



Sustainability in Hardscaping

The Path to a Greener Future

SUSTAINABILITY IN HARDSCAPING

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Executive Summary

When it comes to achieving sustainability in the built environment, there's a lot to talk about. Sustainability as a design objective has never been more sought after and yet the definition of sustainability continues to shift. Iterations of green building programs, such as Leadership in Energy & Environmental Design (LEED™), evolve to reflect heightened performance possibilities and new realms that can now be addressed with design.

Areas that require paved surfaces like roof decks, streetscapes, parks and urban plazas are perfect examples of spaces where hardscape design strategies are evolving to encompass more sustainable practices. Hardscaping encompasses a wide range of materials and elements used in outdoor construction—from natural stone and porcelain to concrete pavers and retaining walls. While each of these materials provides valuable functionality and aesthetic appeal, their production, like many construction materials, can have an environmental impact. Materials with increasingly lower levels of embodied carbon, for example, can be considered for these projects. Systems, such as permeable pavers,

offer solutions that allow outdoor space to be more usable, while improving the way that the site manages rainwater.

By incorporating sustainable practices into hardscape design and construction, designers can help to reduce the environmental impact of a project while delivering functional and visually compelling outdoor spaces.

The chapters that follow will explore specific strategies and solutions that can reduce the environmental impact of hardscape projects, from the use of low-carbon materials to the integration of permeable systems that promote water management and biodiversity.

Unilock has developed this ebook to provide insights into the various sustainability considerations that architects and landscape architects should make when crafting a hardscaped space and the available solutions that can help to make these sustainable outdoor areas a reality.

Happy reading.

