

PERMEABLE AND HEAVY-DUTY SEGMENTAL UNIT PAVEMENTS

TECHNICAL GUIDE



UNILOCK
DESIGNED TO CONNECT.



Eco-Priora™ Case Reserve University, Cleveland, Ohio. DESIGN: Behne Landscape Architecture

UNILOCK[®]
DESIGNED TO CONNECT.™



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PERMEABLE PAVING
Broadway Avenue - Newport, Rhode Island
DESIGN: Beta Group

UNIT PAVER PERFORMANCE AND DESIGN

SUPERIOR CHOICE

SURFACES MUST BE ENGINEERED to withstand the test of time. Unilock pavers not only satisfy requirements for structural integrity, safety, cost, environmental impact, maintenance and field-proven performance, but they also provide superior skid resistance and weathering. Because of the unique combination of product strength, ease of maintenance, aesthetics and reusability, they have a better life-cycle cost than other products. Pavers are a flexible system, so their surface area can move slightly without jeopardizing the structural integrity. Concrete pavers require less maintenance than other products and can withstand heavy loading. They can also be manufactured in different shapes, colors and finishes for your large scale projects. And nothing beats concrete pavers in terms of strength and durability.

STRENGTH AND DURABILITY

ALL UNILOCK PAVERS are manufactured to meet the ASTM C936 standard without compromising the composite, like other pervious products. They are stronger than pour-in-place concrete and bituminous asphalt because of their higher compressive strength, which is achieved by a specialized manufacturing process.



Product: Promenade™ Plank Paver

Location: Cleveland, Ohio

Project: Uptown Alleyway

Design: Riverstone Company

STANDARDS

ASTM STANDARD C936

8,000 psi avg - 55MPa

7,200 psi min unit - 50MPa

5% absorption avg (7% max)

Height tolerance less than +/- 3.2 mm

Dimensional accuracy +/- 1/16" - 1.6 mm

Unilock® meets or exceeds all C936 paver manufacturing standards.

FEATURES

EXCLUSIVE UNILOCK ADDED FEATURES

Ultima™ Concrete Technology (Average 12,000 psi [83MPa])

EasyClean™ Technology

ColorFusion™ Technology

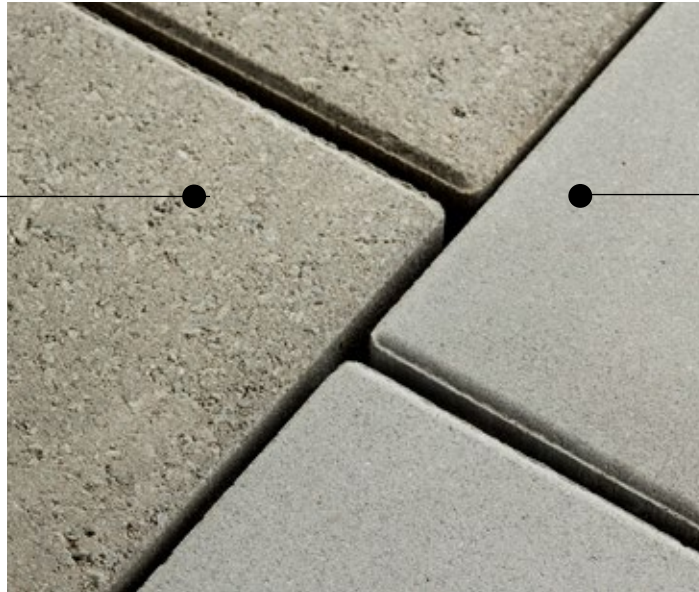
Non-Slip Surfaces

Reala™ Surface Technology

UNILOCK QUALITY GUARANTEED

GOOD CLASSIC

This is how the first pavers were manufactured. The product mix of large and small aggregates is consistent, from top to bottom, with color mixed throughout. The Unilock **Classic** pavers we manufacture exceed all ASTM standards for quality and strength.



BETTER ENDURACOLOR™

EnduraColor products are manufactured in a two-step process which combines a base of coarser aggregates for a stronger foundation, with concentrated color and wear-resistant finer aggregates on top. EnduraColor products are highly resistant to fading because the top layer prevents large, lighter color aggregates from showing through.

THE BEST CHOICE.

ENDURACOLOR™
PLUS ARCHITECTURAL FINISHES

ONLY UNILOCK OFFERS ENDURACOLOR PLUS ARCHITECTURAL FINISHES.

These products set a new standard for everlasting beauty thanks to proprietary blends of some of nature's highest performing minerals such as granite and quartz, combined with manufacturing technologies that are exclusive to Unilock.



UNILOCK CUSTOMIZATION

Unilock allows you to customize products to suit your project. Our vast array of sizes, edges, finish and color options make it easy to achieve your design vision. Speak to your local Unilock Representative about the options available in your market.

FINISH OPTIONS

ENDURACOLOR PLUS ARCHITECTURAL FINISHES



UMBRIANO[®] Mottled Finish
with ColorFusion[™] and EasyClean[™]



SENZO[™] Matte Finish
with EasyClean[™]



SERIES[™] Exposed Aggregate Finish



REALA[™] Finish
with Ultima[™] (Town Hall[®] shown)

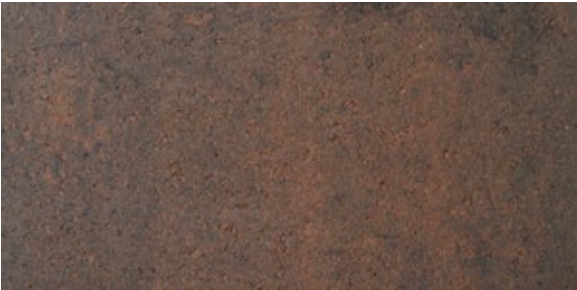
ENDURACOLOR



IL CAMPO[®] Brushed Finish



RIVEN PREMIER Finish



SMOOTH PREMIER Finish

When texture is a primary design consideration, start here. Unilock offers the traditional surface finish as well as very unique and durable mottled, matte, exposed aggregate, brushed, smooth and riven finishes. **To ensure your project delivers on durability and long-lasting color, insist on EnduraColor.**



A FEW OF OUR COLOR OPTIONS

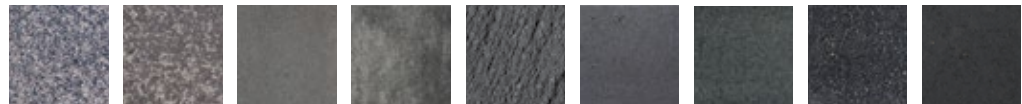
THIS PALETTE IS YOURS TO DISCOVER.



COOL GREY HUES



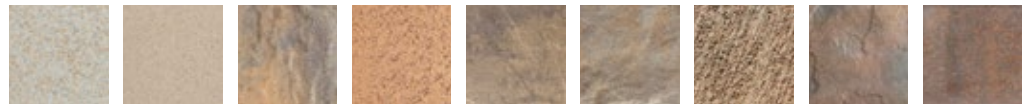
WARM GREY HUES



BLACK HUES



COOL COLOR HUES



WARM COLOR HUES



RED COLOR HUES



BROWN COLOR HUES

Your design is a product of your vision. Sometimes that means creating a unique color to bring that vision to life. As minimum custom production quantities apply, please contact your local Unilock Representative for more information.

Unilock stocks an extensive range of products in a wide variety of colors; check your regional Product Resource Guide for locally stocked product and color options.

BEAUTIFULLY PERMEABLE

The Commonwealth Honors College Residential Complex (CHCRC) is a 500,000 sqft, LEED Gold project within the heart of the University of Massachusetts campus in Amherst. A series of courtyards and a linear plaza had to be constructed in a limited area around the six buildings that comprise the complex.

Collaborating closely with the Landscape Architect, Stantec, Unilock helped develop a permeable solution for paved areas which addressed the challenge presented by the impermeable footprint of the buildings. As well, the Unilock product was produced locally, further contributing to the project's LEED Gold status. Four colors were chosen to create the linear paving design, taking cues from the buildings. An EnduraColor™ finish upgrade was chosen to ensure this color remains vibrant in years to come.

The teamwork of manufacturers, design teams and installers made this, the largest, single construction project at UMass, a beacon of success.

Product: Eco-Priora™

Location: Amherst, Massachusetts

Project: University of Massachusetts, Honors Complex

Design: Stantec



PERMEABLE PAVEMENTS

THE PROBLEM WITH STORMWATER is that it has to have somewhere to go, ideally back into the ground. Today's urban environments are covered with impervious hard surfaces such as rooftops, parking lots and highways in excessive amounts, instead of pervious fields and forests. This runoff flows into storm drains and ultimately into local rivers, lakes and streams, carrying heavy metals, bacteria and other pollutants that foul our water and put our health at risk.

Some communities use separate systems for sewage and stormwater, however, older urban communities use combined sewer systems that allow for overflow from the two inputs that release directly into local rivers and coastal waters when the system is overloaded. This allows for millions of gallons of raw waste and other pollutants into the waters we may fish, swim, boat or may be sources of drinking water.

