geotextile subject to subgrade soil type. Underdrains may be needed over tight soils (clays).

INSTALLATION NOTES: Ensure subgrade is properly compacted before commencing with Granular A placement. See ICPI (Interlocking Concrete Pavement Institute) for recommended installation practices.



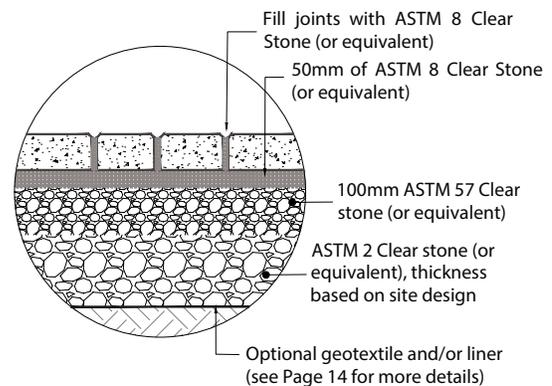
PERMEABLE STONE SET ON SUBGRADE

SUITABLE APPLICATIONS: Most pedestrian and vehicular projects where stormwater management is also an objective.

BENEFIT: Utilizes the same area for traffic / parking and storm water management, frees up other space onsite for revenue generating purposes.

DESIGN NOTES: See ASCE 68-18 for recommended base thickness subject to stormwater management goals, traffic conditions and subgrade soil type. Need for separation geotextile and/or liner, and underdrains, subject to site conditions. See Page 14 for more information.

INSTALLATION NOTES: Consult with Oaks staff on providing contractor training to ensure correct installation practices are being followed.



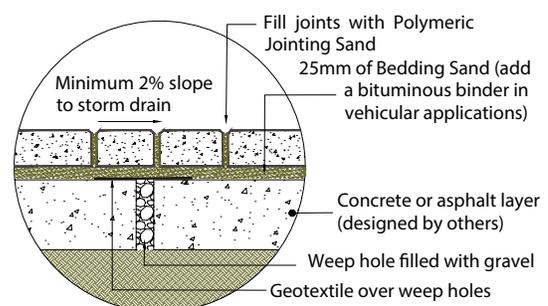
SAND SET OVERLAY ON CONCRETE OR ASPHALT AT GRADE

SUITABLE APPLICATIONS: Recommended over weak native soils. Bituminous set for high traffic areas, crosswalks or intersections

BENEFIT: Combines structural benefits of concrete / asphalt with the aesthetics of pavers and slabs.

DESIGN NOTES: Drain holes are required throughout the pavement area to allow water in the bedding layer to easily drain.

INSTALLATION NOTES: Recommend stabilized jointing sand to minimize water infiltration and tighter height tolerances on the pavers or slabs. For bituminous set, consult with Oaks staff on providing contractor training to ensure correct installation practices are being followed.



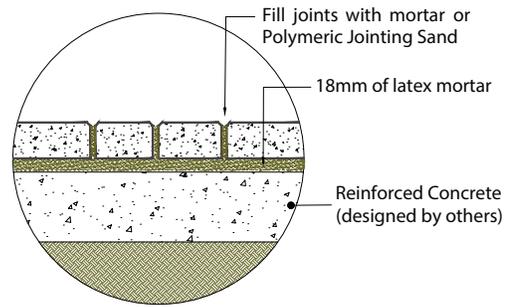
MORTAR SET ON CONCRETE

SUITABLE APPLICATIONS: Interior applications over concrete.

BENEFIT: Creates a very rigid surface.

DESIGN NOTES: For pavers or slabs with small joints, use polymeric sand in lieu of mortar between the units. Control joints in the reinforced concrete need to extend up through the mortar and pavers/slabs.

INSTALLATION NOTES: When using mortar in the joints, be careful to prevent mortar from spilling over the joints, which stains pavers/slabs.



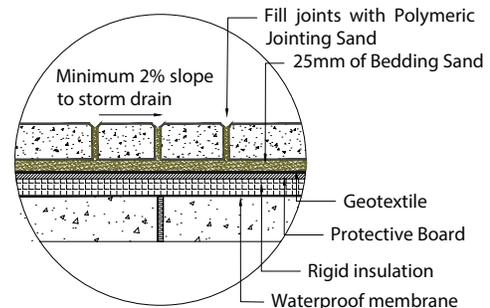
SAND SET ON CONCRETE PATIO OR ROOFDECK

SUITABLE APPLICATIONS: Exterior patios or roofs over concrete decks.

BENEFIT: Provides decorative surfacing over concrete that can be lifted/replaced for maintenance or repairs.

DESIGN NOTES: Concrete deck needs to be sloped away from building to drains as pavement surface follows same slope. Control joints in the reinforced concrete do not need to extend up through the bedding sand and pavers/slabs. Also, see Note 1 below.

INSTALLATION NOTES: Geotextile required above protective board to prevent bedding sand loss.



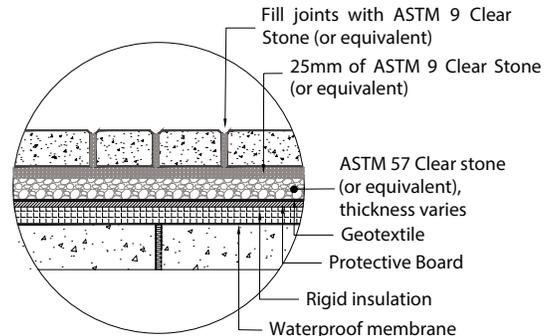
PERMEABLE STONE SET ON CONCRETE PATIO OR ROOFDECK

SUITABLE APPLICATIONS: Exterior patios or roofs over concrete decks where a flat pavement surface is preferred.

BENEFIT: Same as previous, plus pavement surface can be at nominal drainage slope (drainage can occur in the aggregate base).

DESIGN NOTES: Concrete deck needs to be sloped away from building to drains; thickness of ASTM 57 varies as needed to provide flat pavement surface. Also, see Note 1 below.

INSTALLATION NOTES: Size jointing material to accommodate joint width. ASTM 57 stone needs to be manufactured sharp stone (not round river rock) to prevent shifting.



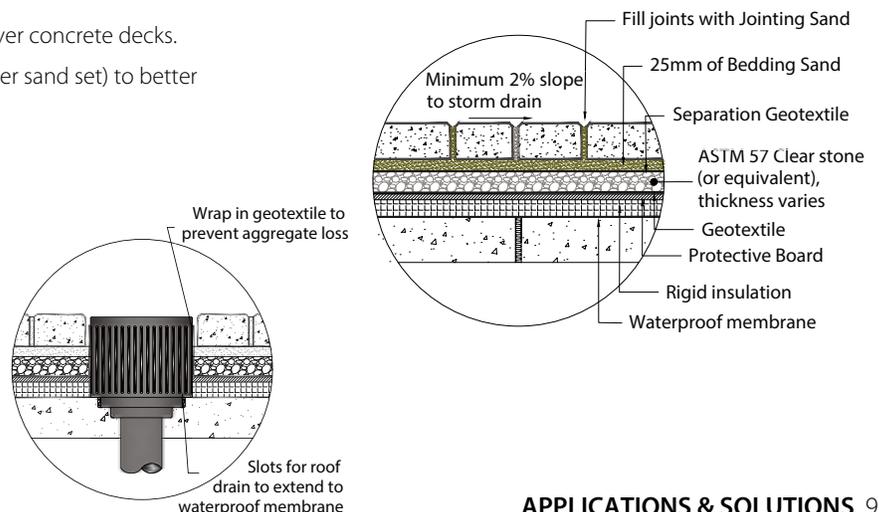
HYBRID SAND/PERMEABLE STONE SET ON CONCRETE PATIO OR ROOFDECK

SUITABLE APPLICATIONS: Exterior patios or roofs over concrete decks.

BENEFIT: Provides increased subsurface drainage (over sand set) to better handle moisture that infiltrated through the joints.

DESIGN NOTES: A separation geotextile is required between the bedding sand and ASTM 57 stone. Also, see Note 1 below.

Note 1: On all concrete patio or roof deck applications, the roof drains need to have side slots that extend down to the waterproof membrane so that any moisture below the pavers can escape. Wrap the outside of the drain with geotextile to prevent bedding material loss.



traffic defines product choices

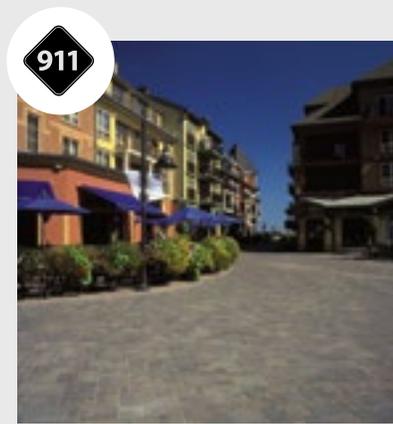
Designers often ask where we recommend each of our pavers and slabs can be used. Given that the answer is dependant on what will be on the pavement, we have identified six primary commercial *Pavement Classifications* with each representing a different traffic and/or vehicle weight scenario. The suitability of our pavers and slabs relative to each classification was then evaluated based on aspect ratio and/or finite element analysis results assuming a *Sand Set* on *Subgrade* installation; see *Oaks Tech Note 6 – Structural Design of Vehicular Paver Systems* for more information. In the Product Solutions Section (starting on Page 38) the icons below are used to identify which Pavement Classifications each of our pavers and slabs are recommended for.

PAVEMENT CLASSIFICATIONS



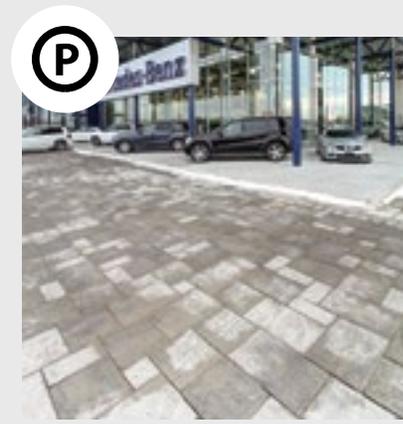
PEDESTRIAN PLAZAS

As long as there is no vehicle traffic, there are no restrictions on the product used. However, special handling equipment may be required for installation of larger scale pavers and slabs.



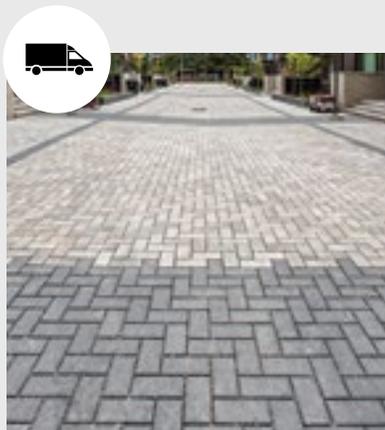
EMERGENCY & MAINTENANCE ACCESS ROUTES

Although primarily used by pedestrians, the occasional use by maintenance, snow removal or emergency response vehicles calls for limitations on the product dimensions to avoid cracking.



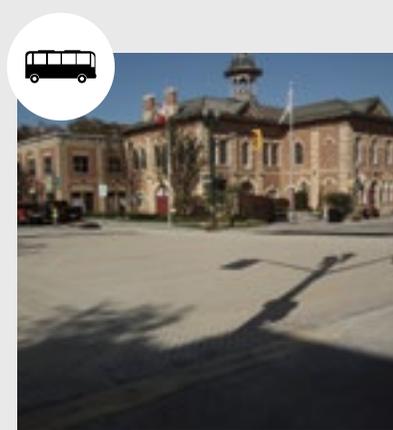
PARKING LOTS

Whether it is an office building or a mall, parking lots are primarily used by passenger cars, pickup trucks, and SUVs, but can be subject to the occasional delivery truck.



RESIDENTIAL ROADS

Provide access to single and multi family residential properties, with occasional truck, construction or bus traffic.



MAIN STREETS

Through traffic in downtown cores with general vehicle mix. Speed limit less than 5 km/hr (35 mph).



INDUSTRIAL AREAS

Frequent low speed heavy vehicle traffic and/or bulk material storage. Special consideration given to dynamic and point loads.

creating patterns & mosaics

One of the main reasons that Oaks Segmental Pavements are used by design professionals is the variety of colors, sizes and textures available. You can create everything from simple patterns to complex mosaics. When reviewing your options, it is important to note that some of our products come pre-blended with multiple-sized pieces in a bundle, while other products have several separately-packaged size, color and/or texture options that can be blended on site based on the design. The Product Summary pages indicate which products come in preblended or separately packaged bundles. PAT (pattern image) files are now available for Oaks pavers. We have made it easier for you to auto-fill design areas and rotate and scale patterns as needed. Copy our PAT files into the default AutoCAD support folder for hatch patterns, and Oaks patterns will be listed in your hatch menu.



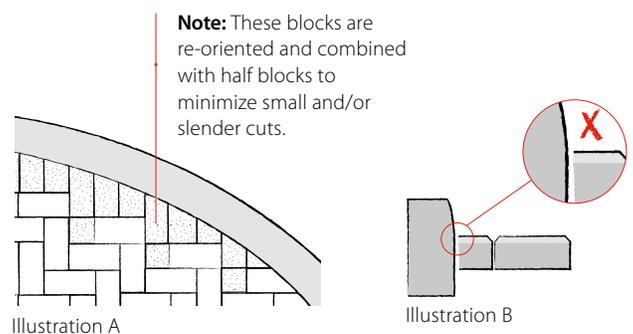
Pavers: Avenue Series, Matrix Finish; Ravenstone Black, San Mateo Rose & Appalachian White

HERE ARE SOME SIMPLE RULES TO FOLLOW WHEN CREATING PATTERNS AND MOSAICS:

1. Only use products approved for the given application (see Page 10 *Pavement Classifications*).
2. As the amount and weight of traffic increases, so does the required degree of interlock – the pavement needs to be able to distribute the forces exerted by starting, stopping and turning vehicles. Avoid extended seams. Sample laying patterns are available upon request or online at OAKSpavers.com.
3. In vehicular areas, avoid cut pieces less than 1/3rd the original paver length or cut longitudinally (see Illustration A). The cut pieces may be significantly weaker than a full-sized paver.
4. Avoid placing the cut face of a block against an adjacent edge restraint (see Illustration B). Cut faces should be positioned against an adjacent block chamfer to reduce visual impacts and prevent surface spalling.

PAT FILES FOR ALL OUR PAVER & SLAB PRODUCTS ARE AVAILABLE ONLINE!

Visit the **DESIGN TOOLS + GUIDELINES** page in the "Resources" section of our website: oakspavers.com/resources. There you'll find everything from laying pattern summaries to AutoCAD patterns, drawings and files.



safe pavements - trips, slips & wheelchair accessibility

Accessibility standards and building codes deal with individual elements of pavement safety. But there is no one regulation that clearly defines a truly safe pavement for all users. To help us develop products that are safe and comfortable for everyone, Oaks reviews and adopts design standards used by other industries.

HEEL SAFE

ASME: A112.6.3 SECTION 7.12 - HEEL RESISTANT STRAINERS AND GRATES

This guideline limits the maximum grate hole size to 0.31" (8mm) to help prevent heels from entering paver joints, causing injury or falls. We use it to develop our paving products, including permeable pavers. This size is well below Ontario's Accessibility Standard of 20mm and the US ADA Standard of 13mm, which focus on wheelchair tires and cane tips.



SLIP-RESISTANT

2012 INTERNATIONAL BUILDING CODE - ANSI A137.1 SPECIFICATIONS FOR CERAMIC TILE

We tested various paver and slab textures (from smooth to textured) and finishes (including EliteFinish™ and ColorBold™) to find out how changes affect slip resistance. All of our products exceeded the recommended DCOF (dynamic coefficient of friction) of 0.42 set by ANSI A137.1 for ceramic tile. Details on the DCOF testing can be found in *Oaks Tech Note 2 – Coefficient of Friction Testing for Pavers and Slabs*.



WHEELCHAIR VIBRATION

ASTM E3028 Standard Practice for Computing Wheelchair Pathway Roughness Index as Related to Comfort, Passability and Whole Body Vibrations from Longitudinal Profile Measurements

PathMeT's was used to measure the Wheelchair Pathway Roughness Index (WPRI) for a number of pavement surfaces. The results showed that pavers/slabs with 2mm wide chamfers have less of an impact on wheelchair users than even poured concrete surfaces. For this reason, all recently developed Oaks products – Eterna, Molina, Presidio, and Market Paver – have micro-chamfers (less than 2mm wide).



ADDITIONAL INFORMATION IS ALSO AVAILABLE ON THESE RELATED TOPICS:

- Light reflectance values of pavers – visual contrast for ramps and tactile surfaces.
- Skid resistance of pavers in vehicular applications.
- Snow melting systems for Segmental Pavements.

capital & life cycle costing

CAPITAL COST

According to an economic analysis report performed by Pavement Technologies Solutions, there are three primary factors that dictate whether a paver installation can be cost competitive to a traditional asphalt pavement, namely:

- the present cost of asphalt, which fluctuates with the price of oil
- the cost of the paver
- the method of paver installation

For our part, Oaks offers several economical machine install products.



Paver: Hydreau Pave



MACHINE INSTALLATION: Some of our products are manufactured in pre-set patterns for optional machine installation (see the adjacent icon). Mechanical installation can reduce costs significantly for projects over 1,000 square meters (10,000 square feet). Please contact us for product-specific stitching details and more information about mechanical installation.

what is the expected
service life of a sidewalk?

Concrete	Pavers	Asphalt
80 years	80 years	40 years

Source: Federation of Canadian Municipalities

LIFE CYCLE ANALYSIS

It has long been accepted that maintenance and rehabilitation costs - not just initial capital costs - should be considered when conducting an LCCA for pavements. "Life Cycle Cost Management of Interlocking Concrete Block Pavements - Methodology Report and Software" was developed by Applied Research Associated of Toronto to conduct LCCA for different pavement options including asphalt, cast-in-place concrete and segmental pavements. Please contact us for copies of the report and the software.

UTILITY MAINTENANCE

Segmental pavements offer the advantage of being able to remove and reinstate the wearing course, which can reduce labor, disposal and material replacement costs. There is no need for short-term patching products, and there are no changes to the area's overall appearance when complete. This alone can save significant costs.

Helpful Maintenance Tools:

- Interlocking Concrete Block Pavement Distress Manual
- Asset Management and Pavement Performance Prediction through Pavement Condition Index (Report and Software)
- ICPI Tech Specs 19 & 23
- Oaks Tech Notes 3 & 4

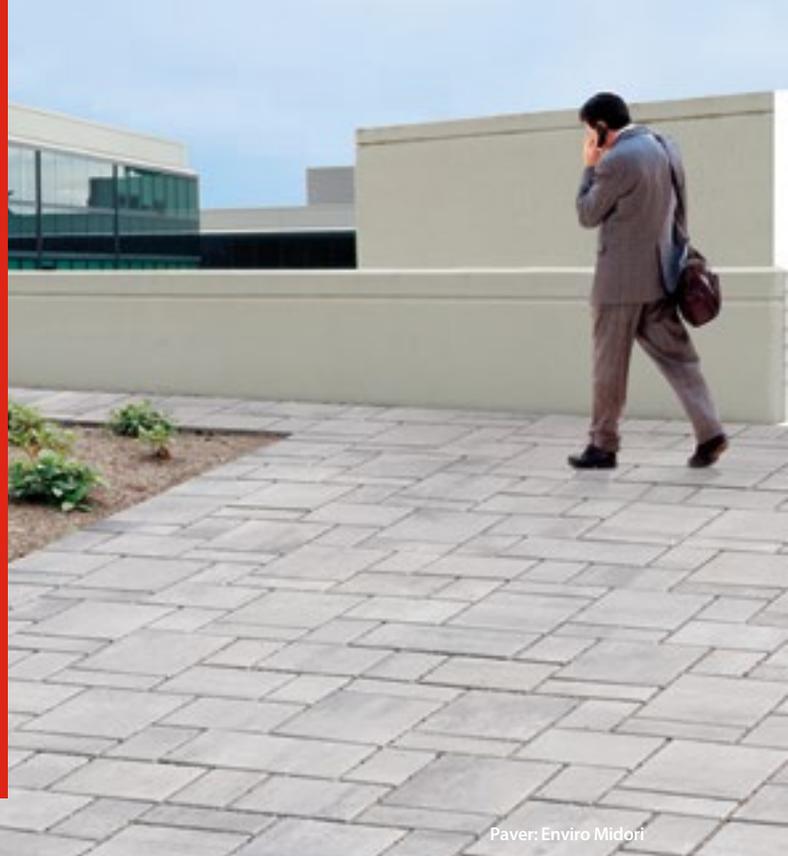


what is a permeable pavement?