Jeanette Fitzgerald Pitts

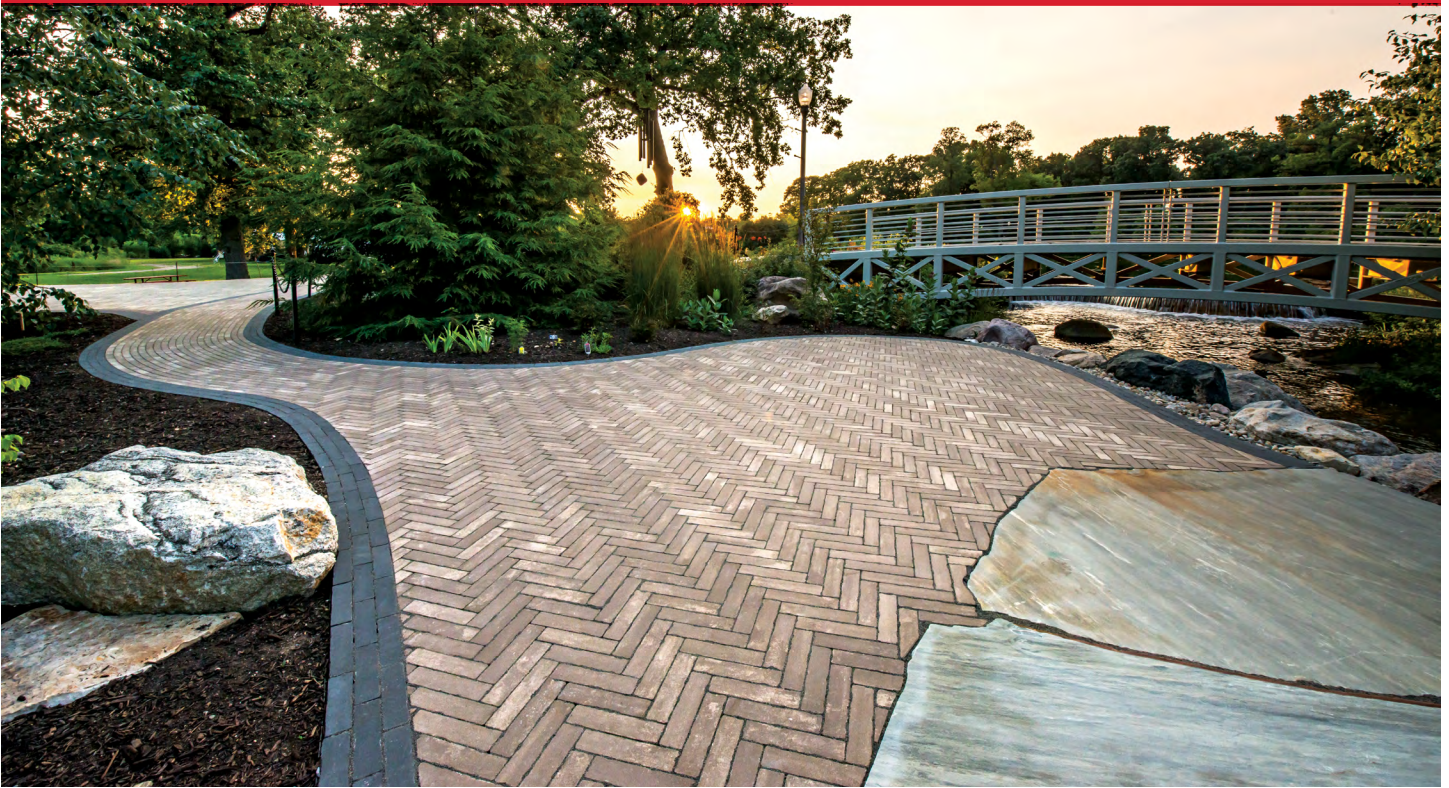
Editor in Chief

Architectural Products

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CHAPTER 1 – Sustainability — Designing for the Future



Botanical Gardens in Elkhart, IN. Designed by Rustic Rocks | Product: Premier Pavers, Size: Mattoni - 2 3/8 x 9 1/2 (2 3/8"), Color: Sable Blend

Building on the achievements of the past 25 years, sustainable design of the built environment is shifting. We're still working to further reduce operational energy usage, leverage neighborhood density to decrease transportation-related consumption of fossil fuels, use less water, and so on. But, the next evolution of sustainable design of the built environment is set to be defined by materiality, resilience, and human benefits.

MATERIALITY: GREATER SCRUTINY, DECARBONIZATION

Building materials are being hailed as the next frontier in reducing greenhouse gases — and we're not talking simply sourcing low-emitting products. Due to the sheer number and variety of building products in each project, materials historically were lumped together to assess environmentally preferable traits. In practice, that meant few building products were individually scrutinized in

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depth. That perspective has changed in the past several years.

LEED v4 took the treatment of materials beyond the total amount used, encouraging deeper discussions of materiality and seeking transparency from suppliers. Life cycle assessments and third-party Environmental Product Declarations, which disclose carbon footprint and environmental data, came into play.

Established in 2018, AIA's Architecture & Design Materials Pledge aims for material selection to consider impacts on the health of humans, the climate, ecosystems, and society, as well as the circular economy. More than 265 firms have signed up, and this year, their participation requires the release of information on their firms. They also have the option to report on project and product categories.

Building on the v4 momentum, LEED v5 will further emphasize the embodied carbon in materials as advocates seek to decarbonize building projects. Embodied carbon refers to emissions from the entire life cycle of the product — the extraction of raw materials, processing and manufacturing, transportation of raw materials to the manufacturing plant and of product to the project site, installation, maintenance, and end-of-life management. Climate Positive Design, which seeks to sequester more carbon than emitted by a project, also stresses embodied carbon.

Advocates are also pushing for products to be able to continue in some way at the end of their useful life, often as broken-down parts that are recycled or reused, creating a circular economy. To that end, design for disassembly will grow more important.

RESILIENCE: CLIMATE READINESS

While resilience — the idea of preventing damage and recovering when damage does occur — is nothing new to architecture, changing weather patterns are creating a sense of urgency around it. Extreme weather events such as hurricanes, tornadoes, heat waves, and floods are increasing. By mid-September, the U.S. had suffered [20 weather/climate disaster events with losses exceeding \\$1 billion each](#) in 2024, and that's only counting the costliest events. A [2022 National Oceanic and Atmospheric Administration \(NOAA\) study](#) cited three reasons for the trend:

- Climate change
- Vulnerability since much of construction growth is in areas at risk from extreme weather, such as coastal cities
- An increase in the built environment that puts more building assets at risk

Property investors today prefer resilient projects as they seek to mitigate financial risks, reduce insurance costs, and increase property value.

Resilience today means far more than ensuring structural integrity for a building to withstand seismic activity. In flood-vulnerable areas, developers are urged to consider elevating buildings on pilings. Naturally, planning for stormwater drainage has become even more crucial, highlighting the need for careful selection of hardscaping and paving.

Buildings aren't the only targets of a desire for resilience. With a diverse range of species boosting an ecosystem's ability to adapt to changes, there's a push for strategies

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fostering biodiversity and habitat restoration. Landscaping and outdoor areas of building projects are being viewed as a vital part of a property's sustainability. Outdoor spaces that support resilient ecosystems will need to blend with the aesthetics of the building and be functional for occupants' outdoor activities.

