Porcelain Pavers: Applications and Use
Purpose and Learning Objectives

Purpose:

Outdoor porcelain pavers have many benefits. They are frost resistant, skid resistant, durable, easy to clean, and have incredibly high breakage loads (up to 2,200 pounds), creating the perfect solution for gardens, terraces, and high-traffic outdoor areas. This course will provide an overview of the manufacturing process of porcelain pavers, explain various installation methods, and discuss how porcelain pavers can contribute to today’s green building programs.

Learning Objectives:

At the end of this program, participants should be able to:

• Discuss the attributes and characteristics of porcelain pavers, and describe the manufacturing process.
• Explain the advantages of using porcelain pavers over other materials in a design project.
• Identify the different installation methods for porcelain pavers.
• Summarize the performance criteria of porcelain pavers relative to today’s green building programs.
Introduction
Materials for Outdoor Landscapes

Throughout history, there have been a variety of materials used in landscape applications, including natural materials such as stone and wood, as well as manufactured materials such as concrete, clay, and composites. Today, porcelain pavers are becoming a viable alternative to traditional landscape materials, allowing designers to create unique exteriors.

Porcelain offers design flexibility with its many finishes and installation methods and appeals to architects and homeowners alike by meeting their desire for sustainable building products. Pavers are adaptable to interior and exterior applications, as tiles offer a modular approach to design, allowing for multiple layout patterns. With a variety of finishes and availability of specialty pieces for pool coping, stair treads, and drainage panels, porcelain pavers help create personalized designs to be enjoyed for many years.
What Is a Porcelain Paver?

Historically, porcelain pavers have been made in Italy, where craftsmen have used raw materials from riverbeds to manufacture clay pavers. With many technological advances, the clay from riverbeds is no longer required and no longer limits the production of tiles to a certain geographical areas. Most clays are now produced rather than taken from riverbeds as in the past.

Porcelain pavers are manufactured using natural raw materials that are mixed in specific proportions. Materials such as dust made out of pulverized rock, slate, or marble; sand, quartz, feldspar, kaolin (fine clay particles that enhance tile coloring), clays, and natural coloring agents; or sometimes other materials like post-industrial and post-consumer glass are commonly used.
What Is a Porcelain Paver?

Raw materials are combined in precise quantities and sequences to create a specific mix design. The material is then dry pressed into molds using a pressing process with up to 24,480 lb/ft$^2$ of pressure to create the desired shape and dimensions. This removes most of the air and moisture from the slabs.

The pressing process for porcelain pavers does not use synthetic resin or chemical substances for bonding, and thus does not alter the purity of the material.

Unlike many paving options that require synthetic additives or chemicals for creating a sturdy paver, porcelain is composed of natural materials that are combined in a controlled environment to meet exacting standards.
What Is a Porcelain Paver?

These pressed clay slabs are then fired in a high-temperature kiln to fuse the materials into a durable paving unit; this process is known as the vitrification process. Vitrification is the fusion of natural raw materials (sand, quartz, feldspars, kaolin, clays, and natural coloring agents) which, when fired at temperatures of above 2,200 degrees Fahrenheit, form into a single material that is an exceptionally hard, almost completely non-absorbent product with unrivalled mechanical characteristics.

The firing process changes the physical properties to create a nonporous paver. Glaze decorations and digital printing on the tile surface may be added at this point and the paver refired in the kiln at over 1350 degrees Fahrenheit.

If a project requires very thin grout lines, tiles are then put through a process called rectifying. A laser cuts the edges of the tile to ensure a uniform edge and a consistent product.
There are a wide range of specifications pertaining to porcelain pavers as shown in this table. Baseline standards for porcelain paving units can vary dramatically in terms of absorption, bending strength, breaking strength, abrasion resistance, and resistance to acids and fire. As such, it is important to call out detailed physical properties in project specifications. Simply calling out a porcelain paver is not sufficient to ensure standardization and appropriateness to specific project conditions. It is also important to have all physical properties of the porcelain paver verified by accredited independent third-party test facilities on a regular basis. This ensures consistency over time and adds another layer of protection when specifying porcelain pavers.