Permeable pavements are pavement systems that allow water to pass through the surface in to an open-graded aggregate base. Recognized as a LID strategy, Oaks permeable pavements conform to municipal storm water regulations.

Associated benefits may include:

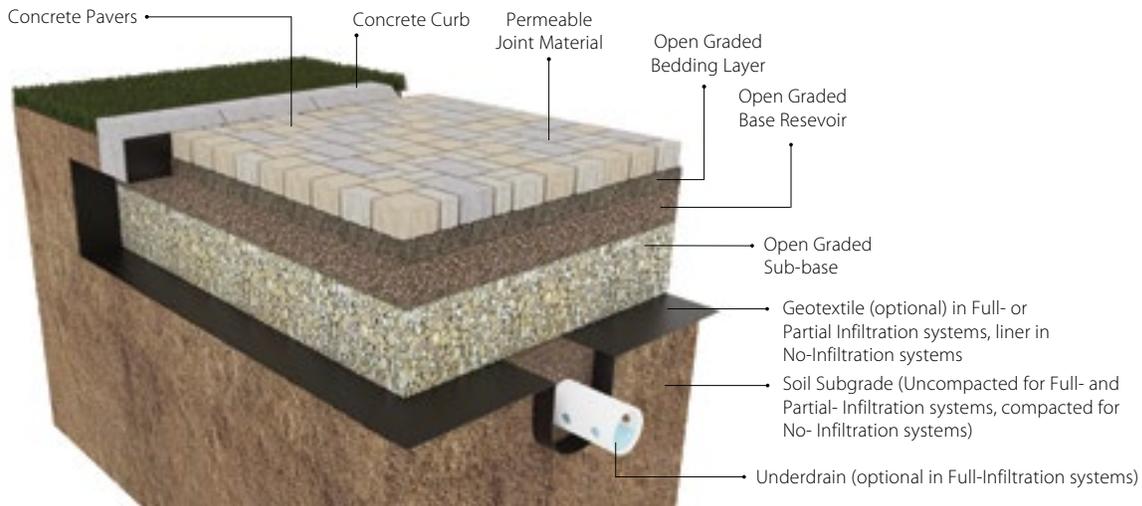
1. On-site storm water quantity management
2. Improved water quality
3. Groundwater and tree root zone recharge
4. Reduced hydraulic, erosion and thermal impacts to receiving waters
5. Possible reduction or elimination of traditional storm water management infrastructure



Paver: Enviro Midori

PERMEABLE PAVEMENT SYSTEM

Below are main components of a Permeable Interlocking Pavement (PICP) system.



ASTM No. 8 Grading Requirements Jointing and Bedding Aggregates	
Sieve Size	Percent Passing
12.5 mm (1/2 in.)	100
9.5 mm (3/8 in.)	85 to 100
4.75 mm (No. 4)	10 to 30
2.36 mm (No. 8)	0 to 10
1.16 mm (No. 16)	0 to 5

(commonly referred to as 1/4" clear stone)

ASTM No. 57 Grading Requirements Base Aggregates	
Sieve Size	Percent Passing
37.5 mm (1 1/2 in.)	100
25 mm (1 in.)	95 to 100
12.5 mm (1/2 in.)	25 to 60
4.75 mm (No. 4)	0 to 10
2.36 mm (No. 8)	0 to 5

(commonly referred to as 3/4" clear stone)

ASTM No. 2 Grading Requirements Subbase Aggregate	
Sieve Size	Percent Passing
75 mm (3 in.)	100
63 mm (2 1/2 in.)	90 to 100
50 mm (2 in.)	35 to 70
37.5 mm (1 1/2 in.)	0 to 15
19 mm (3/4 in.)	0 to 5

(commonly referred to as rail ballast)

All aggregate types listed should have less than 2% passing the No. 200 sieve, and should be manufactured sharp stone (not river rock)



This symbol is used in the Product Solutions section of guide to indicate a permeable paving product. Contact us if you need help sourcing open-graded aggregate materials.

selecting which PICP system to use

Some jurisdictions offer incentives for storm water quantity reduction or have limits on impervious cover, we recommend that you discuss using PICP with your local municipal and/or regulatory agency before proceeding with your project. If the agency is not familiar with PICP, Oaks staff can provide in-house training and design support.

Some common misconceptions about PICP:

1. **PICP can not be used in vehicular applications.** Permeable pavers are suitable for a wide range of vehicular applications, provided that speed limits are less than 65 km/hr (40mph).
2. **PICP are not safe in pedestrian areas.** Early versions of permeable pavers were a concern for pedestrians because of their large openings. Oaks more modern permeable pavers are designed to be safe for wheelchairs and pedestrians, and are heel-safe. (Details on Page 12)
3. **PICP cannot be used on clay soils.** Provided that systems are designed accordingly, PICP can be used on any type of soil. (Details below)
4. **PICP systems are too expensive to build and maintain.** Factoring the total cost of pavement, drainage infrastructure, storm water quality management and land, PICP can be a cost-effective option. (Details on page 21)

PERMEABLE PAVEMENT TYPES

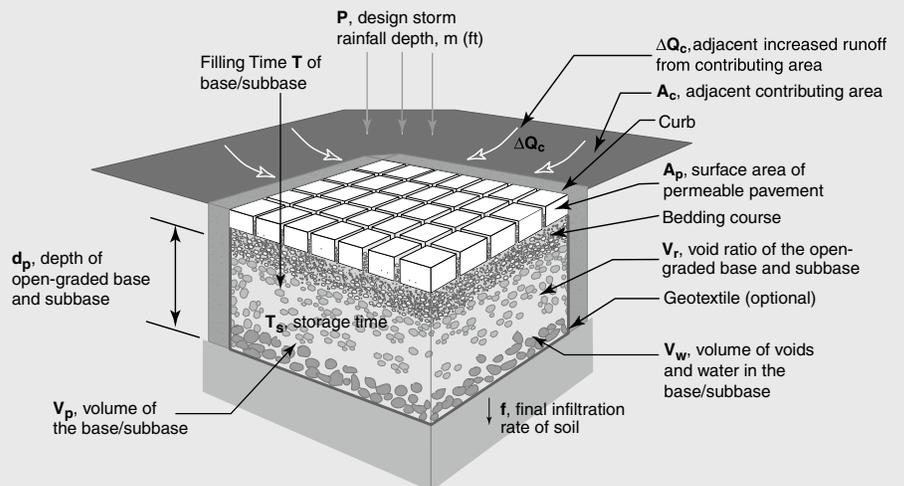
There are three main types of Permeable Pavement designs:

Full-Infiltration, Partial-Infiltration and No-Infiltration, each referring to the amount of water that infiltrates into the native sub-grade.

	SUB-GRADE INFILTRATION FEASIBLE/ PERMITTED	INPUT EXCEEDS INFILTRATION CAPACITY
FULL INFILTRATION: Use Full-Infiltration systems where the infiltration rate of the native soils exceeds the amount of water added to the PICP system. Underdrains and geotextile are optional.	YES	NO
PARTIAL INFILTRATION: Use Partial-Infiltration systems where the amount of water added to the PICP system exceeds the infiltration rate of the native soil and some degree of water storage is required. Include an under-drain and an outlet control device (see Page 18) to control the water storage depth in the sub-base.	YES	YES
NO INFILTRATION: Use No-Infiltration systems over very low permeability, swelling or contaminated soils, or where water harvesting is an objective. Include an under-drain and impermeable liner (on bottom and sides of the system).	NO	-

WATER BALANCE

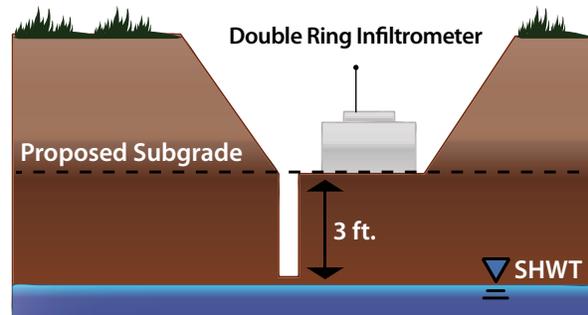
This diagram shows the parameters used in a water balance analysis for PICP (taken from *ASCE standard guidelines: Design, Construction and Maintenance of Permeable Interlocking Concrete Pavement*). Depending on the type of system, water inputs can include direct rainfall (P) and run-on from contributing areas (R). Outputs can include under-drain discharge (Qu) and infiltration into the subgrade (I). The base/sub-base volume (Vp), and the depth of the open graded base and subbase (dp) are based on the volume difference between the inputs and outputs over the duration of a storm.



hydraulic design factors

MEASURING SITE INFILTRATION

On-site infiltration testing should be done whenever possible to determine site values. Oaks recommends following the protocols laid out in Appendix C of the *TRCA / CVC Low Impact Development Stormwater Management Planning and Design Guide*. Double-ring infiltrometer or Guelph Permeameter testing should be used as the results are more accurate (they estimate the vertical movement of water only). The test should be done at the bottom elevation of the proposed subbase, which is where sub-grade infiltration will take place in the finished pavement. It should also be verified that the depth to the seasonably high water table (SHWT) is not within 1 meter (3 feet) of the subbase.



ASSESSING INFILTRATION RATES OF SOILS

As part of its Waste Water Flow Management Plan, the City of Toronto summarized the distribution of rainfall events for 16 rainfall stations across the city. The study concluded that 54% of daily storms in Toronto produce less than 5mm of precipitation, and 98% less than 35mm. This table shows sample infiltration rates for different soils. Precipitation of 1.5mm/hour for silty clay may not seem enough to work with a PICP system. But, comparing the daily total (36mm of water infiltration) to the results of the previous study, and it becomes apparent that this infiltration rate exceeds even the 98th percentile of storm events in Toronto.

In other words, even over silty clay storm water will infiltrate into the sub-grade within the same day as the storm event in all but the most severe storms.

SOIL TYPE	INFILTRATION RATE (mm/hour)
SAND	210mm (8.27")
SANDY SILT	26mm (1")
SILT	7mm (0.27")
SILTY CLAY	1.5mm (0.06")
CLAY	0.5mm (0.02")

Source: Porous Pavements



CONTRIBUTING WATER TO PICP

Many agency regulations allow PICP systems to receive run-on from roofs (see adjacent photo), adjacent impervious pavements, and/or stabilized pervious areas (such as lawns). Although these regulations typically specify a maximum run-on ratio (compared to PICP surface area), Oaks recommends that you perform a water balance analysis (introduced on Page 15) to determine if the system can accommodate the additional storm water. Adjust the design details as required.

To quantify the run-on, define the total area of each run-on source and estimate the contributing runoff from each source using the adjusted design storm(s) based on standard run-off practices. Be sure to also consider the potential for increased sediment and contaminant loads associated with the additional run-on. A sediment control chamber may be needed. (See Page 18)

PIPC pavement design



ASCE 68-18 Permeable Interlocking Concrete Pavement was developed to provide design, construction and maintenance guidance for permeable interlocking concrete pavements to achieve storm water management goals while providing a structurally adequate pavement section to accommodate the anticipated vehicular loading in a cost efficient manner.

For copies of the ASCE Manual, or to receive a lunch and learn on the topic **by one of its authors**, contact Oaks staff.

storm water modelling

Storm water modelling is performed to calculate and compare the following conditions: pre-development, post-development (uncontrolled), and post-development with BMP practices in place. Since there are no default values for PIPC using the Soil Conservation Service (SCS) Curve Numbers (CN) method, it is up to you to determine them.

Start by calculating the expected runoff from the surface of the pavers based on the typical CN for impervious surfaces (CN=98) using the traditional SCS equations below. Remember that a typical 85%-95% solid PIPC surface experiences losses similar to traditional pavements due to the cooling/wetting of the paver surface.

$$Q = (P - Ia)^2 / (P - Ia + S)$$

$$S = 1000/CN - 10$$

Where:

- Q = Total runoff depth (in.)
- P = Total precipitation depth (in.)
- Ia = Initial abstraction of losses before runoff begins (in.)
- S = Potential maximum retention after runoff begins (in.)

With traditional pavements, excess water collects and sheet flows off the pavement surface. With PIPC, excess water infiltrates through the joints between the pavers and into the base/sub-base. Surface overflow occurs only after the infiltration capacity of the sub-grade and/or the storage depth of the reservoir is exceeded. The equations used to calculate adjusted flows (Qadj) and adjusted CN (CNadj) are as follows:

$$Q_{adj} = Q - T_s - T_i$$

$$CN_{adj} = \frac{1000}{10 + 5P + 10Q_{adj} - 10(Q_{adj}^2 + 1.25Q_{adj}P)^{1/2}}$$

Where:

- CNadj = Adjusted curve number
- Qadj = Adjusted runoff depth (in.)
- Ts = Depth of water storage within aggregate reservoir (in.)
- Ti = Depth of water infiltrating into the subgrade over the duration of the design storm (in.)

Examples: 100 yr 24 Hr duration precipitation depth (P) = 8 in; for an asphalt pavement with CN = 98, Q = 7.76 in

Over clay soil using a No Exfiltration System

Ts = 4.8 in (using a 12" thick base)
 Ti = 0 (system is lined)
 Qadj = 7.76 - 4.8 - 0 = 2.96
 CNadj = 57
 (Underdrain discharge would be controlled using an orifice plate or similar)

Over silty clay soil using a Partial Exfiltration System

Ts = 4.8 in (using a 12" thick base)
 Ti = 1.44 in/day (see page 16)
 Qadj = 7.76 - 4.8 - 1.44 = 1.52
 CNadj = 43
 (Underdrain raised to minimize discharge, balance of stored water would infiltrate)

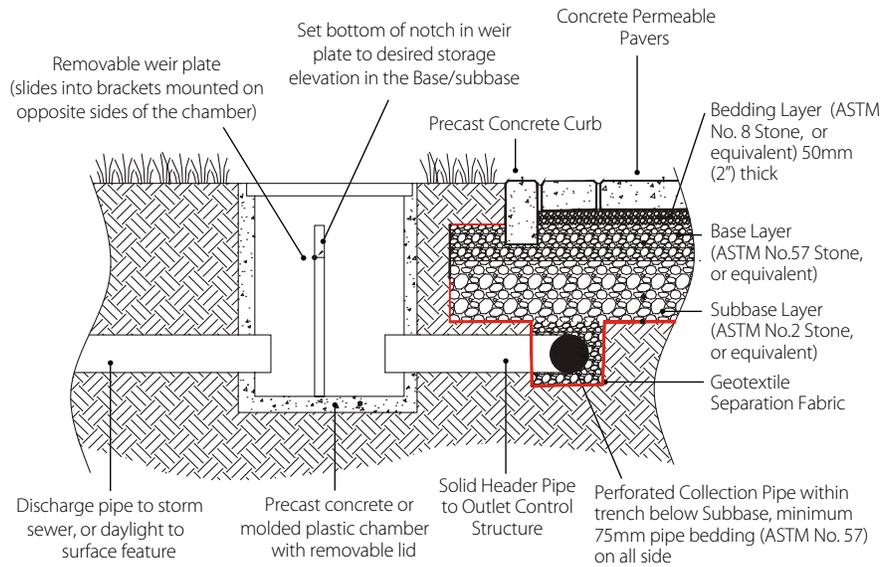
Over silt using a Full Exfiltration System

Ts = 4 in (using a 10" thick base)
 Ti = 6.48 in/day (see page 16)
 Qadj = 7.76 - 4 - 6.48 < 0
 CNadj = 0
 (No underdrain used, balance of stored water would infiltrate)

paying attention to the details

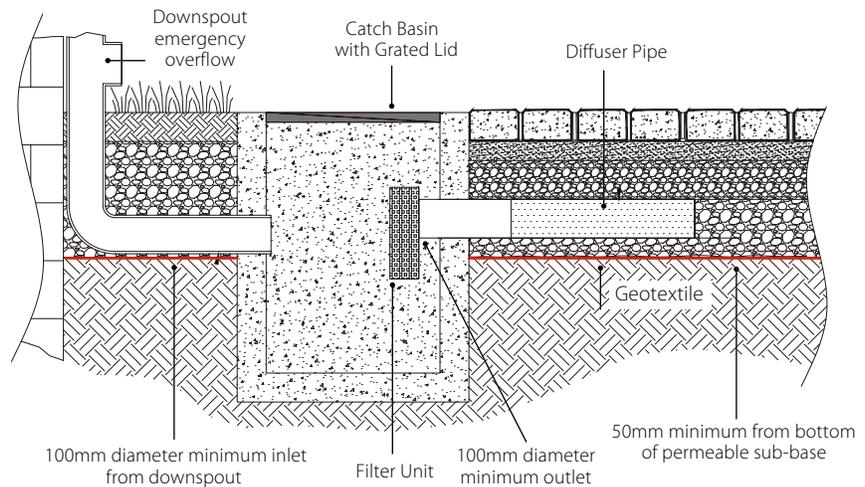
OUTLET CONTROL DEVICE

This device consists of a concrete or plastic vault with a weir plate through the middle. Use it with Partial-Infiltration systems to set the storage elevation of the base/sub-base (where the water does not discharge until it reaches the weir notch) or with No-Infiltration systems to regulate the outlet discharge rate (drill a flow restricting hole through the weir plate).



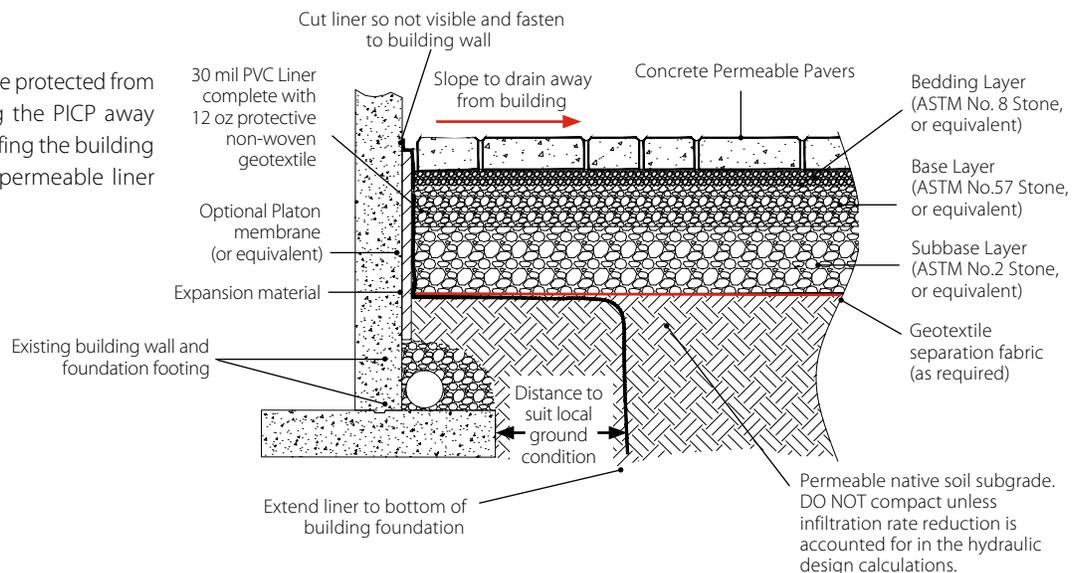
RUN-ON SEDIMENT CONTROL

When adding roof water and storm water from adjacent impervious surfaces, you may need a receiving structure to handle potential sediment and contaminant loads. This diagram shows a sediment control chamber. Please consult with Oaks staff for more information about available alternatives.