Storm frequencies, intensities and duration are shifting and in many regions more severe storms occur more frequently than expected. Increased rainfall and snowfall will place increased demands on stormwater sewer and flood control systems.

REDUCING RUNOFF

The Fuse Condominium project set out to create a new residential community in a very walkable neighborhood, close to major highways and public transportation. However, its location next to the Alewife Brook Reservation, a designated wetland, created unique challenges. The project called for three distinct paver applications: one at ground level and two roof deck amenity spaces. For all three, water would need to be managed to reduce runoff to the neighboring wetland.

At ground level, amenity courtyards and open spaces in this residential community, created with a lively pattern of special-order Eco-Priora colors, set the design canvas and provide highly desirable qualities of life: sunshine, nature, social spaces and more. These pavers were used in one of the roof deck applications as well, installed on a granular base to create patios and dining areas for mid-sized groups with intimate spaces tucked into the edges of a large central lawn. Larger scale, 2'x2' Skyline™ slabs were installed on pedestals to create a pool surround, lounging and dining areas on the second roof deck space. Both permeable roof decks reduce traditional runoff stormwater and the lighter colors chosen, along with plant life, help reduce heat island effect.

Product: Eco-Priora™ **Location:** Cambridge, Massachusetts
Project: Fuse Condominium
Design: Halvorson Design Partnership Ltd



PERMEABLE PAVER INNOVATION



ECOLOC®



8 7/8" x 8 7/8" x 3 1/8"
22.5cm x 22.5cm x 8cm

- > Customizable surface texture and color (page 8-10)
- > Optimized for machine installation
- > 6 mm joint width
- > 12.18% void space

ECO-OPTILOC™



10 1/4" x 10 1/4" x 3 1/8"
26cm x 26cm x 8cm

- > Machine installable averaging 8,000 sq.ft. (750 m²) per machine per day
- > Rectilinear multi-stone design
- > Dual-axis engineering for heavy-duty capability
- > Customizable surface texture and color (page 8-10)
- > 12 mm joint width
- > 7.3% void space

ECO-PRIORA™



LARGE SQUARE
10" x 10" x 3 1/8"
24cm x 24cm x 8cm

RECTANGLE
5" x 10" x 3 1/8"
12cm x 24cm x 8cm

SQUARE®
5" x 5" x 3 1/8"
12cm x 12cm x 8cm

- > 3 compatible sizes for variable patterns
- > Customizable surface texture and color (page 8-10)
- > 3 mm micro bevel for ADA compliance
- > Herringbone mold optimized for machine installation
- > 7 mm joint width
- > 7% void space (herringbone 5" x 10")

CITY PARK PAVER™



8" x 8" x 3 1/8"
20cm x 20cm x 8cm

- > Hexagonal design
- > Appropriate for vehicular or pedestrian applications
- > Customizable surface texture and color (page 8-10)
- > 10 mm joint width
- > 4.2% void space

*Available in select markets



Unilock introduced permeable paving to North America in 1991, and has continued to lead the charge with new innovative products. Our extensive involvement in permeable paving and long-standing international alliances have allowed us to gain valuable knowledge, experience, and best practices that we can share with clients to help ensure their projects are a success.

TOWN HALL®



9 3/4" x 3 7/8" x 2 3/4"
25cm x 10cm x 7cm

- > Reala™ Surface Design replicates old street pavers
- > Ultima™ Concrete Technology provides superior strength
- > Long-term color and wear performance
- > Rounded edges facilitate snow removal
- > 8-9 mm joint width
- > 6.5% void space

THORNBURY™



LARGE SQUARE
13 3/4" x 16 1/2" x 2 3/4"
35cm x 42cm x 7cm

RECTANGLE
13 3/4" x 8 1/4" x 2 3/4"
35cm x 21cm x 7cm

SQUARE®
6 7/8" x 8 1/4" x 2 3/4"
17.3cm x 21cm x 7cm

Sold in a random bundle

- > Three rectangular sizes in one bundles
- > Modestly textured surface
- > Long-term color and wear performance
- > Zero-bevel edge
- > 11-18 mm joint width
- > <4% void space

ECO-LINE®



8 unit Random Bundle
4 units - 9 3/8" - 14" x 3 5/16" x 4"
23.7-35.7cm x 8.4cm x 10cm
4 units - 9 3/8" - 14" x 4 1/12" x 4"
23.7-35.7cm x 11.4cm x 10cm

- > Long, linear shape
- > Permeable spacer nubs
- > Appropriate for heavy-duty applications
- > Customizable surface texture and color (page 8-10)
- > 6.25 mm joint width
- > 5.8% void space

ECO-PROMENADE®



3" x 12" x 4"
7.5cm x 30cm x 10cm
4" x 16" x 4"
10cm x 41cm x 10cm
12" x 12" x 4"
30cm x 30cm x 10cm

- > Long, linear shape
- > Permeable spacer nubs
- > Appropriate for vehicular or pedestrian applications
- > Customizable surface texture and color (page 8-10)
- > 7 mm joint width
- > 9.3% void space

TRIBECA COBBLE™



LARGE SQUARE
10" x 10" x 3 1/8"
24cm x 24cm x 8cm

RECTANGLE
5" x 10" x 3 1/8"
12cm x 24cm x 8cm

SQUARE®
5" x 5" x 3 1/8"
12cm x 12cm x 8cm

Sold in a random bundle

- > Long, linear shape
- > Permeable spacer nubs
- > Appropriate for vehicular or pedestrian applications
- > 7 mm joint width
- > 5.6% void space

DURA-FLOW™



9 7/8" x 9 7/8" x 3 1/8"
25cm x 25cm x 8cm

- > Specially designed for easier cleaning and maintenance
- > Machine installable averaging 8,000 sq.ft. (750 m²) per machine per day
- > Rectilinear multi-stone design
- > Dual-axis engineering for heavy-duty capability
- > Customizable surface texture and color (page 8-10)
- > 12 mm joint width
- > 8% void space



DESIGN CONSIDERATIONS

BENEFITS YEAR ROUND

The Museum of Science and Industry (MSI) installed a new parking lot featuring drop off bays with Optiloc® pavers, drive aisles and employee parking with Eco-Optiloc permeable pavers, and pedestrian walking and crosswalk areas with Eco-Priora permeable pavers. The crosswalks have a slip-resistant, exposed granite face with Onyx Black Series™ finish. This adds visual contrast and helps guide children to the entrance.

The total parking lot and drop-off surface area at MSI is approximately 64,100 square feet (sf), of which 43,560sf is permeable pavers. The base depth of 22 inches created a detention area in which stormwater can reside until it makes its way back to the groundwater system. This enables the system to perform for stormwater events and prevent local flooding. Permeable paving even allows drainage during thaw events, which prevents dangerous refreeze of melted water on the surface.

Product: Eco-Priora™ & Eco-Optiloc™

Location: Chicago, Illinois

Project: Museum of Science & Industry

Design: Stanley Consultants & Carol Yetken
Landscape Architects

PERMEABLE PAVER DESIGN CONSIDERATIONS

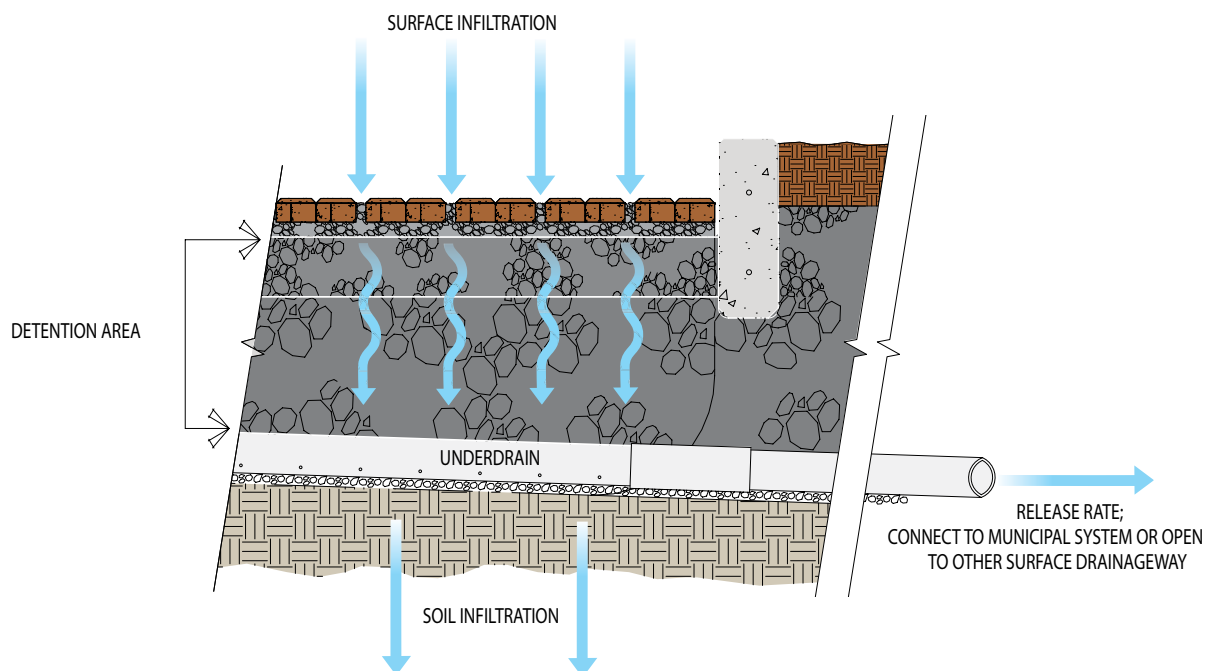
RAINFALL INTENSITY AND DURATION are typically analyzed together for traditional non-permeable surfaces. However, with a permeable paver surface, intensity is less of a factor as the surface infiltration rate will exceed the capabilities of most storms. A permeable paver surface is capable of handling more than 100" (2,540 mm) per hour. The paver joints must be adequately maintained to allow for maximum infiltration.