### Porcelain Pavers (¾”)

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard 14411-G</th>
<th>Standard ISO 130006-G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Absorption</td>
<td>0.05%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Bending Strength</td>
<td>7,977 psi</td>
<td>5,076 psi</td>
</tr>
<tr>
<td>Breaking Strength</td>
<td>3,587 lbs</td>
<td>179.8 lbs</td>
</tr>
<tr>
<td>Resistance to Deep Abrasion</td>
<td>0.0082”³</td>
<td>0.0106”³</td>
</tr>
<tr>
<td>Resistance to Acids</td>
<td>Resists A Class Acids: Only hydrofluoric acid can eat into porcelain, but it cannot be found on the market.</td>
<td>B Class</td>
</tr>
<tr>
<td>Resistance to Fire</td>
<td>A1: Porcelain pavers are fire resistant and can be used in compliance of security norms.</td>
<td>Not Required</td>
</tr>
</tbody>
</table>

*All of the data in the table are averages of several tests.*
Porcelain pavers have undergone the same ASTM testing used for dimensional stone producing remarkable results. When compared to natural stones such as quartz and limestone, porcelain proves to be more resilient. This is due to lower absorption rates, higher abrasion resistance, and higher flexural strengths.

<table>
<thead>
<tr>
<th></th>
<th>Porcelain Pavers (¾″)</th>
<th>Quartz (⅝″)</th>
<th>Limestone (⅝″)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ASTM C97) Water Absorption</td>
<td>0.05%</td>
<td>0.12%</td>
<td>0.75%</td>
</tr>
<tr>
<td>(ASTM C97) Density</td>
<td>148.4 lb/ft³</td>
<td>123 lb/ft³</td>
<td>167 lb/ft³</td>
</tr>
<tr>
<td>(ASTM C880) Flexural Strength</td>
<td>6257 psi</td>
<td>4930 psi</td>
<td>1600 psi</td>
</tr>
<tr>
<td>(ASTM C99) Modulus of Rupture</td>
<td>8593 psi</td>
<td>5410 psi</td>
<td>2250 psi</td>
</tr>
</tbody>
</table>

*All of the data in the table are averages of several tests.*
When ¾-inch-thick porcelain pavers are compared to traditional 2-inch-thick concrete slabs, the benefits of using porcelain pavers in your building project become clear. Porcelain pavers have lower absorption rates, which allow them to be more resistant to water infiltration. Also, because of the composition of the porcelain pavers, they are unaffected by organic and inorganic ingredients that could stain concrete. Plants such as moss or deicing agents that are corrosive to concrete can be used on porcelain with no adverse reaction to the pavers. Porcelain also has higher flexural and compressive strength than traditional concrete slabs, increasing its design flexibility.

<table>
<thead>
<tr>
<th></th>
<th>Porcelain Paver (¾”)</th>
<th>Concrete Slabs</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(ASTM C140)</em> Water Absorption</td>
<td>0.05%</td>
<td>5%</td>
</tr>
<tr>
<td><em>(ASTM C1161)</em> Flexural Strength</td>
<td>6,257 psi</td>
<td>725 psi</td>
</tr>
<tr>
<td><em>(ASTM C1645)</em> Freeze/Thaw Resistance</td>
<td>50 cycles</td>
<td>50 cycles</td>
</tr>
<tr>
<td><em>(ASTM C140)</em> Compressive Strength</td>
<td>30,200 psi</td>
<td>8,000 psi</td>
</tr>
</tbody>
</table>

*All of the data in the table are averages of several tests.*
Porcelain pavers can be manufactured with different thicknesses depending on their use. Normally indoor flooring is $\frac{3}{8}$ inch, whereas exterior porcelain pavers are $\frac{3}{4}$ inch thick. Tiles designed for interior applications should not be used for exterior purposes, as the increased thickness allows external pavers to have a higher load-bearing potential and increased durability. Porcelain pavers also have a more aggressive texture for increased slip resistance in both dry and wet conditions.
Technical Specifications: Squared and Rectified

At the end of the manufacturing cycle, the slab can be made perfectly square and orthogonal using technologically advanced machinery.

