Decorative Treatments for Concrete Floors: A Durability + Design Collection
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Pittsburgh, PA 15203

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Concrete is a versatile material used for structures of all types. Because it is durable—hard wearing and long lasting—it also can be said to meet the definition of a sustainable building material. Concrete is a popular material choice for interior floors and all types of outdoor pavements, and designers are continually searching for ways to enhance the appearance of these concrete slabs.

Coloring concrete adds instant visual appeal, and while many methods can be employed to add color to new or old concrete, this article focuses primarily on chemical stains and pertinent aspects of concrete that play a role in achieving good results with these stains. Other coloring materials and decorative techniques are also briefly discussed.

Color variation in concrete
Stains at one time were used primarily on existing concrete, but are now used on both old and new concrete. Designers and owners want cost-effective decorative finishes, and this has led to the availability of an expanded range of colored concrete slabs. For some time, decorative concrete has been one of the fastest-growing segments of the concrete construction industry.

For new slabs that are to be treated with color, several design recommendations for the concrete mixture and finish are pertinent to the selection of stains. The colors of the cementitious materials used in the concrete have a major impact on the color of the slab, as does the color of the sand. These
materials should be selected with the final color in mind.

Most concrete is made with gray portland cement, but white cement is also available in North America and can yield improved results when coloring concrete. Options for creating the base slab color include the use of white cement alone, blending white and gray cements, or blending white and/or gray cement with other materials.

Nowadays, supplementary cementitious materials, or SCMs, are being used more often, and should be taken into account when applying color by means of stains. These materials generally fall into one of two categories: pozzolans or slag. While the color of the SCM exerts an effect on the paste’s color and therefore the slab’s color, another consideration is the way the SCM affects the chemistry of the cement matrix. Stains may react differently with concrete that contains SCMs.

Concrete aging
The age of newly placed concrete is important because it has an impact on when color can be applied. General recommendations are to wait at least 14 days before applying a stain. But certain colors require a longer waiting period to allow adequate cement hydration and sufficient drying. Some tones require a longer curing period, such as 14 to 28 days or perhaps even 60 days, to allow for adequate drying of the concrete.

For a number of reasons, it is beneficial to specify an adequate quantity of cementitious materials in concrete mixtures for exterior slabs. The table on p. 26, from the Portland Cement Association’s Concrete Finisher’s Guide (Collins, Panarese, and Bradley 2006), provides the association’s minimum recommended cementitious-materials content for slabs as a function of aggregate size.

A concrete mixture could be designed on the basis of strength, but that approach might not provide enough paste for workability, finishability, and durability of the slab. The table gives general recommendations for satisfying all of these requirements. Concrete containing less cement may be used when experience demonstrates that the proposed mixture proportions will produce concrete with good fresh and hardened properties; however, low-cementitious content may still limit the depth or richness of color that a stain can produce.

The condition of existing concrete slabs (age greater than 90 days) should be assessed prior to applying a color stain. The concrete surface must be sound (no scaling, spalling, or other unsound areas) or it must be brought to a sound condition. The surface must also be clean and free of surface contamination of curing compounds, sealers, or any material that would limit the ability of the slab surface to absorb the stain. Surface contamination can impede stain absorption, which would result in non-uniform color.

Whether the concrete is relatively new or has been in place for years, preparing the slab for staining is a key step in the coloring process. Where contamination is known or suspected, physically abrading the slab will remove the contamination, but will also re-
move some of the surface paste, which changes the surface appearance and texture. If this change is not acceptable, it may be possible to use chemical-cleaning methods to remove or extract the contamination. This is likely to be more effective if the problem areas are limited in size.

In all cases, a good scrubbing with water, and perhaps detergent, followed by rinsing, should be the final step before applying a chemical stain.

Concrete stains
Portland cement is the key ingredient in concrete. When mixed with water, cement starts to chemically combine with the water, or hydrate, a process that generates calcium hydroxide. Hydrated portland cement contains 15% to 25% calcium hydroxide (Kosmatka, Kerkhoff, and Panarese 2002).

Chemically reactive stains react with calcium hydroxide in hardened concrete to produce insoluble colored compounds (Kosmatka and Collins 2004). The stains themselves are water-based acidic solutions that contain metallic salts. The greater the amount of calcium hydroxide present, the more potential there is for coloring the concrete. Because SCMs react with calcium hydroxide to form more of the cementing gel that binds the concrete into a strong matrix, they can affect the availability of calcium hydroxide, and therefore, the potential for the slab to react with the color stain. The reacted color compounds become a permanent component in the paste structure near the surface of the concrete.

An important attribute of stains is that they can be applied to old or new concrete. Although the acid in the solution is intended to open the concrete surface for easier and deeper stain penetration, some hard-troweled surfaces may need to be sanded for successful stain penetration. A number of variables that should be considered when using chemically reactive stains include

- cement properties and content of the concrete mixture;
- aggregate type;
- effects of chemical admixtures;
- finishing and curing practices;
- construction schedules; and
- moisture content during stain application.

Stain reacts only with the paste fraction of the concrete mixture or with calcium-based aggregates such as limestone. For this reason, it is recommended that mixtures with low cement content be avoided when stains are used.

Most chemical admixtures exert little negative effect on chemically stained concrete. Calcium chloride accelerators, however, are an exception. These accelerators may lead to discoloration or mottling issues. When concrete is poorly mixed or used at higher dosages, the accelerator may leave areas that the stain cannot color. Calcium chloride accelerators should therefore be avoided in all colored concrete applications.

Concrete finishing, curing, and stain application
Two schools of thought exist with regards to appropriate finishing practices for concrete that is to receive color stains. The first school of thought suggests that a floated surface will more readily accept penetration of the stain, allowing achievement of denser color. The potential drawback of this finishing technique is that a floated surface may not provide the needed durability in high-traffic areas, which would then require a higher degree of sealer maintenance to prevent color loss, or, over time, might require additional
color application.

The alternate finishing technique calls for a hard-troweled surface, which, being more durable, will hold the color for a longer period of time. This method, however, may require additional sanding or stronger acid solutions to open the surface for stain application.

The recommended curing method for new concrete to receive stains is the use of unwrinkled, non-staining, high-quality curing paper—not overlapped. Overlapping might lead to color differences under the overlapped sections. Moist curing methods, such as sprinkling or covering the surface with moisture-saturated fabric materials, may also be appropriate when stains will be applied. Curing compounds are incompatible with staining applications, because these materials prevent stain penetration.

Construction schedules can be an important consideration when using stains with new construction. A minimum recommended curing period prior to staining is 14 days, although the use of blue, green, and gold colors may require a 30-day to 60-day curing period. (Manufacturer recommendations should always be followed.)

Moisture content of the slab at the time of stain application also plays a role in the final color achieved. Higher moisture contents tend to deliver more calcium hydroxide to the slab surface, allowing more reaction products to form, but some colors may darken or even turn black if excess moisture is available for too long a period of time. On the other end of the moisture scale, slabs that receive direct sunlight may become hot and dry, limiting the reaction products that set the stain in the concrete surface. In all cases, the entire new slab should be treated at the same age and moisture condition to improve color consistency.

Effect of concrete color

Stains may be applied to plain concrete, or they may be used on surfaces of colored concrete, where the colored surface creates a background for the effects of the stain. Due to the chemistry involved, the most common chemical stains result in blue-green, black, brown, or gold colors. For other colors, the discussion under the heading “Other Coloring Materials” below provides some idea of the results. An internet search for concrete stains yields a large number of suppliers.

Safety issues

Safety precautions should be followed when working with chemical stains. These are acid-based materials and require proper storage and handling. Areas surrounding the work area need to be protected, and reacted stain must be collected and disposed of properly. In addition, workers should use the proper personal protective equipment. Manufacturers print safety instructions on the packaging of stain materials. Chemical stains create permanent colors because they bind with the cement matrix. But it still can be beneficial to protect the slab following color treatment. Sealers that are penetrating and breathable help keep moisture out of the slab. They also can be formulated to result in a flat finish so that they virtually disappear into the slab, or they can be made with increasing levels of gloss to enhance the color and add shine to the finish.
Maintenance of colored concrete

Colored slabs create visual impact and attract attention due to their appearance. Maintenance of this appearance, as a result, represents an important aspect of colored concrete. This can include regular cleaning, polishing with waxes, and reapplication of sealers. The designer should consider these aspects when specifying the original color application, and should provide recommended maintenance procedures so that the slab maintains the desired appearance for a long time.

Other coloring materials

All of the additional coloring methods described here are applicable to new concrete that will be freshly placed. These methods include the use of integral pigments or colors, dry-shakes, dyes, and tints.

It is not possible to apply integral pigments to existing concrete slabs, because pigments must be blended with the fresh concrete. Likewise, dry-shakes will not work on old concrete because they need to be troweled into the surface of fresh concrete after absorbing its bleed water.

Integral pigments are mixed with the fresh concrete to provide color throughout the entire paste. These pigments are finely ground minerals, are available in a virtually endless color range, and can be blended to achieve custom colors. For easy dosing, dosage is based on the weight of cementitious materials in a batch of concrete (specified as pounds per 100 pounds of cement, or a percentage). A maximum limit of 10% assures adequate strength development of concrete, although much lower dosages are usually adequate for achieving the desired color. White cement allows for the lowest dose of pigment with maximum visual effect, and also facilitates clean pastels and bright colors.

Dry-shakes are usually manufactured products, and are combinations of pigments, cement, fine aggregate, and proprietary ingredients. These materials are broadcast over the freshly finished concrete surface, usually in two or three applications. After each application, the material is allowed to absorb some of the bleed water that works its way to the surface. They are then floated into the surface to intimately mix with the paste and densify it.