PICP ADJACENT TO BUILDINGS

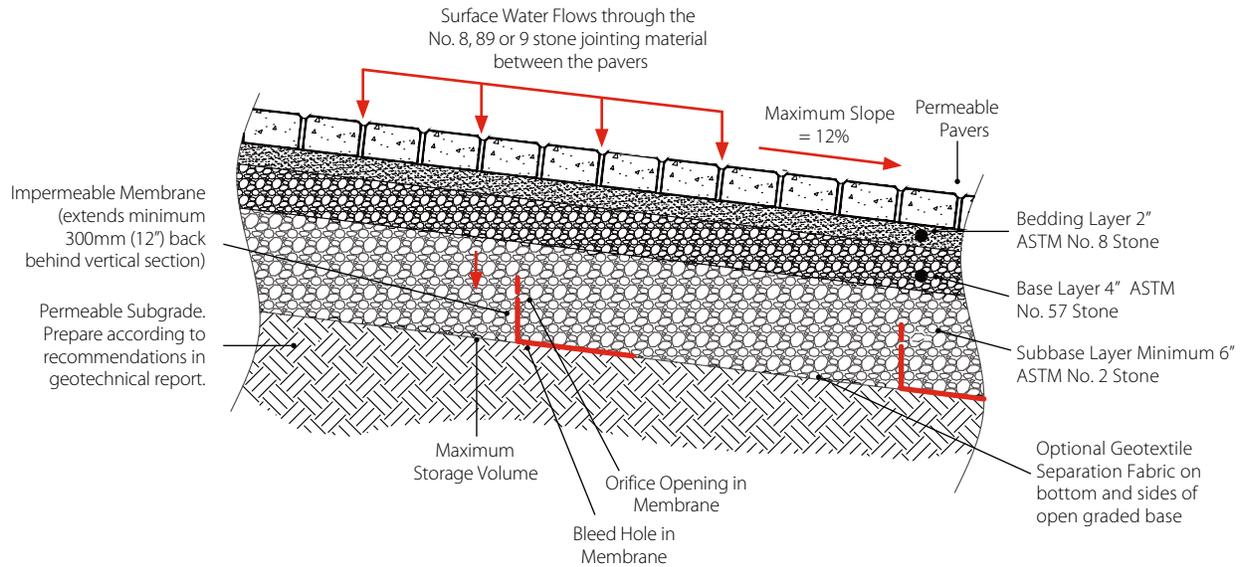
Building foundations should be protected from water infiltration by: sloping the PICP away from the building; waterproofing the building foundation; installing an impermeable liner near the foundation wall.



ALL OF THESE DETAILS ARE
AVAILABLE ONLINE!

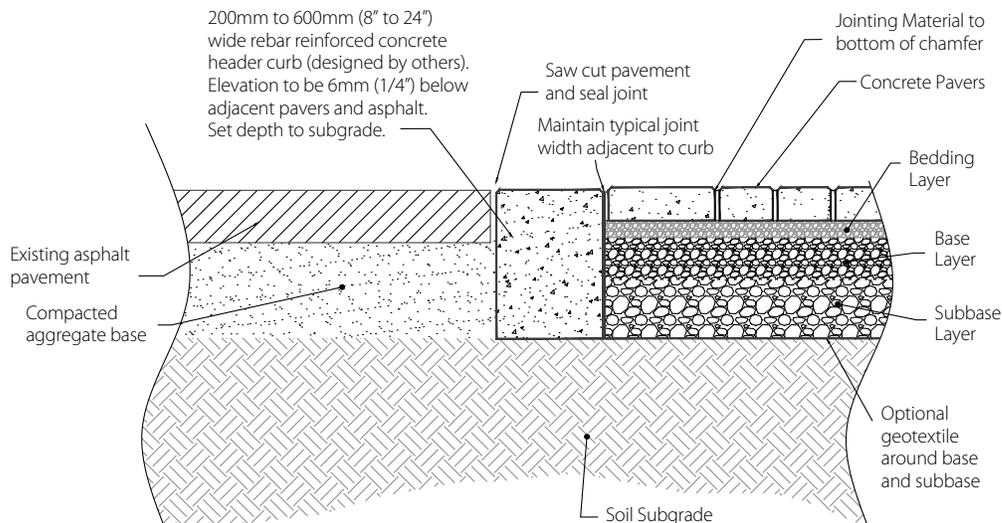
PICP ON SLOPES

For slopes exceeding 5%, use geomembrane check dams to control down slope flows, distribute infiltration over the entire length of the slope and prevent surges from exiting the pavement system at the bottom of the slope.



TRANSITIONS TO IMPERVIOUS SURFACES

Because conventional pavement bases and subbases are not designed for saturation, they require protection from water infiltration. Separate the two pavement systems with an impermeable barrier (geomembrane or concrete). Also consider sloping the PICP sub-grade away from the adjacent conventional pavements or installing under-drains at the interface.



designing for northern climates

Because winter conditions place unique demands on Permeable Pavements, extensive research has been done by the TRCA, the University of New Hampshire and the US EPA among others to evaluate how they perform in cold climates. These are some of the findings.

SNOW AND ICE COVER

Surface accumulations of snow can occur on Permeable Pavement in the winter. Snow has to melt before it can infiltrate. As with any other paving surface, if Permeable Pavement is not cleared before traffic drives on the surface, snow packing and ice formation may occur. To prevent ice formation, we recommend traditional snow plowing followed by spreading traction control aggregate as required. Instead of sand, spread the same aggregate used in the Permeable Paver joints.



Paver: Classic Series

Applying anti-icing or pre-wetting chemicals to Permeable Pavement is not recommended. Anti-icing agents, which melt snow before it can become compacted into ice, will likely infiltrate the system before a storm and impact local groundwater systems. And their magnesium or calcium chloride ingredients chemically attack the cement bond, causing the pavers to disintegrate. If the use of de-icing salts is required, as in the case of a zero ice policy, it is important to note an observation from the University of New Hampshire Stormwater Center: the use of permeable pavements resulted in a 75% average reduction in annual salt. Initial melt water was able to drain, leaving no standing water to re-freeze on the surface.

SURFACE INFILTRATION RATES

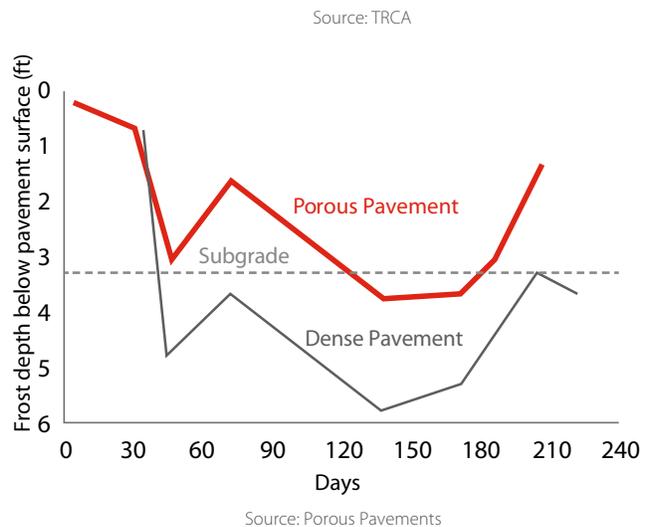
Except when packed ice is present on the surface (as noted above), surface infiltration rates of Permeable Pavement are not adversely impacted in cold climates. Although the jointing and reservoir aggregates may become frozen, they still maintain their porosity and permeability.

FROST PENETRATION

Road construction protocol calls for a non-frost susceptible material for a percentage of the frost penetration depth. Because Permeable Pavement profiles use non-frost susceptible materials (i.e. open graded aggregates) and are normally deeper than non permeable profiles, most Permeable Pavements in cold climates have not shown any slumping or frost heaving after years of monitoring.

Where water may be detained for an extended period of time or sub-grade soils are prone to differential frost heave (silts), deepening the road profile can be considered. If water freezes in the reservoir, it can expand into the open voids of the base/sub-base without heaving the pavement. Base/sub-base aggregates are also not likely to develop frost lenses (which cause differential frost heave) due to the lack of fines. Permeable Pavement reservoirs tend to thaw more rapidly due to infiltrating melt water.

winter data showed permeable pavement systems function well even during freezing temperatures.

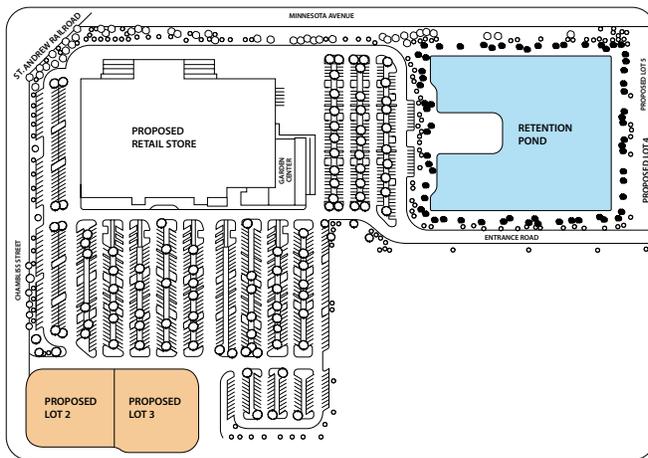


economics of PICP

CAPITAL COST ANALYSIS

To prepare a true capital cost comparison between Permeable Pavements and traditional practices, three areas of the development need to be considered:

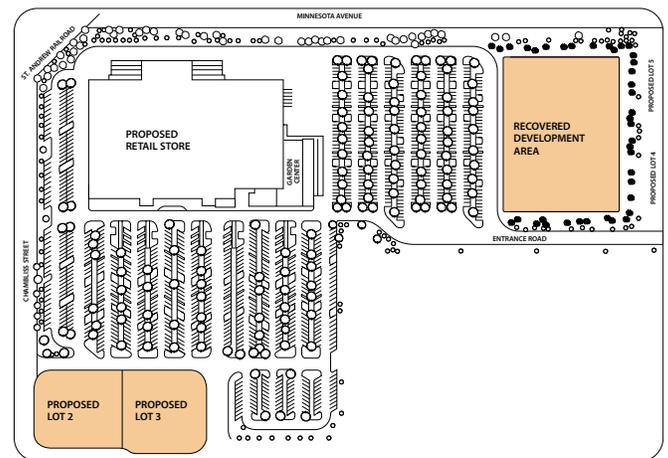
1. **Road Infrastructure** – permeable pavers are installed the same way as standard pavers, with significant cost saving through mechanical installation (see Page 13).
2. **Storm Water Infrastructure** – permeable pavements can reduce and even eliminate the need for traditional storm water infrastructure. The entire pavement surface is one large catch basin/filter, with base/sub-base aggregates providing retention/detention and lateral flow where required.
3. **Income Generating Footprint** – when retention/detention ponds are used, they can take up a lot of property. Consider the profitability of that portion of land if it were available for development, as well as its possible effects on property values. Oaks can provide you with capital cost comparison spreadsheets to help identify the different cost components that should be considered.



< **Option 1** – Traditional storm water management uses a retention pond that consumes 20% of the property footprint.

Using PICP created a **20% increase** in usable (i.e. revenue generating) land

Option 2 – Using PICP to manage onsite storm water, gains 20% of the property footprint for additional parking and revenue-generating buildings. >



LIFE CYCLE/BENEFIT COST ANALYSIS

We recommend using the TRCA Report “Assessment of Life Cycle Costs for Low Impact Development Storm Water Management Practices” and the “Low Impact Development Costing Tool” at the site-specific level. These were developed to help assess the design, installation, maintenance and rehabilitation costs over a 50 year period, based on northern conditions. We can help you work through the analysis to determine if Permeable Pavements can save you money.

A number of reports are available for reference at the municipal level. For example, the Philadelphia Water Department determined that Low Impact Development initiatives would provide 20 times the benefits of traditional storm water infrastructure of an equal value.

LID practice life cycle costs were between 35 and 77% less than conventional

Source: TRCA

PICP maintenance

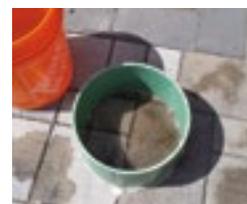
Refer to Oaks tech note #3 - Inspection, Maintenance and Repair of Permeable Pavements – for comprehensive PICP maintenance details. This is a brief summary of selected information.

ROUTINE MAINTENANCE & INSPECTIONS

PICP Maintenance prolongs the performance of the system and prevents problems from developing. Inspections ensure compliance with applicable regulations. This chart outlines recommended PICP routine maintenance and inspections.

ROUTINE MAINTENANCE	FREQUENCY
Display clearly visible signage identifying the surface as a permeable pavement	Improve visibility or replace as required
Vacuum sweep surface debris	Twice annually
Check depth of joint material	Replenish material when >13mm from surface
Check outlets are clear of debris	Ongoing
Verify surface infiltration rate	Annually
Conduct environmental compliance testing as required by the owner / regulatory agency	As specified

Vacuum sweep the PICP surface using a regenerative air sweeper or similar device with a slight vacuum capable of lifting sediment. Do not use a conventional street sweeper, which can remove jointing material and spread additional smaller sediment over the surface. *ASTM C1781 – Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems* is an easily reproducible and low-cost method of monitoring the performance of PICP. All you need is a 12" diameter plastic or metal ring, plumber's putty, a 20L pail and a stop watch. Test areas that most frequently encounter sediment or debris.



REMEDIAL MAINTENANCE

Remedial maintenance involves rectifying a performance problem or safety concern that needs to be corrected.

REMEDIAL MAINTENANCE	FREQUENCY
Repair ruts and deformations	Ruts > 13mm from grade
Reset shifted pavers	Paver > 6mm above or below grade
Re-stripping of lines	As required
Replace broken pavers	As required
Power vacuum surface and replenish jointing material	Infiltration < 250mm/hr or surface ponding observed
Clean out underdrains and inlet/outlet devices	As required

When power vacuuming the surface of the pavers, use a vacuum truck (like an Elgin Whirlwind or equivalent).

Please note: you do not have to vacuum the entire pavement surface, unless needed; focus vacuuming on specific areas prone to clogging; joint material will also be removed, so you will need to replace it immediately after the area is cleaned.

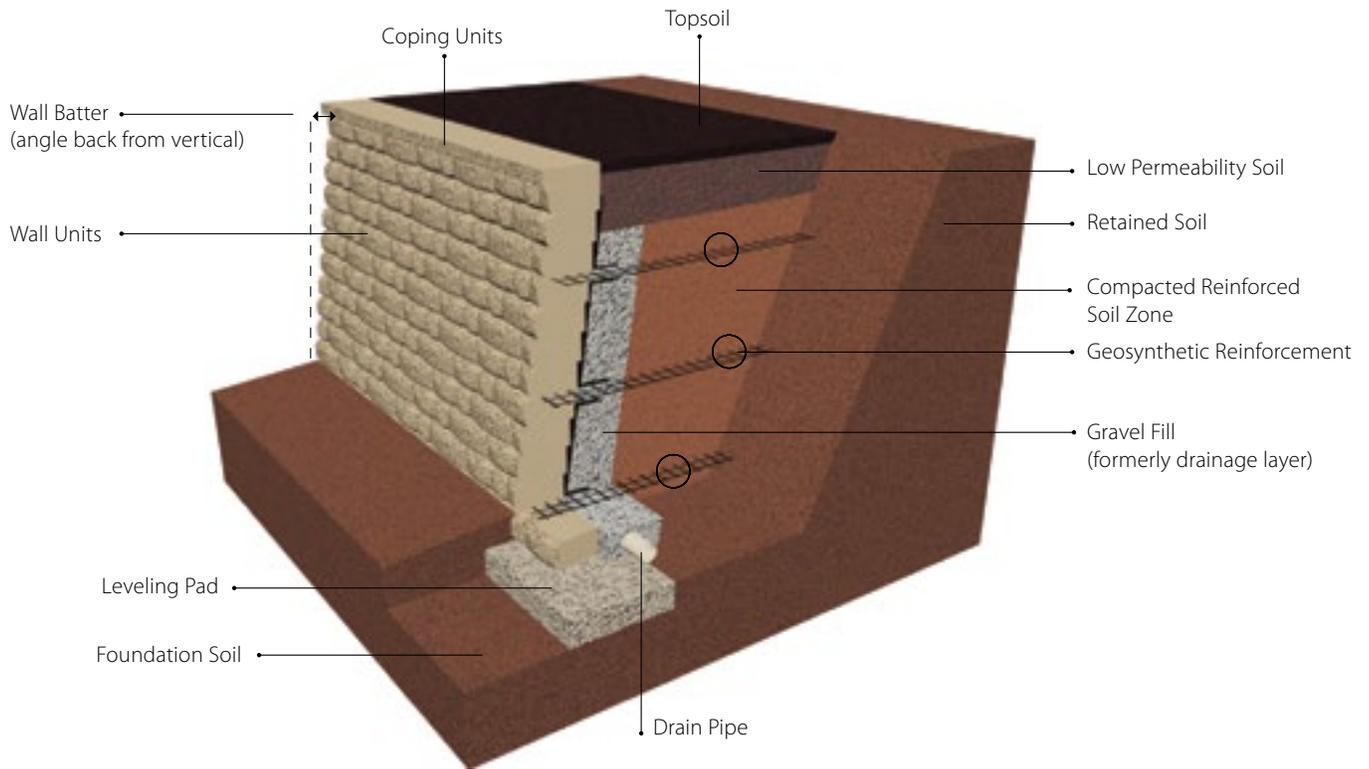


There is an ongoing study through the University of Toronto and NSERC that is investigating maintenance best management practices for PICP. New and innovative maintenance equipment, like the Typhoon PICP Joint Cleaning system are being introduced and evaluated. Contact Oaks for updates and information on the test results.