Precise manufacturing standards result in exact dimensions that allow for precise fit and joint lines even when combining various sizes. Installation with pavers that are not rectified may result in projects with varying joint lines and uneven spacing.
Porcelain pavers are available in a variety of sizes to accommodate various applications. These size options allow for greater creativity in design while facilitating installation. It is important that pavers are rectified to ensure consistency, uniform spacing, and the ability to combine various sizes accurately. It is possible to lay different collections in modules that can be combined together, provided the thickness is compatible.
Applications: Design Flexibility

This exactness in the manufacturing process enables porcelain pavers of various sizes to be combined to create a unique modular appearance.
Porcelain Paver Features

Porcelain pavers are designed and manufactured to provide durable walking surfaces that can withstand even the harshest conditions. Porcelain pavers fully comply with current statutory safety requirements in terms of heavy loads, thermal shock, chemical and fire resistance, and anti-slip surfaces for public and private settings.

**Color**
Porcelain pavers preserve their color qualities throughout the life of the product and do not fade even when exposed to UV.

**Resistance to thermal shock and frost**
Porcelain pavers are resistant to frost, and their physical properties remain unaltered at temperatures of -58 degrees Fahrenheit to more than 140 degrees Fahrenheit.

**Breakage load**
Porcelain pavers (24 inches x 24 inches x ¾ inch) can withstand loads of up to 2,200 pounds.
Porcelain Paver Features

**Fire resistance**
Porcelain pavers are fireproof and do not spread flame or give off harmful toxins.

**Resistance to stains**
Porcelain pavers have low absorption rates that deter stain infiltration, with no special sealing required.

**Non-deteriorating**
Porcelain pavers are resistant to corrosion from salt, chlorine, and saline water.

**Resistance to chemical aggression**
Porcelain pavers are naturally resistant to acids (with the exception of hydrofluoric acid) and chemicals; there is no sealing required.

Porcelain pavers are designed to provide a low-maintenance, virtually worry-free paving surface.
Porcelain Paver Features

Absorption
Because of the density of the porcelain, the pavers have a very low absorption rate of less than 0.05 percent. This makes them resistant to freeze-thaw cycling and impervious to staining. This also allows the pavers to be easily cleaned.

Weight
Porcelain pavers weigh 38 pounds per slab (24 inches x 24 inches x ¾ inch). They are a lightweight paving option weighing just under 10 pounds per square foot. This allows the pavers to be easily set in place without the use of equipment or specialty tools.
Porcelain Paver Features

For many years, ASTM C1028 was the industry standard for evaluating slip resistance by measuring the static coefficient of friction. Unfortunately, this test was proven to be ineffective at measuring slip resistance and was officially withdrawn by ASTM in 2014. The new standard test method is ASTM E303: Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester, which measures skid resistance. This tester is a pendulum with a small piece of rubber attached to its foot. The pendulum is designed to move across a floor for 123–125 millimeters. As the pendulum moves, it produces readings; a slippery floor has a reading of zero, while floors that show a greater slip resistance have readings further from zero. This test method is accepted worldwide for calculating slip resistance and has become the national standard in more than 45 countries for evaluating pedestrian slip resistance. It is important when specifying a porcelain paver to require a minimum British pendulum tester number (BPN) for both dry and wet conditions. As previously discussed, porcelain pavers have a more aggressive texture to provide increased slip resistance when compared to interior tiles.

Anti-slip regulations: ASTM wet and dry standard: American National Standards Institute, ANSI A 137.1. Porcelain pavers require no special maintenance or seasonal treatments. Pavers can meet ASTM’s anti-slip standards wet and dry depending on the surface of the product.

- ASTM E303: dry BPN > 0.75
- ASTM E303: wet BPN > 0.42

BPN: British Pendulum (Tester) Number
Natural Stone Pavers

Natural stone offers some advantages as a paving product. It has a natural, timeless look, and each stone is unique, giving projects a distinctive visual appeal. It is a durable product that can be cut into various shapes such as square, rectangular, and irregular.