Although many rainfall events only last for a few minutes, for larger rainfall events, the impact of duration is important to recognize. A heavy rain could fall at the intensity rate of 6" (152 mm) per hour, but the duration may only last for 10 minutes with a resulting actual rain amount of only 1" (25 mm). Longer duration events can often be more demanding, even with less intensity. Actual monthly rainfalls in the Midwest U.S., for example, average 4" (100 mm). Therefore, permeable paving systems can easily contain most rainfall events.

RUNOFF COEFFICIENT (C VALUE) is used to measure the percentage of water that runs off different surface types. For example, bituminous asphalt has a C value of 0.85. This means that during a rainfall, 85 percent of the water will run off the surface. (Source: Design and Construction of Sanitary and Storm Sewers, American Society of Civil Engineers, New York, p. 332, 1969). In comparison, turf has a C value of 0.15 or 15 percent. The C value of permeable paving, with up to a 5 percent slope, is actually zero, unless the rainfall intensity exceeds the surface infiltration rate or the entire open-graded base reaches capacity. With a properly designed permeable paver system, capacity will rarely be reached. To achieve maximum surface infiltration, maintenance of the joints may be necessary.

SOIL INFILTRATION is another way to absorb runoff. During the site investigation project phase, conducting a geotechnical or porosity test will determine the soil infiltration rate, which will establish stormwater design requirements. Typical industry recommendations suggest installing an underdrain for soil with less than 0.5" (13 mm) per hour of infiltration. It is possible for underdrain systems to be eliminated for soils with infiltration rates greater than 0.5" (13 mm) per hour.

RELEASE RATE refers to the volume of water that is allowed to be discharged into a municipal system or waterway, usually measured in cubic feet per second. Many stormwater regulatory agencies require that the post-development release rate not exceed pre-development conditions. Permeable paving slows and detains stormwater in the open-graded base so that it can be gradually released. Local jurisdictions should be contacted for required release rates.





INFILTRATION

GREEN COMMUNITY DESIGN

The Iowa Green Streets Project serves as a catalyst to revitalize the local economy in West Union, attract and support local businesses and stimulate further investment to the historic downtown.

The complete renovation of six blocks in West Union replaced aging water, storm and sanitary sewer infrastructure. The project also showcases innovative sustainable design strategies as a model for other communities, including permeable pavement roadways using Eco-Optiloc, pedestrian crosswalk treatments with Eco-Priora, rain gardens, energy efficient lighting, and a district-wide geothermal heating and cooling system.

Prior to design and construction, a cost analysis was completed for the permeable unit paving system. The analysis compared the cumulative cost of permeable unit paving versus that of a traditional bituminous asphalt surface. Analysis showed a payback period of approximately 15 years. Conservatively, the entire system is projected to save over \$104 million in operation costs within the next 50 years.

Product: Eco-Priora™ & Eco-Optiloc™

Location: West Union, Iowa

Project: Green Streets Pilot

Design: Conservation Design Forum



BENEFITS OF INFILTRATION

RAINWATER INFILTRATION is extremely important to the groundwater supply. According to the U.S. Geological Survey, one of America's most important natural resources is groundwater. Half of the drinking water in the U.S. comes from groundwater, with the balance coming from lakes and rivers. It is vital to agriculture and other industries, as well as essential for ensuring the health of rivers, streams, wetlands and other water bodies. Urban sprawl contributes to the decrease in pervious area for rainwater infiltration and reduced groundwater levels. Soil infiltration is a simple method for ensuring future water availability.

Installing a permeable paver system above porous soils allows for rainwater infiltration, reducing runoff and flooding. Most soils, even clay, allow for some infiltration. Soils with high porosity, such as sand, can have a higher infiltration rate than the actual rate of rainfall. For example, if it is raining at a rate of 2" (51 mm) per hour, and the soil has an infiltration rate of 4.5" (114 mm) per hour, the soil will absorb water before it can run off. Even poor soil with a low infiltration rate will work. For example, a soil with 0.25" (6 mm) per hour of infiltration will have complete infiltration after about four hours per inch of rainfall.

TYPICAL INFILTRATION RATES OF VARIOUS SOIL GROUPS

SOIL CONSERVATION SERVICE GROUP	TYPICAL SOIL TYPE	SATURATED INFILTRATION RATE	
		in/hr	mm/hr
A	Sand	8.27"	210 mm
A	Loamy Sand	2.41"	60 mm
B	Sandy Loam	1.02"	26 mm
B	Loam	0.52"	12.7 mm
C	Silt Loam	0.27"	6.8 mm
C	Sandy Clay Loam	0.17"	4.3 mm
D	Clay Loam and Silty Clay Loam	0.09"	2.3 mm
D	Clay	0.06"	1.5 mm

INFILTRATION RATES FOR UNILOCK PERMEABLE PAVERS - NEWLY INSTALLED

	PAVER	JOINT MATERIAL	JOINT WIDTH*	VOID SPACE*	INFILTRATION RATE**	MINIMUM INFILTRATION RATE** FOR RAINFALL INTENSITY OF:				
						2"/hr	4.5"/hr	6.5"/hr	11"/hr	
ADA COMPLIANT	Small: 1/4" Joint	Eco-Line®	ASTM # 9 Aqua Rock	6.25mm	5.8%	560	34	78	112	190
		Eco-Promenade®	ASTM #9 - SEK Chip	7 mm	10.12%	934	20	44	64	109
		Eco-Priora™ Herringbone	ASTM #9 - SEK Chip	7 mm	7.08%	676	28	64	92	155
		Eco-Priora™ 5 x10	Kafka - 1/8 to 3/16"	7 mm	6.8%	633	29	66	96	162
		Eco-Priora™ Pattern H	ASTM #9 - Roscoe Chip	7 mm	5.7%	509	35	79	114	193
		Eco-Priora™ Pattern H	IDOT FA 22	7 mm	5.7%	347	35	79	114	193
		Eco-Priora™ 10 x 10	Kafka - 1/16 to 3/16"	7 mm	4.6%	327	43	98	141	239
	Medium: 1/4" to 3/8" Joint	Town Hall®	Kafka - 1/8 to 3/16"	9mm	6.5%	784	31	69	100	169
		City Park Paver™	ASTM #9 - SEK Chip	10mm	4.2%	934	48	107	155	262
	Large: 3/8" to 1/2" Joint	DuraFlow™	ASTM #8 IDOT CA-16	12mm	8%	912	25	56	81	138
		Eco-Optiloc™	HPB	12 mm	7.3%	404	27	62	89	151
		Eco-Optiloc™	ASTM #8 IDOT CA-16	12 mm	7.3%	912	27	62	89	151
	Extra Large: >1/2"	Tribeca Cobble™		10mm	5.6%	400	36	80	116	196
		Thornbury™	ASTM # 9 Aqua Rock	18mm	4.4%	385	45	102	148	250
Eco-Stone™		ASTM #8 IDOT CA-16	6 mm	10.18%	784	19	42	60	102	
Ecoloc®		Kafka - 1/8 to 3/16"	7 mm	12.18%	1060	18	41	59	99	

NOTE: The 2", 4.5", 6.5" and 11" per hour Rainfall Intensity examples are based on common 5 minute rainfall intensity charts and are not the same as total rainfall quantity.

* Joint Width is measured at the top of the paver. Void Space is calculated at the base of the paver.

** Infiltration rate is inches per hour based on testing done when first installed and is an approximation.



DETENTION AND VOLUME CONTROL

REDUCE LOCAL FLOODING

As part of an extensive resiliency plan to mitigate flooding in a Hoboken neighborhood, a one-acre parking lot was turned into a one-of-a-kind park. New green space offers a refined spot for a variety of recreational activities with moveable seating areas, a lawn, child-friendly play zones, and much more.

Permeable pavers helped the park successfully meet the city's demand for sustainability with integrated green infrastructure, capable of managing 200,000 gallons of stormwater in its underground water detention system. Eco-Promenade™ is designed to direct rainwater back into the subbase and detention system through the joint material and keep it away from sewer systems.

The paving pattern was achieved using the special-order Series™ finish in three colors on the Eco-Promenade shape. The colors play on the building hues of the neighborhood creating an interesting and vibrant space for all to enjoy.