HUMAN BENEFITS: BIOPHILIA, OUTDOOR SPACES

The “people” prong of the triple bottom line theory (people, planet, and profit) is enjoying heightened status. Occupant considerations in sustainable design have often revolved around such concepts as thermal comfort, indoor air quality, daylighting, and views of the outdoors. But today, the spotlight is on health and wellness as well as social equity. This is driven by factors such as the lasting effects of the pandemic, the desire for employers to attract top talent, economic concerns, and social justice movements. Spending on construction projects designed with wellness in mind rose 18.1% between 2019 and 2023 and is expected to reach \$912.6 billion by 2028, according to the [Global Wellness Institute](#).

Launched in 2014, the WELL Building Standard has been gaining momentum and is now used across more than 5 billion square feet of space in 130 countries. It focuses on how buildings affect occupants' health, such as ensuring healthy food, encouraging physical activity, mitigating noise, fostering mental health, and promoting a collaborative community. In 2016, it was joined by Fitwel, a simpler standard created by U.S. government agencies. Fitwel has grown to encompass

more than 2.5 billion square feet of real estate. LEED v5 includes new requirements for teams to analyze the social impact of a project and promote inclusivity as well as enhanced health and wellness requirements.

The growing focus on health makes Health Product Declarations (HPDs), which disclose a product's contents and health risks for apples-to-apples comparisons, more desirable to assist with material selection. Another design trend of the past few years, biophilia, will continue to play an important role. Biophilic design considers humans' need for a connection to nature. The blurring of indoor and outdoor space and design that encourages the use of outdoor areas — a trend catapulted by the pandemic, particularly in the office and restaurant markets — is seen as beneficial to physical and mental well-being.

UNILOCK: A SUSTAINABLE PARTNER

Unilock is committed to becoming a carbon neutral company. We continue to actively minimize our use of fossil fuels, implement water recycling and harvesting practices, and replace cement in our products with supplementary cementitious materials – all while manufacturing the highest quality product. By working towards making our products and our company more sustainable, we will be able to support designers to build a legacy of beautiful landscapes that enhance our lives, our health and our environment. Read on about our initiatives and how our products can help.

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CHAPTER 2 – Climate Positive Design



McDonald's Chicago Flagship in Chicago IL. Designed by Ross Barney Architects | Product: Series™ Permeable Pavers, Size: 3 x 12 (3 7/8"), Color: 3 Custom Colors

Climate positive design extends beyond individual product selections. It involves designing projects to counterbalance materials with embodied carbon by integrating features that actively sequester carbon. There's

a diverse range of carbon sequestration options, such as boosting on-site greenery, optimizing soil for carbon capture, diversifying plant species, and implementing green roofs. It's crucial to broaden the scope beyond the embodied

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carbon of products; a holistic approach is essential to assess the entire design's impact on daily life and the environment.

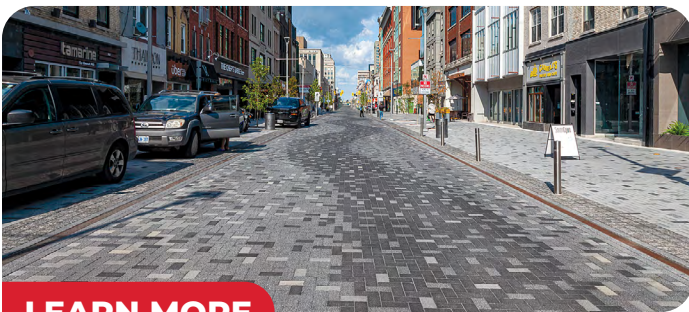
CREATE WALKABLE COMMUNITIES

Transportation has a significant negative impact on our environment. Improving the walkability score of an urban area presents an opportunity to reduce emissions. Establishing an environment where all essential amenities are within walking distance, coupled with the implementation of safe, clean, and dependable infrastructure, contributes to the development of walkable communities.

COMPLETE STREETS

Comprehensive street designs, known as complete streets, are an essential component of walkable communities and have positive environmental impacts. Offering safe transportation alternatives that are net-zero, such as walking or biking, results in reduced emissions. Improving safety, encouraging health and wellness, stimulating economic growth, while creating a sense of place, and improving social interaction benefits site users of all ages.