However, when compared to porcelain pavers, there are many disadvantages in using natural stone in your projects. Often it is necessary to increase the thickness of the slab to ensure higher mechanical performance. Due to high water-absorption rates, natural stone can be susceptible to frost damage. Stone may require special sealing treatments to prevent fading and, if the need arises, special cleaning methods, as some cleaning chemicals may damage the stone.

Since porcelain pavers are manufactured to exacting standards, they offer more design flexibility than natural stone. Porcelain pavers are more durable, and they are typically lighter than natural stone, enabling homeowners to install pavers themselves. Because porcelain pavers are rectified, they have very precise dimensional tolerances, which allow for more precise installation. Porcelain pavers require no special coatings or treatments to maintain their stain resistance and may be cleaned with mild detergents or pressure washers.
Wood Pavers

Standard wood offers many advantages as a paving product. It is flexible, lightweight, durable, and fairly resistant to impact. The wood grain texture lends a beautiful rustic appeal that, if left unsealed, fades with time to a natural patina. It does not absorb heat as readily as other materials so can be used in areas with barefoot traffic.

However, wood species are perishable and also susceptible to temperature shifts, resulting in frost damage in cold climates and splitting in hot, dry climates. If owners do not want the natural wood color to fade, then yearly staining and sealing maintenance will be required. Special chemicals are needed if cleaning or stripping is necessary. Woods are also prone to staining from organic and inorganic materials. Some plant life, for example, different types of moss, can cause damage to wood tiles. Also, most wood tiles are highly flammable unless subjected to special treatments, resulting in limited applications due to safety regulations.
Wood Plastic Composite Pavers

Wood plastic composite, or WPC, offers the advantages of being lightweight and very easy to install with a price point that is usually more competitive than other natural products such as wood and stone.

WPC is a perishable product unless it is subjected to special treatments. It is not frost resistant and can warp in warmer climates. There are minimal layout installation options and limited tile choice, which can be frustrating for homeowners who would like versatility in their project designs. Maintenance is required in the form of special treatments to maintain the color. And as WPC is composed of plastics and other chemicals, it may have a negative environmental impact.

As mentioned, using porcelain pavers in design projects gives the homeowner a lightweight, fade-resistant, frost-resistant, non-perishable product that offers multiple layout designs and a multitude of tile choices.
Paver Design Flexibility

With today's high-definition printing, porcelain pavers can accurately reproduce the look of different materials to complement a wide variety of architectural styles. Interpretations of stone, wood, marble, metal, and concrete can be printed onto porcelain pavers, offering the appearance of materials that may be scarce or difficult to procure in a product that is durable, cost-effective, and environmentally friendly.

Wood  Concrete  Natural Stone  Marble  Metal
Complementary Pieces

There are a wide range of porcelain specialty pieces that can complement a homeowner’s outdoor landscape design, creating a fully coordinated project. These specialty pieces are manufactured to the same exacting standards as the porcelain pavers, resulting in uniform appearance and performance.

Specialty pieces can extend the applications of porcelain pavers. Some examples may include stair treads, trim and coping for pools, and drainage panels.
Seamless Transition

Because porcelain is such a lightweight and durable product, it lends itself to a wide variety of applications. With the wide range of colors, textures, and sizes, it facilitates a seamless transition from indoor to outdoor living spaces. Due to the chemical and slip resistance, it is an ideal option for around pools and spas. With its fire and stain resistance, porcelain works well around fireplaces and barbeques.
Seamless Transition

Harmonious designs with indoor and outdoor surfaces are achievable with porcelain pavers. With the wide variety of colors, sizes, and finishes, exterior porcelain pavers coordinate beautifully with interior flooring options. This allows for a seamless transition from interior to outdoor living spaces. Porcelain pavers not only create an aesthetically pleasing environment but a durable surface that will last many years with little maintenance.
Installation
Porcelain pavers use the same installation systems as ordinary outdoor materials. However, due to their strength and durability, porcelain pavers can be installed in a variety of innovative applications including: stepping stones in lawn areas, over dense grade aggregate and sand, on top of a concrete slab secured with mortar or adhesive, and raised installations using pedestals.