Product: Eco-Promenade™

Location: Hoboken, New Jersey

Project: Southwest Park

Design: Starr Whitehouse

DETENTION AND VOLUME CONTROL OPPORTUNITIES

TRADITIONAL SURFACE DETENTION PONDS which act as holding facilities for rainfall are an inefficient use of space. For most land uses and all impervious areas, such as roofs, roads and parking lots, stormwater runoff flows through a system of pipes that release it into detention or retention ponds. This valuable surface area could be much more effectively utilized.

A permeable paving base for stormwater detention is a very efficient use of land. With this system, the surface is pervious, allowing detention area to be contained underneath. The detention is created under every square foot of permeable paving, as deep as necessary.

Permeable paver systems use crushed, angular, open-graded aggregate base materials. These materials are entirely different from those used for traditional impervious roads and parking lots. Those traditional systems use dense-graded aggregates containing fines, making them extremely slow-draining. Conversely, the use of open-graded aggregates provides a void space or porosity of approximately 40 percent. This is utilized for detention and allows for a rapid surface infiltration rate of over 500" (12,700 mm) per hour (see page 30 for aggregate infiltration rates).



STREETSCAPE REMAKE

A desire for urban beautification in Manhattan led to the largest district-wide use of state-of-the-art sustainable street features in the city. Among the tools permeable pavers allow rainwater to flow into the specifically-designed tree trenches that feed vegetation. As well, permeable paving helps capture stormwater, a benefit that became top-of-mind following the extensive flooding caused by Hurricane Sandy.

Product: Eco-Priora™ **Location:** Manhattan, New York
Project: Hudson Sponge
Design: Mathews Nielson

BASE STORAGE CAPACITY

CRITERIA				RAINWATER HARVEST VOLUME			BASE STORAGE CAPACITY			SURPLUS / (DEFICIT) STORAGE			% Used
Rainfall In/Hr (mm/hr)	Surface Area Ft ² (m ²)	Base Depth In (cm)	Void Space	Cubic Ft (m ³)	Acre Feet	Gallons (m ³)	Cubic Ft (m ³)	Acre Feet	Gallons (m ³)	Cubic Ft (m ³)	Acre Feet	Gallons (m ³)	
1 (25 mm)	43,560 (4,047 m ²)	14 (35 cm)	40%	3,630 (103 m ³)	0.08	27,154 (103 m ³)	20,328 (576 m ³)	0.47	152,064 (576 m ³)	16,698 (473 m ³)	0.38	124,910 (473 m ³)	17.9%
1 (25 mm)	43,560 (4,047 m ²)	18 (46 cm)	40%	3,630 (103 m ³)	0.08	27,154 (103 m ³)	26,136 (740 m ³)	0.60	195,511 (740 m ³)	22,506 (637 m ³)	0.52	168,357 (637 m ³)	13.9%
1 (25 mm)	43,560 (4,047 m ²)	22 (56 cm)	40%	3,630 (103 m ³)	0.08	27,154 (103 m ³)	31,944 (905 m ³)	0.73	238,958 (905 m ³)	28,314 (802 m ³)	0.65	211,804 (802 m ³)	13.9%
3.04 (77 mm)	43,560 (4,047 m ²)	14 (35 cm)	40%	11,035 (312 m ³)	0.25	82,548 (312 m ³)	20,328 (575 m ³)	0.47	152,064 (575 m ³)	9292.92 (263 m ³)	0.21	69,516 (263 m ³)	54.3%
3.04 (77 mm)	43,560 (4,047 m ²)	18 (46 cm)	40%	11,035 (312 m ³)	0.25	85,548 (312 m ³)	26,136 (740 m ³)	0.60	195,511 (740 m ³)	15,101 (428 m ³)	0.35	112,963 (428 m ³)	42.2%
7.58 (19 mm)	43,560 (4,047 m ²)	14 (35 cm)	40%	27,515 (779 m ³)	0.63	205,827 (779 m ³)	20,328 (575 m ³)	0.47	152,064 (575 m ³)	(7187) 203 m ³	(0.16)	53,763 (204 m ³)	135.4%
7.58 (19 mm)	43,560 (4,047 m ²)	22 (56 cm)	40%	27,515 (779 m ³)	0.63	205,827 (779 m ³)	31,944 (905 m ³)	0.73	238,957 (905 m ³)	4,429 (125 m ³)	0.10	33,131 (125 m ³)	86.1%

Detention volumes or storage capacities for permeable paving are based on different rainfall events.



WATER QUALITY

WETLAND REQUIREMENTS

Cleveland Clinic Hospital located in Avon, Ohio needed to expand in order to continue meeting the health care needs of its community. The clinic identified the need to build a new, multi-story bed tower and the byproduct of this tower was the need for a massive increase in parking on a tight budget. The challenge the design team faced was that much of the available property and the adjacent property was wetland. In order to protect the wetland, stormwater runoff from the parking lot was not allowed.

The design team, in conjunction with the Army Corps of Engineers, decided that permeable pavers were the best approach to deal with the stormwater sensitivities. The high infiltration rate of Eco-Optiloc meant that stormwater would be reabsorbed below ground. The 'L' interlocking shape of Eco-Optiloc provided superior resistance to heavy vehicular and truck traffic. The mechanical installation of the pavers, coupled with the low cost of maintenance, kept the project on budget in the short and long term.

Product: Eco-Optiloc™

Location: Avon, Ohio

Project: Cleveland Clinic Hospital

Design: Cawrse & Associates, Inc.

IMPROVED WATER QUALITY



WITHOUT WATER, life cannot survive. For fish, wildlife and humans, clean water is a necessity. Even plants need a certain quality of water. The infiltration process of a permeable paving system will remove harmful pollutants such as oil. The EPA recognizes permeable paving as a best management practices (BMP) for non-point source pollutants. Utilizing permeable pavers is a simple step to ensure cleaner water and to minimize increases in water temperature. Often forgotten, water temperature is an important quality issue. Increased water temperatures can increase the amount of bacteria and algae, and can decrease aquatic life. Allowing the water to immediately drain from the surface ensures it will not be heated from an impervious surface before it reaches a runoff area.

The Interlocking Concrete Pavement Institute (ICPI) has conducted tests that determine water quality. Their findings indicate that cleaner water results from being filtered through a permeable paving system. Traditional systems have no means for cleaning water. Many municipalities in North America have begun to implement strategies to improve water quality by using BMPs like permeable paver systems. Even smaller communities have joined in the effort to create more sustainable water management systems.

MEDIAN POLLUTANT REMOVAL

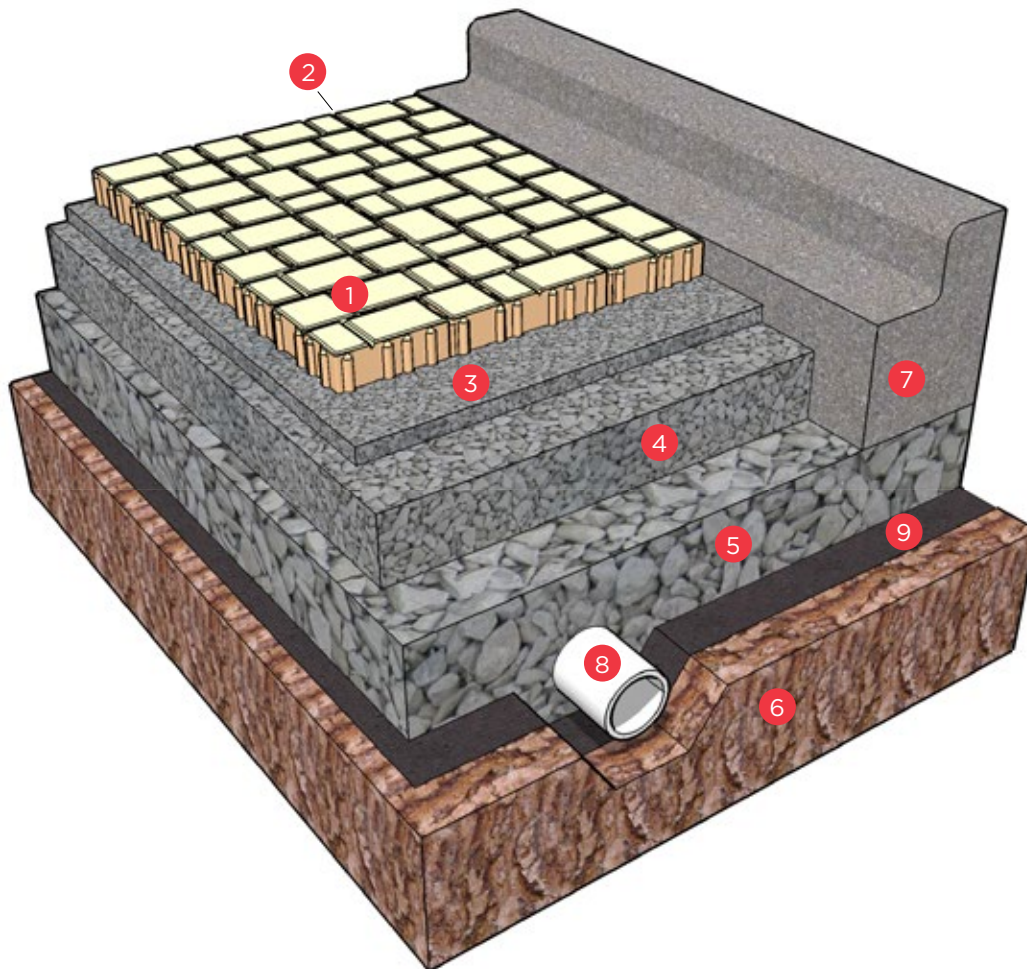
POLLUTANT	INFILTRATION TRENCH DESIGN TYPE*			Infiltration Trenches & Porous Pavement Median Pollutant Removal**
	0.5 in (13mm) Runoff per Impervious Acre	1.0 in (25mm) Runoff per Impervious Acre	2-Year Design Storm Treatment	
Total Suspended Solids	60-80%	80-100%	80-100%	95%
Total Phosphorous	40-60%	40-60%	60-80%	70%
Total Nitrogen	40-60%	40-60%	60-80%	51%
Biological Oxygen Demand	60-80%	60-80%	80-100%	-
Bacteria	60-80%	60-80%	80-100%	-
Metals	60-80%	60-80%	80-100%	99% (Zn)

