

**Achieving Sustainable Flooring through Polished Concrete (RP)**  
**AIA# ICC03B**

Slide	Notes
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3	<ul style="list-style-type: none"> <li>• TAKE A LITTLE BIT OF ROCK, SAND AND WATER, ADD SOME CEMENT ....AND YOU'VE PRODUCED JUST ABOUT THE MOST NATURAL FLOORING AND BUILDING PRODUCT AVAILABLE.....            These properties were used in Roman construction hundreds of years ago and are still used today all around the world.</li> <li>• Concrete is a mixture of cement, coarse aggregate, sands and water</li> <li>• (Additives may be included in the mix design to enhance the finishing process)</li> <li>• All of these ingredients are sourced and mixed locally, making concrete one of the most natural and locally sourced building products available today.</li> </ul>
4	Finishing techniques, screeding techniques (laser screed vs. manual screed), edge finishing vs. machine finishing, and flatness of the concrete all influence the final outcome of the polished concrete.
5	This slide illustrates the unflatness of many concrete floors. The highs and lows of a concrete floor are illustrated. As the floor is ground, it begins to expose aggregate on the high spots before the machine touches the low spots. As the machine begins to grind the low spots, there is larger aggregate where the high spots were and we get uneven aggregate exposure throughout the slab. A flat surface helps avoid this uneven aggregate exposure.
6	These two photos, show the results of low spots (on the right) and high spots (on the left). This uneven aggregate can be avoided by having better control of the concrete flatness and pour.
7	These two floors were polished by the same crew, using the same equipment, diamond tools, densifier, and overall same process. The only difference was the flatness of the concrete before the grinding and polishing began. The floor on the left is hard, durable, polished and easy-to-clean. However, you can see the added clarity and depth of shine on the right because of the flatness of the floor.
8	Properly curing the floor ensures good hydration and a stronger, more durable surface.
9	There are 3 basic steps to polishing concrete. The first step is to grind the concrete with specialized grinding machines and industrial diamond tools. The diamond tools are attached to the bottom of these grinding machines, as seen in this photo. The diamond tools, being harder than the concrete, will grind the concrete surface. These diamond tools can be made out of metal, ceramic, or resin.
10	Different equipment can be used in the grinding and polishing process
11	Machines with planetary heads create high rpms and good down pressure

12	There are propane and electric machines.
13	Edge grinders and hand held machines are used to get edges and corners.
14	Whatever equipment is used, the purpose is to get the diamond tool in contact with the floor to grind and polish the concrete.
15	Here you can see 3 different classes to define the amount of grinding being done. Class A is a very light grind, leaving the cement paste and only lightly exposing cement fines. Class B is a heavier grind than Class A, exposing fine aggregate, or the sand and small aggregate of the concrete. Class C is a heavy grind and exposes the large coarse aggregate. These different classes of grinding create very different amounts of aggregate exposure and different looks to the floor, while helping to define the level of grinding and setting the proper grinding expectation.
16	<p>The second step in the grinding process is to densify the concrete surface. In regards to the longevity and sustainability of polished concrete, this step of densification is the most important step.</p> <p>The densifier penetrates into the floor surface through the concrete pores. As the densifier penetrates the concrete, it reacts with the calcium hydroxide in the concrete. This reaction makes the concrete much harder and crates a crystalline growth. These crystals grow and fill in the pores. By filling the pores, it creates a much denser surface. This is why these products are referred to as “densifiers” – they remove the porosity and make the surface dense. This is all done through inorganic chemical reaction with the concrete, creating permanent surface hardness, abrasion resistance, dust proofing and densification.</p>
17	<p><b>Here you are looking at the physical attributes of densified concrete magnified 2500 times</b></p> <p><b>On the left</b> is bare concrete prior to densification</p> <p><b>On right:</b> you can see the same concrete following densification</p> <p><b>Note the tightness and uniformity of the densified concrete</b></p>
18	<p><b>Because densifiers need to penetrate into the top 1/16 – 1/8<sup>th</sup> of an inch of concrete, it should be flooded onto the surface and allowed to penetrate for 30-60 minutes. Applying less than 250 square feet per gallon will result in minimal penetration and a diminished chemical reaction. This limited densification reduces the hardness and sustainability. In order to reduce costs, some applicators and manufacturers are applying the densifier at a very light coverage rate. This is keeping the floor from reaching full densification and long term results.</b></p> <p>In order to avoid this, densifiers should be specified at 200 – 300 square feet per gallon and allowed to soak into the floor for 30 – 60 minutes. This will assure that contractors are not cutting corners and applying less product than is necessary. As</p>