Dry-shake materials often combine color and hardening into one step, which adds wear resistance to the slab. They are surface applied materials and only affect the uppermost color of the slab. If the surface gets chipped or damaged, the underlying plain concrete can be exposed.

Dyes are water- or solvent-based mixtures that contain extremely fine transparent coloring agents. The solvent carries the pigments into the slab, where they are deposited. Dyes have a wide range of color, including reds and yellows that can’t be achieved with chemical stains, and can often be blended to create even more colors. They are affected by traffic or abrasion and require periodic maintenance, and are also subject to fading if exposed to sun-
light. For all these reasons, they are best used in protected interior environments (Nasvik 2004).

Tints are different from dyes in that they contain much larger color particles. As a result, they do not penetrate the surface and are opaque, meaning they can be used to “even out” colors (or cover up problems) on chemically stained slabs. The particles are metal, carbon, or metallic oxides (Nasvik 2004), and can add a metallic appearance to slabs.

**Completing the picture: Textures and combinations**

The simplest surface textures are floated, broomed, or troweled. The troweled finish is more suited to interior exposures and surfaces that will be primarily dry, because they do not afford adequate slip resistance for safety. Floated or broomed finishes are suited for exteriors and wet environments because they provide traction even when wet.

Contemporary texturing techniques include a wide range of stamping patterns to mimic natural stones, rock, or brick pavers. Abrasive blasting can be used as an overall treatment or to define borders. Grooves or sawed joints can be used to provide definition to shapes or create patterns on slab surfaces.

A variety of interesting and striking effects can be created on concrete by combining colors and textures with one or more decorative processes, such as the use of exposed aggregate, integral color, shake hardeners, stains, tints and dyes, abrasive blasting, and scoring and grooving. For example, alternate areas of exposed aggregate can be eye-catching when combined with plain, colored, stained, or textured concrete. Ribbons and borders of concrete masonry or brick add a distinctive touch when combined with exposed aggregate. Stamped and stained strips may be used to divide areas of colored concrete, or vice versa. Scored and stamped designs are enhanced when combined with integral, dry-shake color, stains, or abrasive blasting exposures (Kosmatka and Collins 2004).

Using color and texture to treat a slab surface generates a seemingly limitless range of options for the designer. For example, applying several colors and then blasting to remove portions of the surface exposes different layers. Combining stains with tints and dyes expands the range of colors possible.

These are just a few ideas and combinations; the possibilities are endless. With a little imagination, a concrete driveway, sidewalk, plaza, floor, patio, or pool deck can be tailored to fit the mood and style of any architecture or landscape.

**References**


Concrete stains can prove to be a highly effective technique for reproducing colors often found in natural earth and rock. When combined with simple and creative application techniques, stains allow for truly unique concrete installations that complement a variety of hardscape and flooring designs.

Stains can also prove quite useful in creating finishes that convey a more contemporary, customized appearance. The use of stains has helped make concrete floors, countertops, and walls very much in demand.

Stains can facilitate the innovative use of concrete in both interior and exterior construction, as we will seek to illustrate in the following discussion. We will address product selection, surface preparation, application techniques, and maintenance as they relate to application of stains to concrete.

The materials
Stains for use on concrete include three types: chemically reactive stains, non-reactive stains and dyes, and opaque stains.

Chemically reactive stains
Concrete can be colored during installation or after it is fully cured or hardened. Coloring processes employed following cure involve topically applied stains or dyes. Depending on the stain, matted, variegated earth tones or opaque, vibrant col-
orations are possible. Including a limited range of translucent, potentially highly variegated, and mottled earth tones, chemically reactive stains consist of metallic salts in an acidic solution that react with the hardened concrete.

The curing or hardening of concrete involves several distinct chemical reactions. One of the by-products of these chemical reactions is the production of calcium hydroxide—3Ca(OH₂)—also referred to as hydrated lime. The acid in the chemical stain “opens” the surface of the concrete, allowing the metallic salts to penetrate and reach the hydrated lime deposits. The water in the stain solution then initiates the coloring reaction. If the chemical stain is unable to penetrate the concrete surface because of dirt, sealer, wax, or oil residues, then the coloring reaction may be inhibited. Therefore, surface cleaning prior to chemical staining is critical, even on new concrete.

With chemically reactive stains, most manufacturers offer a limited range of standard colors, and custom colors are difficult to produce. The use of many faux painting techniques, however, can broaden the palette of colors and create many interesting effects. A sealer is applied after the staining process is completed to protect the colored surface.

**Non-reactive stains or dyes**

Non-reactive stains or dyes encompass a broad range of translucent, mottled hues, and are based on color concentrates mixed with water or solvent, depending on the manufacturer’s formula. As the name implies, non-reactive stains/dyes do not create color by a chemical reaction. Instead, the color concentrate’s ultrafine pigments are carried into the concrete surface by the solvent or water. Surface cleaning and preparation is particularly important with these products, since the material must penetrate the concrete as opposed to drying on the surface like a paint or coating.

As with chemically reactive materials, non-reactive stains and dyes should only be applied to hardened and cured concrete. They should be used when chemical stains cannot produce the desired color due to limitations on the available palette, or when the reaction of a chemical stain is inhibited due to the condition of the concrete. Custom colors are more readily available with non-reactive stains, and colors can also be mixed in the field. For example, dark brown can be mixed with white to produce a light brown. Additionally, a non-reactive coloring system can be used if concerns about the safety or environmental effects of applying an acid-based material are a factor. It should be noted, however, that not all dye products may be UV-stable and suitable for outdoor use. Again, a sealer should be applied after the staining process is completed.

**Opaque stains**

Opaque concrete stains are offered in a wide range of colors, usually with more color choice than is the case with chemical and non-reactive stains. Earth tones as well as bright and vibrant colors can be easily produced with opaque stains. The color produced is generally more uniform compared to chemical and non-reactive stains, and will completely hide or mask the underlying concrete color. Depending on the manufacturer, opaque stains are available as single- or multi-component systems that are mixed with
These stains produce a low-gloss and abrasion-resistant surface, and are suitable for coloring new (cured 28 days) and existing interior concrete floors and exterior concrete hardscapes. They are ideally suited for re-coloring previously colored concrete or renovating weathered or discolored concrete surfaces. It may not be necessary to apply a sealer following application of an opaque stain.

Generally, manufacturers provide a different color chart for each opaque stain product. Even though comparable hues may be found among different staining systems, the product lines have their own distinct palette, properties, and attributes, often dictating which product should be used. It is advisable to contact the manufacturer to verify that the stain product is aesthetically and functionally suitable for the given project.

**Surface preparation**

Surface preparation prior to stain application is highly important, particularly for older, dirtier concrete surfaces. If the substrate is dirty or contaminated, the coloring stains will not penetrate or “wet” into the pores of the substrate, which will affect color development and sealer durability. This is particularly critical for the chemically reactive stains.

The surface must be free of curing compounds, sealers, wax, mastic, grease, oil, and other contaminants that can block the pores of the substrate. Interior floors that have received a hard-trowel or burnished finish may also impede stain penetration. The extent of penetration can be judged by wetting the surface with water. If the water is readily and evenly absorbed and darkens the surface, it’s likely that extensive preparation is not required. If the water beads on the surface and darkening does not occur, surface preparation is necessary before stain application commences.

Detergent washing combined with scrubbing with a black pad on a rotary floor machine can remove dirt, soil, grease, and oil. Sealers and coatings may require mechanical grinding or chemical stripping. It is important to note, however, that mechanical grinding and chemical stripping, and even scrubbing with a black pad, may change the surface texture and color. Cleaning with muriatic acid is not generally recommended.

All cleaning procedures should be evaluated with test sections before proceeding with the project as a whole. Once surface cleaning and preparation are completed, another test for penetration by water should be done.

**Preparation of new concrete**

Concrete should be at least 21 days old and dry before stain is applied. After the concrete has been placed, the surface should be protected from all construction activity prior to staining, employing protective coverings while the various trades are likely to come into contact with the surface. The protective coverings are removed after work is completed.
Lumber, steel, plumbing, masonry, chemicals, or liquids should not be stored on the newly placed concrete floor, and dirty water, food, and drink should not be allowed to come into contact with the concrete. Construction activity should be minimized on the floor to prevent damage or discoloration of the concrete.

The surface should be pressure washed or scrubbed with a rotary floor machine to remove dirt and dust from the surface, using a low-foaming, alkaline cleaner and scrubber with a black pad. Then, the surface is thoroughly rinsed and wet-vacuumed to remove cleaning residues. These cleaning methods are generally effective for water-soluble contamination prior to the application of topical stains and sealers. Finally, the surface should be tested for water penetration prior to chemical staining.

**Preparation of existing concrete**
Older concrete must be free of sealers, wax, mastics, grease, oil, and other contaminants that block the pores of the substrate. Hard-troweled interior floors will require mechanical abrasion using a 60- to 80-grit screen on a low-speed floor machine and employing water to control dust. For more aggressive cleaning or on textured surfaces, brushes with polyethylene bristles and water should be used. It should be noted that mechanical preparation may change the surface texture and color. The effectiveness of the preparation process should be evaluated thoroughly before proceeding.

Once surface cleaning and preparation is completed, a low-foaming, alkaline cleaner should be employed to scrub the floor with a black pad, followed by a rinse and wet vacuum to remove any residue generated during preparation and removal of contaminants. Again, the surface should be tested for water penetration prior to staining.