*Note: These rates are not based on actual data since monitoring what enters and leaves any infiltration facility is difficult to measure. This data is based on land application of pollutants and their treatment through soils.

**Actual monitored removal rates.



NINE COMPONENTS OF A HIGHLY SUCCESSFUL PERMEABLE PAVEMENT



1 UNILOCK PERMEABLE INTERLOCKING CONCRETE PAVER

With various aesthetically pleasing colors and textures, creative choices are not compromised by function. Permeable Interlocking Concrete Pavers (PICPs) are the most durable of any porous pavement material. Unilock's minimum 8,500 psi (57 MPa), high-strength, no-slump concrete allows water to infiltrate between paver units instead of through the material. The joint sizes vary between paver options, ranging from 0.25" (6 mm) to 0.5" (13 mm), which meet the Americans with Disabilities Act specifications for permeable pavement, and allows a minimum of 100" (2,540 mm) per hour of surface infiltration.

2 JOINT AGGREGATE - ASTM NO. 8 OR 9

As the initial filtering layer, the 0.25" (6 mm) crushed, angular, chip stone captures approximately 80 percent of debris in the first 1" (25 mm) to 2" (51 mm). The secondary function of the joint aggregate is to increase the positive interlock between the paver units, which is essential to the structural stability of the PICPs. The joint aggregate must always remain filled to the lip of the PICP units to reduce unnecessary clogging.

3 SETTING BED AGGREGATE - ASTM NO. 8

Using the 0.25" (6 mm) crushed, angular, chip stone, instead of sand, provides a smooth leveling course for placing pavers and additional structural interlocking of the PICPs. Unlike sand, the setting bed aggregate allows for rapid water infiltration with over 500" (12,700 mm) per hour through the 40 percent void-space. Sand must be avoided as a setting bed in a PICP application.

4 BASE AGGREGATE - ASTM NO. 57

When subsoil conditions are conducive to supporting the ASTM No. 57 (12.5-25mm) crushed, angular, open-graded base material without migration, it can be used without ASTM No. 2 (50-63mm) subbase aggregate. Minimum thickness must be designed to sufficiently support anticipated loads, as well as accommodate stormwater detention in the 40 percent void space of the material. The ASTM No. 57 base aggregate, with a minimum thickness of 4" (102 mm), serves as a transition material between the ASTM No. 8 (2-10mm) setting bed and the ASTM No. 2 subbase aggregate. The infiltration rate of the ASTM No. 57 is over 500" (12,700 mm) per hour.

5 SUBBASE AGGREGATE - ASTM NO. 2

Subsoil conditions will dictate the necessity of this larger ASTM No. 2 (50-63mm), crushed, angular, open-graded subbase aggregate thickness. Installation of such material will provide increased structural stability on sites with poor soil conditions. A minimum thickness of 8" (203 mm) is required for effective performance. Subbase aggregate thickness must be designed to sufficiently support anticipated loads. As an added feature, the ASTM No. 2 subbase aggregate temporarily detains stormwater runoff in the 40 percent void-space of the material. The ASTM No. 2 also has an infiltration rate of over 500" (12,700 mm) per hour.

6 SUBGRADE

Existing soil materials will determine the performance capabilities of the PICP system. Pre-construction soil analysis, including percolation, California Bearing Ratio and penetrometer measurements (blow counts), are mandatory for proper design. Subsoils with less than 0.5" (13 mm) per hour of infiltration may require underdrainage, scarification and potentially amendments. Subsoils with greater than 0.5" (13 mm) per hour are considered highly permeable. Subsoil compaction can cause a detrimental reduction in permeability and can be eliminated.

7 EDGE RESTRAINT

PICP containment is vitally important to the success of interlocking properties. Lack or failure of an edge restraint will negatively impact the integrity of the pavement surface. For all vehicular PICP applications, an edge restraint, such as a concrete curb, is required. For non-vehicular and pedestrian areas, a plastic edging is sufficient when properly anchored into the subbase.

8 UNDERDRAIN

In PICP systems, the underdrain pipe is based on several factors, such as the permeability of the subsoil, detention requirements, and stormwater release rate of the site. With highly permeable subsoils over 0.5" (13 mm) per hour, the underdrain pipe could be eliminated. Underdrain pipe size is inconsequential, provided the flow rate is greater than the release rate.

9 MECHANICAL BASE STABILIZATION

Subsoil characteristics will determine the need for base stabilization. Specifically designed geogrid style systems, such as DriveGrid System™, can be placed between the subsoil and ASTM No. 57 (12.5-25mm) base aggregate or ASTM No. 2 (50-63mm) and subbase. DriveGrid is not required between aggregate material layers. The base stabilization must be determined by soil conditions specific to each project. Drivegrid should be considered for any weaker subsoils.



DESIGN AND TECHNICAL INFORMATION

TYPICAL RUNOFF COEFFICIENTS FOR THE RATIONAL METHOD

LAND USE TYPE	RECOMMENDED VALUE	SURFACE TYPE	RECOMMENDED VALUE
Industrial	0.75	Bituminous Asphalt	0.85
Downtown Business District	0.85	Pour-In-Place Concrete	0.85
Single-Family Residential	0.40	Lawns - Sandy Soils	0.13
Multi-Family Residential	0.60	Lawns - Heavy Soils	0.20
Parks	0.20	Permeable Pavers	0.0*

Source: *Design and Construction of Sanitary and Storm Sewers. American Society of Civil Engineers, New York, p. 332, 1969.*

* Actual value until detention in permeable base reaches capacity.

Coefficients are based on 5 - 10 year storm frequencies.



		SOIL SUBGRADE TEXTURE / INFILTRATION RATE INCHES / HOUR (MM/SEC)											
		Sand	Loamy Sand	Sandy Loam	Loam	Silt Loam	Sandy Clay Loam	Clay Loam	Silty Clay Loam	Sandy Clay	Silty Clay	Clay	
Criterion	T_s (hrs)	8.27 (6×10^{-5})	2.41 (2×10^{-5})	1.02 (7×10^{-6})	0.52 (4×10^{-6})	0.27 (2×10^{-6})	0.17 (1×10^{-6})	0.09 (6×10^{-7})	0.06 (4×10^{-7})	0.05 (3×10^{-7})	0.04 (2×10^{-7})	0.02 (10^{-7})	
	$f \times T_s / V_r$	24	496 (12.6)	145 (3.7)	61 (1.5)	31 (0.8)	16 (0.4)	10 (0.25)	5 (0.12)	4 (0.1)	3 (0.07)	2 (0.05)	1 (0.02)
	for	48	992 (25.2)	290 (7.4)	122 (3.1)	62 (1.6)	32 (0.8)	20 (0.5)	11 (0.3)	7 (0.17)	6 (0.15)	2 (0.15)	2 (0.05)
	($V_r = 0.4$)	72	1489 (37.8)	434 (11)	183 (4.6)	93 (2.4)	149 (1.2)	31 (0.8)	16 (0.9)	11 (0.13)	9 (0.2)	7 (0.17)	4 (0.1)

T_s = Maximum allowable storage time

V_r = Voids ratio

Lowest values unless base exfiltration is supplemented with drain pipes.

Maximum allowable depths, inches (m) of storage for selected maximum storage times (T_s in hours), minimum infiltration rates and inches/hour (mm/sec)(31).

The Natural Resources Conservation Service (NRCS) method typically uses 24-hour storm events as the basis for design. Therefore, this design method is based on controlling the increased runoff for a specific 24-hour storm. The specific duration and return period (e.g., 6 months, 1 year, 2 years, etc.) are provided by the locality. If the increase in peak discharge associated with the storm event cannot be managed, a first-flush event should be the minimum selected for design.

BASE & AGGREGATE CHARTS

Careful selection of base material, as described below, ensures that an installation can handle almost any amount of rainfall. Testing results of all the aggregates listed below show a void ratio of approximately 40 percent. Choosing the correct void filter is critical as well. The aggregate infiltration rates below illustrate the performance of the system.