Please note: you do not have to vacuum the entire pavement surface unless needed; focus cleaning on specific areas prone to clogging. Joint material will also be removed, so be prepared to replace it immediately after the area is cleaned.

segmental retaining & architectural walls

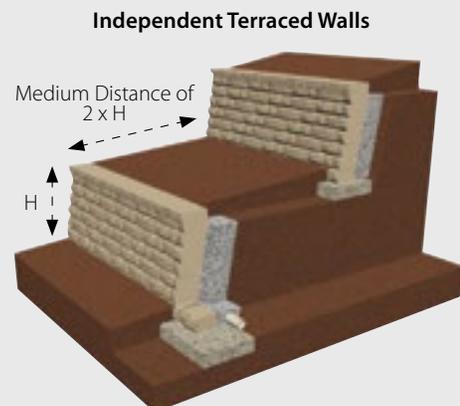
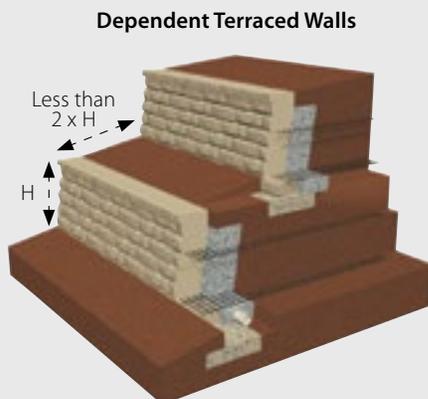
Segmental block walls and reinforced soil have been used for centuries (the most famous application is the Great Wall of China). Today's Segmental Retaining and Architectural Walls are a modern version of this age-old technology. The diagram below lists the parts of a typical Segmental Retaining Wall, while diagrams on page 24 shows the five primary commercial *Wall Classifications*. Icons identify where each wall product is recommended for use in the *Product Selections* pages.



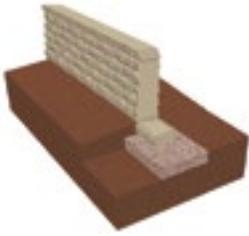
TIERED WALLS

For each wall to be independent of the other, tiered walls need to be built using a 2:1 ratio, with the upper wall built a distance away from the lower wall of at least twice the height of the lower wall. As well, the upper wall must be equal to or less than the height of the lower wall. This is a general rule of thumb and exceptions do exist.

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 into account global stability - the resistance to overall mass movement of the whole segmental retaining wall system in a circular or sliding mode.

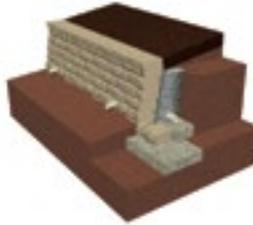


WALL CLASSIFICATIONS



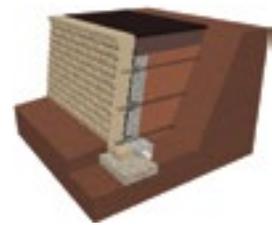
FREESTANDING

Freestanding walls are vertical architectural features finished on both sides. Typically they are small sitting walls (less than 600mm (2') high), but they have also been used as divider walls (see page 29) and even security features.



GRAVITY

Simple (single depth) Gravity walls depend on the mass of the individual wall units dry-stacked on top of one another to hold back the earth behind the wall. Due to the limited mass, these are typically restricted to low retaining walls.



GEOGRID

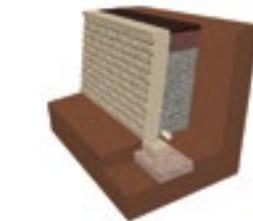
Geogrid (soil) Reinforced walls include multiple layers of geogrid reinforcement sandwiched between the wall units and extending back into the compacted reinforced soil zone. They are used when the limitations of a conventional Gravity wall are exceeded.



MULTI DEPTH GRAVITY

Multi Depth Gravity walls use products of at least two different depths to increase the overall mass of the wall. (**Note:** there must be a connection between the rows of wall units).

See adjacent page for more information.



STABILIZED BACKFILL

The Stabilized Backfill system is a unique solution commonly used when lot lines, rock outcroppings or other obstructions limit the amount of excavation that can be done, or to provide enhanced stabilization for fences situated close to the back of the wall.

See adjacent page for more information.

For batter, alignment and installation options, go to page 52 of the **Product Selections** section.

CALL BEFORE YOU BUILD – what are the local rules for retaining walls?

Retaining walls are engineered structures that require a site-specific design prepared by a Professional Engineer certified in the jurisdiction where the wall is being constructed. For example:

1. The Ontario Building Code (OBC) requires a site-specific design for retaining walls exposed over 1m (3') that are adjacent to; public property; access to a building; private property allowing public access such as a person's front yard for mail delivery to the front door.
2. Some local municipalities in Ontario have expanded Building Code requirements to include any retaining wall over 1m (3'), including those on private property.
3. The CSLA Canadian Landscape Standards recommends that any wall over 1.2m (4') or one that may be exposed to heavy or dynamic loading should be designed by a structural engineer. An evaluation of soil conditions by a geotechnical engineer may be required.

Check with your local municipality before proceeding with your construction project. Consult with Oaks staff if you require a site-specific design package. (See Page 26 for guidance on how to initiate a site specific design through Oaks)

GUARDS: The OBC also requires a guard at the open side of any wall that meets the above requirements, to prevent pedestrians from falling over the edge. Some municipalities have expanded this requirement to include any steps, ramps, exterior landings, porches, balconies, mezzanines, galleries, or raised walkways where:

1. There is a difference in elevation of more than 600mm (2') between the walking surface and the adjacent surface.
2. The adjacent surface within 1.2m (4') of the walking surface has a slope greater than 1:2.

You will need to incorporate additional design loads into the retaining wall design to compensate for pedestrians pushing against the guards. (See Pages 33 to 36 for more information on pedestrian guards and fences)

stabilized backfill wall

WHAT IS STABILIZED BACKFILL?

Stabilized backfill is a low strength ready mix concrete consisting primarily of aggregate, cement and limited water (low slump); the sand component is not included. Additives are used as required for local conditions. Mix designs are available.

WHAT DOES STABILIZED BACKFILL DO?

Stabilized backfill serves two primary functions: it increases the overall mass of the retaining wall structure, and it serves as the drainage layer behind the wall (reason why no sand is included in the material).

HOW IS STABILIZED BACKFILL PLACED?

Stabilized backfill can be poured directly from a ready mix delivery truck; conveyors and/or pump trucks can also be used where available. The material should be placed in maximum 600mm (2') lifts, and because it has a low slump will need to be worked into place. Do not add water as this could compromise the strength of the end product. Geogrid is placed between the wall blocks and stabilized backfill at every third course to provide a connection between the two materials.

WHEN TO USE STABILIZED BACKFILL?

This approach is commonly used when lot lines, rock outcroppings or other obstructions limit the amount of excavation that can be done, or to provide enhanced stabilization for fences situated close to the back of the wall.

Please consult with Oaks staff for stabilized backfill supplier contacts.



multi depth gravity wall

WHAT IS A MULTI DEPTH GRAVITY WALL?

Multi depth gravity walls use products of at least two different depths (Proterra, Ortana) to increase the overall mass of the wall.

WHAT DO THE DEEPER UNITS DO?

The deeper units increase the overall mass of the retaining wall structure, eliminating the need for geogrid behind the wall.

HOW ARE THE DEEPER UNITS PLACED?

Clamps are required to place Proterra units, where double or triples are used, the clamp needs to open to as much as 1125mm wide (see photo below).

WHEN TO USE MULTI DEPTH GRAVITY WALLS?

This approach is commonly used when lot lines, rock outcroppings or other obstructions limit the amount of excavation that can be done, or where future works behind the wall could potentially compromise the structural integrity of a geogrid reinforced wall. Examples would be future planting of trees or installation of an inground pool. In both cases, any geogrid behind the wall could become damaged during excavation.

Please consult with Oaks staff when ordering for multi depth gravity walls as the specific units needed will differ depending on the desired facial appearance of the wall.



wall design – how can Oaks help?



retaining wall design request form

GENERAL INFORMATION

Applicant: _____ Date: _____
 Contact Name: _____ Wall Installer: _____
 Phone #: _____ Wall Installer Contact #: _____
 Email: _____ Wall Installer Email: _____
 Applicant Type: Architect Engineer Landscape Architect Contractor
 Home Owner Developer Other _____

PROJECT INFORMATION

Project Name: _____
 Project Address: _____
 Contact: _____
 Site Plan Available: Yes No Geotechnical Report Available: Yes No

DESIGN SERVICE INFORMATION

Date Needed: _____ Bid/Start Date: _____
 Service Requested: Wall Design for Quoting Drawing for Building Permit Application
 Construction Drawings
 Product Requested: Protterra Ortana/Ortana Plus Ortana Extended Nueva Wall
 Wall Type: Single Unit Gravity Multi Unit Gravity Stabilized Backfill Geogrid Reinforced

BASIC SITE INFORMATION

Number of walls on project: _____ Wall batter: (check the appropriate boxes)
 Maximum height: _____ 0° 3.5° 7° 8° 16°
 Surcharge at top of wall: Landscape/Pedestrian Vehicular Slope
 Building Pool Other _____
 Tiered: Yes No
 If yes, provide tier information (setback, heights, # of tiers) _____

 Rail or fence at top of wall? Yes No If yes, type of rail or fence: _____
 Site soil description: Clean sands and gravel (ø=36") Sands, sandy silts (ø=32") Silts, sandy and silty clays (ø=27")
 (if geotechnical report not available)
 Slope below wall: Yes No How steep: _____ How high: _____
 Site soil used for infill? Yes No Engineered or native? _____
 Water application? Yes No Details: _____
 Special site requirements/Information: _____

	0°	3.5°	7°	8°	16°
Ortana			X	X	X
Protterra™ (split)		X	X	X	X
Protterra™ (smooth)		X	X	X	X
Nueva 150 Wall				X	X

Each specific retaining wall product, and each Wall Classification, have their own benefits and limitations. Oaks staff are available to help you decide which product/classification combination(s) will work best for your given application.

Oaks created the adjacent check list to ensure we know all the required particulars of your given project. We ask that you submit this completed form, along with a site plan and geotechnical report (where available) so that we can properly evaluate the project.

Factors that Oaks staff will consider include:

- Wall purpose
- Wall height and alignment
- Desired aesthetics
- Surcharge conditions
- Proximity to property line or other existing / proposed barriers behind the wall
- Water impacts above, below or behind the wall
- Construction access
- Site soils
- Type of backfill material being used

To download a digital fillable version of this form go to: www.oakspavers.com/ESF_EN.pdf

general costing comparisons

Once we have narrowed down the most suitable product / design option(s), we can use our proprietary estimating tool to generate costing comparisons. Below is an example of a comparison between geogrid reinforced and multi depth gravity designs for a proposed 2m high wall. Costing is broken down into Material & Labour, and Material Only so it is clear where the true costs are.

ECONOMIC COMPARISON	GRID WALL		GRAVITY WALL	
	Mat & Labour	Material Only	Mat & Labour	Material Only
Levelling Pad	\$22.05	\$3.89	\$46.56	\$8.21
Proterra	\$553.99	\$403.99	\$851.39	\$701.39
Gravel Fill & Drainage	\$36.69	\$26.34	\$36.69	\$26.34
Reinforced Zone & Grid	\$450.65	\$138.14	NA	NA
Low Perm Soil & Geotextile	\$14.46	\$3.70	\$14.46	\$3.70
TOTAL PER METRE OF WALL	\$1,077.84	\$576.06	\$949.10	\$739.64
TOTAL PER SQUARE METRE	\$485.51	\$259.49	\$427.52	\$333.17

project specific quantity estimates

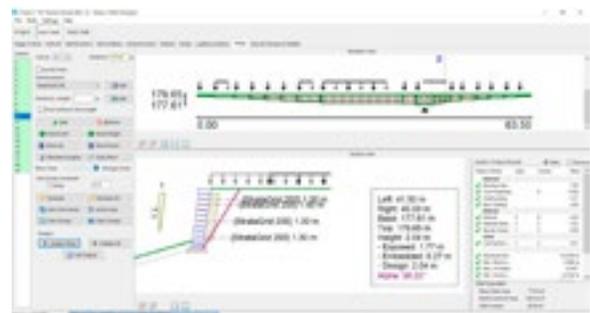
VESPA MSE (Mechanically Stabilized Earth) design software was created by retaining wall design experts to provide accurate quantity estimates and comprehensive reports while simultaneously performing the necessary analysis in accordance with NCMA (National Concrete Masonry Association) methodologies.

WHAT WE NEED FROM YOU?

A scalable site plan complete with TOW (top of wall) and BOW (bottom of wall) elevations is ideal, but hand sketches will work as long as the distances between elevation points are provided.

WHAT VESPA DOES

Once we input the dimensions of the wall, along with some site specific design details, VESPA generates a wall profile (upper part of screen) and series of cross sections (lower part of screen). The wall profile shows the location of every single unit within the wall. The cross sections show the required lengths of geogrid, or depths of stabilized backfill, for each panel in the wall.



Quantities

Wall	Facing	Wall/Cap Length [m]	Facing Area [m ²]	Total Wall Area [m ²]
East Wall	Proterra	64	66	78
West Wall	Proterra	22	8	12
		85	73	89

Wall	Leveling Pad [m ²]	Reinforced Fill [m ³]	Drainage Fill [m ³]	Core Fill [m ³]
East Wall	6.6	45.8	16.2	0.0
West Wall	2.2	0.0	1.5	0.0
Totals:	8.8	45.8	17.6	0.0

Reinforcements

Wall	SG200 [m ²]	Geogrid Connectors
East Wall	202.3	0
West Wall	0.0	0
Totals:	202.3	0

WHAT OAKS GIVES TO YOU

Material quantities (see adjacent) can be exported directly from VESPA that list not only the area and length of the wall (from which we can determine the retaining wall product needs) but also the volume of aggregates needed for the levelling pad, reinforced fill (where applicable), and drainage fill as well as the quantity of geogrid and geotextile needed.

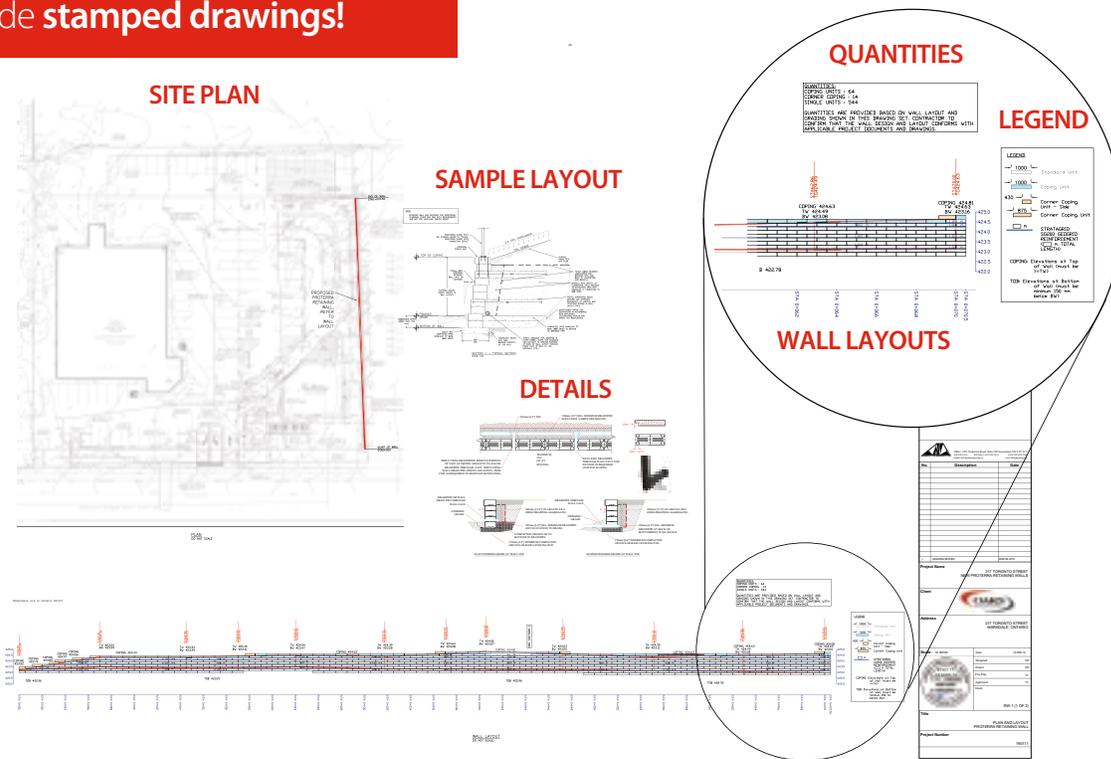
In short, there is more than sufficient information available for local contractors to generate an accurate price estimate.

stamped wall drawings

As mentioned on Page 24, site specific design drawings may need to be submitted to the local regulatory agency for approval and/or construction drawings are desired for tender purposes. Oaks can assist with that.

Wall cross sections and elevation views generated by VESPA can be imported directly into AutoCAD to make a clear and comprehensive drawing package complete with material quantities, color coding of different units for easy identification during construction, wall layouts complete with grid locations / lengths for the entire wall, and applicable details to ensure a quality installation.

We provide **stamped drawings!**



Below is an example of a mosaic in a wall. This particular wall is adjacent to a wave pool, so the contractor decided to incorporate a wave into the wall itself. Where a mosaic is desired, we can show exactly what the mosaic will look like on the wall layout (see above). Because every unit in the wall is shown on the layout, there is no guess work onsite during construction – in essence, we are providing a large scale Lego kit complete with instructions.



creating outdoor features or spaces



Pavers: Eterna, Dover, Nickel & Onyx
Wall: Modan, Cloudburst

Garden walls are an aesthetic and effective way of separating patios and gardens. The very nature of architectural wall products make them an economical alternative to complex prefab kits or veneered masonry walls. Architectural walls are an easy way to delineate an outdoor patio, create a cozy courtyard in which customers and staff can sit and relax, or simply provide extra seating.



Firepit: Castlerok 2, Sandstone
Pavers: Enviro Passagio, College Red with Wexford, Santa Fe border
Curb: Castlerok 2 Curb, Sandstone



BBQ Surround: Modan, Cloudburst & Twilight
Pavers: Eterna, Dover & Onyx



Proterra™ (split), Natural



Proterra™ (smooth), Natural

positive first impressions



Ortana, Timberwood & Greyfield blended on site

Segmental blocks can enhance the character of a site by creating simple entrance features, planter boxes, pillars and low garden walls. They can also manage troublesome grade changes and, using tiered walls, provide for pockets of color and life. Raised planter areas also help protect vegetation by discouraging pedestrians from walking in the area.



Ortana, Timberwood & Greyfield blended onsite



Modan, Cloudburst



Proterra™ (smooth), Natural

First impressions are important. People are more likely to enter an establishment if the entrance is inviting. Entrance features can also take on a grand scale, conveying a sense of prestige.

segmental retaining walls increase usable space



Proterra™ (split), Natural

Retaining walls are commonly used to create more usable space onsite, particularly where there are dramatic grade changes over short distances. The rear yard in the above photo would have been un-usable by the home owner without the addition of the retaining walls, and accessibility is maintained between levels through built in staircases.



Proterra™ (split), Natural

In commercial applications, consideration must to be given to providing easy access to customers / clients. A retaining wall was used in the adjacent project to “flatten” the parking lot making it easier to push around the available shopping carts.