Details of these installation methods are explained in the following slides.
For stepping stone applications in lawn areas, installers will need to follow the steps below:

- Cut out the sod and remove the soil to match the outside dimensions of the paver. The depth of the soil to be removed will vary depending on the soil and climatic conditions.
- Fill the void to 1¾ inches below the desired finish surface with compacted ¾ inch minus road base material.
- Place 1 inch of compacted sand bedding course on top of the compacted road base, screed to a smooth surface.
- Install the paver on the compacted sand and aggregate base.
Stepping Stone Installation

Please note:
• Never compact porcelain pavers with a plate compactor.
• A minimum 4-millimeter space is required between all pavers.
• Pavers should only be cut with a tile saw equipped with a wet cut porcelain blade.
When installing porcelain pavers over dense grade aggregate, it is important to ensure proper perimeter containment with a peripheral restraint that will hold the compacted sand and paver in place. Key components to this type of installation include:

- Perimeter containment through peripheral restraints or structural curbs.
- Compacted road base. The depth of this will be determined by soil and climatic conditions.
- 1-inch pre-compacted sand.
- Minimum 4-millimeter spacing between pavers to prevent damage from pavers colliding.
Installation onto Dense Graded Aggregate

Note: Do NOT compact the pavers; doing so will result in damage.

Porcelain 20mm (¾" nominal) Slabs

Minimum 4mm (3/16") spacing between slabs

Peripheral Restraint System spiked into 6–8" over base area

Soil

Subgrade

Peripheral Restraint System spiked into 6–8" over base area

Sand Bedding Course: 1" pre-compact thickness

Compacted Road Base: ¾ minus road base material. Base thickness is determined by soil and climatic conditions.

20mm (0.7874") Porcelain Slab

1" Pre-Compact Torpedo Sand

1.5" tall Peripheral Restraint System spiked into 6–8" over base area
Adhesive Installation

Installing porcelain pavers creates a more aesthetically pleasing surface with increased durability. When installing over a concrete slab, key factors to consider are:

• The condition and stability of the concrete slab.
• The thickness of the concrete slabs are based on traffic loads and are to be designed and constructed in accordance with American Concrete Institute (ACI) and Portland Cement Association (PCA).
• Paver joints need to be aligned with expansion/saw cut contraction joints of the concrete slab.
• Use an approved adhesive that is suitable for climatic conditions.
Adhesive Installation

Please note:

• Never compact porcelain pavers with a plate compactor.
• A minimum 4-millimeter space is required between all pavers.
• Pavers should only be cut with a tile saw equipped with a wet cut porcelain blade.

Cementitious Adhesive

3/8" Grout-Filled Joint

Porcelain 20mm (¾” nominal) Slabs

Cementitious Base: Thickness and reinforcement requirements are based on traffic loading and are to be designed and constructed according to ACI and PCA standards.

Saw-Cut Contraction Joint, spaced according to ACI and PCA guidelines and placed exactly in the center of the slab joint. The depth of the saw cut must be a minimum of ¼ of the thickness of the concrete slab.

Induced Crack Beneath Saw-Cut Contraction Joint
Raised Installation Using Pedestals

Porcelain pavers can be installed on both fixed-height and adjustable pedestals. Any pedestal height above 1 inch requires factory-applied galvanized steel backing. The galvanized steel backing is designed to provide a safety net in the event a heavy object is dropped on the paver that could result in the paver fracturing. The galvanized steel back will prevent the paver from collapsing, which otherwise could cause potential harm.