AGGREGATE INFILTRATION RATES

APPROXIMATE PARTICLE SIZE	PERMEABILITY (K) IN./HR (M/S)
ASTM No. 8 (2 - 10 mm)*	1,400 - 4,000 (3×10^{-1} to 1×10^{-2})
ASTM No. 9 (2 - 5 mm)	140 - 1,400 (1×10^{-2} to 1×10^{-3})
ASTM No. 10 (1 - 3 mm)	14 - 140 (1×10^{-3} to 1×10^{-4})
ASTM No. 57 (12.5 - 25 mm)*	500 - 2,000
ASTM No. 2 (50 - 63 mm)*	>1,000

Permeability ranges of joint fill aggregates for permeable pavers.
* Unilock recommendations

SETTING BED AGGREGATE

SIEVE SIZE	PERCENT PASSING
0.5" (12 mm)	100
0.375" (9.5 mm)	85 - 100
(4.75 mm) (No. 4)	10 - 30
(2.36 mm) (No. 8)	0 - 10
(1.16 mm) (No. 16)	0 - 5

Grading requirements for ASTM No. 8 bedding and joint / opening filler. Setting bed aggregate can be used as joint aggregate for Eco-Optiloc™.

BASE AGGREGATE

SIEVE SIZE	PERCENT PASSING
1.5" (37.5 mm)	100
1" (25 mm)	95 - 100
0.5" (12 mm)	25 - 60
(4.75 mm) (No. 4)	0 - 10
(2.36 mm) (No. 8)	0 - 5

Grading requirements for ASTM No. 57 base.

SUBBASE AGGREGATE

SIEVE SIZE	PERCENT PASSING
3" (75 mm)	100
2.5" (63 mm)	90 - 100
2" (50 mm)	35 - 70
1.5" (37.5 mm)	0 - 15
0.75" (19 mm)	0 - 5

Sieve sizes for ASTM No. 2 aggregates.

BASE THICKNESS

Permeable paving is not a typical segmental pavement. Unilock recommends that a professional engineer design a site-specific plan based on available site information. Along with information provided in this brochure, Unilock offers comprehensive software solutions, and industry-experienced consultants to assist you in the design of your pavement.

PAVEMENT USE	SUBBASE ASTM NO. 2	BASE ASTM NO. 57	MINIMUM TOTAL
Heavy-duty industrial	14" (355 mm)	6" (152 mm)	20" (508 mm)
Municipal street	12" (305 mm)	6" (152 mm)	18" (457 mm)
Light-duty parking lot	8" (203 mm)	6" (152 mm)	14" (356 mm)
Residential driveway	n/a	12" (305 mm)	12" (305 mm)
Non-vehicular sidewalk	n/a	10" (254 mm)	10" (254 mm)

Notes:

- 1) All permeable pavers require a 1.5" (38 mm) setting bed of ASTM No. 8 for placement.
- 2) All thicknesses are after compaction.
- 3) Geotextiles between subgrade and ASTM No. 2 are optional and based on soil conditions.
- 4) Geotextiles are not required between the subbase, base or setting bed layers.

UNILOCK® PERMEABLE PAVER FEATURES

SHAPE AND COLOR

UNILOCK OFFERS PERMEABLE PAVERS in many different shapes and sizes. From the basic rectangle to 'L' shaped, hexagonal to plank, the range of choice ensures the right product for your design.

Unilock offers more aesthetic paver options than any other manufacturer. We have stock colors that can be applied to any of the Unilock product lines. If we don't have the color required for a project, we can create it.

Recently, surface color has become more than just an aesthetic choice. Using lighter colors with high reflectivity can dramatically reduce urban heat islands. Generally, an increase of 10 percent in reflectivity decreases pavement temperature by 7°F, according to Lawrence Berkeley National Laboratories. Potential LEED credits are available with these products.



Product: Eco-Priora™ **Location:** Chicago, Illinois
Project: Saddle & Cycle Club
Design: Daniel Weinbach & Partners LTD

MECHANICAL INSTALLATION

Eco-Optiloc™ has the highest mechanical installation rates of any interlocking permeable paver. The patented L-shaped design makes the paver clusters easy to install quickly and accurately. Installation rates up to 12,000 sq.ft. per machine per day have been documented (U.S. Cellular Field, Lot L) however typical installation average 8,000 sq.ft. per machine. This makes Eco-Optiloc a very competitive permeable pavement that can be installed even in adverse weather conditions. Eco-Priora™ Eco-Line® and DuraFlow™ are also available for mechanical installation.





LEED CREDIT OPPORTUNITIES

LEED®, Leadership in Energy & Environmental Design, is a green building certification program that recognizes best-in-class building strategies and practices that have a positive impact on the health of occupants, while promoting renewable, clean energy. To receive LEED certification, building projects satisfy prerequisites and earn points to achieve different levels of certification. Unilock products can help with your certification goals.

POTENTIAL LEED CREDITS LEED V4

RAINWATER MANAGEMENT: LEED V4

Up to three points can be achieved for retaining rainwater onsite based on the percentile kept.
 85% (zero lot line projects only) • **3 points** - 95% • **2 points** - 98% • **3 points**. (All except Healthcare - subtract one point)
 See LEED v4 for more specific project/site details.

MATERIALS AND RESOURCES: LEED V4









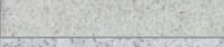


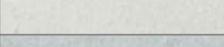
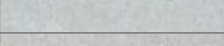
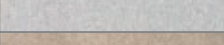





Building Product Disclosure and Optimization - Sourcing of Raw Materials - Sourcing of Raw Materials and Extraction • **1 point**
 Building Product Disclosure and Optimization - Sourcing of Raw Materials - Leadership Extraction Practices • **1 point**
 Building Product Disclosure and Optimization - Material Ingredient Reporting - Material Ingredient Reporting • **1 point**
 Building Product Disclosure and Optimization - Material Ingredient Reporting - Material Ingredient Optimization • **1 point**
 Building Product Disclosure and Optimization - Environmental Product Declaration • **1 point**

HEAT ISLAND REDUCTION - NON-ROOF: LEED V4

Paving materials with a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation OR use an open grid pavement at least 50% previous
 • **2 points (except Healthcare - 1 point)**
 See LEED v4 for more specific site calculations.

SOLAR REFLECTANCE

Solar Reflectance Index (SRI) is a criterion used by USGBC that measures values of sunlight and radiation bouncing from built surfaces. It is used to measure urban heat island effects in city centers. Dark pavement absorbs heat during the day and then releases it at night. This process creates a situation that causes urban centers to stay warmer all the time which contributes to air pollution and increased energy consumption. Careful selection of materials and colors can help reduce urban heat island effects.

SAMPLE OF QUALIFIED UNILOCK COLORS (≥33)				
Surface Finish	Color	Swatch	Solar Reflectance	SRI*
Umbriano® (mottled)	Summer Wheat		0.42	48
	Winter Marvel		0.35	38
Series™ (Exposed aggregate)	Golden Tan		0.40	45
	Chardonnay Tan		0.39	44
	Coral Gem		0.37	41
	Ice Grey		0.35	38
	Mineral Ice Grey		0.31	33
	Platinum Grey		0.28	29
	SS0016		0.41	46
	SS0025		0.42	48
	SS0026		0.37	41
Smooth/Premier (any Unilock paver shape)	SS0080		0.44	50
	SS0088		0.32	34
	TX Active White		0.46	53
	Tuscany Blend		0.39	44
	Opal		0.32	34
Standard Finish	Nevada		0.31	33
Arcana	Modena		0.46	53
Stonemark Finish	Iron River		0.52	61

Values may change slightly by region due to variations in local aggregate. Please be sure to contact your Unilock Representative for a comprehensive and current list of SRI product values.

RECYCLED CONTENT

SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCM)

CONCRETE IS A MIXTURE of sand, coarse aggregate, water and the principal cementitious material which is Portland cement. Today, most concrete recipes also contain supplementary cementitious material (SCM) admixtures. These can be by-products from other processes or natural materials that may or may not have been further processed for use in concrete. These materials may include Fly Ash (Class C or F), Ground Granulated Blast Furnace Slag (GGBFS), Silica Fume, Natural Pozzolans, recycled glass and more.

These admixtures can contribute toward achieving the cumulative minimum recycled content criteria for Leadership Extraction Practices.

Speak with your Unilock Representative about local SCM's available for custom orders.