Case Study: Dundas Place

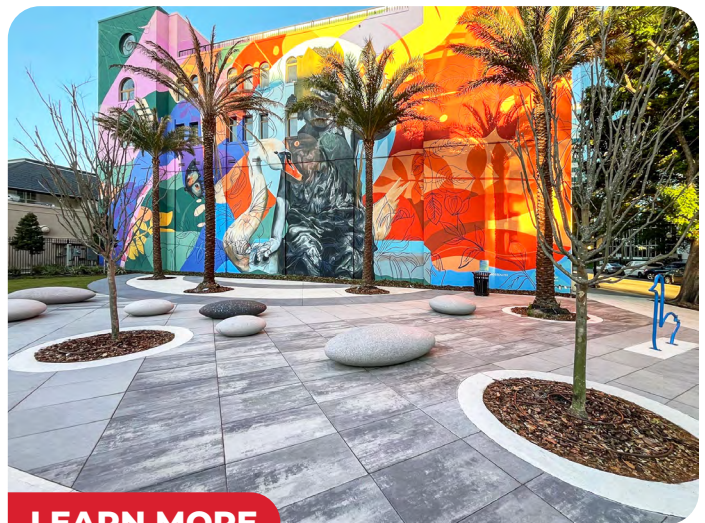


[LEARN MORE](#)

POCKET PARKS

Created from vacant lots, forgotten and underutilized spaces, pocket parks serve to enhance communities and the environment, as well as improve mental and physical well-being. They foster social improvements, engage neighborhoods, mitigate heat island effect, allow for simple implementation and maintenance, all while functioning as a carbon sink, thereby assisting in offsetting local emissions.

Case Study: Eola Pocket Park



[LEARN MORE](#)

PERMEABLE PAVING SYSTEMS

Including permeable paving systems in your design significantly decreases your project carbon footprint while incorporating stormwater management. These systems reduce local flooding, improve water quality and mitigate the risk of heating local waterways, but also demonstrate exceptional durability and low maintenance requirements.

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Case Study: Hoboken Southwest Park



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HIGH SOLAR REFLECTANCE

Reduce heat island effect by choosing pavers with a High Solar Reflectance Index (SRI) value. The surface will reflect the sun's energy, which will prevent heat absorption, reduce urban temperatures, and minimize the heating of runoff water that enters neighboring creeks and streams, that would otherwise disrupt the natural ecology.

Case Study: Lake and Aberdeen Roof Deck



[LEARN MORE](#)

UNDERSTANDING MATERIAL OPTIONS

Employ innovative design approaches that reduce material consumption or integrate reclaimed, recycled and sustainably harvested materials. Understand how materials work within their systems to mitigate effects on the climate. Look for locally sourced materials and fully understand the deconstruction process of the project at the end of its life cycle.

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CHAPTER 3 – Sustainable Hardscape Materials



Unilock Permeable Pavers

Hardscape solutions can contribute toward the overall sustainability of a project in several ways—from improving a site’s ability to manage stormwater to helping mitigate the heat island effect. Additionally, the composition of concrete pavers can positively impact the embodied carbon and recycled content of the material, further contributing to climate positive designs.

PERMEABLE PAVERS

Permeable pavers are designed with a crucial feature that sets them apart from traditional

pavers: wider joint spacing. These wider joints are key to allowing rainwater to flow through the surface, rather than running off and contributing to water management issues. In permeable systems, these joints or openings, created by spacer bars on the paver edges, allow rainwater to filter through and soak into the subsoil below. This design helps reduce stormwater runoff, alleviating pressure on local stormwater systems.

Since 1991, Unilock has been at the forefront of innovation with the introduction of permeable pavers to North America. Unilock offers an extensive selection of permeable

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pavers, available in various shapes, sizes, finishes and colors. This versatility allows for a wide range of aesthetic choices and applications, allowing you to customize your permeable paver selection and bring your vision to life.

Whether you are designing for a heavy duty or pedestrian application, Unilock permeable pavers provide both durability and aesthetic appeal. With Unilock you don't have to choose between style and sustainability - our permeable pavers ensure that beauty and environmental stewardship go hand in hand.