**The value of mock-ups**
Chemically reactive stains and, to a lesser extent, non-reactive stains or dyes will produce color variations. The degree of variation is a function of concrete porosity, texture, age, application method, and the original color of the substrate. Experience with a particular stain on a project does not guarantee the same result on the next project using an identical color. The final color of a stain application can be determined by producing and approving a mock-up on the actual surface that will be stained. A mock-up should include all the tools, techniques, and materials that will be used on the job, including cleaning and preparation, saw cuts, designs and texture, stain, sealer, and maintenance wax (in the case of an interior floor).

As stains produce a translucent color, shade variations in the concrete prior to staining will likely remain noticeable after application. Therefore, stains are not used to hide construction errors or dramatic color variations in the substrate. For the same reason, a randomly patched concrete floor may not be a good candidate for staining. Not only will the patched areas remain visible, but they may also produce a very different coloration from the adjacent concrete surfaces. If these conditions exist, the “problem areas” are included in the mock-up to assess their impact on the project. If those problem areas are objectionable, the use of an opaque stain might be a more aesthetically effective option.

**Stain application**
Stains should not be applied to frozen concrete or to a concrete slab if the temperature
will drop below freezing within four to six hours after application. On the other hand, elevated ambient and slab temperatures, low humidity, or high wind will result in rapid drying of the stain, which may necessitate additional applications or modification of the application methods to achieve the desired coloration.

All surfaces to be stained must be clean and dry, and adjacent surfaces that are not to be stained (or will be stained a different color) should be protected with plastic. Duct tape should not be used, particularly on surfaces that will be stained, since adhesive residue may leave a shadow or inhibit the stain’s penetration; blue painters’ tape is preferred. Plastic sheeting or tape should be removed from masked areas as soon as staining is complete, particularly on hot and sunny surfaces.

The surface to be stained is divided into smaller working areas utilizing walls, control joints, and other fixed objects as natural termination points, ensuring a wet edge during application. Application is planned to minimize walking through the wet stain and possible tracking into other areas.

**Chemically reactive stains**

For application of chemically reactive stains, application tools such as brushes, sponges, containers, and sprayers must be acid-resistant. Brush bristles must be capable of holding the stain without excessive dripping. Application equipment with metal components cannot be used, nor should tools that will soften or deteriorate, or leave a color residue when in contact with the chemical stain. Also to be avoided is the use of a paint roller, as it will create distinct overlap lines. During application, it is important to avoid random dripping, spillage, and rundown from the equipment, as this may produce undesirable colorations that will be difficult to remove. For most applications, a manually pumped or pressurized garden sprayer can be used to apply chemical stain in a random or circular motion.

The chemical stain should “fizz” when applied. If it does not, additional cleaning is needed, or the concrete is too old and does not contain enough reactive materials to produce a chemical-stain reaction. During application, a wet edge should be maintained at all times, with the saturation amount consistent throughout application. If chemical stain is splashed, dripped, or puddled, those areas will produce darker-colored effects. Again, it is recommended that application equipment and techniques be evaluated with a mock-up panel.

The chemical stain is allowed to react on the surface for a minimum of four hours; reaction time may vary with ambient and slab temperatures, wind, and humidity. For single-color and multicolored applications, a small area should be scrubbed and rinsed for effective color evaluation, with additional chemical stain applied as needed to achieve the desired colorations. The use of shallow saw cuts can be used to effectively separate different colors.

The reaction of chemical stain with the concrete will produce a powdery residue, and
this residue must be neutralized and removed to prevent tracking or functioning as a bond breaker when a sealer is applied. The residue is neutralized by scrubbing with a solution of 1 pound of baking soda with 5 gallons of clean water; soap should be avoided, since soap residue may act as a bond breaker when the surface is sealed. The surface should be rinsed and wet vacuumed until rinse water is clean and clear. If the surface is not thoroughly neutralized and rinsed, the longevity of the stained surface and sealer will be diminished.

Non-reactive stains or dyes
The concrete surface and joints must be thoroughly dry before application of non-reactive stains. Adjacent surfaces are covered for protection with plastic during mixing and application, as overspray and spills are difficult to remove. Application is done with a clean, high-volume, low-pressure (HVLP) sprayer, using a tip that produces a conical spray pattern. The stain is sprayed evenly over the prepared substrate in a circular or random motion.

For larger applications, an airless sprayer may be used, but a pump-up sprayer is the least desirable method of application, since it may not adequately atomize the material. During application, the product is periodically agitated in the mixing pail and sprayer reservoir, as settlement will occur. The stain may also be applied with a foam brush when coloring small designs or patterns.

A shallow saw cut is recommended for effectively separating different colors. More than one application may be required on very porous concrete to achieve the desired coloration, but over-application should be avoided.

The material should not be allowed to puddle and dry on the surface or in joints. Excess material should be redistributed or wiped up with a clean cloth before it dries; otherwise, it will require a more thorough clean-up before sealer application. If the material appears wet for longer than one minute, more product should not be applied. Walking on the stained surface should be avoided for approximately eight hours after application, along with contact by water or other liquids.

Opaque stains
Application methods for opaque stains vary depending on their chemical composition and whether they are one- or multi-component products. Brush, roller or a powdered sprayer can be used, although the product manufacturer should be consulted for particular product-application recommendations. Generally, surfaces should be clean and dry.

These products may also be subject to working time that is shortened at elevated ambient and surface temperatures, and may also be subject to specific recoat times.

Maintenance issues
Hardened concrete contains pores—it essentially is a rigid sponge that is susceptible to dirt accumulation by anything dripped or dropped onto it. Concrete surfaces can be cleaned, but it is more practical to seal out grime than scrub out dirt embedded in this porous surface. Some blemishes, such as oil stains, are difficult to remove completely, and certain cleaning procedures that may chemically etch (using acid-based cleaners) or abrade (using excessive scrubbing or grinding) the surface may mar the decorative surface. Sealing of a stained concrete surface, particularly interior floors, is highly recommended to prevent dirt buildup on the surface.
Typical concrete sealers are solvent- or water-based products based on acrylic resins. Regardless of the sealer used, however, none last forever, and most are prone to scratching and scuffing. Sealers eventually require reapplication with exposure to weathering and wear.

The initial application (and reapplication) of sealers must be factored into the budget and expectations for the decorative surface. Often, job callbacks occur when sealing and maintenance have been ignored, particularly for interior floors. There is no such thing as a maintenance-free concrete floor.

If neglected, the sealer will eventually wear from the surface. At this point, reapplication can be costly and disruptive for a business.

A more proactive and cost-effective approach involves the periodic application of a maintenance wax over the sealer. Waxes, which are typically liquid emulsions, function as a sacrificial surface; if regularly reapplied, they protect and spare the underlying sealer from scratching, excessive wear, and eventual removal from the concrete. Waxes can be handled by in-house maintenance personnel and do not require the expertise, time, and cost associated with stripping and reapplying the original sealer.

Creative opportunities with concrete stains

Stained concrete flooring no longer lurks on the fringe of architectural and interior design. As materials and processes have evolved, concrete is no longer viewed as just a structural building material—it is also regarded as a creative medium suitable for many installations, such as residential and commercial hardscapes, natural-looking and artistic floors, and even custom countertops.

Greater awareness of the aesthetic and performance possibilities of concrete stains—and the methods involved in their application—will help to facilitate the effective selection, specification, and use of these materials.
Concrete Polishing

The range of flooring options available in today’s marketplace is vast, with each of these alternatives offering unique appearance and performance characteristics. As a result, owners and design professionals must evaluate many factors to determine the best flooring option for a structure’s given needs and environment.

One flooring system or option currently gaining in popularity is polished concrete. Although polished concrete is relatively new in North America (approximately 15 years), the system offers many advantages.

Concrete is a durable material, and thus meets an important sustainable-design criterion. In addition, the polishing process enhances concrete’s natural appeal. These attributes have contributed to the increased use of polished concrete in public and institutional buildings such as schools, hospitals, retail stores, restaurants, and other settings.

In this discussion, we will seek to provide a review of the polished-concrete process, which involves a sequence of steps that begins with initial grinding and preparation of the floor. Application of densifying agents and polishing with machines employing diamond-grit discs produce a surface that is durable, attractive, and highly reflective. A major factor in the integrity and performance of polished concrete is the use of high-quality liquid hardener and densifier materials.

Polished concrete: An overview

Polished concrete, because it does not involve a coating, is a breathable system—one that allows transmission of water vapor and thus is not subject to failure due to moisture migration from below.

By Mark B. Vogel, W.R. Meadows Inc.
When properly installed and maintained, polished concrete can last the life of the structure, avoiding the time and labor of installing subsequent flooring systems.

Polished concrete can be used in almost any interior area. In exterior settings, however, acid rain has a tendency to prematurely etch the surface and cause early deterioration of the shine. Polished concrete can be treated with integral concrete colors, color dyes, and edge-tinting products to produce an attractive floor surface.

Maintenance is relatively simple and economical, and involves cleaning the surface with an agent formulated for this purpose. A concentrated cleaning solution with a neutral pH is added to the cleaning water in an auto scrubber. The auto scrubber applies the cleaning solution, buffs, and vacuums any remaining solution and dirt particles, leaving no residue and a clean surface. Maintenance of polished concrete is quite low in cost, averaging 5 to 7 cents per square foot per year. No special waxes or strippers are required.

**Dry or wet process**

With dry polished concrete, vacuums are used to extract dust; with wet polished concrete, wet slurry is used to remove concrete particles. The wet-grinding process requires special disposal methods.

With dry polished concrete, pre-separators and vacuum systems are used to control airborne dust and contaminants. The dry powder or cement particles can be safely disposed of and can even be recycled. Incorporating a low- or zero-VOC (volatile organic compound) hardener/densifier completes a “green,” environmentally friendly flooring system.