	THE step that assures the longevity and sustainability of these floors, the right amount of material and thus a full densification is imperative.
19	<p>The 3<sup>rd</sup> and final step is to continue polishing the surface with finer and finer grit diamond tools to achieve the level of gloss that the customer and architect are expecting.</p> <p>This polishing process is similar to sanding wood. You begin sanding with larger grit sand paper and finish with fine grits to polish and close off the wood. This is very similar to what is being done to the concrete, through the use of diamond tools.</p>
20	<p>This slide shows 4 different levels of polish that can be achieved. Level 1 is flat or ground concrete. This level of polish creates a matte finish and reflectivity is only visible from a distance. Level 2 is satin or honed concrete and begins to have a nice gloss on the surface. Level 3 is considered polished concrete and has great reflectivity. Level 4 is highly polished concrete and the polish looks to be deep into the floor. Between the 3 classes of grind and the 4 levels of polish, there are many different looks that can be achieved to any floor.</p>
21	<p>Polished concrete delivers several important benefits.</p> <p>Increased reflectivity up to 30%* or more  Increased impact resistance</p> <p>Although these floors are polished and might look slippery, they meet OSHA and ADA recommendations for slip resistance and are considered “high traction” floors by the National Floor Safety Institute.</p> <p>As we will discuss further, polished concrete has the lowest life cycle cost of any flooring surface.</p> <p>It is also important to notice the abrasion resistance numbers. Polished concrete can increase the abrasion resistance by up to 400%. Nothing else can increase the abrasion resistance of concrete this dramatically.</p> <p>There are a number of recognized manufacturers of silicate densifiers. It is important to request third party testing of each product to verify which products meet these results..</p>
22	<p>Along with the benefits of polished concrete, there are also some limitations you should be aware of.</p> <p>Densified and polished concrete is not resistant to concentrated acids. Additional protection should be used in restaurants, grocery stores and locations where acids will come in contact with the concrete.</p> <p>Polished concrete is not elastomeric, like a coating – It will not span cracks</p> <p>Will not hide variations of the concrete color</p>

	<p>Minimum 28 day cure time is recommended to ensure complete hydration of the concrete, along with having a stronger &amp; harder floor to grind and polish</p> <p>If there will be salt or deicing agents present, a well-designed walk-off mat system and good maintenance can help keep it from trafficking into the building.</p>
23	<ul style="list-style-type: none"> <li>• There are several color options for polished concrete. Integral color, dry shake, and topical dyes and stains. If it is an existing floor, only topically applied dyes and stains can be used. If the concrete has not been poured yet, any of these color options are available.</li> </ul>
24	<p>Both of these floors received the exact same acid stain and they are both the same Mexican restaurant brand with very similar traffic. The left floor had acid stain applied, and then received a topical sealer to protect it. As you can see, the coating wears, then the traffic wears away the concrete and the color is removed. The floor on the right was stained and then densified and polished. The increased abrasion resistance provided by the densification of the polished concrete provides the acid stain with protection from wear. The 400% increase in abrasion resistance we talked about, keeps the concrete and stain from trafficking away.</p>
25	<p>These photographs show the longevity and sustainability of polished concrete. These floors were colored, densified and polished between 2002 and 2003. The photos on the right were taken in 2016. There has been no reapplication of any products on this floor.</p> <p>The floor is cleaned regularly with a dust mop and with a wet mop, as needed. This very minimal cleaning has maintained these results after 12 years of heavy traffic.</p> <p>Polished concrete works well in both schools and healthcare facilities because it does not support the growth of mold, mildew, allergens or dust-mites, and it is a dust-free surface.</p>
26	<p>This high school was colored, densified and polished between 2002 and 2003. The photos on the right were taken in 2015. This floor has withstood the heavy traffic and abuse from a high school setting. No coatings or reapplications of any products during this time and the maintenance is a regular dust mop and a scrubbing machine, as needed. The maintenance compared to other flooring options is minimal.</p>
27	<ul style="list-style-type: none"> <li>• Polished concrete can be used on cementitious terrazzo as well as concrete.</li> </ul> <p>This was a 20 year old facility that had been maintained the way terrazzo and many other floor coverings are maintained. It was waxed and burnished on a regular basis. After the layers of wax would begin to turn yellow and have layers of dirt trapped inside, the wax was stripped off, using caustic chemicals and the process of waxing and burnishing would start over again. The wax and other chemicals end up in our water system and the ongoing maintenance is</p>