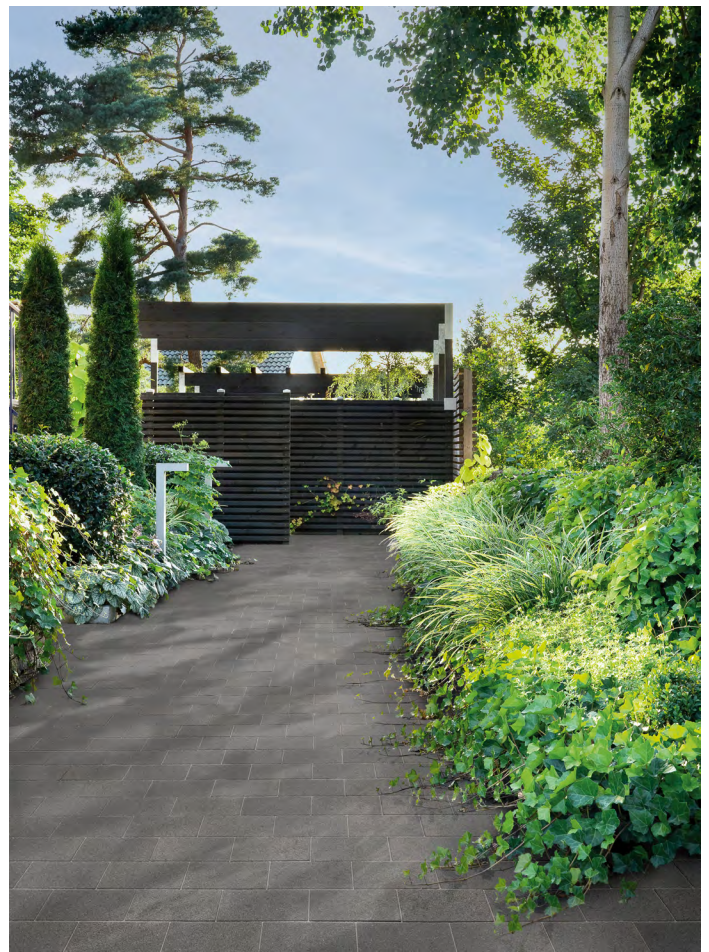
The 61 E Banks Roof Deck showcases Arcana™ slabs in the color Avorio which boasts a high SRI value of 66.

HIGH SOLAR REFLECTANCE PAVERS AND SLABS

Light-colored paving materials have a high solar reflectance that contributes to the reduction of surface temperatures and minimizes the amount of heat that is absorbed into the pavement. The 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 pavements have low SRI values, whereas light pavements typically have higher SRI values.

The right paver colors can minimize heat island effect, help decrease energy consumption, earn LEED points and decrease air pollution.

Unilock offers an impressive selection of colors with high solar reflectance, allowing you to achieve a high SRI value without sacrificing design. From striking whites and soft greys to warm tans and reds, the possibilities are endless. With a variety of finishes to choose from, you can create a customized look that balances sustainability with stunning visual appeal.



Walkway paved with Unilock EcoTerra in Light Steel Grey Blend

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ECOTERRA™ TECHNOLOGY (for more content: [Eco terra sustainable pavers | Unilock Commercial](#))

Unilock is leading the way towards a more sustainable era in hardscaping through the introduction of our cutting-edge EcoTerra technology. This paver innovation features a 100% cement-free face-mix, delivering a reduction in carbon dioxide emissions by up to 15%. Beyond its environmental benefits, EcoTerra offers a number of other advantages, including exceptional durability and performance, enduring vibrant colors, zero efflorescence, and minimal maintenance.

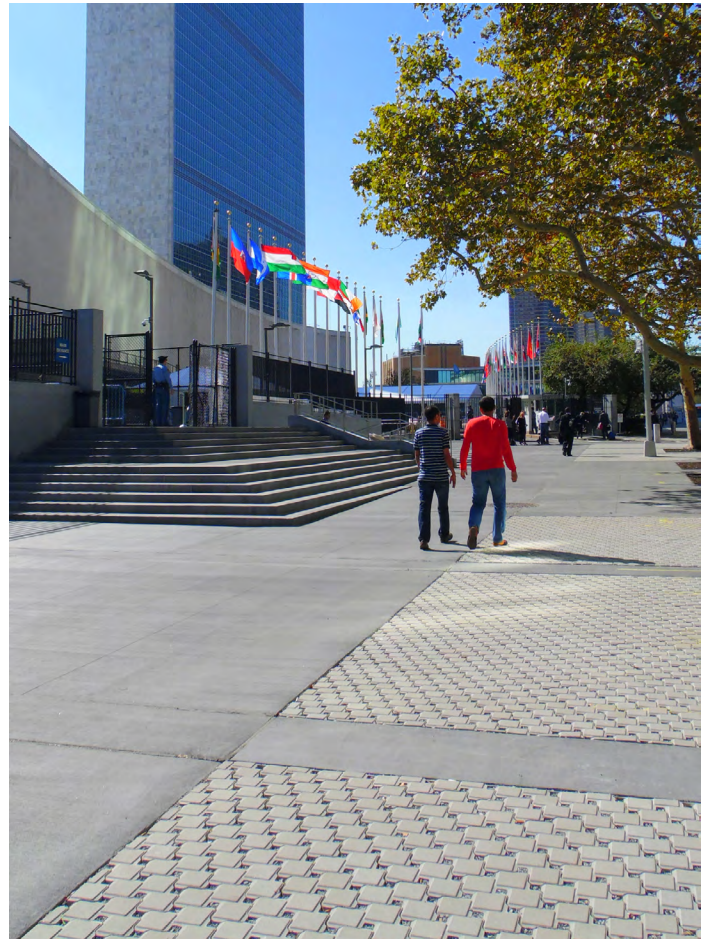
After 7 years of extensive research, a new binding agent was developed as an alternative to cement, and is now being used in the top layer of products manufactured with EcoTerra technology. Not only are these products considerably less carbon-intensive to produce, but their high compressive strength (> 12,000 psi) makes them more durable and longer-lasting than traditional paving products. Additionally, their low absorption rate (< 5%) helps with freeze-thaw climate effects.