A densifier works by chemically converting weak calcium hydroxide \([\text{Ca(OH)}_2]\) and calcium carbonate \([\text{CaCO}_3]\) compounds in the concrete to form calcium silicate hydrate (CSH). CSH is insoluble in water and is highly resistant to water, acids, and other chemicals. The formation of the CSH is proportionate to increased concrete hardness and density due to the replacement of soluble lime \([\text{Ca(OH)}_2]\) with CSH. Once the concrete pores are filled with CSH, migration of moisture from the surface to the substrate will be inhibited, as the process produces a hard, dense, and sealed surface in which abrasion resistance is increased by approximately 50%.

Concrete densifiers are typically based on lithium silicate, sodium silicate, and potassium silicate.

**The process steps**

A true grinding and polishing system requires a process consisting of five to 10 steps, depending on the desired shine of the floor and its original condition. Assessing the condition of the concrete requires on-site analysis, general knowledge of concrete and mix design, and diagnosis of hardness, porosity, and aggregate types.

Grinding and polishing techniques are divided into two categories: Those employing metal-bonded diamonds (16 to 150 grit) that are used in the initial grinding or preparation phase, and resin-bonded diamond segments (100 to 3000 grit) that are used in the subsequent polishing phases. Metal-bonded diamonds are more aggressive in their effect on the concrete substrate than resin-bonded diamond segments.

The initial grinding step removes high spots, imperfections, and contaminants such as
Polishing revs up the performance of concrete floor at racecar art shop

They may be making a extended pit stop for cosmetic alterations, but the sleek racing cars at JKS Motorsports in the heart of North Carolina’s NASCAR country almost appear to float on the shimmering polished-concrete floor at the company’s facility in Welcome, NC.

JKS Motorsports, which creates logos and other artistry that decorates stock-car racing vehicles, placed a bet on polished concrete as a practical, but eye-appealing, surface for the company’s new facility. The process transformed 34,000 square feet of plain gray concrete into a glistening, reflective surface courtesy of the INDUROSHINE system developed by W.R. Meadows Inc.

The facility was a design/build project by Samet Corp., Greensboro, NC. The concrete contractor was Triad Construction Services, High Point, NC. The concrete polishing contractor was Blair Duron, Raleigh, NC.

Casey Chandler, W.R. Meadows’ sales representative in the Carolinas and Virginia, gives high marks to Triad for installation of a high-quality, hard-troweled, water-cured, 3,500-psi concrete mix design, providing a sound basis on which to work some polished-concrete magic.

Chandler says he was able to make a case for the polishing process, based on attributes that include light reflectivity, durability, slip resistance (impression of slickness to the contrary), and resistance to abrasion, oil, and chemicals. A key selling point was the relative permanence of the densified and polished concrete. The polishing process is without a doubt labor intensive, but should not have to be repeated if successfully executed.

“With polished concrete, it’s essentially a one-shot deal,” Chandler says. “You are changing the composition of the concrete, and it’s a permanent solution.”

The project began with initial grinding to prepare the surface for application of the liquid sodium silicate densifier, with 45-, 80-, and 150-grit discs used. W.R. Meadows’ Liqui-Hard densifier was spray applied, then left in place for a dwell time of 45 minutes to an hour. Any excess densifier remaining on the surface was then removed with water and shop vacuum. The next day, the polishing was completed with increasingly finer diamond grits of 110, 400, and 1,500 sizes.

In some projects, the polishing stage can progress all the way to a 3,000-grit stage, but the hard-troweled concrete in this case didn’t require the finer-grit polishing, Chandler says.

Chandler concedes that the techniques are “something like an art. You have to evaluate the conditions and operate sophisticated machinery.”

A final step was applying W.R. Meadows’ Bellatrix, a propriety topical treatment that enhances reflectivity and resistance to staining from oil, grease, and other petroleum-based substances.

The owner opted to retain the inherent gray color of the concrete rather than introduce color by means of integral coloring of the concrete or field application of stains or dyes. A 10-inch-wide strip of solid-color epoxy coating was applied, however, to floor edges along walls that were not given the polishing treatment. A separate edge treatment of this type is often recommended due to the logistical limitations of the grinding and polishing equipment. The burgundy-colored coating provides contrast—an accent to the natural color of the concrete surface.

The resulting mirror-like, polished surface stands in marked contrast to the slate gray of a conventional concrete floor. For JKS Motorsports, it has the look of a winning entry.

Gentlemen, start your polishing-machine engines! —Joe Maty, Editor, D+D
cure and seal materials, mastics, or chemicals. This grinding phase may require one to three stages, but it will consume 60-65% of the total time required to complete the densification/polishing process. Grinding and prep work are critical, however, in achieving the ultimate result in the final floor finish.

Resin-bonded diamonds are used following application of the hardener/densifier to polish and remove the scratch pattern created by the initial grinding process.

The three primary degrees of shine are categorized based on the diamond grit of the final polishing step: 800, 1500, or 3000—which translate to semigloss, gloss, and high-gloss finishes. The cost increases incrementally by 10–15% when upgrading from a semigloss to a gloss range, and another 8–12% when upgrading from a gloss to high-gloss range, based on the total value of the project. The majority of the cost is related to the preliminary preparation stages, as labor intensity is greatest in the grinding stages.

A mock-up at the job site is always the best way to identify the capabilities of the designated slab and its affinity to the polishing process. In addition, the mock-up can help determine the polishing level needed to suit the building and achieve satisfaction of the customer and its occupants.

A final, optional step involves application of a type of topical or penetrating agent to immediately seal the surface until the densifier can fully develop to its potential. Because the densifier must fill all the voids in the concrete through a chemical reaction, sealing does not happen immediately and is highly dependent on the porosity of the concrete.

**Densifying and hardening**

Once the metal-bonded diamond phase and prep is complete, the densification process begins. This key step plays a central part in achieving longevity of the shine and a high level of performance of the finished floor. Densification results in a water-, stain-, and chemical-resistant surface.

After the initial grinding stage “opens” the concrete to facilitate the chemical reaction of the densifier and concrete, a sprayer or squeegee is used to apply the liquid densifier at a rate of 16 to 19 square meters per liter (175 to 200 square feet per gallon). The densifier is allowed to soak in for 10 minutes, and is then scrubbed into the surface for 15 to 20 minutes (or until gel formation) with a broom or, preferably, an auto scrubber for optimum penetration. This is followed by a light misting of water, and then a re-scrubbing and flushing of the remaining material from the surface, depending on heat and airflow conditions. Specific manufacturer directions should be referenced, as some application methods vary.

It is critical to not allow the densifier to dry on the surface, as this may leave a white residue or haze. Large quantities or concentrations of densifier left on the surface are difficult to remove and may actually stain the concrete a dark color. Water is used to help remove any remaining densifier.

The recommended temperature and humidity ranges for densifier application vary from manufacturer to manufacturer; product guidelines should be referenced. The installer can extend the application time by adding more densifier in the first 15 to 20 minutes, as the concrete can readily absorb the additional material. Water can be added after 20 minutes,
as this will thin the densifier material as it gels to help facilitate deeper penetration and simplify the job of removing excess product.

The environmental profile of the densifier product also plays a primary role in the “green” credentials of the specific concrete-polishing process. This profile is determined by VOC content, the nature of the waste material generated, and disposal parameters.

The entire densification process takes approximately 30 to 45 minutes. The surface is then allowed to dry for 24 hours before the resin-bond diamond segments are used to polish to the desired level. The process produces a hard, dense, and sealed surface.

Adding color
If coloring of the concrete is part of the picture, numerous options are available, including integral coloring of the concrete, staining, and dyeing.

With integral coloring, an admixture is incorporated in the concrete mix to produce uniform color throughout the slab. With a dye or stain, the concrete surface is colored before applying the densifier, allowing unlimited color combinations and edge-tint options. Dyes or stains are typically applied after polishing at the 400-grit level. A second coat may be added later in the process or at the end to increase the effect or intensity of the color. Care should be taken to wash the surface of dyed or stained sections with water, followed by complete drying before the next polishing phase begins.

Levels of shine
Attaining the desired level of shine depends on the number of passes of the diamond disc grinder, as each step increasingly flattens the floor and enhances light reflectivity. Polishing systems that require minimal process steps—less than five—do not constitute a true grinding and polishing system, which involves a five- to ten-step process, including the hardening and densification application.

These less-complete (and lower-cost) types of systems are commonly referred to as topical, as their penetration of the surface is limited, leading to early wear and loss of gloss and reflectivity.

The safety issue: Polishing and slip
Contrary to a common perception, the degree of polish or shine is not directly related to slip resistance. A 400-grit finish can and usually is less slip-resistant than a 1500- or 3000-grit final finish.

It helps to think of it in this way: when a floor is wet and a person walks on it, the peaks and valleys in the landscape of the surface create a tendency for the person to “hydroplane.” On a completely flat surface such as that produced by 1500 or 3000 grit, the water is pressed out from under the shoe, putting the sole directly in contact with the concrete surface—actually making the shoe stick to the surface.

A true grinding and polishing system with the highest levels of shine (using 3000-grit polishing) and gloss (gloss meter readings in the range of 45 to 65) exceeds OSHA (Occupational Safety and Health Administration) and Americans with Disabilities Act (ADA) standards for coefficient of friction and slip resistance, which are the two most widely accepted standards for these safety criteria. The process creates an attractive environment with increased light reflectivity, a desirable characteristic in today’s safety-conscious marketplace.

Standard coefficient of friction (COF) numbers for an 800-grit or semigloss polished-concrete surface will range from .79 to .84, a 1500-grit or gloss finish will yield a COF of .84 to
.87, and a 3000-grit or high-gloss finish will yield a COF of .87 to .89. These numbers all exceed the OSHA standard of .50 and the ADA standard of .60 on flat surfaces. The flatter the floor, the higher the standard of coefficient of friction.