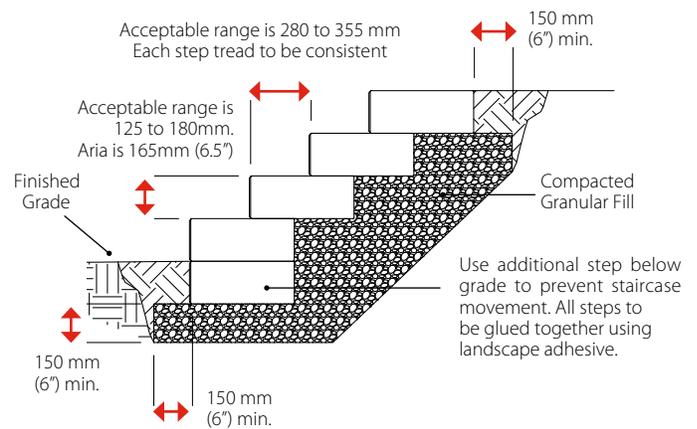
Just a reminder that the associated retaining wall designs can be quite complex – please remember to ask Oaks about design assistance.

constructing ramps, staircases & seating

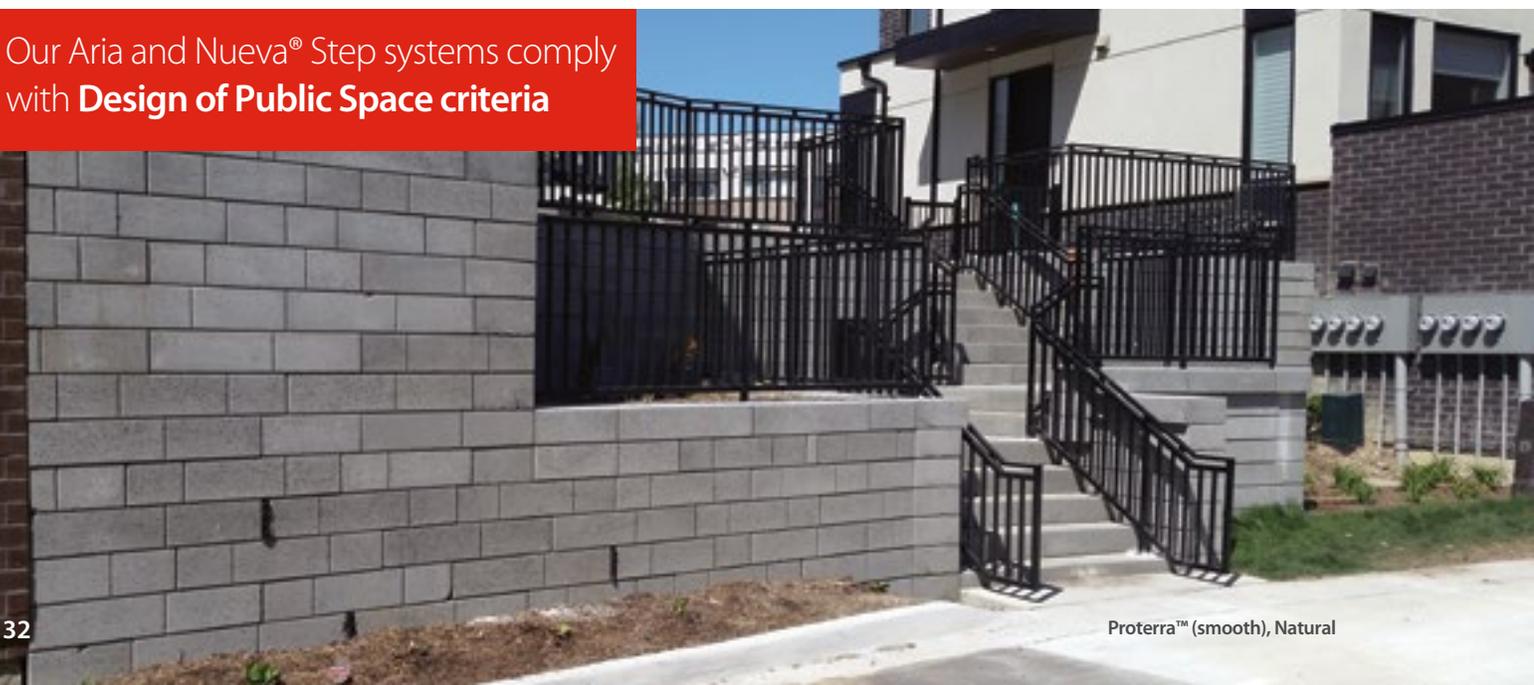
Ramps are an economical method of providing accessibility compliance to grade changes. Architectural and retaining walls are often used to contour along the outside of a gentle entrance way ramp, or to provide the actual grade change for elevated ramp structures.



The Integrated Accessibility Standards define an acceptable range of tread rise (vertical change) and run (depth of step tread) that is more stringent than the original OBC criteria – see adjacent. After consultation with contractors and designers, Oaks developed two step systems (to date) to address their aesthetic objectives, provide compliant design options, and improve constructability and in turn long term stability – see Page 57 for product details.



Our Aria and Nueva® Step systems comply with **Design of Public Space** criteria



incorporating guards, fences and barriers



Proterra™ (split), Natural

Whenever a guard, fence or barrier is placed at or near the top of a retaining wall, there is a potential for overturning at the post location. People lean against guards. A car can strike the barrier. Snow could be pushed up against the fence. Wind can exert pressure on solid (glass panel or board) fences. For these reasons, minimum setback requirements from 0.3m (11.8") to 1.0m (39.4") are usually applied between the back of the wall and the centerline of the guard, fence or barrier. The greater the setback, the lower the impact on the wall facing. Because property owners prefer not to have large spaces between the fence and the back of the wall (wasted space that is difficult to maintain), Oaks has developed creative ways to incorporate guards, fences and barriers into SRWs.

MECHANICS OF WALL OVERTURNING

People or objects pushing against a guard or fence can cause overturning around the bottom of the guard/fence post. If the guard/fence post is buried behind the wall, a surcharge at the back of the wall can occur. To avoid this and prevent the whole system from moving, the weight of the wall and soil in front of guard/fence and the resistance of the geogrid, need to be sufficient.

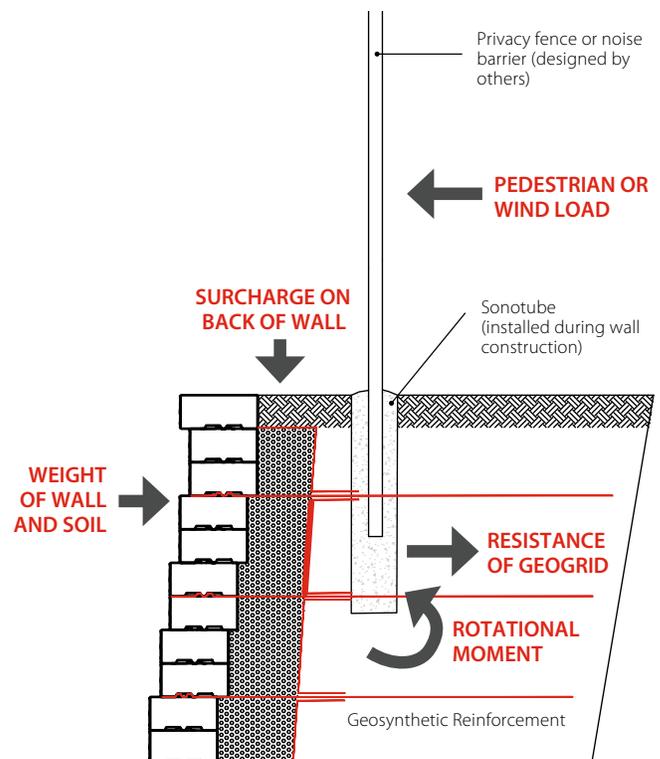
When designing pedestrian guards you need to analyse the following:

1. The horizontal load applied inward or outward on any point at the top of the guard (e.g. 200 lbs at each post).
2. An evenly distributed vertical load applied at the top of the guard (e.g. 50 lbs/linear foot of wall).

The load that creates the most critical condition applies.

For wind loads consider:

1. The percent of area obstructed by the fence – this can range from 3% for chain link to 100% for solid wood.
2. Wind pressure – available in Canada in the National Building Code, Appendix C. Typically 1/30 hourly is used.

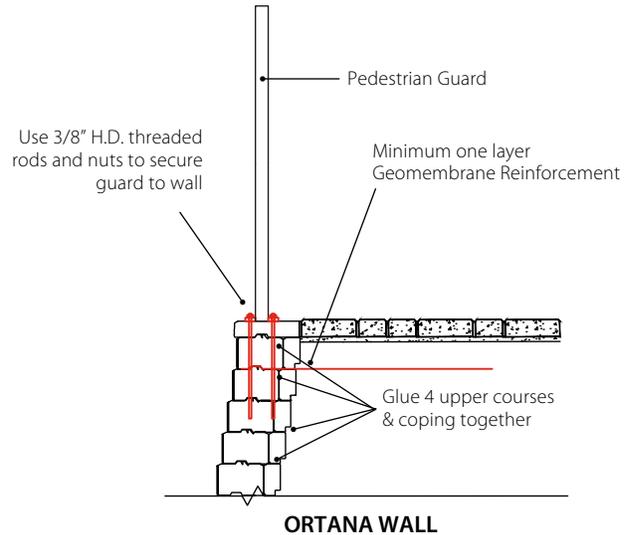


incorporating guards, fences and barriers

PEDESTRIAN GUARD OPTIONS

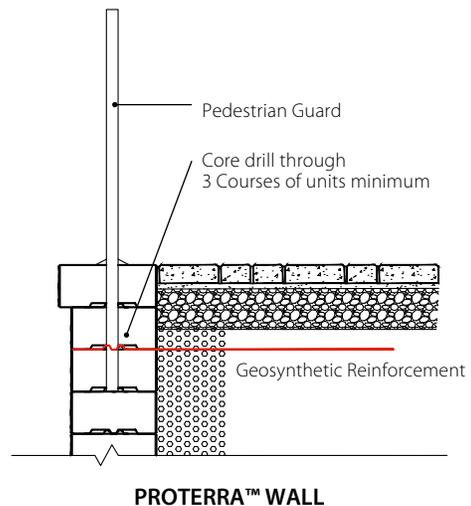
SURFACE MOUNTED

With our Proterra™ and Ortana products, it is possible to surface mount the guard to the top of the wall. (DO NOT simply glue the top few units together!) Fasten together mechanically a minimum of three courses of wall block using threaded rods epoxy'd into place, with the face plate of the guard fastened directly to the rods.



CORE DRILLED INTO WALL

If you are using Oaks Proterra™, you can core drill into the wall blocks and grout tubular steel pedestrian guard posts into place. At the very least, the posts should extend through three courses of block to provide sufficient weight to resist overturning. Be sure to crown the grout at the surface to shed water away from the core holes.



SURFACE MOUNTED WITH SONOTUBE REINFORCEMENT

For smaller Oaks products, the weight of the wall will not provide the required resistance to overturning. For best results, secure the guard posts in Sonotubes filled with concrete. These are best located behind the wall (per diagram on Page 33). Where space is tight, you can install the Sonotubes under the wall, with the SRW independent of the fence posts.

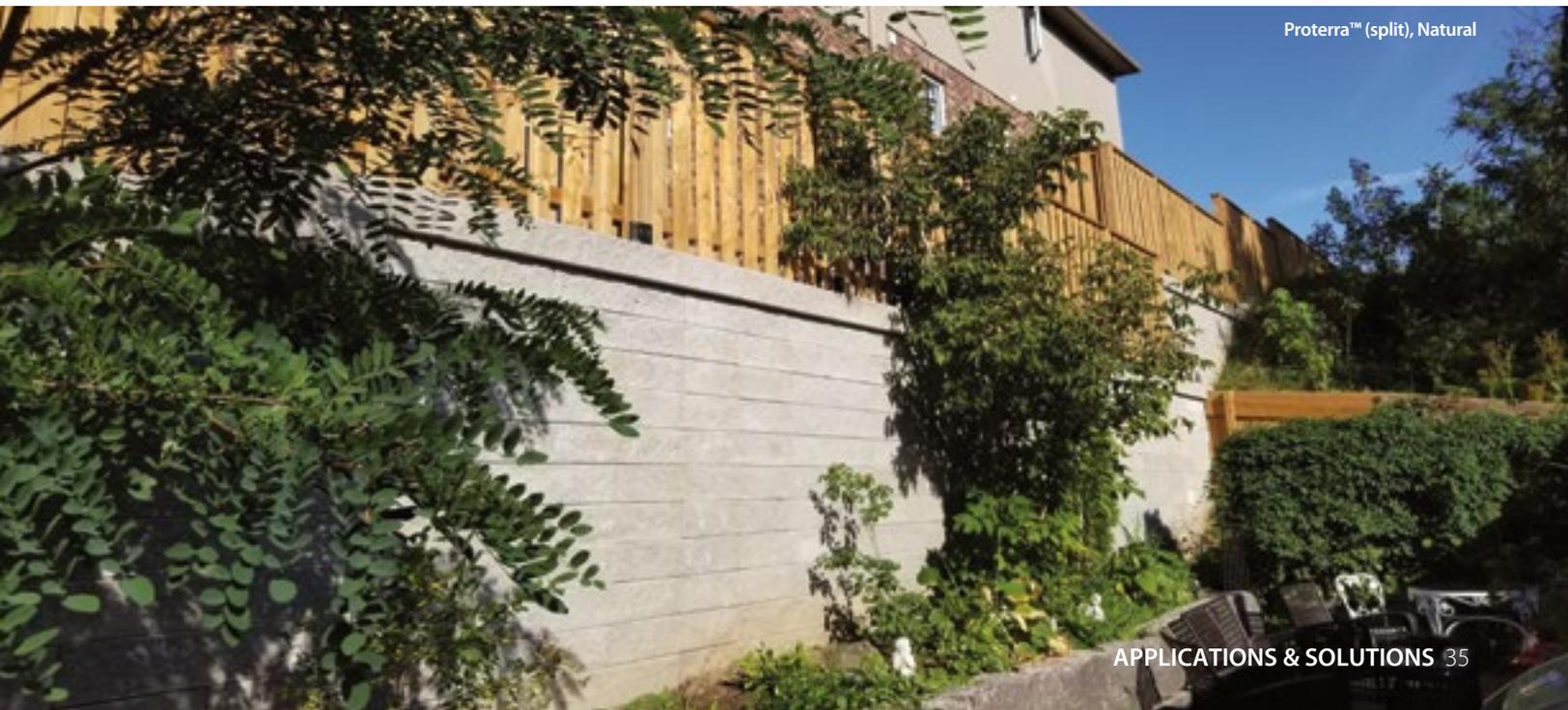
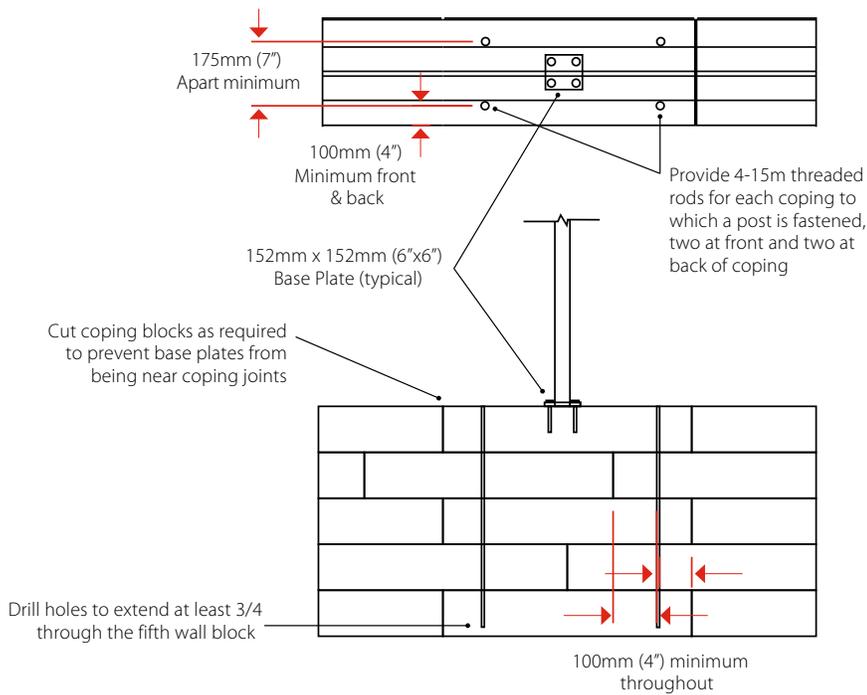
incorporating guards, fences and barriers

FENCE OPTIONS

Design requirements for walls with fences at or near the top depend on the type of fence. With limited wind load, chain link fences are designed the same way as pedestrian guards. Wooden privacy and glass panel guards/fences on walls act as large sails, so the wall must be designed to account for wind loads.

With Oaks Proterra™, you can surface-mount the fence posts to the coping units, as long as the coping is mechanically fastened to at least four additional courses of wall block. Epoxy a rod into a drill hole at each of the four corners of the coping. (See diagram)

PRIVACY FENCE OR NOISE BARRIER SURFACE MOUNTED ONTO WALL

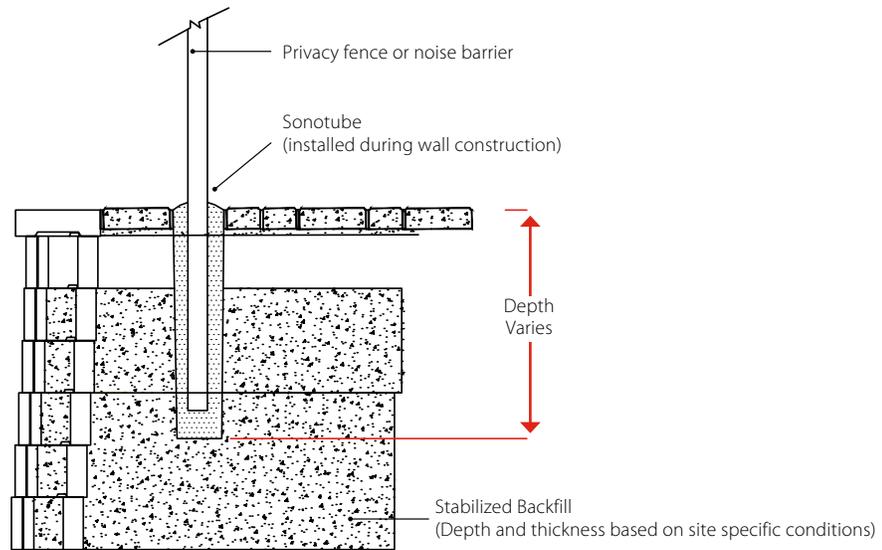


Proterra™ (split), Natural

incorporating guards, fences and barriers

FENCE OPTIONS

PRIVACY FENCE OR NOISE BARRIER IN STABILIZED BACKFILL



If you are using smaller Oaks wall products, install fences in Sonotubes 1m (3') behind the wall or use stabilized backfill behind the wall (per above graphic and image below). Stabilized backfill is much more rigid than granular fill; the increased rigidity distributes the overturning action over a greater area which allows the fence or barrier to be moved closer to the wall face.

TRAFFIC BARRIER OPTIONS

For gravity and geogrid walls, always install traffic barriers in 1.5m (5') deep Sonotubes a minimum of 1m (3') behind the wall. For stabilized backfill walls, you can move the traffic barrier closer to the wall. The photo adjacent shows this type of installation, with traffic barrier posts inserted and grouted into the Sonotubes after the wall was completed.