EcoTerra is denser, featuring closed pores that help repel water and prevent dirt and stains from penetrating its surface. This characteristic makes it not only structurally superior but also easier to clean and maintain. Given these products are produced with zero cement in the surface layer, EcoTerra pavers produce zero efflorescence, as there is no limestone and cement reaction. All the while, these products retain their vibrant colors, even longer.

Choosing EcoTerra over traditional pavers is akin to planting 27 trees for every 1,000 square

feet of pavement. This means that EcoTerra not only delivers superior durability but also contributes to the creation of beautiful, climate positive outdoor realms.

In the face of increasing climate change impacts, the time is now for a shift in the paving industry. With the introduction of EcoTerra, together, we can embark on a journey to foster a better, healthier, and more sustainable world.



The United Nations Secretariat building replaced its sixty year old single-pane glass window panels and ground the old glass into a 'pozzolan' called Pozzotive® and used it to replace 20% of the portland cement in the permeable paver Ecoloc®

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PAVERS WITH SUPPLEMENTARY CEMENTITIOUS MATERIALS

Supplementary Cementitious Materials (SCMs) are a broad category of materials that can be used to supplement cement in concrete paver mixtures. While some SCMs may contain recycled content, others may be by-products of other industrial processes. These materials can help reduce the overall environmental impact of concrete production and this is something that Unilock has been including in their concrete mix designs since the 90s.

Examples of SCMs:

- FlyAsh – from coal burning
- Slag - is from the smelting process (to obtain metal from ore)
- Silica Fume - ferrosilicon industry – raw materials for steel and others

- Calcium Carbonate - form of Limestone or recycled carbon dioxide
- Natural Pozzolans- volcanic rock, clays, shale, glass

To create sustainable, long-lasting concrete pavers, there must be a delicate balance between environmentally conscious designs and the pavers' performance. Designers should collaborate closely with manufacturers throughout the project's sustainability journey to understand their manufacturing capabilities and determine how much supplementary cementitious materials can be used effectively. For durability, high compressive strength and low absorption rates are essential. Manufacturers adhere to ASTM standards, and SCMs can impact these performance metrics. Work with Unilock to incorporate SCMs into your next design.

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CHAPTER 4 – Digging Deeper into the Details



Exploring the specific LEED™ green building criteria that hardscaping pavers can contribute toward is an excellent way to summarize the various sustainable qualities these solutions offer. This chapter not only digs deeper into LEED points, but also compares the embodied carbon of paver solutions and poured-in-place concrete to give architects and landscape architects real ways to impact the sustainability of a project through the specification.

LEED POINTS

Leadership in Energy & Environmental Design (LEED), 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 contribute toward

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achieving your certification goals with sustainable components and characteristics, as well as Health Product Declarations and Environmental Product Declarations.

LEED Credit Opportunities with Unilock Pavers

LEED v4.1 Credit Category: Sustainable Sites

Rainwater Management (up to 3 points)

Implementing low-impact and green infrastructure design strategies that aid in reducing runoff and improving water quality present the opportunity to earn up to 3 points towards LEED certification. These points are achieved for retaining rainwater onsite based on the percentile kept. Permeable interlocking concrete paving (PICP) systems are one option that designers can employ to help meet the requirements for 'Rainwater management'. They have the ability to both retain water onsite and mimic a site's natural hydrology.

Heat Island Reduction – Non-Roof and Roof (up to 2 points)

Up to 2 points can also be awarded to projects that seek to reduce heat islands. Among a number of strategies outlined by the USGBC, the use of pavement that offers an initial solar reflectance of at least 0.33 can help meet the criterion for 'Heat Island Reduction – Non-Roof and Roof'.

LEED v4.1 Credit Category: Materials and Resources

Sourcing of Raw Materials (1 point)

Choosing products from companies that demonstrate responsible sourcing of raw materials can offer points towards a LEED certification. Within the hardscaping industry, there is an opportunity to utilize recycled content in manufacturing of concrete pavers and walls.

Concrete typically contains 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 admixtures can contribute toward achieving the cumulative minimum recycled content criteria for 'Responsible Sourcing of Raw Materials'. Within this credit category, materials that are extracted and products that are manufactured/purchased within 100 miles (160 km) of the project site are considered twice as valuable as their original contributing cost.