**Polished concrete: An effective solution on several counts**

With the vast amount of flooring options available today, architects, specifiers, and owners are well advised to consider all available options to meet the needs of a structure and its occupants. Issues such as durability, safety, initial and ongoing maintenance costs, replacement needs, the service environment, and the environmental profile of the system should be weighed in determining the ideal flooring system for the given setting. Polished concrete can provide an answer to many of these needs by enhancing a common building component—concrete—that meets the definition of a sustainable building material in many ways.

In evaluating any flooring option, it is important that best practices and detailed specifications are employed. Effective choices regarding flooring systems can deliver safe, environmentally friendly solutions that are cost effective and contribute to the highly coveted goal of sustainability in design and construction.
The current trend of greater specification and use of sustainable or “green” coatings and other construction materials can be attributed to a large degree to the LEED Green Building Rating System, which has gained significant traction in the marketplace.

Polished-concrete floor systems can be considered as contributors to green-building objectives, due to a combination of the increased sustainability of the new or existing concrete floor, the reduced energy consumption in the building, and the environmental profile of the materials and processes involved in terms of waste minimization and effect on indoor air quality.

Polished-concrete floor systems (MasterFormat Section 033500 Concrete Finishing, and/or 030130 Maintenance of Cast in Place Concrete) include those installed by the dry-grinding method. This process is designed for use on concrete floors or for concrete-surface restoration.

Dry polishing is executed by means of the mechanical grinding of a concrete surface and the extracting and retaining of the dust during the grinding process. This dry process differs from some other polished concrete floor installation processes.

The dry-grinding process begins with the grinding and smoothing of a concrete floor with diamond-impregnated abrasive discs fitted to a heavy floor grinder. The process then moves through a succession of steps, using progressively finer diamond pads, increasing the smoothness of the floor with each step. With the assistance of a factory-trained installer, an owner can specify the desired smoothness.

After completing the abrasive smoothing steps, the process is completed by applying two coats of a high-performance chemical densifier. The use of this proprietary chemical treatment is necessary to penetrate, densify, and harden the exposed cement paste located in the top 1/16 to 1/8 in. of the floor substrate.

Other types of concrete floor polishing methods are similar to classic terrazzo grinding techniques. These methods involve ex-
tensive use of water during the grinding process and multiple applications of a chemical densifier, and generate concrete slurry. This wet paste can present disposal issues and bring into play environmental-compliance requirements. Slurry cannot simply be washed down a sanitary sewer; EPA regulations require the containment of concrete washout.

In addition, the building team has to anticipate spending more time and money for wet-grind floor resurfacing and the accompanying waste disposal. This could become a significant factor in delivering a project on time and within budget.

A polished concrete floor system, when viewed as a whole, can help provide opportunities for increasing the energy efficiency within a building envelope. A polished concrete floor can also allow for a reduction in the use of interior lighting fixtures due to the floor’s high gloss and reflectivity. This reduces initial construction cost and lowers long-term energy requirements. A shake-on pigment can be added after the slab pour and before the polished concrete floor is installed for even higher reflectivity.

Simply put, with more light reflected in the space, less artificial lighting is needed as the floor helps maximize existing light from fixtures and any natural daylight reaching the floor.

Energy efficiency also is enhanced by the thermal mass of the concrete floor. In colder periods, the concrete absorbs daytime warming and releases the heat during the cooler nighttime hours, lessening heating requirements. The effect is reversed in warmer weather, as the concrete absorbs nighttime cooling and generates a cooling effect as the air temperature rises.

The concrete slab in this type of flooring system also possesses LEED potential for reuse and for recycling interior concrete surface elements. And the coloring system offers the potential for LEED points in the categories involving indoor air quality, due to the absence of VOCs or harsh chemicals needed for maintenance. The only additional tools and energy needed for the maintenance of a polished concrete floor system is a concrete conditioner, a wet mop, and some “elbow grease.” A concrete conditioner product is typically a mild cleaner that contains a measured amount of concrete densifier, combined with emulsifying and wetting agents. The conditioner helps maintain the finish and can restore slight microscopic wear, called micro-pitting, caused by normal floor use.

Paul Nutcher of Green Apple Group, an industry consultant on the assessment of sustainable building products, says polished concrete floors present great potential for inclusion in green-building projects.

“Due to new advances in the installation of polished concrete, the patented ‘dry-grind’ application method, and greater awareness in the marketplace about the sustainable benefits of concrete surface treatments, polished concrete floors are a cost-effective alternative to terrazzo, vinyl, carpet, tile and other floor surface finishes,” Nutcher says.

**Case study: Recreation center**

A polished concrete floor was installed in various common areas of the Cardel Place recreational center, the Canadian city of Calgary’s first project to achieve LEED Gold certification. The 195,000-square-foot facility houses three gyms, two regulation-size hockey rinks, a sports clinic, a public library, and an array of public meeting rooms, food service facilities, and offices.
The central feature of the building’s interior is a dramatic, oversized athletes’ ramp that connects the upper and lower levels, providing a functional walking and stretching zone. The visuals are enhanced by large windows on both sides of the ramp, which take full advantage of the natural sunshine.

The floor of the ramp, as well as the floors in the hallways and common gathering areas of the facility, utilize L&M Construction Chemicals’ FGS/PermaShine System, which adds to the brightness of the natural light along the approximately 40,000 square feet of polished concrete in the facility.

The polished-concrete finish eliminates the need for carpeting, vinyl, or other conventional floor coverings, and the sustainability of the finish can be measured in terms of a projected decades-long service life.

“We maintain the floor using a mild solution of conditioner and a medium-size walk-behind scrubber,” says Dennis O’Byrne, operations manager. “We looked at other options, but the air-quality factors and reduced maintenance cost with polished concrete have exceeded all of our expectations,” he adds.

The prescribed maintenance involves a VOC-free conditioner and small amounts of soap and water, a combination that helps maintain interior air-quality standards for the building. The maintenance program also can result in maintenance-cost savings.

The Cardel Place center also achieved LEED points for its energy-efficient performance beyond the ASHRAE 90.1 benchmark. The building is designed to consume 30% less energy than would normally be used, as estimated by the Canadian Model National Energy Code. The thermal properties of the concrete floor help lower heating and cooling loads and assist in achieving energy savings. The building is partially buried in the slope of a hillside, further adding to its energy efficiency.

**Polished concrete specified for LEED Platinum design**

A developer in Oregon is collaborating with L&M Construction Chemicals on what might prove to be the “greenest” polished-concrete floor ever designed for a LEED Platinum project. The Independence Station developer is attempting to achieve LEED points exceeding any other mixed-use building project registered with the U.S. Green Building Council.

Independence Station is a 57,000 sq. ft. building complex with 15 condominiums, a restaurant, retail and office space, and a research lab and classroom. The FGS/PermaShine Polished Concrete Floor System was specified for the project.

This project was the brainchild of developer Steven Ribeiro, of Aldeia LLC. “This project will borrow the best of those elements of a small town while updating the built environment and the pedestrian friendly main street with today’s sustainable building technologies,” says Riberio.

The project could gain 64 LEED points, which is well beyond the minimum point total needed for Platinum certification by the USGBC. Green Building Services in Portland is providing a LEED accredited professional as a consultant on the project.

The project team sought to make the most of rapidly renewable energy sources, including vegetable oil and the sun, and to optimize energy performance with a radiant heating system via the thermal properties of the concrete slab. The owner specified the Polished Concrete Floor System for most of the finished concrete surfaces, says Melissa Fryback, marketing director for Aldeia.

Polished-concrete flooring products specified include a slab densifier and the dye-coloring system. “We are going to try to get really creative with this,” says Fryback. “We
want the radiant floors to be as beautiful as they are energy efficient.”

Don Brown Concrete Finishing is the certified installer that will oversee the flattening, grinding, coloring, and polishing of the concrete floors once the project enters the final construction phase. The plans call for using waterborne dyes for a portion of the space, while other portions of the slab will be decorated with recycled glass and natural concrete aggregate.

“I think it’s about as green as you can get,” says Brown. Once the polishing process is completed, the floor maintenance routine is minimal with the application of the conditioner.

**Polished concrete and LEED points**

Various design elements in the projects reviewed here generate points toward LEED certification, including the polished concrete floor. The LEED credit category where a polished concrete floor can deliver the most points is the section on Materials & Resources Credits, which includes points for recycled content, the reuse of the existing concrete slab, and materials produced in the surrounding region.

**EA (Energy & Atmosphere)**

Credit 1: Optimize Energy Performance (1-10 points)

The intent of this category or credit is to establish the minimum level of energy efficiency for the proposed building and systems. In order to meet this credit standard, the building team must design the building to comply with both the mandatory provisions of ASHRAE/IESNA Standard 90.1-2004 and the prescriptive requirements of 90.1, or the Section 11 performance requirements of 90.1 (without amendments), or the requirements in the local energy code (whichever criteria is more rigorous).

A polished-concrete floor system can be part of a whole-building approach to maximizing a building’s energy-efficient design as a result of the thermal mass of a concrete floor. The thermal properties of concrete floors can reduce the cooling and heating loads within a building envelope.

Reflective properties from the high gloss finish of the polished-concrete floor system can also ease the energy needs for lighting of building interiors. Various surface coloration products, for both new and existing concrete floors, can deliver additional light-reflectance properties to provide further potential for a reduction in lighting requirements. This strategy is of particular importance to building teams seeking a design that maximizes the natural light entering the building, or to those pursuing the design and implementation of a daylighting strategy.