	<p>extremely expensive. Not to mention the environmental concerns of producing and shipping these chemicals over the years.</p> <p>The wax was removed, the terrazzo densified and then polished. These are the results after 1 year of minimal cleaning and no more waxing, stripping, and burnishing.</p>
28	Exposing the large aggregate, like this Whole Foods, creates a terrazzo appearance at a fraction of the cost.
29	<p>The appearance of a terrazzo floor can be achieved by broadcasting aggregate or recycled glass into the surface of the newly poured slab, and then performing the grinding steps to expose the aggregate or glass in a relatively uniform and terrazzo-like appearance.</p> <p>Two examples are:</p> <ul style="list-style-type: none"> <li>• Upper left - Whole Foods in Toronto cast with large aggregate</li> <li>• Lower right- Russellville High School in Arkansas cast with recycled black and red glass</li> </ul>
30	It is important to analyze an existing floor to make sure it is a good candidate for polished concrete. In order to determine if the floor is a good candidate for Polished Concrete, we will want to know what type of floor prep is needed – are there coatings or other existing floor coverings to remove? Are there pour backs or patching on the floor? These will all create a certain look to the floor. Mock ups and samples are needed to verify the final look of an existing floor.
31	Here we can see several examples of what can be seen on an existing floor – pourbacks, ghosting from tile mastic, different aggregate exposure. These should all be taken into consideration when polishing an existing floor. Some customers love this industrial-sheek look and others do not. A mock up will help everyone get on the same page.
32	Color matching is an art. You can see in these two examples the need for finding a good match. Both floors will perform well, but the one on the right looks much better.
33	If there are existing cracks, they can be filled and shaved to blend into the concrete and to give added structural strength. The filled cracks also make it easier to clean this surface.
34	When it is done right, you have to look close to see where the repairs were made.
35	Two examples of using joint fillers as part of the design of the building. On the left is a hotel in Costa Rica. Small saw cuts were placed in a rectangular pattern to give the appearance of tiles. On the right is a Big O Tire store, where the white joint filler was used to

	contrast the black floor. The joints and joint fillers can become part of the design element
36	<ul style="list-style-type: none"> <li>• We put the Saw Cut and control Joint into the floor to tell the floor where to crack.</li> <li>• The photo on the right is of an actual crack formation in the curing of a slab, and as you can see, it is directly below the joint.</li> <li>• Saw cuts should be 25% of the depth of the slab. A 4 inch slab should have 1 inch saw cuts.</li> </ul>
37	<ul style="list-style-type: none"> <li>• A 2 part 100% solids polyurea is being shot into the control joint.  It sets up and hardens and bonds to the joint wall  The joint is then shaved so that it is flush with the concrete.</li> </ul>
38	<ul style="list-style-type: none"> <li>• Grinding, Polishing, Crack Repair, Spall Repair, Coloring, Edge / Hand Polishing are all artistic applications. They should be done by certified applicators and artisans.</li> <li>• Skilled craftsmen with experience should be used on these sort of projects.</li> </ul>
39	<p>The daVinci Arts Middle School, in Portland, Oregon was the first public school building to achieve LEED Platinum and Net Zero Classifications. Polished concrete was a big part of the sustainability of this building.</p> <ul style="list-style-type: none"> <li>• <b>What is sustainability?</b></li> </ul> <p>There are a lot of products that claim to be “sustainable”, so what does it mean? <b>Sustainability is the endurance of a system or process.</b> The longevity and maintenance of something are a big part of their sustainability.</p> <p>There are several reasons why polished concrete is a sustainable system and its longevity and ease of maintenance are at the top of that list.</p>
40	<p>Additional sustainability benefits of polished concrete include</p> <ul style="list-style-type: none"> <li>• Energy cost savings</li> <li>• Reduced life-cycle impacts</li> <li>• No off-gassing – no VOC’s</li> <li>• Improved thermal comfort</li> </ul>