These can be installed over a concrete slab on grade as shown or on a rooftop deck. Raised pedestal applications allow for greater flexibility by creating a level surface over a sloped base. Water is able to drain freely below the pavers thus reducing water accumulation on the walking surface. Pedestals also create a space where irrigation and utility lines can be run. In the event that these lines or drains need to be serviced or cleaned, individual pavers can easily be removed and put back in place when done.
Raised Installation Using Pedestals

Concrete Base:

- Thickness and reinforcement requirements are based on traffic loading and are to be designed and constructed according to ACI and PCA standards.

Soil:

- Subgrade

Pedestals:

- Sectioned Pedestal anchored or adhesively bonded to concrete base
- 20mm (¾") Pedestal for raised installation (sectional)

Porcelain Slabs:

- 20mm (¾" nominal) Slabs
LEED v4 and Green Credentials
On October 24, 2014, UL Environment released an environmental product declaration (EPD) for ceramic tile manufactured in North America. An EPD is similar to a nutrition label and highlights the environmental benefits as well as the disadvantages in using a certain type of product. This EPD summarizes the tile manufacturing process from raw materials to end of life, focusing on green building community concerns and emissions to air, water, and land. In a summary article titled “The EPD for North American-Made Ceramic Tile: Certified and LEED Friendly” written by Bill Griese, he states, “When using this EPD alongside other flooring products’ EPDs, one thing is clear: ceramic tile has the lowest 60-year environmental impact per square foot (and per square meter) across all major impact categories: global warming, abiotic resource depletion, acidification, smog formation, eutrophication, and ozone depletion.”

As the majority of tile manufactured in North America is covered by this EPD, most tiles could contribute toward LEED and potentially to requirements in other green standards, such as Green Globes, the International Green Construction Code (IgCC), and the 2012 NAHB National Green Building Standard. For further information on this article, click here. (Accessed February 2017.)
Tiles and pavers made in Italy are manufactured to the same exacting standards as the tiles in the United States. Tiles produced in Italy are colorfast, lightweight, and extremely durable, lasting 50 years or more. All porcelain pavers are made from inert materials such as clay, sand, quartz, and natural coloring agents and do not emit any volatile organic compounds (VOCs), nor do they absorb toxins or odors from the environment, contributing to improved indoor air quality.

Porcelain pavers from Italy are fire resistant, slip resistant, and easy to clean with neutral cleaners, making them a great design choice for many areas such as pools and decks, around fire pits, and patios and walkways, both commercial and residential.

Many Italian porcelain pavers meet Ecolabel standards. Ecolabel is the European ecological quality mark awarded for the environmental performance of products and services. The label certifies a low environmental impact over the entire life cycle of the product, from the extraction of raw materials through to production, use, and disposal.

Always check with manufacturers to confirm a product’s green building and safety standard certifications.
LEED v4

Using porcelain pavers in a building project may contribute toward earning points under the following credits in the LEED v4 Building Design and Construction (LEED BD+C) rating system. Contact individual manufacturers to find out more about how porcelain pavers can be incorporated in a LEED project.

**Sustainable Sites**

**Heat Island Reduction**

Roof and Non-roof: Use 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. Use an open-grid pavement system (at least 50 percent unbound). An open-grid pavement consists of loose substrates supported by a grid of a more structurally sound grid or webbing. Pervious concrete and porous asphalt are not considered open grid as they are considered bounded materials. Unbounded, loose substrates do not transfer and store heat like bound and compacted materials do.

Heat island effect can be reduced by using porcelain pavers with an aged SR value of 0.28 or greater or initial SR value of 0.33 or greater, and/or as a permeable system over open graded aggregate.
Sustainable Sites

Open Space

Provide outdoor space greater than or equal to 30 percent of the total site area (including building footprint). A minimum of 25 percent of that outdoor space must be vegetated (turf grass does not count) or have overhead vegetated canopy.

The outdoor space must be physically accessible and be one or more of the following:

- a pedestrian-oriented paving or turf area with physical site elements that accommodate outdoor social activities; and/or
- a recreation-oriented paving or turf area with physical site elements that encourage physical activity.