Material Ingredients: Material Ingredient Reporting (1 point)

Within the requirements of this credit opportunity, USGBC outlines a number of programs that can be used to demonstrate the chemical inventory of a product. Health Product Declarations (HPD's) are one of the accepted approaches. At Unilock, we offer material transparency through published HPD's, providing a summary of product contents as well as the results from screening individual chemical substances against HPD Priority Hazard Lists and the GreenScreen for Safer Chemicals®. Therefore, Unilock products can help designers earn 1 point towards their LEED certification for 'Material Ingredient Reporting'.

Environmental Product Declarations (EPD's) (1 point)

With environmental sustainability at the forefront of design, it's important to feel empowered when making product selections that work within an ecosystem to achieve

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project goals and climate-positive objectives. This is where Environmental Product Declarations (EPDs) come into play.

EPDs are documents that transparently communicate the environmental performance or impact of any product or material over its lifetime.

EPDs use embodied carbon (e-CO₂) by kilogram per meter cubed to express the measurement of the impact. The greater the value, the greater the impact the product has on the environment. The lower the value, the less carbon is emitted in the products defined life cycle.

Currently, EPDs are being used to compare products in order to select products with lower carbon values. However, it is not always appropriate to make direct comparisons within product categories.

Be sure to compare the following to make sure that you are comparing EPDs that use the same framework in their development.

- **EPD type** – Industry, Project Group, Product Specific, Supply Chain
- **Life-Cycle** – Cradle to Gate, Cradle to Site, Cradle to Grave
- **ASTM or other Industry Standards**
- **Is the EPD Verified?**

EPDs play a vital role in promoting transparency and facilitating informed decision-making regarding the environmental impact of products. By employing embodied carbon measurements, following established PCR's and utilizing various types of Life Cycle Analysis, EPDs provide comprehensive insights into a product's environmental performance.

OPTIMIZING SPECIFICATION ALTERNATIVES

When comparing pavers to alternate materials, such as poured in place concrete, you have a real opportunity to save materials and embodied carbon value on your project. For pedestrian application with a spec of 150mm (6") Poured-In-Place (PIP) concrete, a 6cm paver alternative could be used, creating a 60% material savings and a 25% embodied carbon savings.