IMPORTANT When a fence is within the Reinforce Soil Zone, install Sonotubes during wall construction. This will prevent damage to the grid resulting from sleeves being punched or augured through the reinforced zone. Wrap the geogrid around the Sonotube. Cut only the cross members of the grid, not the strength members. Provide at least 25mm (1") clearance between the inside of the sleeve and the outside of the post to allow for mortar and grout.

drainage design & water considerations



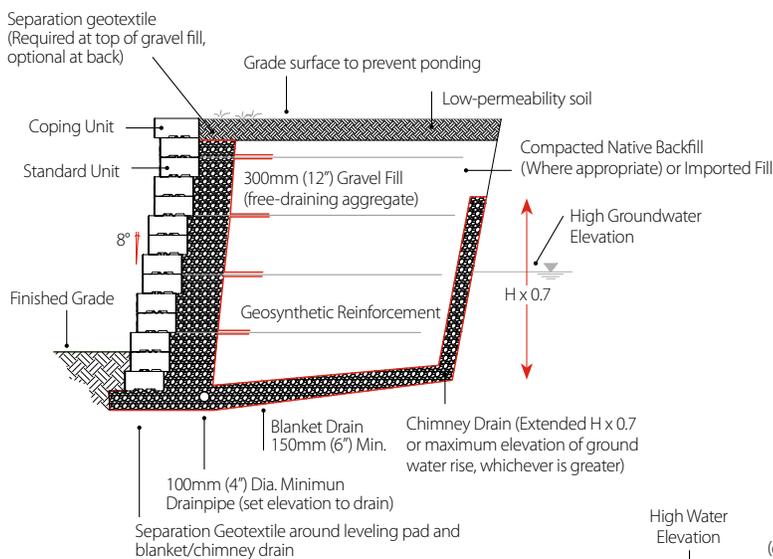
Improper management of surface water can cause erosion. When water infiltrates the Gravel Fill or Reinforced Soil Zone, it can overload a wall. Drainage swales made of low to negligible permeability materials such as clay, plastic liners or concrete can divert water around the back of the wall (see below). Scuppers can provide for controlled flows over the crest of the wall, but they need to include proper erosion control features at the toe of the wall. Drainage inlets can collect water and direct it towards storm water facilities or out the face of the wall.

WATER CAN INCREASE THE PRESSURE BEHIND A WALL BY 2.5 TIMES!

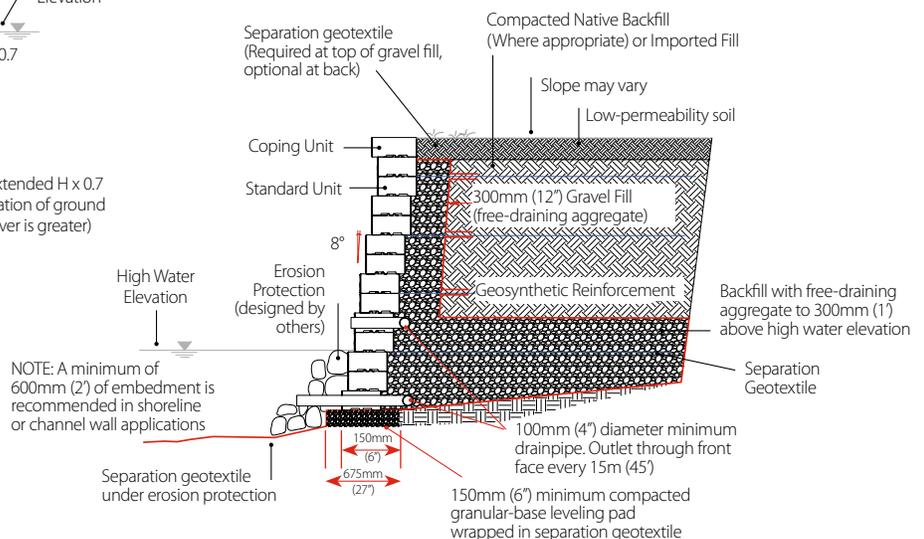
Groundwater can weaken foundation soils supporting the wall, clog drain pipes, and increase external loads on the wall. Blanket or chimney drains may be required to divert groundwater around the wall structure (see below).

When using walls for shoreline stabilization or erosion / sedimentation control along stream banks, some unique considerations need to be addressed in the wall design, such as: erosion at the toe of the wall; potential build up of hydrostatic pressure behind the wall (especially when rapid water level draw down occurs); the forces of waves and ice sheet flows exerted on the face of the wall.

POTENTIAL GROUND WATER DETAIL



WATERFRONT APPLICATION

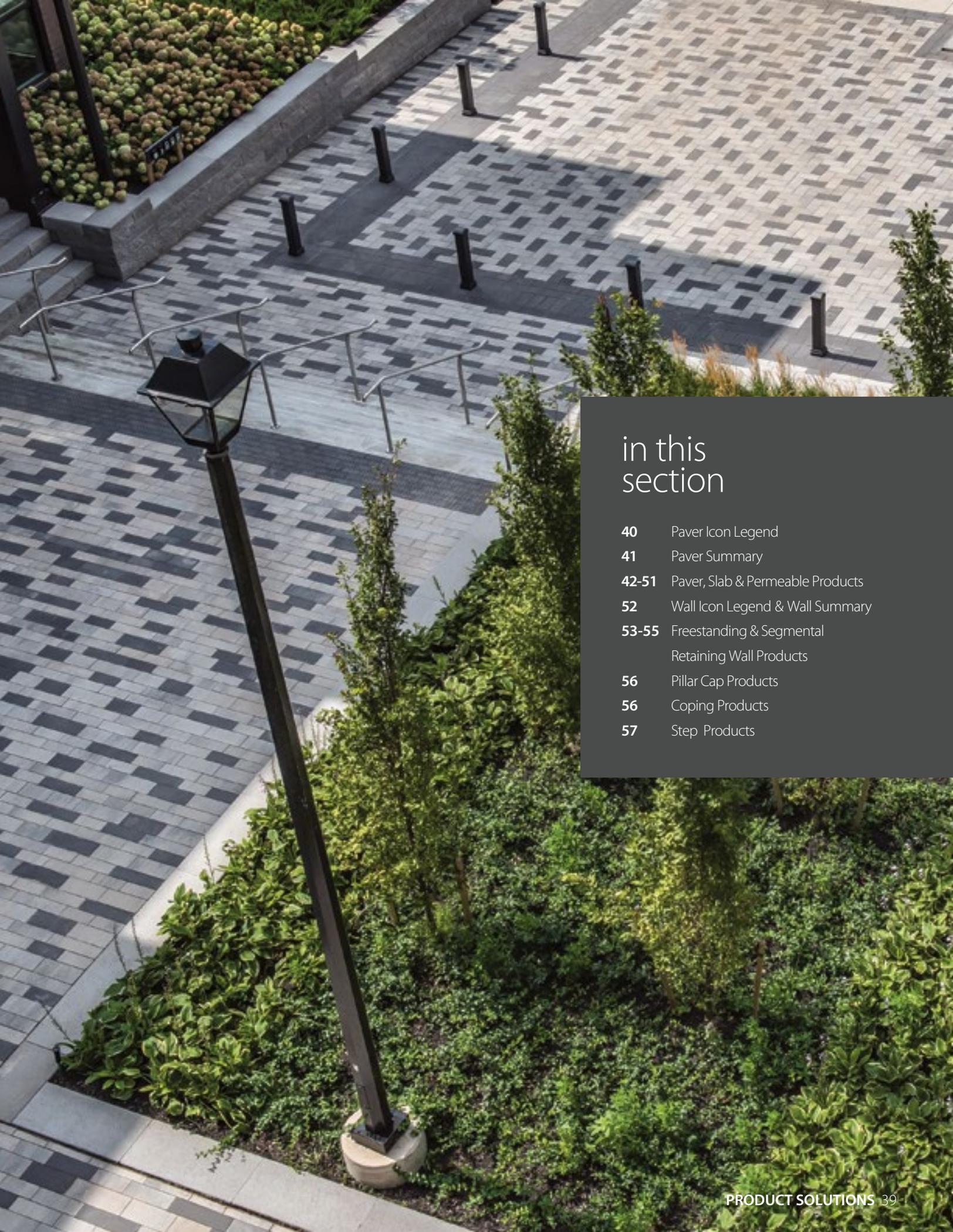


product solutions

Owing to the range of colors, sizes, thicknesses, textures and applications available, Oaks Products are the preferred choice of design professionals. This section will guide you through making the right choices for your segmental pavement or wall design application, including product selection, color palettes and applications. With all Oaks Products, we are always available to assist you with any special requirements of your project, such as soil type, barrier construction or water management.

Paver: Presidio, Marble Grey & Onyx
Wall: Proterra™, Natural (split)





in this section

- 40** Paver Icon Legend
- 41** Paver Summary
- 42-51** Paver, Slab & Permeable Products
- 52** Wall Icon Legend & Wall Summary
- 53-55** Freestanding & Segmental Retaining Wall Products
- 56** Pillar Cap Products
- 56** Coping Products
- 57** Step Products

paver icon legend

PAVER TRAFFIC LOAD

- PEDESTRIAN PLAZAS
- RESIDENTIAL ROADS
- RESIDENTIAL DRIVEWAYS
- MAIN STREETS
- EMERGENCY & MAINTENANCE ACCESS
- INDUSTRIAL AREAS
- PARKING LOTS

See page 10 for details on each of these Paver Traffic Loads.

ENVIRONMENTAL COMPLIANCE

- CAN APPLY FOR LEED CREDITS
- PERMEABLE PAVER
- SOLAR REFLECTANCE INDEX (SRI)

INSTALLATION METHODS

- DESIGNED FOR MACHINE INSTALL (SEE PAGE 13)

TECHNOLOGY

- EliteFinish™**
Product produced with enhanced finish technology
- ColorBold™**
Product produced with enhanced color technology

See page 5 for details on each of these Technologies.

how to use this section

Tells you the colors available within the product line

Tells you the paver name & thickness

Tells you which country has this paver available as a stock item

Tells you if this product has any environmental accreditations or unique technology features

product name (thickness)

Swatch Image COLOR NAME Swatch Image COLOR NAME Swatch Image COLOR NAME Swatch Image COLOR NAME Swatch Image COLOR NAME

STONE NAME Unit Image Stone Name Width 000 mm (0.0') Length 000 mm (0.0') Pieces/layer: 00 Coverage/layer: 00%

STONE NAME Unit Image Stone Name Width 000 mm (0.0') Length 000 mm (0.0') Pieces/layer: 00 Coverage/layer: 00%

STONE NAME Unit Image Stone Name Width 000 mm (0.0') Length 000 mm (0.0') Pieces/layer: 00 Coverage/layer: 00%

STONE NAME Unit Image Stone Name Width 000 mm (0.0') Length 000 mm (0.0') Pieces/layer: 00 Coverage/layer: 00%

BUNDLE (IF APPLICABLE) Unit Image Unit Image Unit Image Unit Image Stone Name Width 000 mm (0.0') Length 000 mm (0.0') Pieces/layer: 00 Coverage/layer: 00%

STONE NAME Unit Image Stone Name Width 000 mm (0.0') Length 000 mm (0.0') Pieces/layer: 00 Coverage/layer: 00%

Tells you the Traffic Load and Installation Method for the specific paver unit or bundle

If the specific color has an SRI of 29 or greater, it will be indicated with this icon and the SRI rating

Tells you the individual stone sizes available and bundling options

paver summary

	Width(s) in millimeters	Length(s) in millimeters	Paver Thickness							
AVENUE SERIES - PAGE 46 (SPECIAL ORDER)										
4x8 Herringbone	100	100, 200	80	•	•	•	•	•	•	•
4x8	100	100, 200	80	•	•	•	•	•	•	•
8x8	200	200	80	•	•	•	•	•	•	•
8x12	200	300	80	•	•	•	•	•	•	•
12x12	300	300	80	•	•	•	•	•	•	•
12x16	300	400	80	•	•	•	•	•	•	•
CASSINA COPING - PAGE 48										
8x12 Stone	200	300	70	•	•	•	•	•	•	•
CENTURION - PAGE 47										
Combo	70, 140, 210	140, 210, 280	70	•	•	•	•	•	•	•
Standard	140	210	70	•	•	•	•	•	•	•
Jumbo	210	280	70	•	•	•	•	•	•	•
Quad	280	280	70	•	•	•	•	•	•	•
Double Jumbo	280	420	70	•	•	•	•	•	•	•
CLASSIC SERIES - PAGE 50										
4x8 Herringbone (SPECIAL ORDER)	100	100, 200	60	•	•	•	•	•	•	•
4x8	100	100, 200	60	•	•	•	•	•	•	•
8x8 (SPECIAL ORDER)	200	200	60	•	•	•	•	•	•	•
12x12 (SPECIAL ORDER)	300	300	60	•	•	•	•	•	•	•
COLONNADE - PAGE 49										
Combo	75, 150	150	60	•	•	•	•	•	•	•
6x9	150	225	60	•	•	•	•	•	•	•
9x9	225	225	60	•	•	•	•	•	•	•
9x12	225	300	60	•	•	•	•	•	•	•
ENVIRO MIDORI - PAGE 44										
Herringbone	120	120, 240	80	•	•	•	•	•	•	•
Random	120, 240	240, 360	80	•	•	•	•	•	•	•
ENVIRO PASSAGIO - PAGE 47										
Combo	125	152, 190, 228, 266	70	•	•	•	•	•	•	•
ETERNA - PAGE 42										
100x300	100	300	100	•	•	•	•	•	•	•
100x400	100	400	100	•	•	•	•	•	•	•
200x600	200	600	100	•	•	•	•	•	•	•
400x600	400	600	100	•	•	•	•	•	•	•
NUEVA® SLAB - PAGE 51										
Combo	200, 400	400, 600	50	•	•	•	•	•	•	•
Rectangle	200	400	50	•	•	•	•	•	•	•
HYDR'EAU PAVE - PAGE 45										
Combo	100, 200	100, 200, 300	80	•	•	•	•	•	•	•
MARKET PAVER - PAGE 46										
4x8	100	200	70	•	•	•	•	•	•	•
MOLINA® (80 mm) - PAGE 42										
Combo	300	300, 450, 600	80	•	•	•	•	•	•	•
MOLINA® (60 mm) - PAGE 49										
Combo	300	300, 450, 600	60	•	•	•	•	•	•	•
MONTEREY - PAGE 50										
8x16 Small Rectangle	200	400	50	•	•	•	•	•	•	•
Random	300, 400, 600	400, 600	50	•	•	•	•	•	•	•
16x32 Large Rectangle	400	800	50	•	•	•	•	•	•	•
OASIS COPING - PAGE 49										
Coping Unit	600	360	60	•	•	•	•	•	•	•
PRESIDIO - PAGE 44										
Rectangle Stone	168	336	80	•	•	•	•	•	•	•
Combo	126, 168	301, 401, 501	80	•	•	•	•	•	•	•
RIALTO (50 mm) - PAGE 51										
Random	200, 400	400, 600	50	•	•	•	•	•	•	•
16x24 Rectangle	400	600	50	•	•	•	•	•	•	•
RIALTO (80mm) - PAGE 43										
Random	200, 400	400, 600	80	•	•	•	•	•	•	•
16x24 Rectangle	400	600	80	•	•	•	•	•	•	•
RIDGEFIELD PLUS - PAGE 48										
Large Combo	200, 300	300, 400	70	•	•	•	•	•	•	•
RIDGEFIELD SMOOTH - PAGE 48										
Large Combo	200, 300	300, 400	70	•	•	•	•	•	•	•
TURF-SLAB - PAGE 45										
Combo	400	600	80	•	•	•	•	•	•	•
VILLANOVA - PAGE 45										
Rectangle	199	398	80	•	•	•	•	•	•	•
Combo	398	398, 597	80	•	•	•	•	•	•	•

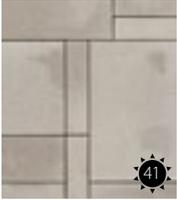
paver, slab & permeable products

eterna (100 mm)  

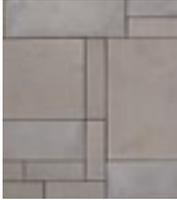


STOCK COLORS

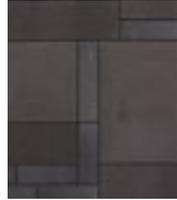
SPECIAL ORDER ONLY



DOVER



NICKEL



ONYX



DARK OAK



OLIVE



PLUM



TERRA COTTA

100x300 STONE



100x300 Stone

Width 100 mm (3.94")
Length 300 mm (11.81")
Pieces/layer: 33
Coverage/layer: 100%
Individually Packaged



100x400 STONE



100x400 Stone

Width 100 mm (3.94")
Length 400 mm (15.75")
Pieces/layer: 22
Coverage/layer: 100%
Individually Packaged



200x600 STONE



200x600 Stone

Width 200 mm (7.87")
Length 600 mm (23.62")
Pieces/layer: 8
Coverage/layer: 100%
Individually Packaged



400x600 STONE



400x600 Stone

Width 400 mm (15.75")
Length 600 mm (23.62")
Pieces/layer: 5
Coverage/layer: 100%
Individually Packaged



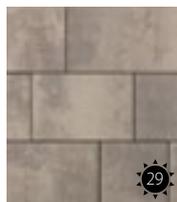
NOTE:

Color and tonal consistency between different sizes and batch lots cannot be guaranteed.

molina® (80 mm)  



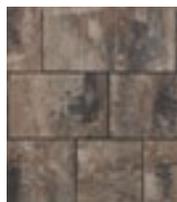
CATHEDRAL



CLOUDBURST



MEADOW



MORaine



TWILIGHT

Molina® pairs well with the following:

- Modan
- Nueva® 150
- Nueva® Step
- Aria Step

COMBO BUNDLE



300x300 Stone

Width 300 mm (11.81")
Length 300 mm (11.81")
Pieces/layer: 3
Coverage/layer: 25%



300x450 Stone

Width 300 mm (11.81")
Length 450 mm (17.72")
Pieces/layer: 2
Coverage/layer: 25%



300x600 Stone

Width 300 mm (11.81")
Length 600 mm (23.62")
Pieces/layer: 3
Coverage/layer: 50%



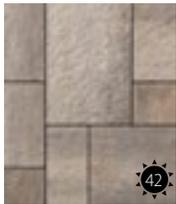
Also available in 60 mm units!

See page 49



paver, slab & permeable products

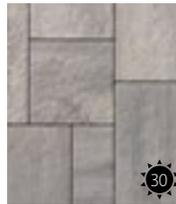
rialto (80 mm)



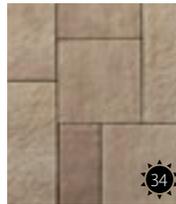
CHAMPAGNE



MACKINAW



MARBLE GREY



MILANO



Also available in 50 mm units!

See page 51

rialto (80 mm)



CHAMPAGNE



COLORADO



MACKINAW



MARBLE GREY



MILANO



NOTE:

Rialto bundle configurations are identical in both Canada and the US, colors as indicated above.