The number of LEED points a polished concrete floor can achieve in this section of the LEED rating system will depend on the area of the building with concrete flooring. For example, if the building team can document that the concrete floor has increased the energy efficiency of a building by 10.5% over the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004, then one point is awarded under LEED-NC. Theoretically, a maximum of 10 points could be awarded if a 42% increase in energy efficiency is demonstrated. Some of the increase is potentially attributable to the thermal mass of a concrete floor assembly.

In the long term, the polished-concrete floor system saves energy typically expended on maintenance of other types of floor finishes, because foot traffic actually enhances the shine of the floor. A polished-concrete floor conditioner is designed to eliminate frequent waxing and other surface-maintenance measures.
MR (Materials & Resources)
Credits 1.1, 1.2 & 1.3–Building Reuse (1 point each)
The intent of the Building Reuse credits in LEED is the extension of the lifespan of existing buildings. This helps to conserve resources, retain important cultural landmarks, reduce waste, and lessen the environmental impact of new buildings in terms of materials, manufacturing, and transportation. A polished-concrete floor system addresses the intent of this LEED category for reuse of an existing building’s structural and interior elements.

The requirements of this category include the reuse of existing structural and interior non-structural elements (interior walls, doors, floor coverings and ceiling systems) in at least 50% (by area) of the completed building (including additions). If a project includes an addition to an existing building, this credit is not applicable if the square footage of the addition is twice the square footage of the existing building.

The potential contribution of the polished concrete floor to MR Credits 1.1, 1.2, and 1.3 is likely to be found in these categories. The polished-concrete floor should last the lifetime of a building and accommodate a variety of future occupant requirements. In projects where the concrete flooring comprises 75% to 95% of the materials in the original building, the polished-concrete process may generate points toward LEED certification of a major renovation. These projects can include buildings with large expanses of concrete floor that can be reused, such as warehouses or retail showrooms.

The polished-concrete floor product or process can also reduce the impact of construction or demolition in several ways. The process results in reuse of an existing concrete floor, the elimination of demolition, and the diversion of scrap materials from landfill disposal. Depending on the size of the floor, this process may also contribute to maintaining 50% of the interior non-structural elements, and therefore extend the life cycle of the building’s existing flooring materials.

MR (Materials & Resources)
Credit 3.1, 3.2–Material Reuse: 5% and 10% (1 point)
The intent of the MR Credit 3.1: Materials Reuse: 5% is the reuse of building materials and products in order to reduce demand for virgin materials and to reduce waste generation. This reuse reduces impacts associated with the extraction and processing of raw materials and resources.

The requirement for this credit is the use of salvaged, refurbished, or reused materials to the extent that the sum of these materials constitutes at least 5%, based on cost, of the total value of the materials used in the project. The calculation for this credit can only include materials permanently installed in the project that have been “repurposed.” For example, the slab on which a polished-concrete system is installed could be cut and “repurposed” as a counter or windowsill in a new or existing building.

The intent of MR Credit 3.2: Materials Reuse: 10% is the same as Credit 3.1, with additional requirements for the use of salvaged, refurbished, or reused materials so that the sum of these materials constitutes at least 10%, based on cost, of the total value of the materials on the project.

A polished-concrete floor system generates LEED points by means of the repurposing and reusing of concrete flooring, in line with MR Credit 3.1 and 3.2. To gain the points, a project with a polished-concrete floor system must demonstrate the reuse of existing concrete materials that cost at least 5%, and possibly up to 10%, of the total materials on the project.
MR Credit 4.1: Recycled Content– 10% (post-consumer + 1/2 pre-consumer) (1 point)
The intent of this credit is to increase use of building products that incorporate materials containing recycled content. This objective helps reduce the effects resulting from the extraction and processing of virgin materials.
Earning this point requires the use of materials with recycled content. Here, the sum of the post-consumer recycled content plus 1/2 of the pre-consumer content must constitute at least 10% (based on cost) of the total value of the materials in the project.
A polished-concrete floor system utilizing a concrete slab containing fly ash as an additive/replacement for Portland cement can figure in the pre-consumer recycled content portion of the compliance equation. The addition of fly ash to concrete is considered a green practice due to reuse of the fly ash and replacement of up to 30% of the Portland-cement content in the concrete.
Fly ash also offers other secondary environmental advantages, including reduced water demand due to improved performance, quality, and plasticity of concrete. The more plastic the concrete, the more efficiently the concrete slab can be placed and finished. Fly ash for use in Portland cement concrete should conform to the requirements of ASTM C 618, Standard Specification for Flyash and Raw or Calcined Natural Pozzolan Class C Flyash for use as a mineral admixture in Portland cement concrete.

MR Credit 4.2: Recycled Content– 20% (post-consumer + 1/2 pre-consumer) (1 point)
The intent of this credit is identical to Credit 4.1. The requirements differ, however. Here, the building team must use materials with recycled content so that the sum of their post-consumer recycled content plus 1/2 of their pre-consumer content constitutes an additional 10% beyond MR Credit 4.1 (a total of 20%, based on cost) of the total value of the materials in the project.
While the polished-concrete densifier may not contain recycled material, it is applied to a polished concrete floor that, when viewed as an assembly containing recycled content, can contribute to credits in this section of LEED.

MR (Materials & Resources)
Credit 5.1, 5.2 Regional Materials– 10% Extracted, Processed & Manufactured Regionally (1 point)
The intent of this credit is to increase demand for building materials and products that are extracted and manufactured within the region where the building project is located. This practice supports the specification of indigenous resources and reduces environmental impacts resulting from transportation.
The credit requires the use of building materials or products that have been extracted, harvested or recovered, or manufactured within 500 miles of the project site for a minimum of 10% (based on cost) of the total materials value. If only a fraction of a product or material is extracted/ harvested/ recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
The MR Credit 5.2: Regional Materials: 20% Extracted, Processed & Manufactured Regionally requirements are similar to Credit 5.1. The difference here is that use of building materials or products that have been extracted, harvested or recovered, or manufactured within 500 miles of the project site must come to an additional 10% beyond MR Credit 5.1 (total of 20%, based on cost) of the total materials value.
EQ Credit 4.1: Low-Emitting Materials–Adhesives & Sealants (1 point)
The intent of this credit is to reduce indoor air contaminants that are odorous, irritating, or harmful to the comfort and well-being of installers and occupants. To gain points in this credit category, the building team must specify that all adhesives and sealants used in the building interior shall comply with the requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168.

The polished-concrete process can reduce the quantity of indoor air contaminants that are odorous, irritating, and harmful to the comfort and well-being of installers and occupants of a building, as required by the USGBC.

In addition, concrete floors can provide relief to building occupants who are susceptible to allergies, according to Austin Energy’s Green Building Program. Concrete-finish floors do not retain dust, mold, dust mites, or pollens.

LEED-NC Version 2.2–Innovation in Design (2 points)
Innovation in Design credits offer the opportunity for LEED points in areas not specifically addressed by the LEED-NC Green Building Rating System.

The dry polished-concrete process can contribute points in this category due to a slurry-free installation method. The dry, mechanical method of installation for a new concrete floor or concrete surface restoration is completed through the grinding of a concrete surface. It continues with the containment of the dust during the grinding process.

This vacuum-captured byproduct can be collected in lightweight 20-pound bags and safely disposed in a sanitary landfill. A preliminary Initial investigation is aimed at assessing the recycling of this residue for use as filler in paving for asphalt road projects.

EQ (Indoor Environmental Quality) Credit 7.2: Thermal Comfort– Verification (1 point)
This credit category can deliver LEED credit points if the strategy is documented and implemented according to LEED standards.

The intent of EQ Credit 7.2: Thermal Comfort is assessment of building thermal comfort over time. Earning a point in this category requires the implementation of a thermal-comfort survey of the building’s occupants within a period of six to 18 months after occupancy. This survey should collect anonymous responses about thermal comfort in the building as a way to measure overall satisfaction with thermal performance and identification of thermal comfort-related problems. Building owners must agree to develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with thermal comfort in the building. This plan should include measurement of relevant environmental variables in problem areas in accordance with ASHRAE Standard 55-2004.

The dry-process concrete-polishing system can contribute to points under EQ Credit 7.2 due to the thermal properties of concrete. In-floor radiant or passive solar heating and cooling are widely considered to be efficient and comfortable. Polished concrete can expose more concrete mass, which adds to thermal mass, which in turn reduces heating and cooling loads.

Taking into account the thermal comfort enhancements described above, a polished concrete floor system increases the probability that occupants will be satisfied with the temperature controls at their workstations.
Diamond-polished Concrete:
A New Spin on an Old Technology

By Walter Scarborough, HALL Building Information Group LLC

Contrary to popular belief, processing of concrete (grinding, honing, and polishing) is not really new; it’s been around for years, as has as dyeing or staining concrete.

Over the last decade, however, diamond-polished concrete—with or without color—has become a widely popular finish for floors, and rightfully so for a variety of reasons. The visual appearance is favored because the materials used in concrete, sand and aggregate, are materials of nature and can yield a warm, earthtone look. Diamond-polished concrete costs less and is more durable than many other floor coverings and finishes, and long-term maintenance costs are lower.

Diamond-polished concrete is a versatile floor-finish option. It can be selected and specified for virtually any project—residential, commercial, architectural, or monumental—and it can be performed on new or existing concrete floor slabs. Diamond-polished concrete floors have become the floor finish of choice for many large retail store chains.