Product: Uni Eco-Stone™

Location: New York, New York
Project: United Nations Headquarters
Design: di Domenico + Partners LLP
Recycled Content: SCM from Pozzotive®

PERMEABLE TEST & RESEARCH STUDY SITES

PROJECT	LOCATION	AGENCY	REPORTS
EPA - Green Infrastructure Research	Hopelawn	NJ	U.S. Environmental Protection Agency https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=P100POHA.txt
Case Studies of LID Implementation and Performance - Ohio	Various	OH	Chagrin River Watershed Partners, Inc. http://crwp.org/files/NERR_SC_Case_Study_Report_2015_Final.pdf
Willoughby Hills Community Center Parking Lot	Willoughby Hills	OH	Chagrin River Watershed Partners, Inc. Currently being monitored http://www.crwp.org/files/Whills_Community_Center_Parking_Fact_Sheet.pdf
Kortright Centre - Permeable pavement evaluations - Five Year Performance report	Kleinburg	ON	Toronto and Region Conservation Authority / University of Guelph https://sustainabletechnologies.ca/home/urban-runoff-green-infrastructure/low-impact-development/permeable-pavement/evaluation-of-permeable-pavements-in-cold-climates-kortright-centre-vaughan-ontario/
IMAX Corporate Office parking lot	Mississauga	ON	Credit Valley Conservation Authority https://www.creditvalleyca.ca/wp-content/uploads/2014/02/IMAX_Case_Study_Final_21Feb.pdf
Seneca College King Campus	King	ON	Toronto and Region Conservation https://sustainabletechnologies.ca/home/urban-runoff-green-infrastructure/low-impact-development/permeable-pavement/performance-evaluation-of-permeable-pavement-and-a-bioretenion-swale-seneca-college-king-city-ontario/
Permeable Pavements in Cold Climates: State of the Art and Cold Climate Case Studies	St Paul	MN	Minnesota Department of Transportation www.cts.umn.edu/Publications/ResearchReports/pdfdownload.pl?id=2612

PERMEABLE PAVER MAINTENANCE GUIDE

Much like any impervious paving surface with catch basins and underground infrastructure, maintenance is necessary with any type of permeable system. Over the lifetime of the permeable paver system, there will be a need to clean any sediment, soil, dirt and debris from the joint aggregate material to maintain a sufficient infiltration rate. Every project will vary in performance needs, as well as to the frequency in which the joint material must be cleaned. Unilock suggests establishing a routine visual inspection and maintenance plan using the techniques in this guide to prevent clogging. Ask your Unilock Representative for more information.



UNILOCK® PERMEABLE PAVER INSTALLATIONS

MILLIONS OF SQUARE FEET INSTALLED

PARKS AND MUNICIPAL COMMONS

Storrs Town Center	Mansfield	CT
The Morton Arboretum	Lisle	IL
Buckingham Fountain	Chicago	IL
Kane County Veterans Memorial	Geneva	IL
Navy Pier	Chicago	IL
Knoch Knolls Park	Naperville	IL
Squirrel Brand Park	Cambridge	MA
Riggs Park	Van Buren Twp.	MI
Hoboken Park	Hoboken	NJ
New York Botanical Gardens	Manhattan	NY
Roosevelt State Park	Yorktown	NY
Cleveland Public Square	Cleveland	OH
First & Main Park	Hudson	OH
The Port Lands	Toronto	ON
South Shell Waterfront Park	Oakville	ON

GOVERNMENT AND MUNICIPAL FACILITIES

7th District Police Station	Chicago	IL
Geneva Water Treatment Facility	Geneva	IL
Chinatown Library	Chicago	IL
Washington Park SRO	Chicago	IL
Villa Park Police Department	Villa Park	IL
City of Grand Rapids Water System	Grand Rapids	MI
Amtrak Station (overflow lot)	Grand Rapids	MI
City Hall of Ann Arbor	Ann Arbor	MI
Newark International Airport	Newark	NJ
Harrison Station (TX Active)	Harrison	NJ
NYS Office of Parks & Recreation	Cortland	NY
Central Ohio Transit Authority	Columbus	OH
NASA Glenn Research	Cleveland	OH
Hudson Station	Hudson	OH
Earth Rangers at Kortright Centre	Caledon	ON
East Gwillimbury GO Station	Newmarket	ON
Dufferin Transfer Station	Toronto	ON
Philadelphia Museum of Art	Philadelphia	PA
RIPTA Para Transit Maintenance	Providence	RI

UNIVERSITIES, SCHOOLS, CHURCHES AND INSTITUTIONS

Stamford Hospital	Stamford	CT
Loyola University	Chicago	IL
Governors State University	University Park	IL
Western Illinois University	Moline	IL
North Central College	Naperville	IL
Waubensee Community College	Plano	IL
University of Michigan	Ann Arbor	MI
UMASS CHCRC	Amherst	MA
Plymouth North High School	Plymouth	MA
Culinary Institute of America	Hyde Park	NY
PS 62R (Net Zero School)	Staten Island	NY
Lorain Community College	North Ridgeville	OH
Inniskillin Wines Inc.	Niagara-on-the-Lake	ON
Mohawk College	Hamilton	ON
Middleton Community Church	Middleton	WI

COMMERCIAL PARKING & VEHICULAR AREAS

ACMAT	Farmington	CT
Springbrook Prairie Market	Naperville	IL
United Airlines Cargo	Chicago	IL
Maxwell Street Market	Chicago	IL
Whole Foods	Naperville	IL
Streeter Place	Chicago	IL
Plympton Plaza	Plympton	MA
Dow • Howell • Gilmore • Associates Inc	Midland	MI
Mason L. Brown & Associates, Inc.	Auburn Hills	MI
Whole Foods	Brooklyn	NY
Cleveland Clinic	Avon	OH
Center Street Village	Mentor	OH
Ontario Provincial Campus	Toronto	ON
Edwards Gardens	Toronto	ON
Honda Canada Headquarters	Markham	ON
Whole Foods	Mississauga	ON
Garden City Shopping Center	Cranston	RI
Krupp	Madison	WI

STREETS & STREETSCAPES

East Village	Calgary	AB
Baltic Village	Sprague	CT
Norwalk Streetscape	Norwalk	CT
Green Streets Pilot Project	West Union	IA
Autumn Trails	Moline	IL
Warrenville Road	Warrenville	IL
Highland Park	Highland Park	IL
Easy Street	Ann Arbor	MI
Union Street	Traverse City	MI
Port of Rochester	Rochester	NY
Village of Carey	Carey	OH
Avon Crescent Laneway	Toronto	ON
Delrose Street	Pittsburgh	PA
Frick Environmental Center	Pittsburgh	PA
Broadway Avenue	Newport	RI
Gorman / Fitchburg	Fitchburg	WI

STADIUMS

U.S. Cellular Field	Chicago	IL
Kane County Cougars Stadium	Geneva	IL
UMASS Football Complex	Amherst	MA
Citi Field	New York	NY

CONDOMINIUMS


Mystic Condominiums	Mystic	CT
Poet's Landing	Danbury	CT
Fuse Condominium	Cambridge	MA
Cape Cod Irish Village	Yarmouth	MA
Jeff Montgomery Apartment Complex	Wayne	MI
West Bloomfield Residence	Bloomfield	MI
Flats on Vine	Columbus	OH
Rouge Valley Retirement Residence	Markham	ON
Fashion House	Toronto	ON



PERMEABLE HEAVY-DUTY PAVING
Grand Traverse Fire Station - Grand Traverse, Michigan
DESIGN: Gourdie-Fraser, Inc.
PRODUCT: Eco-Optiloc™

HEAVY-DUTY PERMEABLE AND NON-PERMEABLE



 This symbol denotes permeable paver.

TRI-AXIS TECHNOLOGY

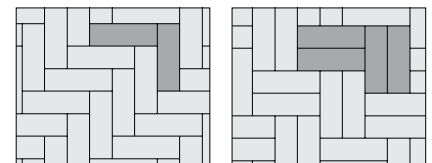
Unilock has a variety of shapes and sizes available to fit your heavy-duty application and style preferences. For maximum performance where twisting and tipping will be factors, consider the **unique “L” interlocking shape** as it provides superior resistance under heavy loads. The patented locking features work in tandem with the “tri-axis” technology. The result? A stronger, more stable pavement surface.

Unilock’s heavy-duty paving systems are also designed for rapid mechanized installation making them competitive and affordable.

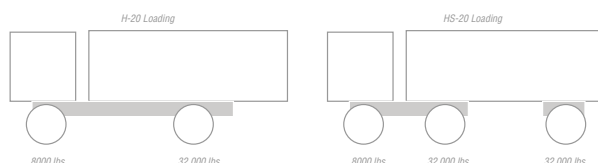


LAYING PATTERN CONSIDERATIONS

The laying pattern used in your application can also add a significant amount of strength to your design. A herringbone pattern provides the best ‘lock-up’ adding strength against rotational forces such as tires at a roadway intersection, in the same way the ‘L’ shaped paver provides maximum performance. *Speak with your Unilock Representative for more information.*



H-20 & HS-20 LOAD RATING



Similar to top of deck stresses per AASHTO H-20 loading conditions (32,000 lbs/14,500 kg), Unilock pavers can support 3-4 axle vehicles. This would include delivery, fire and semi-truck and trailer traffic in light-duty roadway applications.



PERMEABLE PAVING
Northwestern Lake Forest Hospital, Lake Forest IL
DESIGN: oslund.and.assoc.
PRODUCT: Eco-Line®

THE IMPORTANCE OF ASPECT RATIO

Simply defined, the aspect ratio is the overall length of a paver divided by its height.