RANDOM BUNDLE



8x16 Stone

Width 200 mm (7.87")
Length 400 mm (15.75")
Pieces/layer: 3
Coverage/layer: 20%



16x16 Stone

Width 400 mm (15.75")
Length 400 mm (15.75")
Pieces/layer: 3
Coverage/layer: 40%



16x24 Stone

Width 400 mm (15.75")
Length 600 mm (23.62")
Pieces/layer: 2
Coverage/layer: 40%



RECTANGLE BUNDLE



16x24 Stone

Width 400 mm (15.75")
Length 600 mm (23.62")
Pieces/layer: 5
Coverage/layer: 100%
Individually Packaged



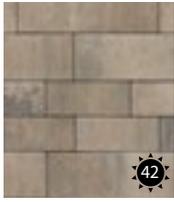
paver, slab & permeable products

presidio (80 mm)  



STOCK COLORS

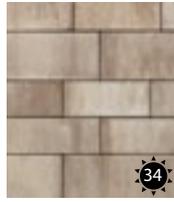
SPECIAL ORDER ONLY



CHAMPAGNE



MARBLE GREY



MILANO



ONYX



MATRIX FINISH - RAVENSTONE BLACK

RECTANGLE



Rectangle Stone
Width 168 mm (6.61")
Length 336 mm (13.23")
Pieces/layer: 15
Coverage/layer: 100%
Individually Packaged



COMBO BUNDLE



Stone 1
Width 126 mm (4.96")
Length 301 mm (11.85")
Pieces/layer: 4
Coverage/layer: 15%



Stone 2
Width 126 mm (4.96")
Length 401 mm (15.79")
Pieces/layer: 4
Coverage/layer: 20%



Stone 3
Width 126 mm (4.96")
Length 501 mm (19.72")
Pieces/layer: 4
Coverage/layer: 25%



Stone 4
Width 168 mm (6.61")
Length 301 mm (11.85")
Pieces/layer: 2
Coverage/layer: 10%

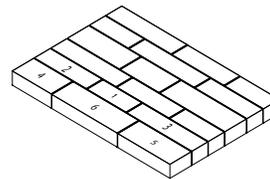


Stone 5
Width 168 mm (6.61")
Length 401 mm (15.79")
Pieces/layer: 2
Coverage/layer: 13.3%



Stone 6
Width 168 mm (6.61")
Length 501 mm (19.72")
Pieces/layer: 2
Coverage/layer: 16.7%

Combo Bundle Layout by Layer



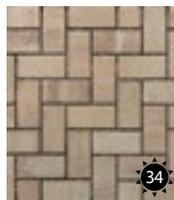
enviro midori (80 mm)  



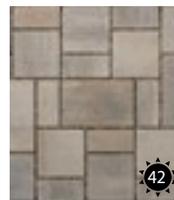
CHAMPAGNE - Herringbone



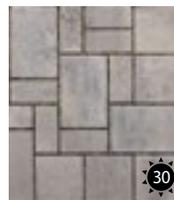
MARBLE GREY - Herringbone



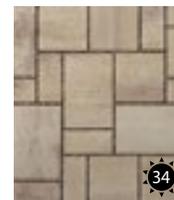
MILANO - Herringbone



CHAMPAGNE - Random



MARBLE GREY - Random



MILANO - Random

HERRINGBONE BUNDLE



5x5 Stone
Width 120 mm (4.72")
Length 120 mm (4.72")
Pieces/layer: 6 or 7
Coverage/layer: 10.7% or 11.1%



5x10 Stone
Width 120 mm (4.72")
Length 240 mm (9.45")
Pieces/layer: 25 or 28
Coverage/layer: 89.3 or 88.9%



5x10 Stone
Width 120 mm (4.72")
Length 240 mm (9.45")
Pieces/layer: 10
Coverage/layer: 25%



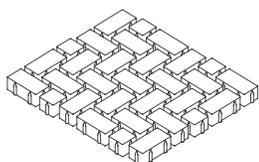
10x10 Stone
Width 240 mm (9.45")
Length 240 mm (9.45")
Pieces/layer: 9
Coverage/layer: 45%



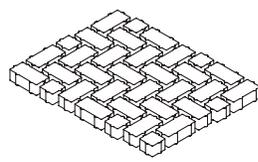
10x15 Stone
Width 240 mm (9.45")
Length 360 (14.17")
Pieces/layer: 4
Coverage/layer: 30%



Herringbone Bundle layout varies by production location. Be sure to verify plant location prior to order placement.



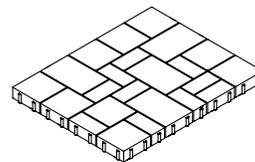
Markham – 25 full and 6 half



Hillsdale – 28 full and 7 half

RANDOM BUNDLE

Random Bundle Layout by Layer



paver, slab & permeable products

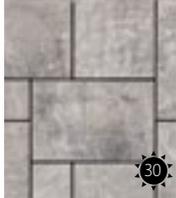
villanova (80 mm)



CHAMPAGNE



MACKINAW



MARBLE GREY



ONYX

Onyx available in Rectangle Stone only. Ideal for soldier coursing or banding.

RECTANGLE



Rectangle Stone

Width 199 mm (7.83")
Length 398 mm (15.67")
Pieces/layer: 15
Coverage/layer: 100%

Individually Packaged



COMBO BUNDLE



Square Stone

Width 398 mm (15.67")
Length 398 mm (15.67")
Pieces/layer: 3
Coverage/layer: 40%



Large Rectangle Stone

Width 398 mm (15.67")
Length 597 mm (23.5")
Pieces/layer: 3
Coverage/layer: 60%



hydr'eau pave (80 mm)



MACKINAW



SILVERSAND



ONYX

COMBO RANDOM BUNDLE



4x4 Stone

Width 100 mm (3.94")
Length 100 mm (3.94")
Pieces/layer: 1
Coverage/layer: 1%



4x8 Stone

Width 100 mm (3.94")
Length 200 mm (7.87")
Pieces/layer: 12
Coverage/layer: 24.2%



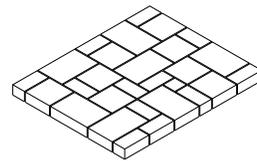
8x8 Stone

Width 200 mm (7.87")
Length 200 mm (7.87")
Pieces/layer: 8
Coverage/layer: 32.3%



8x12 Stone

Width 200 mm (7.87")
Length 300 mm (11.81")
Pieces/layer: 7
Coverage/layer: 42.4%



Combo Bundle Layout by Layer



turf-slab (80 mm)

CALL FOR AVAILABILITY



Available in Natural color only.



Width 400 mm (15.75")
Length 600 mm (23.62")
Pieces/layer: 5
Coverage/layer: 100%
Individually Packaged

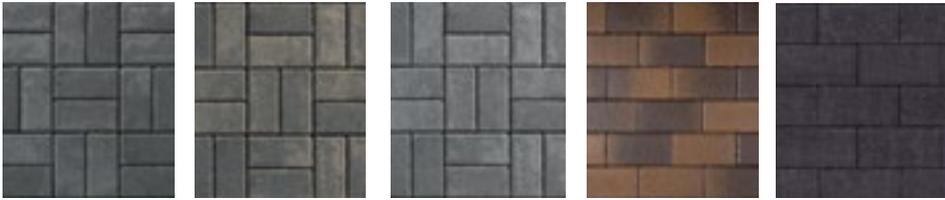
TYPICAL USES:

Cottage Parking / Emergency & Service Vehicle Access Routes / Slope Erosion Protection / Retention Pond Linings and Vehicular Access Roads / Ditch & Channel Linings / Low Use Turf Areas for Overflow Parking / Environmentally Sensitive Area Erosion Protection / Small Lake Boat Launching Ramps



paver, slab & permeable products

avenue series (80 mm) SPECIAL ORDER ONLY



Call for custom colors.

CHARCOAL

EXECUTIVE

GREYFIELD

TIMBERWOOD

MATRIX FINISH -
RAVENSTONE BLACK

8x8



8x8 Stone
Width 200 mm (7.87")
Length 200 mm (7.87")
Pieces/layer: 30
Coverage/layer: 100%
Individually Packaged

8x12



8x12 Stone
Width 200 mm (7.87")
Length 300 mm (11.81")
Pieces/layer: 20
Coverage/layer: 100%
Individually Packaged

12x12



12x12 Stone
Width 300 mm (11.81")
Length 300 mm (11.81")
Pieces/layer: 12
Coverage/layer: 100%
Individually Packaged

12x16



12x16 Stone
Width 300 mm (11.81")
Length 400 mm (15.75")
Pieces/layer: 9
Coverage/layer: 100%
Individually Packaged

4x8 HERRINGBONE BUNDLE



4x4 Stone
Width 100 mm (3.94")
Length 100 mm (3.94")
Pieces/layer: 6
Coverage/layer: 6.8%



4x8 Stone
Width 100 mm (3.94")
Length 200 mm (7.87")
Pieces/layer: 41
Coverage/layer: 93.2%



4x8 STANDARD BUNDLE



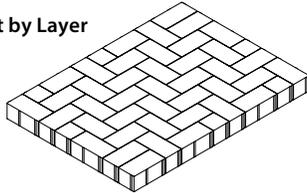
4x4 Stone
Width 100 mm (3.94")
Length 100 mm (3.94")
Pieces/layer: 2
Coverage/layer: 1.9%



4x8 Stone
Width 100 mm (3.94")
Length 200 mm (7.87")
Pieces/layer: 53
Coverage/layer: 98.1%



Herringbone Bundle Layout by Layer



market paver (70 mm)



ONYX



SANGRIA



SERENGETI

RECTANGLE



4x8
Width 100 mm (3.94")
Length 200 mm (7.87")
Pieces/layer: 54
Coverage/layer: 100%
Individually Packaged

paver, slab & permeable products

enviro passagio (70 mm)

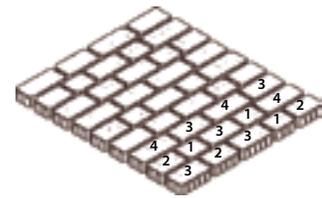


COLLEGE RED MOUNTAIN SALEM

COMBO BUNDLE



Stone 1 Width 125 mm (4.92") Length 152 mm (5.98") Pieces/layer: 9 Coverage/layer: 15.4%	Stone 2 Width 125 mm (4.92") Length 190 mm (7.48") Pieces/layer: 9 Coverage/layer: 19.2%	Stone 3 Width 125 mm (4.92") Length 228 mm (8.98") Pieces/layer: 15 Coverage/layer: 38.5%	Stone 4 Width 125 mm (4.92") Length 266 mm (10.47") Pieces/layer: 9 Coverage/layer: 26.9%
---	---	--	--



Combo Bundle Layout by Layer

centurion (70 mm)



CHAMPAGNE MILANO DARK OAK (Border) ONYX (Border)

Dark Oak available in Jumbo & Standard Units only.

Onyx available in Double Jumbo, Jumbo & Standard units only.

STANDARD



Standard Stone
Width 140 mm (5.51")
Length 210 mm (8.27")
Pieces/layer: 42
Coverage/layer: 100%
Individually Packaged

JUMBO



Jumbo Stone
Width 210 mm (8.27")
Length 280 mm (11.02")
Pieces/layer: 16
Coverage/layer: 100%
Individually Packaged

QUAD



Quad Stone
Width 280 mm (11.02")
Length 280 mm (11.02")
Pieces/layer: 12
Coverage/layer: 100%
Individually Packaged

DOUBLE JUMBO



Double Jumbo Stone
Width 280 mm (11.02")
Length 420 mm (16.54")
Pieces/layer: 9
Coverage/layer: 100%
Individually Packaged

COMBO BUNDLE



Small Stone Width 70 mm (2.76") Length 140 mm (5.51") Pieces/layer: 6 Coverage/layer: 5.9%	Square Stone Width 140 mm (5.51") Length 140 mm (5.51") Pieces/layer: 12 Coverage/layer: 23.5%	Standard Stone Width 140 mm (5.51") Length 210 mm (8.27") Pieces/layer: 12 Coverage/layer: 35.3%	Jumbo Stone Width 210 mm (8.27") Length 280 mm (11.02") Pieces/layer: 6 Coverage/layer: 35.3%
---	---	---	--

paver, slab & permeable products

ridgefield plus (70 mm)



CHAMPAGNE



CEDAR BLEND



EXECUTIVE

42

LARGE COMBO BUNDLE



8x12 Stone

Width 200 mm (7.87")

Length 300 mm (11.81")

Pieces/layer: 4

Coverage/layer: 22.2%



12x12 Stone

Width 300 mm (11.81")

Length 300 mm (11.81")

Pieces/layer: 4

Coverage/layer: 33.3%



12x16 Stone

Width 300 mm (11.81")

Length 400 mm (15.75")

Pieces/layer: 4

Coverage/layer: 44.4%



ridgefield smooth (70 mm)



CHAMPAGNE



MARBLE GREY

42

LARGE COMBO BUNDLE



8x12 Stone

Width 200 mm (7.87")

Length 300 mm (11.81")

Pieces/layer: 4

Coverage/layer: 22.2%



12x12 Stone

Width 300 mm (11.81")

Length 300 mm (11.81")

Pieces/layer: 4

Coverage/layer: 33.3%



12x16 Stone

Width 300 mm (11.81")

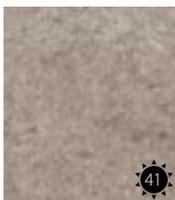
Length 400 mm (15.75")

Pieces/layer: 4

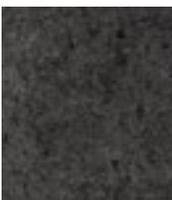
Coverage/layer: 44.4%



cassina coping (70 mm)



DOVER



ONYX

41



Cassina Coping Stone

Width 203 mm (8")

Length 305 mm (12")

Pieces/layer: 39

Coverage/layer: 100%

Individually Packaged

The narrow width allows for smoother curves on a radius pool coping.



paver, slab & permeable products

oasis coping (60 mm) **NEW!**



DOVER



ONYX

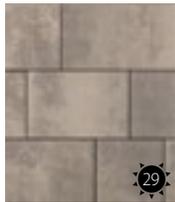


Coping Unit
 Width 609.6 mm (24")
 Length 358.78 mm (14.125")
 Pieces/layer: 4
 Coverage/layer: 100%
Individually Packaged

molina® (60 mm)



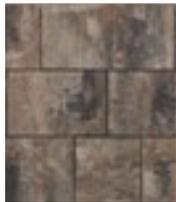
CATHEDRAL



CLOUDBURST



MEADOW



MORAINE



TWILIGHT

Molina® pairs well with the following:

- Modan
- Nueva® 150
- Nueva® Step
- Aria Step

COMBO BUNDLE



300x300 Stone
 Width 300 mm (11.81")
 Length 300 mm (11.81")
 Pieces/layer: 3
 Coverage/layer: 25%



300x450 Stone
 Width 300 mm (11.81")
 Length 450 mm (17.72")
 Pieces/layer: 2
 Coverage/layer: 25%



300x600 Stone
 Width 300 mm (11.81")
 Length 600 mm (23.62")
 Pieces/layer: 3
 Coverage/layer: 50%



Also available in 80 mm units!

See page 42

colonnade (60 mm)



GREYFIELD



SANDALWOOD



SILVERSAND



TIMBERWOOD



DARK OAK (Border)



ONYX (Border)

Dark Oak & Onyx available in 6x9 stone only.

6x9



6x9 Stone
 Width 150 mm (5.91")
 Length 225 mm (8.86")
 Pieces/layer: 32
 Coverage/layer: 100%
Individually Packaged



9x9



9x9 Stone
 Width 225 mm (8.86")
 Length 225 mm (8.86")
 Pieces/layer: 20
 Coverage/layer: 100%
Individually Packaged



9x12



9x12 Stone
 Width 225 mm (8.86")
 Length 300 mm (11.81")
 Pieces/layer: 16
 Coverage/layer: 100%
Individually Packaged



COMBO BUNDLE



3x6 Stone
 Width 75 mm (2.95")
 Length 150 mm (5.91")
 Pieces/layer: 12
 Coverage/layer: 12.5%



6x6 Stone
 Width 150 mm (5.91")
 Length 150 mm (5.91")
 Pieces/layer: 42
 Coverage/layer: 87.5%



paver, slab & permeable products

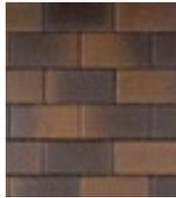
classic series (60 mm)



CHARCOAL



GREYFIELD



TIMBERWOOD



NORTHERN

4x8



4x8 Stone

Width 100 mm (3.94")
Length 200 mm (7.87")
Pieces/layer: 53
Coverage/layer: 98.1%*
* Two 4x4 stones/layer
Individually Packaged

8x8 - SPECIAL ORDER ONLY



8x8 Stone

Width 200 mm (7.87")
Length 200 mm (7.87")
Pieces/layer: 30
Coverage/layer: 100%
Individually Packaged

12x12 - SPECIAL ORDER ONLY



12x12 Stone

Width 300 mm (11.81")
Length 300 mm (11.81")
Pieces/layer: 12
Coverage/layer: 100%
Individually Packaged

HERRINGBONE BUNDLE - SPECIAL ORDER ONLY



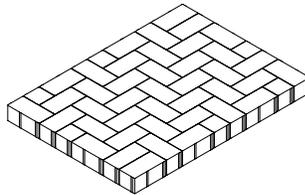
4x4 Stone

Width 100 mm (3.94")
Length 100 mm (3.94")
Pieces/layer: 6
Coverage/layer: 7.3%



4x8 Stone

Width 100 mm (3.94")
Length 200 mm (7.87")
Pieces/layer: 41
Coverage/layer: 92.7%



Herringbone Bundle Layout by Layer

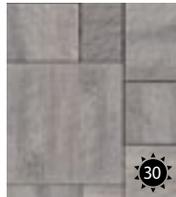
monterey (50 mm)



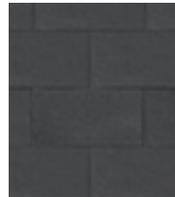
TWEED



WICKER



MARBLE GREY



ONYX

Onyx available in 8x16 Small Rectangle Stone size only.

SMALL RECTANGLE



8x16 Small Rectangle Stone
Width 200 mm (7.87")
Length 400 mm (15.75")
Pieces/layer: 12
Coverage/layer: 100%
Individually Packaged

RANDOM BUNDLE



12x24 Stone
Width 300 mm (11.81")
Length 600 mm (23.62")
Pieces/layer: 2
Coverage/layer: 30%



16x16 Stone
Width 400 mm (15.75")
Length 400 mm (15.75")
Pieces/layer: 3
Coverage/layer: 40%



24x24 Stone
Width 600 mm (23.62")
Length 600 mm (23.62")
Pieces/layer: 1
Coverage/layer: 30%



LARGE RECTANGLE

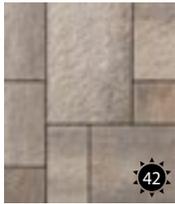


16x32 Large Rectangle Stone
Width 400 mm (15.75")
Length 800 mm (31.50")
Pieces/layer: 3
Coverage/layer: 100%
Individually Packaged



paver, slab & permeable products

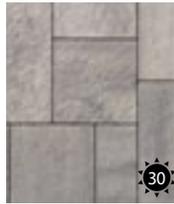
rialto (50 mm)



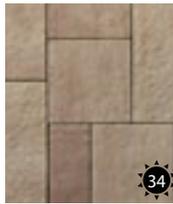
CHAMPAGNE



MACKINAW



MARBLE GREY



MILANO

Also available in 80 mm units!

See page 43

rialto (50 mm)



CHAMPAGNE



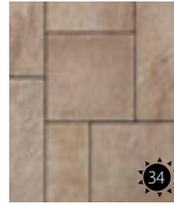
COLORADO



MACKINAW



MARBLE GREY



MILANO

RANDOM BUNDLE

RECTANGLE



8x16 Stone

Width 200 mm (7.87")
Length 400 mm (15.75")
Pieces/layer: 3
Coverage/layer: 20%



16x16 Stone

Width 400 mm (15.75")
Length 400 mm (15.75")
Pieces/layer: 3
Coverage/layer: 40%



16x24 Stone

Width 400 mm (15.75")
Length 600 mm (23.62")
Pieces/layer: 2
Coverage/layer: 40%



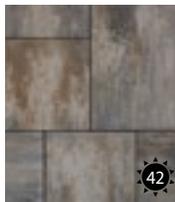
16x24 Stone

Width 400 mm (15.75")
Length 600 mm (23.62")
Pieces/layer: 5
Coverage/layer: 100%
Individually Packaged



NOTE: Rialto bundle configurations are identical in both Canada and the US, colors as indicated above.

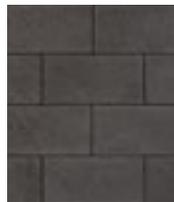
nueva® slab (50 mm) **NEW!**



CHAMPAGNE



MARBLE GREY



ONYX

Onyx available in Rectangle Stone only.