Poured-in-Pace Concrete Installation

(T) Thickness of concrete = 150mm

Embodied Carbon Value = 400kg CO₂e per m³

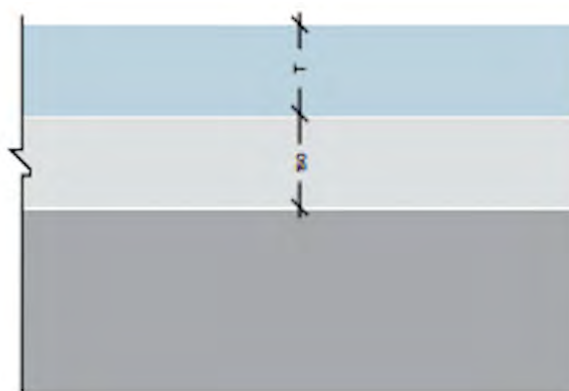


Photo Caption

Concrete Paver Installation

(T) Thickness of concrete = 60mm

E= Embodied Carbon Value =750kg CO₂e per m³

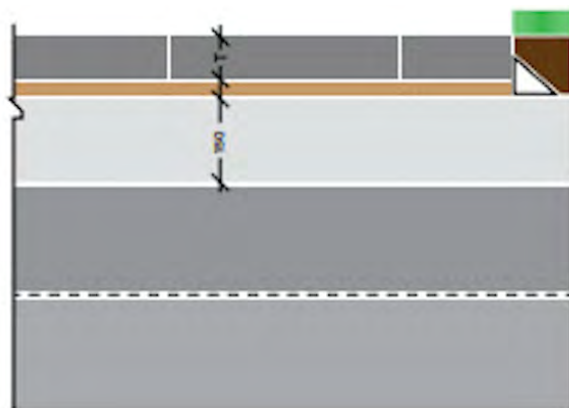


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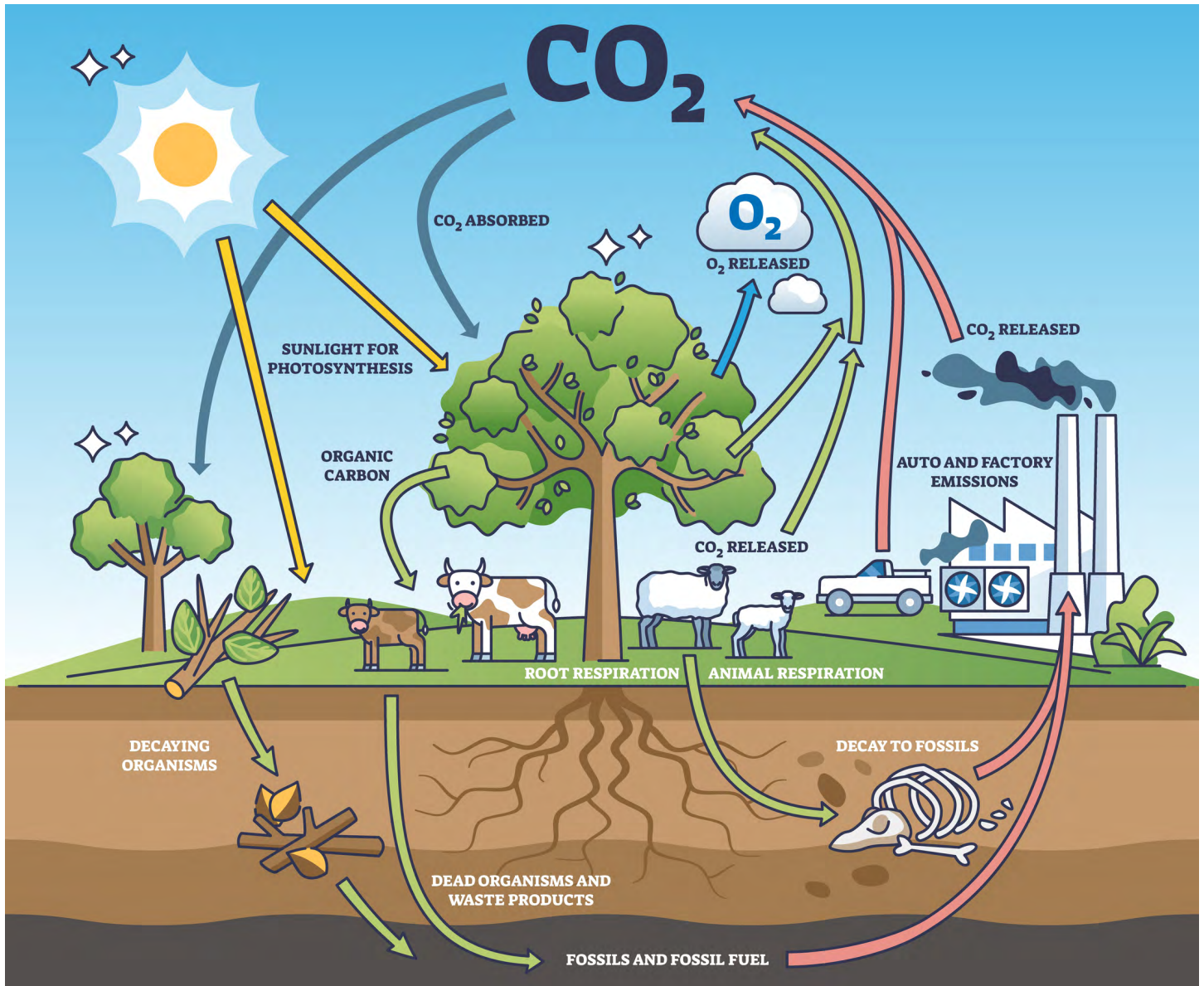
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MORE THAN A NUMBER - A SYSTEMIC APPROACH

Landscaping projects are living, breathing systems. These systems breathe in the carbon dioxide from our atmosphere and sequester the carbon in the trees, soils, and even concrete. Each product in your project is assigned an embodied carbon value; however, consideration must be given to how that product works within the system to soak up carbon.

A recent study says that about 55% of the global cumulative cement process emissions were sequestered by cement materials from 2000-2013. Carbon uptake by cement materials in 2021 was equivalent to 7.67% of the global industrial emissions of CO₂ and approximately 8.23% of the average global land carbon sink. There is no doubt that concrete can sequester CO₂, however, a value must be applied to your designs.



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About Unilock



In 1972, [Unilock](#) was the first company to begin manufacturing concrete pavers in North America, and in doing so, established a new industry that has come to be known as 'hardscaping'. Read more about this category creating company.



UNILOCK JOURNEY TO SUSTAINABILITY

Unilock is committed to becoming a carbon neutral company. We have implemented initiatives that continue to minimize our use of fossil fuels, recycle and harvest water, and replace cement in our products with supplementary cementitious materials while manufacturing the highest quality product. Read more about our journey to carbon neutrality.

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