LENGTH/HEIGHT = ASPECT RATIO

If an insufficient aspect ratio is used, any flexing or rocking caused by movement on the surface such as pedestrian or vehicular traffic, could result in breakage of the paver units. Not only is this breakage unsightly, but it can also compromise the integrity of the segmental system.

3 : 1 OR LESS HEAVY-DUTY VEHICULAR

4 : 1 LIGHT-DUTY VEHICULAR

OVER 5 : 1 PEDESTRIAN ONLY

HEAVY-DUTY PAVERS AT A GLANCE

Unilock pavers listed in the table to the right meet or exceed the 3:1 aspect ratio requirements for heavy-duty pavers.

Note: The shape of the paver in combination with the laying pattern can also effect the performance in heavy-duty applications. Please speak with your Unilock Representative for more details.

PAVER	SHAPE	MEASUREMENTS
Anchorlock [®]	L-Shape	8 7/8" x 8 7/8" x 3 1/8"
Bronte™ Street Paver	Rectangle	8 3/8" x 5 1/4" x 4"
Brussels Block [®]	Standard Stone	6 7/8" x 8 1/4" x 2 3/4"
	Half Stone	4 1/8" x 6 7/8" x 2 3/4"
Brussels Dimensional™ Paver	Rectangle	4" x 8" x 12"
City Park Paver™	Hexagonal 7cm	8" x 8" x 2 3/4"
City Park Paver Permeable	Hexagonal 8cm	8" x 8" x 3 1/8"
Cophorne [®]	Standard	2 1/2" x 7 7/8" x 2 3/8"
Courtstone [®]	All Units	Random bundle
Dura-Flow™	L-Shape	9 7/8" x 9 7/8" x 3 1/8"
Eco-Line [®]	All Units	Random bundle
Eco-Optiloc™	L-Shape	10 1/4" x 10 1/4" x 3 1/8"
Eco-Priora™	Large Square	10" x 10" x 3 1/8"
	Rectangle	5" x 10" x 3 1/8"
	Small Square	5" x 5" x 3 1/8"
Hollandstone™	Hollandstone 8cm	4" x 8" x 3 1/8"
	Double Holland 8cm	8" x 8" x 3 1/8"
Lockstone [®]	Large Square	12" x 12" x 4"
	Small Square	6" x 6" x 2 3/4"
Il Campo [®]	Small Rectangle	4" x 6" x 2 3/4"
	Medium Rectangle	6" x 8" x 2 3/4"
	4x8 Rectangle	4" x 8" x 3 1/8"
	Small Square	6" x 6" x 2 3/4"
Optiloc [®]	L-Shape	10 1/4" x 10 1/4" x 3 1/8"
Promenade™ Plank Paver	Rectangle	4" x 12" x 4"
	Rectangle	3" x 12" x 4"
Series™	Medium Square	8" x 8" x 2 3/4"
	Small Square	6" x 6" x 2 3/4"
	Small Rectangle	4" x 8" x 3 1/8"
Town Hall [®]	Rectangle	9 3/4" x 3 7/8" x 2 3/4"
Umbriano [®]	Small Square	8" x 8" x 2 3/4"
Unigranite [®]	Large Square	6" x 6" x 2 3/4"
	Small Square	4" x 4" x 2 3/4"
Special Order Sizes Available in Various Finishes		6" x 12" x 4"
		4" x 12" x 4"
		3" x 12" x 4"
		8" x 8" x 4"
		3" x 6" x 4"
		4" x 4" x 2 3/8"



NON-PERMEABLE HEAVY-DUTY PAVING
E.L. Harvey & Sons, Westborough, Massachusetts
DESIGN: Hayden Construction & Utilities
PRODUCT: Optiloc®

OPTILOC® & ECO-OPTILOC™


Optiloc is one of the best solutions for vehicular pavements. While maintaining a rectilinear look and feel, it utilizes the locking principle of the Tri-Axis Technology. Unilock was the first to introduce “tri-axis engineering” in North America.

Eco-Optiloc was a natural product evolution from Optiloc, introducing a permeable version of North America’s most successful heavy-duty paver system. Both products can be used seamlessly together on any project where superior load-bearing properties and drainage are critical. These products can be mechanically installed.



Optiloc
10 ¼" x 10 ¼" x 3 ⅞"
26cm x 26cm x 8cm



Eco-Optiloc
10 ¼" x 10 ¼" x 3 ⅞"
26cm x 26cm x 8cm 



Product: Optiloc

Location: Toronto, Ontario

Project: Rogers Centre Bus Parking

Design: IBI Group

ECO-PRIORA™

This versatile and customizable, permeable paver, brings you all of the benefits of a “green” paver system, while empowering you with all of the aesthetic and performance advantages of EnduraColor™ and EnduraColor™ Plus. Even with the permeable joint size, Eco-Priora still remains ADA-compliant.



Small Square*
5" x 5" x 3 ⅞"
12cm x 12cm x 8cm



Rectangle
5" x 10" x 3 ⅞"
12cm x 24cm x 8cm



Large Square*
10" x 10" x 3 ⅞"
24cm x 24cm x 8cm



Product: Eco-Priora

Location: Ann Arbor, Michigan

Project: University of Michigan
Central Campus Transit Center

Consultant: Grissim, Metz, Andriese Assoc

*Available in select markets

ECO-LINE®

This permeable, heavy-duty paver with its long, linear shape and custom finish and color options, it will suit any modern high-traffic space. The eight modules are manufactured on the same bundle layer to be mechanically installed, making this product is not only beautiful, but cost-effective.



Random Bundle (eight different size units)

9 7/8" - 14" x 3 5/16" - 4 1/2" x 4"
23.7 - 35.7cm x 8.4 - 11.4cm x 10cm



Product: Eco-Line

Location: Chicago, Illinois

Project: Casa Querataro

BRONTE™ STREET PAVER

This distressed paver is ideal for heavy-duty applications with superior load-bearing properties. The interlocking tongue and groove proves maximum performance where vehicle turning creates a test load on the paver.



8 3/8" x 5 1/4" x 4"
22cm x 14cm x 10cm



Product: Bronte Street
Paver

Location: Eden Mills, Ontario

Project: York Street

DURAMAT™

Duramat is an effective erosion control product for use in spillways and retention pond applications. The unique locking design ensures that the units will remain connected regardless of water flow and erosion.



19 3/4" x 19 3/4" x 4"
50cm x 50cm x 10cm



Product: DuraMat Project: Retention Pond

TURFSTONE™

Unilock Turfstone is an ideal product for overflow and parking lot expansion and also where emergency access routes are required over turf areas.



15 3/4" x 23 3/8" x 3 1/8"
40cm x 60cm x 8cm



Product: Turfstone Project: Private Office Complex

URBAN REHABILITATION

The transformation of this former quarry and landfill site into a metropolitan park, is one of the most ambitious environmental rehabilitation projects ever undertaken by the City of Montreal. Today's environmental best practices were used to create this park, with recreational green spaces and a large public square which serves as a meeting place and a harmonious transition between the urban city and greenspace.

Eco Priora and Town Hall permeable pavers were chosen to minimize stormwater runoff and help recharge groundwater. A light-colored, Smooth Premier finish was chosen for Eco-Priora to counter urban heat island effect, with Town Hall added for a splash of color with a custom orange added to the mix to echo the color of a pergola on the site.

Today the park is a destination for cultural, sports and educational activities, as well as festivals, art events, walking, jogging, cycling and snowshoeing. It is truly a park for all seasons.

Product: Eco-Priora™ & Town Hall®

Location: Montreal, Quebec

Project: Parvis du parc Frédéric-Back

Design: Groupe BC2 / CIMA+



THE UNILOCK ADVANTAGE

At Unilock, our job is to make your job easier. That's why we maintain a dedicated team of professionals to work with you on your project.

- Background engineering
- Site specific engineering for walls*
- Budget pricing
- Specifications, cross-sections and details for pavers and walls*
- Lunch and Learn - Continuing Education Credits Samples

Contact your Unilock Representative to see how we can help you.



SOFTWARE

Vespa.RS* is a retaining wall engineering software program which enables the user to input grading and layout information directly from the CAD design. The software will easily produce full wall layouts with accurate quantity estimates and comprehensive reports that are specific to your site. Contact a Unilock representative for more information. Lockpave Pro* is a pavement engineering software program developed by Dr. Brian Shackel, the world's leading authority on unit paver pavement design. This powerful software is capable of designing pavement structures for parking lots and roadways, and has even been used to design international shipping ports.

PCSWMM™ (PP) is software that can be used to analyze permeable pavement applications that specifically incorporate the hydraulic properties of Unilock permeable pavements. It allows the user to develop a simple model of a permeable pavement design, run the program with specific storm water data, and analyze the results of the model.

Contact your Unilock Representative for more information.

VISIT US ONLINE FOR:

- > The complete Unilock Architectural catalog
- > Over 250 hatch patterns for CAD
- > Retaining wall engineering software*
- > Unit paver and retaining wall specifications
- > Over 250 CAD cross-section drawings*

** from Risi Stone**



UNILOCK[®]

DESIGNED TO CONNECT.

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