COMBO BUNDLE

RECTANGLE BUNDLE



200x400 Stone

Width 200 mm (7.87")
Length 400 mm (15.75")
Pieces/layer: 3
Coverage/layer: 20%



400x400 Stone

Width 400 mm (15.75")
Length 400 mm (15.75")
Pieces/layer: 3
Coverage/layer: 40%



400x600 Stone

Width 400 mm (15.75")
Length 600 mm (23.62")
Pieces/layer: 2
Coverage/layer: 40%



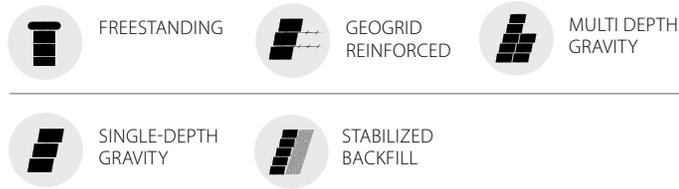
Rectangle Stone

Width 200 mm (7.87")
Length 400 mm (15.75")
Pieces/layer: 15
Coverage/layer: 100%
Individually Packaged

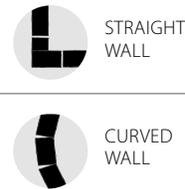


wall icon legend & summary

WALL TYPE



ALIGNMENT



INSTALLATION OPTIONS



See page 24 for more details on each of these wall types.

CHOOSING THE RIGHT WALL FOR YOUR PROJECT

In this section, we have included batter, alignment and installation options to further assist in selecting the correct wall for your given application. Please note for 0 degree (vertical) batter walls, we recommend placing a slight back slope to the leveling pad to accommodate forward rotation of the wall during installation; contact Oaks for more details.

SUMMARY CHART

	Connector Type	Batter Options								
MODAN - PAGE 53	Glue	0°		•					•	
NUEVA® 150 - PAGE 53										
Combo Bundle	Split tongue	0°, 3.5°, 7°	•	•				Pending ¹	Pending ¹	•
Wedge Unit	Split tongue	0°, 3.5°, 7°	•	•				Pending ¹	Pending ¹	•
ORTANA - PAGE 54										
Standard/Tapered	Split tongue	0° or 7°	•	•	•	•	•	•	•	•
Extended (SPECIAL ORDER)	Split tongue	0° or 7°		•	•			•		
PROTERRA™ - PAGE 55										
	Split tongue	0°, 8° or 16°	•	•	•	•	•	•	•	•
GARDENIA LINEAR - PAGE 56										
	Rear lip	5°		•					•	

Note¹ - connection data for Nueva® 150 still pending at time of print.

how to use this section

Tells you the wall name

Tells you which country has this product available as a stock item

Tells you if this product has any environmental accreditations or unique technology features

Tells you the colors available within the product line

Tells you the individual unit sizes available, setback (batter), connector type and bundling options

Tells you the Wall Type, Alignment and Installation Options for the specific unit or bundle

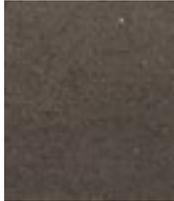
nueva® 150 **NEW!** Nueva® 75 Coming in 2020!



CHAMPAGNE



MARBLE GREY



ONYX

Onyx is available in Coping only.

COMBO BUNDLE



16" Unit

Width 400 mm (15.75")
Height 150 mm (5.91")
Depth 300 mm (11.81")
Setback: 0°, 3.5°, 7°
Connection Type:
Split Groove
Pieces/layer: 2
Coverage/layer: 20%



20" Unit

Width 500 mm (19.69")
Height 150 mm (5.97")
Depth 300 mm (11.81")
Setback: 0°, 3.5°, 7°
Connection Type:
Split Groove
Pieces/layer: 2
Coverage/layer: 25%



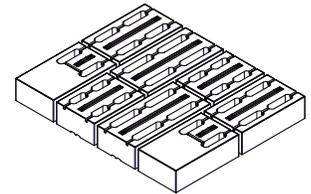
20" End Unit

Width 500 mm (19.69")
Height 150 mm (5.91")
Depth 300 mm (11.81")
Includes one closed end
Setback: 0°, 3.5°, 7°
Connection Type:
Split Groove
Pieces/layer: 2
Coverage/layer: 25%



24" Unit

Width 600 mm (23.62")
Height 150 mm (5.91")
Depth 300 mm (11.81")
Setback: 0°, 3.5°, 7°
Connection Type:
Split Groove
Pieces/layer: 2
Coverage/layer: 30%



Combo Bundle Layout by Layer

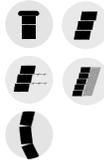
WEDGE UNIT



Wedge Unit

Width 330 mm (12.99")
Height 150 mm (5.91")
Depth 300 mm (11.81")
Setback: 0°, 3.5°, 7°
Connection Type:
Split Groove
Pieces/layer: 12
Coverage/layer: 100%

Individually Packaged



COPING BUNDLE



Coping

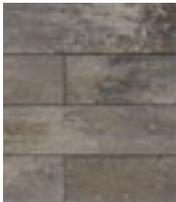
Width 600 mm (23.62")
Height 75 mm (2.95")
Depth 340 mm (13.93")
Pieces/layer: 2
Coverage/layer: 67%



End Coping

Width 600 mm (23.62")
Height 75 mm (2.95")
Depth 340 mm (13.93")
Includes one closed end
Pieces/layer: 1
Coverage/layer: 33%

modan



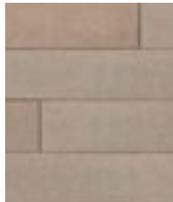
CHAMPAGNE



CLOUDBURST



MARBLE GREY



SANDBAR



TWILIGHT

NOTE: Maximum height not to exceed 660 mm or 6 courses, including buried course.

COMBO BUNDLE



660 Unit

Width 660 mm (25.98")
Height 110 mm (4.33")
Depth 220 mm (8.66")
Pieces/layer: 4
Coverage/layer: 33.3%
No Connector, glue required
Setback: 0°



550 Unit

Width 550 mm (21.65")
Height 110 mm (4.33")
Depth 220 mm (8.66")
Pieces/layer: 4
Coverage/layer: 27.8%
No Connector, glue required
Setback: 0°



440 Unit

Width 440 mm (17.32")
Height 110 mm (4.33")
Depth 220 mm (8.66")
Pieces/layer: 4
Coverage/layer: 22.2%
No Connector, glue required
Setback: 0°



330 Unit

Width 330 mm (12.99")
Height 110 mm (4.33")
Depth 220 mm (8.66")
Pieces/layer: 4
Coverage/layer: 16.7%
No Connector, glue required
Setback: 0°



LINEAR UNIT



Width 440 mm (17.32")
Height 110 mm (4.33")
Depth 220 mm (8.66")
No Connector, glue required
Setback: 0°
Individually Packaged



ortana



DESERT



GREYFIELD



MOUNTAIN



NATURAL

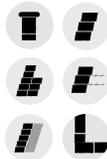


SANDALWOOD

STANDARD UNIT



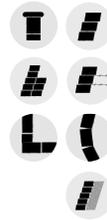
Standard Unit
 Width 200 mm (7.87")
 Height 150 mm (5.91")
 Depth 300 mm (11.81")
 Setback: 0° or 7°
 Connector Type:
 Split Tongue
Individually Packaged



TAPERED UNIT



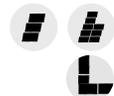
Tapered Unit
 Width 200 mm (7.87")
 Height 150 mm (5.91")
 Depth 300 mm (11.81")
 Setback: 0° or 7°
 Connector Type:
 Split Tongue
Individually Packaged



EXTENDED UNIT - SPECIAL ORDER



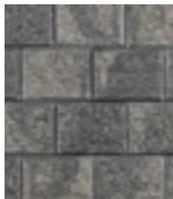
Extended Unit
 Width 200 mm (7.87")
 Height 150 mm (5.91")
 Depth 457 mm (17.99")
 Setback: 0° or 7°
 Connector Type:
 Split Tongue
Individually Packaged



ortana



DESERT



GREYFIELD



MOUNTAIN



SANDALWOOD

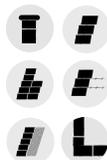


TIMBERWOOD

STANDARD UNIT



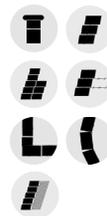
Standard Unit
 Width 200 mm (7.87")
 Height 150 mm (5.91")
 Depth 300 mm (11.81")
 Setback: 0° or 7°
 Connector Type:
 Split Tongue
Individually Packaged



TAPERED UNIT



Tapered Unit
 Width 200 mm (7.87")
 Height 150 mm (5.91")
 Depth 300 mm (11.81")
 Setback: 0° or 7°
 Connector Type:
 Split Tongue
Individually Packaged



ortana accessory units



90° Corner Unit
 Width 300 mm (11.81")
 Height 150 mm (5.91")
 Depth 200 mm (7.87")
 Split on front face and one end
Individually Packaged



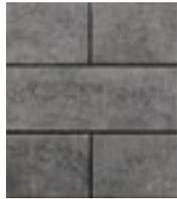
2' Split-Face Coping Unit
 Width 610 mm (24.02")
 Height 75 mm (2.95")
 Depth 300 mm (11.81")
Individually Packaged



1' Split-Face Coping Unit (Available in USA only)
 Width 305 mm (12")
 Height 75 mm (2.95")
 Depth 300 mm (11.81")
Individually Packaged

wall products

proterra™ smooth



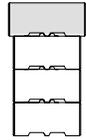
GREYFIELD - Smooth



NATURAL - Smooth

Note: Colored wall units also available as custom order. Minimum quantities apply.

Proterra™ Coping

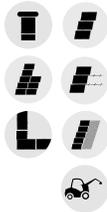


Smooth Coping and Wall
(Coping centers over wall)

STANDARD UNIT



Standard Unit
Width 1000 mm (39.37")
Height 185 mm (7.28")
Depth 375 mm (14.76")
Setback: 0°, 8° or 16°
Connector Type:
Split Tongue
Smooth on both faces.
Individually Packaged



DOUBLE UNIT



Double Unit
Width 1000 mm (39.37")
Height 185 mm (7.28")
Depth 750 mm (29.52")
Setback: 0°, 8° or 16°
Connector Type:
Split Tongue
Smooth on one face,
Split on one face.
Comes with one split-face Standard Unit



TRIPLE UNIT



Triple Unit
Width 1000 mm (39.37")
Height 185 mm (7.28")
Depth 1125 mm (44.29")
Setback: 0°, 8° or 16°
Connector Type:
Split Tongue
Smooth on both faces.
Individually Packaged



proterra™ split



GREYFIELD - Split



NATURAL - Split

Note: Colored wall units also available as custom order. Minimum quantities apply.

Proterra™ Coping

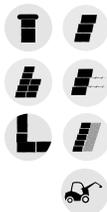


Split Coping and Wall
(Coping overhangs one side)

STANDARD UNIT



Standard Unit
Width 1000 mm (39.37")
Height 185 mm (7.28")
Depth 375 mm (14.76")
Setback: 0°, 8° or 16°
Connector Type: Split Tongue
Two units split on one face,
smooth on one face.
One unit split on both faces
Individually Packaged



DOUBLE UNIT



Double Unit
Width 1000 mm (39.37")
Height 185 mm (7.28")
Depth 750 mm (29.52")
Setback: 0°, 8° or 16°
Connector Type: Split Tongue
Split-face on one face, smooth
on one face
Comes with one Standard Unit



proterra™ smooth & split accessory units



**Coping Corner/
End Unit - Smooth**
Width 1000 mm (39.37")
Height 185 mm (7.28")
Depth 430 mm (16.92")
Smooth on both
faces and closed end
Individually Packaged



**Standard Corner
Unit - Smooth**
Width 1000 mm (39.37")
Height 185 mm (7.28")
Depth 375 mm (14.76")
Smooth on both
faces and closed end
Individually Packaged



**Coping-Step Unit
Smooth**
Width 1000 mm (39.37")
Height 185 mm (7.28")
Depth 430 mm (16.92")
Smooth on both faces
Individually Packaged



**Coping-Step Unit
Split**
Width 1000 mm (39.37")
Height 185 mm (7.28")
Depth 430 mm (16.92")
Split on front face, smooth
on back face
Individually Packaged



**Standard Corner
Unit - Split**
Width 875 mm (34.44")
Height 185 mm (7.28")
Depth 375 mm (14.76")
Split-face on front and
closed end
Individually Packaged



**Corner Coping
Unit - Split**
Width 875 mm (34.44")
Height 185 mm (7.28")
Depth 430 mm (16.92")
Split-face on front and
closed end
Individually Packaged

wall, pillar cap & coping products

gardenia linear



CHARTAN

GREYSTONE

SANDSTONE

LINEAR UNIT



Length 600 mm (23.62")
 Height 150 mm (5.91")
 Depth 200 mm (7.87")
 Setback: 5°
 Connector Type: Rear Lip
Individually Packaged

90° CORNER UNIT



Width 300 mm (11.81")
 Height 150 mm (5.91")
 Depth 200 mm (7.87")
 Split on one face and one end.
Individually Packaged

NOTE: Maximum height under ideal conditions not to exceed 825 mm (including buried course) which is 5 courses plus coping.

wyevale pillar cap



CHARCOAL

NATURAL

TAN

Provides a finishing touch to pillars or columns.



Wyevale Pillar Cap
 Available in two sizes:

Option 1
 Width 610 mm (24")
 Depth 610 mm (24")
 Height 76 mm (3")

Option 2
 Width 711 mm (28")
 Depth 711 mm (28")
 Height 76 mm (3")

oasis coping **NEW!**



DOVER

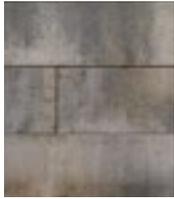
ONYX



Coping Unit
 Width 609.6 mm (24")
 Height 60 mm (2.36")
 Depth 358.78 mm (14.125")
 Pieces/layer: 4
 Coverage/layer: 100%
Individually Packaged

step products

nueva® step 



CHAMPAGNE

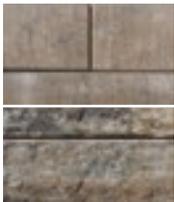


MARBLE GREY



Step Unit
 Width 1000 mm (39.37")
 Height 150 mm (5.91")
 Depth 400 mm (15.75")
 Smooth on front face
 and both ends
Individually Packaged

aria step 



CHAMPAGNE



GREYFIELD



MILANO

Smooth Side

Textured Side



Step Unit
 Width 1200 mm (47.24")
 Height 165 mm (6.5")
 Depth 400 mm (15.75")
 Textured on one face, smooth
 on one face and both ends
Individually Packaged

proterra™ step 



GREYFIELD -
Smooth



NATURAL -
Smooth



GREYFIELD -
Split



NATURAL -
Split

STEP UNIT



**Coping-Step Unit
Smooth**
 Width 1000 mm (39.37")
 Height 185 mm (7.28")
 Depth 430 mm (16.92")
 Smooth on both faces
Individually Packaged



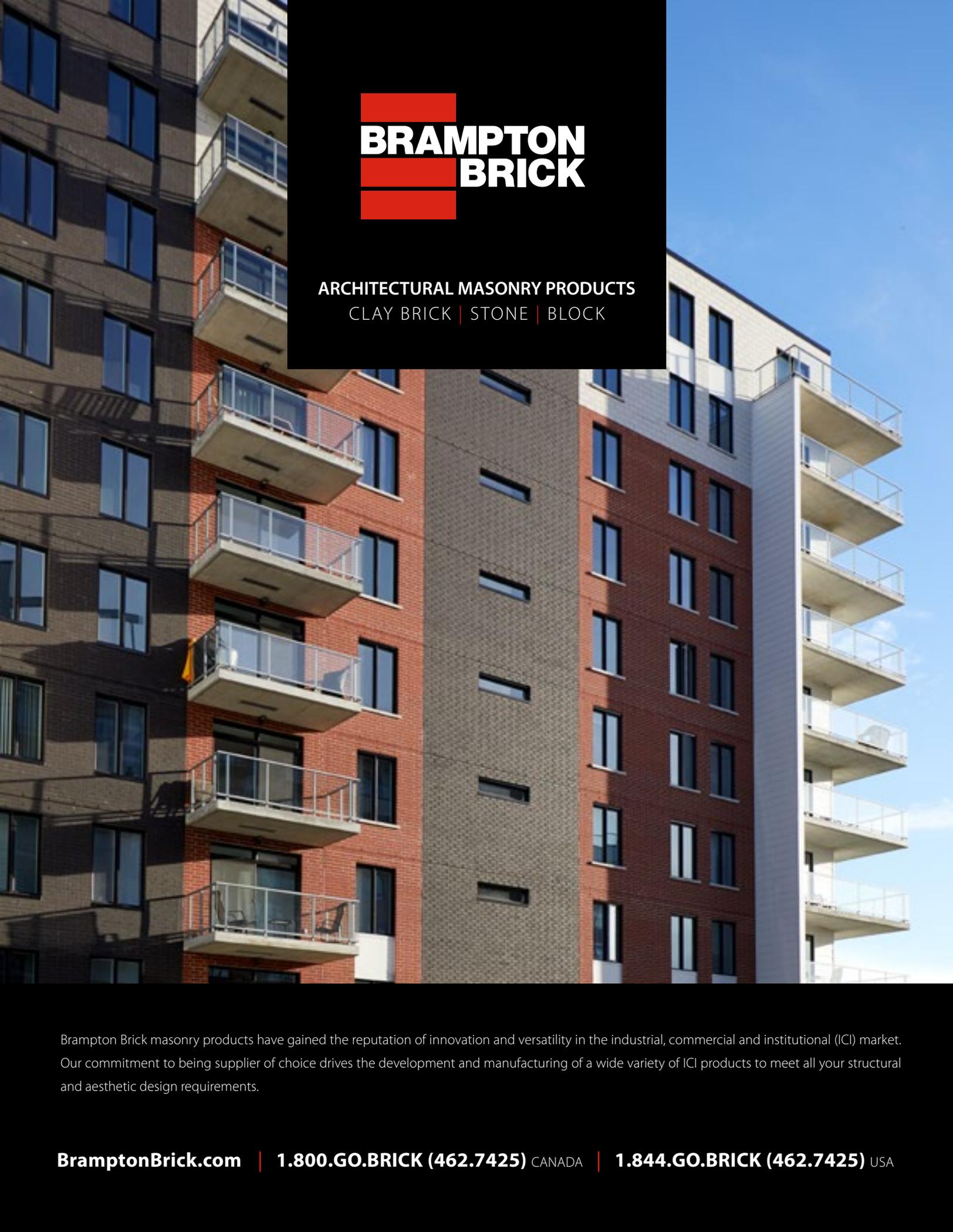
**Coping-Step Unit
Split**
 Width 1000 mm (39.37")
 Height 185 mm (7.28")
 Depth 430 mm (16.92")
 Split on front face, smooth
 on back face
Individually Packaged



**Step End Unit
Split**
 Width 875 mm (34.44")
 Height 185 mm (7.28")
 Depth 430 mm (16.92")
 Split on front face and
 closed end
Individually Packaged



**Step End Unit
Smooth**
 Width 1000 mm (39.37")
 Height 185 mm (7.28")
 Depth 430 mm (16.92")
 Smooth on both faces and
 closed end
Individually Packaged



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On the cover:
Paver: Presidio, Marble Grey & Onyx
Wall: Proterra™, Greyfield (split)



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CA/USA-EO5K/08/19