Other benefits include a more abrasion-resistant floor finish; a floor surface that is more permanent than floor coverings; reflectivity that can reduce a higher lighting load than might be necessary for other floor finishes; and the only floor finish that can be renewed to its original condition at any time in its service life (unlike floor coverings that have to be removed and a new covering installed). In addition, diamond-polished concrete is not vulnerable to moisture vapor from the concrete floor slab and underlying subgrade, as are vapor-impermeable floor coverings. Polished-concrete finishes are inherently slip resistant (they can achieve the required slip resistance coefficient) because polished finishes are smooth and a shoe has more contact surface with the floor. It is the roughness of a floor, or the minute ridges and valleys in the surface, that contribute to a floor being slippery. Polishing eliminates the ridges and valleys in the concrete.

Diamond-polished concrete, by definition

The Concrete Polishing Association of America (CPAA) defines diamond-polished concrete as “the processing of the concrete surface through means of a mechanical process that uses an abrasive medium where each step is refined to its purest possible...
form on a microscopic level from one progressively finer abrasive to the next until the desired level of 'polish' is achieved.”

Diamond polishing of concrete is a multiple-step process that consists of a series of work activities. It begins with grinding of a new or existing concrete floor slab with industrial-grade diamond abrasives (low grit numbers) to achieve one of four levels of aggregate exposure classes. It is then polished with industrial grade diamond abrasives (high grit numbers) to accomplish one of four levels of reflectivity, or sheen. A densifier is applied during the process at the appropriate time to harden the concrete. The concrete may or may not be stained or dyed, depending on the aesthetic design intent, and a protective coating is usually applied as a final step.

A successful work result depends on the convergence of science and art:
- Science: The appropriate concrete mix design, the surface finish, the proper equipment to do the work, and the quality of the concrete chemicals that will be applied
- Art: Skill of the processing contractor to “read” the concrete and “listen” to the equipment on the concrete, and the artistic talent to deliver the finished product that meets the desired design intent.

What diamond-polished concrete is not
Diamond polished concrete is not terrazzo. While somewhat similar, diamond polished-concrete and terrazzo are distinctively different. Both are a mixture of binder and aggregates with a polished finish, but terrazzo is a covering over the very concrete surface that will be processed as a polished finish.

The chart on the next page (Fig. 2) compares the two.

Design intent
Several considerations and decisions must be dealt with to establish the design intent for a diamond-polished concrete floor finish.

First, the designer who selects it for a floor finish should understand that the concrete placed for the floor slab is the basis of the finish. It is not an applied covering.
Second, the mottled variations of the normal gray color of the portland cement mix, inherent in the concrete, will be the final color of the floor, unless a color treatment is part of the process. If a particular color is desired, it can be accomplished with one of the following color-treatment methods.

- Color additives: Non-fading synthetic mineral-oxide pigments in a powder or liquid form integrally mixed with the concrete at the batch plant.
- Stains: Metallic salts dissolved in hydrochloric or phosphoric acid and field applied, which chemically reacts with the concrete.
- Dyes: Inert, non-reactive, synthetic or natural organic chemicals soluble in water or common solvents, field applied, that fill the concrete pores with color.

Third, the class of aggregate exposure should be selected from four classes of exposure as can be seen in the drawing in the lower left corner of the illustration above. Again, the aggregate that will be exposed will be the aggregate that is normally used by the concrete producer. If a particular aggregate is desired, it has to be transported from another location to the concrete producer specifically for the project.

Another option is to broadcast a particular aggregate over wet concrete during the concrete-finishing operations. The four classes of aggregate exposure are shown in Fig. 3.

Fourth, the amount of reflectivity should be determined and selected from four levels of sheen, as can be seen from Fig. 4.

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**The diamond-polishing process**

The processing contractor begins the polishing process by evaluating the unprocessed concrete to determine its condition and identify several variables, such as hardness, imperfections to be removed, flatness, concrete mix and finishing, and the possible presence of coatings or other substances (the “art” of processing concrete). From this evaluation, the processing steps are established; these are similar to the steps detailed in the illustration on the previous page (Fig. 1).

It is important for the processing contractor to accomplish full, or maximum, refinement of each abrasive cut. Refinement is defined by the CPAA as “when the abrasive has refined the surface to the degree to which it no longer cuts, or cuts very little under its (the cutting machine) current weight.” When concrete is grinded, honed, or polished, the diamond abrasives cut into the surface, creating ridges and valleys. The depth of cut is based on the weight of the cutting machine, and full refinement is accomplished when the surface profile is free of the ridges and valleys. At this point, the surface is ready for processing by the next, incrementally finer abrasive. As indicated previously, the absence of ridges and valleys renders the surface more slip resistant than...
if it had the ridges and valleys.

At some step in the process, (again, part of the “art” of polishing concrete; application is not always at the point shown in Fig. 1) the concrete is hardened with a topically applied densifier, which increases the durability of the surface. Densifiers introduce additional silicate, carried by sodium, potassium, or lithium, that chemically reacts with the excess calcium hydroxide (also known as free lime, which is a byproduct of curing) and silica, and forms calcium silicate hydroxide, which increases the bond between the cement and the aggregates and fills the capillaries of the concrete and improves its hardness and impermeability.

While not always necessary, an impregnating micro-filming product (low-molecular-weight, emulsified crosslinking polymer) can be applied at the conclusion of the process to protect the surface finish from staining, deterioration, and penetrating contaminants. Also, the filming product can provide scuff and scratch resistance and can minimize ultraviolet-light degradation of dyed surfaces.

The sustainability issue

Typical use levels for the epoxy silanes range from 0.5% to 3% by weight of epoxy resin dispersion. Higher use levels can cause orange peel in the coating, particularly in low-VOC primers. For smoother, glossier films with maximum film performance, the silane should be incorporated into the epoxy component during pigment grind.

* Floor-covering products and installation materials are manufactured in other locations and transported to the project. A smaller volume of products (abrasives, densifiers, and chemicals) are produced and transported to the project for polished-concrete processing; consequently, a smaller amount of energy is consumed and less pollution is created.

* When a floor covering reaches the end of its service life, the old covering has to be removed and disposed of in landfills or recycled, the concrete is prepared for a new covering, and a new covering is installed. Diamond-polished concrete is not removed or replaced, it is only polished again; additional grinding, honing, and densifying is not necessary.

* Reflectivity of ambient lighting is greater with diamond-polished concrete than with floor coverings, which could translate into lower electrical-power consumption. Also, as already pointed out, processed concrete requires less maintenance attention and cost than floor coverings.
Uncertainties persist about design and the process of polishing concrete

As is typically true of every new product, material, or technique, a widespread lack of understanding persists about how a diamond-polished concrete floor is accomplished. Among the uninitiated, there are those who believe the process only involves a topically applied finish. Many architects, designers, specifiers, general contractors, and specialty flooring contractors do not understand the process and what is necessary to appropriately select and specify diamond-polished concrete. CPAA is a new trade association that is dedicated to improving the understanding of diamond-polished concrete, advancing the concrete processing industry, assisting with the establishment of standards, and providing guide specifications. More about the association and its mission can be learned on the association website, www.concretepolishingassociation.com.

About the author

Walter R. Scarborough, CSI, SCIP, AIA, is Dallas regional manager, HALL Building Information Group LLC based in Charlotte, N.C., and provides specifications consulting, manufacturing consulting, peer reviews, and legal assistance. He is a registered architect and specifier with more than 30 years of technical experience with many building types, including sports, healthcare, governmental, hospitality, entertainment, detention, banks, and commercial. Scarborough was formerly director of specifications for 10 years with one of the largest architectural firms in the world, and was with the firm for more than 22 years.

Scarborough is the revision author for the new CSI Project Delivery Practice Guide, co-author of the college textbook Building Construction, Principles, Materials and Systems, has written articles for a number of periodicals, has taught college courses about contracts and specifications, and has given numerous presentations at local, state, regional, and national conferences. He is active in the Construction Specifications Institute at the national and chapter levels, and is a past president of the Dallas CSI chapter president and is a current member of the CSI Education Committee. He also is architectural representative to the board of the Concrete Polishing Association of America (CPAA). He has CDT, CCS, and CCCA certifications from CSI, and received CSI’s J. Norman Hunter Memorial Award in 2008. He also is an ARCOM MasterSpec Architectural Review Committee member.
Whether the setting is a college commons area, a famous motor-speedway attraction or a one-of-a-kind “Bubble Bar,” demand for eco-friendly, sustainable concrete floor coatings is coming from an increasing array of project types.

And while Ave Maria University, Daytona Motor Speedway and China’s National Aquatics Center—which all recently applied high-performance, sustainable coatings technology to their flooring—may be trendsetters, they’re not alone in seeking more eco-friendly, attractive and durable concrete floor coatings.

THE FORCE IS WITH ECO-FRIENDLY COATINGS

Several sustainability factors are contributing to the rising market demand for high-performance, eco-friendly concrete floor coatings. More stringent regulations regarding volatile organic compounds (VOCs) and odor are part of the equation.

As sustainable requirements become more prevalent in most construction projects, coatings technologies have been forced to evolve or go extinct. Because of their widely adjustable attributes, polyurethane coatings can be formulated to provide the durability, renewable content, and other requirements now specified by many green-building guidelines.

When it comes to durability and fast return-to-service times, few coating solutions exist for protecting concrete in the built environment that offer the long-term, proven performance of those based on polyurethane technology.

In addition, as VOC and indoor air pollutant limits have shrunk, polyurethane coatings have continued to excel, offering a more environmentally friendly option compared with traditional solvent-borne coatings.

For example, some traditional solvent-borne coatings may create end-of-life concerns since they may contain hazardous additives. By contrast, sustainable concrete-coating technologies are formulated to contain no heavy metals or plasticizers so, if necessary, a building owner can dispose or reuse concrete as he sees fit. Incidentally, this can lead to cost savings by potentially reducing future remediation steps.