Developing pedestrian- and recreation-oriented areas using porcelain pavers in a design project may help contribute to earning LEED points.
Sustainable Sites

Rainwater Management

In a manner best replicating natural site hydrology processes, manage on site the runoff from the developed site for the 95th percentile of regional or local rainfall events using low-impact development (LID) and green infrastructure.

Permeable paving systems have been proven on field tests to be an effective stormwater best management practice (BMP) system. The following slide shows an example of how porcelain pavers can be used in a rainwater management system.
LEED v4: Sustainable Sites Rainwater Management

Full Infiltration – Permeable Subgrade

Peripheral Restraint System spiked into base every 6–8"

Minimum 4mm (3/16") space between pavers

½" Porcelain Paver

2” Bedding Course of ¾ inch Open Graded Aggregate

Compacted Base Course of ¾ inch Open Graded Aggregate

½" Porcelain Paver

2” of ¾ Compacted Open Graded Aggregate

Geotextile

Geogrid to stabilize the restraint system

2½" Peripheral Restraint System spiked every 6–8” over base system
LEED v4

Sustainable Sites

Places of Respite

Provide places of respite that are accessible to patients and visitors, equal to 5 percent of the net usable program area of the building. Provide additional dedicated places of respite for staff, equal to 2 percent of the net usable program area of the building. Places of respite must be outdoors or located in interior atria, greenhouses, solaria, or conditioned spaces; such interior spaces may be used to meet up to 30 percent of the required area if 90 percent of each qualifying space’s gross floor area achieves a direct line of sight to unobstructed views of nature. For more information on this credit, click here.

Indoor Air Quality

Low-Emitting Materials

This credit includes requirements for product manufacturing as well as project teams. It covers volatile organic compound (VOC) emissions into indoor air and the VOC content of materials, as well as the testing methods by which indoor VOC emissions are determined. Project flooring must meet 100 percent compliance with general emissions evaluation. Building products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario. For more information on this credit, click here.
Regional Priority

Earn up to four of the six Regional Priority credits. These credits have been identified by the USGBC regional councils and chapters as having additional regional importance for the project’s region. A database of Regional Priority credits and their geographic applicability is available on the USGBC website.

Regional Priority Points are bonus points, awarded for achieving LEED points that are designated as a priority for the project’s geographic region. Porcelain pavers may contribute to a project achieving Regional Priority Points.

Materials and Resources

Building Product Disclosure and Optimization – Environmental Product Declarations

Use at least 20 different permanently installed products sourced from at least five different manufacturers that meet one of the disclosure criteria. For more information on this credit, click here.
LEED v4

Materials and Resources

Building Product Disclosure and Optimization – Sourcing of Raw Materials

Use at least 20 different permanently installed products from at least five different manufacturers that have publicly released a report from their raw material suppliers which include raw material supplier extraction locations, a commitment to long-term ecologically responsible land use, a commitment to reducing environmental harms from extraction and/or manufacturing processes, and a commitment to meeting applicable standards or programs voluntarily that address responsible sourcing criteria. For more information on this credit, click here.

Building Product Disclosure and Optimization – Material Ingredients

Use at least 20 different permanently installed products from at least five different manufacturers that use any of the following programs to demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm). For more information on this credit, click here.
Applications
Applications: Outdoor Living Spaces

Due to its versatility, porcelain provides an aesthetically pleasing and durable surface for outdoor living spaces. Whether the application is urban or rural, commercial, or residential, porcelain pavers help create a distinctive outdoor area.
Applications: Outdoor Living Spaces

Porcelain pavers can be installed over an existing concrete slab or framed deck to create a beautiful, long-lasting surface that can endure the elements.
Applications: Outdoor Living Spaces

When properly installed, porcelain pavers work in conjunction with vegetative systems, including grasses and planting beds, to create an ideal outdoor living space. Full perimeter containment is important to prevent pavers from shifting out of place.
Applications: Outdoor Living Spaces

Walkway and patio applications are an example of pavers installed in sand set over a compacted aggregate base.

With their resistance to stains and chemicals, porcelain pavers are a great paving option for outdoor dining and pool areas.
Applications: Outdoor Kitchens

Due to their durability and resistance to stains, porcelain pavers are an ideal paving surface for outdoor kitchens. Food, grease, and drinks that will damage other paving systems have no effect on porcelain pavers. Pavers can be easily cleaned with minimal effort and will retain their attractive appearance for years to come.
Applications: Driveways

Porcelain pavers can be used for residential driveways with light vehicular traffic (no commercial vehicles) when properly adhered to an approved concrete base. It is important to note that porcelain pavers are not suited for heavy vehicular traffic. They do, however, provide a durable surface for residential driveways and are resistant to staining that is common with most other paving surfaces.
Applications: Walkways

Porcelain pavers create an attractive walkway between vegetative areas. Perimeter containment is essential to maintain the pavers in the desired location.
Applications: Walkways

Porcelain pavers can be used in a variety of applications, including walkways and patios. Due to the available sizes, colors, and finishes, they lend themselves to a distinct appearance.
Applications: Fireplaces

Porcelain pavers are resilient and can be subjected to extreme temperatures. They make an ideal surface around fire pits and outdoor fireplaces. Note: Surfaces can become hot when placed near the source of the fire.
Applications: Pool Decks

Pool decks are routinely subjected to harsh chemicals such as choline, salt, salt water, and cleaning chemicals that can cause tile deterioration and discoloration. However, porcelain pavers will retain their color and appearance as they are unaffected by chemicals or ultraviolet (UV) rays.
Applications: Pool Decks

Porcelain pavers create clean, distinct lines that complement a wide range of architectural styles.
Applications: Pool Decks

Here is an example of a pool deck application over permeable aggregate.
Double-Sided Special Trim

With specialty trim and accessory pieces such as stair treads and pool coping, porcelain pavers integrate smoothly to pool decks.
Swimming Pool Trim Specialty Pieces

Optional finishes for pool trim include drainage channels and grip areas.
Wall and Stairs Trim Specialty Pieces

Specialty pieces may be available for stair treads, stair risers, and wall copings and facades. Wall and stair trim are available with both straight and bull-nosed edges. Adding these pieces will help a designer or homeowner achieve a finished look to their projects.
Applications: Pavers

Porcelain pavers create attractive walkways that blend flawlessly with the surrounding environment.
Applications: Pavers

With their precise dimensional tolerances, porcelain pavers allow designers to create distinguished environments that are welcoming and long lasting.
Applications: Turf, Raised, and Pool Decks

Porcelain pavers can be installed in multiple applications to accommodate various site conditions.
Applications: Commercial Areas

Due to their durability and low maintenance, porcelain pavers are ideal for commercial areas that experience heavy pedestrian traffic.
Summary and Resources
Summary

Porcelain pavers are made from naturally occurring materials such as sand, quartz, kaolin, feldspar, and coloring agents combined in specific proportions and dry pressed to form tiles. These tiles are then fired at 2,200 degrees Fahrenheit to form a durable, non-absorbent material. The fired tiles are then rectified to ensure uniform characteristics. It is important when specifying porcelain pavers that you include specific physical characteristics such as absorption, flexural strengths, and chemical resistance that have been tested and verified by accredited test facilities. This will ensure superior paver performance.

While natural stone and wood offer some benefits, neither is as durable as porcelain pavers. Porcelain pavers are fade-resistant and extremely durable, resisting damage from chemical cleaning agents and acids. They are slip resistant, frost resistant, and fireproof, and have a breakage strength of more than 2,200 pounds. Offering homeowners flexibility in the methods of application, porcelain pavers can be installed in a variety of ways: as stepping stones in grass, applied over aggregate and sand, with the use of adhesives on concrete, and even in raised applications.

Many porcelain pavers have been approved by green building certifications; consult the manufacturer for specific details on the pavers used in your design project.

Creative personalized designs are achievable with porcelain pavers. With the wide variety of colors, sizes, and finishes and layout flexibility, porcelain pavers not only create an aesthetically pleasing environment but also offer a durable surface that will last many years with little maintenance.
Resources


Conclusion