These extremely durable floor-coating options allow the contractor to offer sustainable solutions to his clients while preserving the beauty and functionality of the decorative floor investment. The latest concrete coatings materials offer ease of use, long-term durability, low VOC, and clarity and gloss, and can be formulated to meet sustainability standards. It’s advantageous to explore these benefits in more detail.
Usability and durability

Traditionally, contractors and applicators may be reluctant to adopt an unproven coating when it is introduced to the market. Common concerns could be that the coating doesn’t “wet out” as hoped, the applied film won’t last long enough, or the curing speed isn’t fast enough.

New technologies built into the resins of today’s second generation of sustainable coatings enable faster drying capabilities. These coatings’ viscosity is naturally lower, so the use of solvents or plasticizers isn’t necessary to decrease the viscosity as required by some traditional coatings, leading to lower VOC and the elimination of property-robbing plasticizers.

Fast cure is especially important as it helps quicken the pace of a project. The reality is that flooring is one of the last items installed or finished during projects. At that point, the project timeline may be behind schedule. The fast-cure attribute can help meet a deadline or make up lost time at a project’s end.

For example, the Daytona USA motor sports attraction required a floor coating system not only with high abrasion resistance, but with odor-free application for 4,000 square feet of walkways and other paintable surfaces. The goal was to minimize closures and other visitor disruptions and to facilitate regular maintenance at the attraction, which is adjacent to Daytona Speedway in Daytona Beach, Fla.

Conventional solvent-borne polyurethane floor coating systems provided the necessary abrasion resistance, but their strong odor during application and curing were drawbacks. Fortunately, a new two-component water-borne polyurethane coating solved the odor and drying challenges for regular maintenance repainting.

In fact, during the application of the topcoat just prior to the facility’s grand opening, electricians and other contractors were still at work to meet their deadlines. Fortunately, the crews were able to work without disruption or discomfort, in virtually the same area as the painters, demonstrating the value of utilizing an odor-free coating.

In addition to their ease-of-use benefits, these high-performance coatings are extremely durable, and also offer abrasion and ultraviolet (UV) resistance. Previously, contractors may have had to trade the durability of a solvent-borne coating for sustainability. The latest water-borne polyurethane coating technology offers durability that is equal to or better than traditional solvent-borne polyurethane coatings.

UV resistance is especially valuable with the increased role of daylighting in green building construction. Traditional floor coatings could get away with a lack of great UV resistance, as building construction relied more heavily on traditional lighting. As green buildings are increasingly designed to let the sunshine in by increasing the number of windows, the enhanced UV-resistance of these new coatings is becoming a plus.
Odor and safety
Reduced odor was a key reason that Ave Maria University chose a polyaspartic floor coating using Bayer MaterialScience raw materials for 70,000 square feet of decorative concrete flooring throughout its Tampa campus, including a café/dining area and heavy-traffic hallways.

In addition to offering reduced odor and great looks, this sustainable concrete coating provided cost effectiveness compared with the original concept for the flooring, which was marble tile.

For Ave Maria University, Decosup Inc. recommended a system comprised of its ChemTone® Acid Stain and DecoShine sealer, a polyaspartic sealer developed using Bayer MaterialScience polyurethane technology.

The acid stain provided a beautiful marble-like finish. Additionally, it was the only acid stain in the world without hydrochloric acid, so it’s safer to use and has no nasty fumes, said Art Pinto, president, Decosup. The polyurethane sealer locked in the finish and created a high-gloss finished look.

In general, the decorative concrete finishes protected with eco-friendly coatings may also produce significant cost savings, too. Ave Maria University saved as much as one-fifth the costs of marble or granite, through its use of the polyaspartic technology.

Clarity and gloss
Indeed, concrete floor coatings are increasingly expected to not only provide protection, but also offer the right look that enhances aesthetics. Whereas some coatings may dull the colors of a decorative stain, both the water-borne and polyaspartic coatings let the natural colors shine through, providing the color “pop” customers are seeking.

The “Bubble Bar,” which is part of the National Aquatics Center in Beijing, China, is one example of a facility that needed to have an interesting look. The Bubble Bar served VIPs during the 2008 Summer Olympics. The decorative concrete coating system was composed of an epoxy primer, a bio-based self-leveling coating, an advanced aliphatic polyurethane coating to achieve the blue color, and an advanced water-borne polyurethane topcoat.

TYPES OF SUSTAINABLE TECHNOLOGIES
High-performance decorative concrete floor coating technologies based on natural-oil polyols (NOPs), two-component waterbornes, polyaspartics, bio-based materials, and UV-cure resins enable architects and contractors to meet customers’ expectations.

Natural-oil polyol coatings
Currently, coatings utilizing natural-oil polyols (NOPs) are commercially available in the U.S. from several sources and in several different forms. These polyols have been formulated into products requiring minimal structural or tensile properties, but can help the bulk finished polymer satisfy other requirements such as rigidity, flexibility, or insulative needs.
Castor oil has been looked at both in its unmodified state and as a chemically modified derivative in the coatings and adhesives markets. Many of these products are derived from castor beans grown in the top producing countries such as India, China, and Brazil. With consistent and repeatable supply, modified castor oil-based coatings have been successfully developed into formulas that address both on-site and end-use challenges while providing the market with a durable, impact-resistant basecoat with very high renewable content.

NOP coatings are especially useful when re-tasking a facility as a self-leveling basecoat to smooth out spalling and concrete imperfections, such as an old industrial warehouse. The coating is resistant to humidity and moisture, a significant benefit if it’s being applied in an unconditioned space as it provides the contractor a rugged alternative to traditional coatings.

Two-component water-borne polyurethane coatings
For decades, solvent-borne polyurethane coatings have been considered the mainstay for high-performance coatings used in architectural, industrial maintenance, corrosion, and construction applications due to their excellent mechanical and weathering properties. But increased governmental, regulatory, and sustainability pressures have created a need for coatings technology that would reduce or eliminate VOCs, Hazardous Air Pollutants (HAPS), heavy metals, and/or other environmentally detrimental compounds.

In the past decade, the first generation of water-borne polyurethane coatings was formulated and introduced to the market. While offering the chance to replace some of the VOCs and solvents with water, many of these coatings still had in excess of 250 grams per liter (g/L) of cosolvent and a fairly strong odor.

In addition, these coatings often fell significantly short of the solvent-borne polyurethane standard in resistance to chemicals, abrasion and UV. This limited their use in many applications. As with most emerging technologies, the learning curve was steep and the second generation of water-borne polyurethane coatings was developed with the goal of meeting or exceeding the desired traits of the solvent-borne polyurethane coatings, but with significant reductions in VOC and solvent levels.

Today’s second-generation water-borne polyurethane coatings have achieved the property goals and are “truly water-borne”— 0-20 g/L VOC levels and nearly odor-free.

Additionally, two-component water-borne coatings can be formulated to create high-gloss to ultra-matte finishes without the use of solvents or matting agents.

These coatings have been used for industrial commercial flooring, such as those with heavy forklift traffic, due to their excellent chemical resistance, and for graffiti-resistant formulations that help reduce maintenance costs. These benefits also make the technology a good fit for decorative concrete floorings.

Polyaspartic resins
Polyaspartic technology, when used in conjunction with polyisocyanates as a two-part system, can be formulated into tough, durable coatings that offer near-zero VOC levels.

Furthermore, polyaspartic coatings offer rapid curing, good chemical resistance and durability. Whether the use is for residential garage floors, game rooms and basements, or commercial applications such as warehouses, universities, restaurants and general retail-space floors, polyaspartic floor coatings enable the end user to minimize downtime.
Coatings made with polyaspartic esters can even be applied at temperatures below 50 F, which extends the application season.

Polyaspartic coatings can be applied with a simple brush and roller and typically can be applied in multiple coats from start (base coat) to finish (top coat) in an eight-hour workday. Additionally, they may require fewer coats compared to traditional coatings, since they can be formulated as a high-build coating that contributes to time savings and ultimately significant cost savings.

UV resins
These user-friendly, high-molecular-weight UV resins feature a number of beneficial properties. They are odorless, cosolvent free, light stable for resistance to weathering, abrasion and chemical resistant, and exhibit good adhesion to the concrete substrate. Coatings formulated with these resins can be applied with existing equipment by roller, pad, squeegee, or other means. Typical applications include lobbies, restaurants, hospitals, parking garages, or other areas where extremely fast return to service is a must.

Contractors can use a variety of methods for UV curing. Formulations for outdoor applications can be cured by natural sunlight. Or, coatings can be applied and cured on-site with portable UV lamps in less than one hour, which is a significant productivity advantage. Another key advantage is that multiple coats can be applied, dried, then cured at once—with just one UV coating.

SUSTAINABLE CONCRETE FLOOR COATINGS: HERE TO STAY
A myriad of factors is contributing to the increasing demand for sustainable decorative concrete floor coatings. The coatings advances detailed here are giving contractors and designers the ability to meet customers’ desire for concrete coatings that are eco-friendly without sacrificing durability or ease of use.

Furthermore, these coatings provide designers and architects the latitude to expand the use of decorative concrete.

As the coatings industry continues to enhance its products to meet the evolving needs of the market, novel coatings technologies will continue to gain prominence and, in turn, spur the next generation of sustainable coatings.

About the author
Steven Reinstadtler is market development and green building manager for Bayer MaterialScience’s Coatings, Adhesives and Specialties Business Unit in Pittsburgh. He received a BS in chemistry with a polymer science option from the University of Pittsburgh. He joined the Polyurethanes Division of Bayer in 1987 as a chemist working on high-performance prepolymer and spray elastomers. He transitioned into the coatings area in 2006, where he was responsible for the research activities of the Construction Coatings group as well as forward marketing activities.