	<ul style="list-style-type: none"> <li>• Benefits from increased daylighting</li> </ul>
41	<p>Awarded LEED Platinum two times making it “double platinum.” The Academy of Sciences is one of the largest public Platinum-rated buildings in the world, and is also one of the world’s greenest museums. Polished concrete throughout was a large contributor to this award.</p>
42	<p><i>If you look closely at the lighting of this Volkswagen manufacturing and warehousing facility, you will see lighting that has been turned off. This facility has been able to turn off 1/3 of it’s lighting due to the reflective benefits of polished concrete. Even with 1/3 of its lighting turned off, it is still a very bright and safe environment, thanks to the polished concrete.</i></p>
43	<p>Daylighting has been touted for its many aesthetic and health benefits by Designers and researchers alike... daylit environments increase occupant productivity and comfort, and provide the mental and visual stimulation necessary to regulate human circadian rhythms.”</p> <p>“high correlation between schools that reported improvements in student test scores – upwards of 10 percent – and those that reported increased daylight in the classroom</p> <p>Buildings with highly reflective floors, such as densified polished concrete enhance the use of natural daylight</p>
44	<p>During the 12 years of traffic and use, this floor has had no re-application of any products. Only simple cleaning, when needed.</p> <p>Ease of maintenance and long term performance make polished concrete a truly sustainable system.</p>
45	<p>This 10 year life cycle comparison chart was put together by the National Terrazzo Association and other independent sources. It shows the cost to install various flooring products and the annual maintenance costs to extrapolate a 10 year life-cycle cost.</p> <p>See chart</p>
46	<p>Specifications, mock ups and samples help get everyone on the same page. The beauty of concrete is that it is a very natural product. However, being natural means that there can be different sizes of aggregate exposed. Each floor can have a different color and look. There are many variables when dealing with a natural product. Just like the uniqueness in marble and granite, each concrete floor has unique characteristics. The customer should understand the unique and natural character of concrete.</p> <p>The concrete flat worker needs to understand their important role in the process.</p> <p>The concrete polisher needs to know the aggregate exposure and polish level desired.</p> <p>By assuring that everyone has the same expectations, through well written specifications and samples, they can all be on the same page.</p>

47	<p>The specifications are written to create consistency and accountability</p> <p>Make sure everyone understands them, from office to field, and that everyone buys off on the need to follow them</p>
48	<p>The pH of the cleaner is important for concrete floors. The ideal pH is between 9 – 10, the same pH as the concrete.</p>
49	<p>It is important to use a detergent that pulls the dirt into solution for easy removal from the floor.</p>
50	<p>Using the right brushes can make sure the floor gets cleaned properly, while not damaging the scratch pattern and polish on the floor.</p>
51	<p>When cleaned, polished concrete floors have been shown to be one of the safest hard surface floors available, with slip ratings acceptable per ANSI B-101.3 testing.</p>
52	<ul style="list-style-type: none"> <li>• The versatility of polished concrete allows it to be specified in numerous industries.</li>   <li>• Some of the industries that are well-suited for concrete polishing include restaurants, hospitals, schools and industrial facilities.</li> </ul>
53	<p>It is used regularly in automotive facilities, LEED projects, retail, commercial and more.</p> <p>No other flooring option is used in so many different environments. It is a versatile flooring option and is seen in many different spaces.</p>
54	<p>To finish, we will run through a few case studies, where polished concrete has been used effectively.</p> <p>This is an Audi dealership in California. You can see how reflective and especially how clean this facility is. This photo was taken 1 year after the dealership was opened. At the end of each day, the mechanic, working at each station, takes 1 minute to clean the floor in their work area. They have a walk-behind floor scrubber and quickly pick up any grease, oils or other dirt and liquids from the day's work. That minimal maintenance keeps this floor looking good and performing well.</p>
55	<p>Polished Concrete was used to refurbish this 40 year old automotive parts manufacturing and distribution facility.</p> <p>This facility had used a clear epoxy to coat their floor for years. Each year, they would shut down the facility over Christmas and New Year to reapply the epoxy coating. You can see on the left how the floor looked after a year of use. After 40 years of this, they decided to look for a new solution. They found polished concrete! They removed the old epoxy and densified and polished the concrete. The photo on the right was also taken after 1 year of use and abuse. It looks great and has no need of any reapplication of products. This is a great example of the durability and sustainability of polished concrete.</p>

56	Polished and dyed concrete adds a positive feel to the shopping at Bass Pro Shops. Using color patterns allows them to delineate different sections of the store.
57	This children's hospital in Canada received a LEED Platinum award. Notice that at this facility, they wanted more of a matte finish, as opposed to the high polish in other examples we have seen. This project received the highest LEED point total in the world for a cold climate building and is the largest LEED Platinum certified building in Canada.
58	This hardware store in Australia used polished concrete for its strong abrasion resistance, needed for the heavy foot traffic, forklift traffic, and equipment used in these facilities. The high polish and ease of maintenance make it the ideal flooring option for a retail facility with heavy traffic.
59	This Harley Davidson dealership incorporated dye colors and polished concrete to create a beautiful and durable surface, to match their beautiful and durable merchandise.
60	This restaurant's polished concrete in Bilboa, Spain highlights the brightness and cleanliness the owner was hoping for. The white, large aggregate was broadcast into the floor during the concrete finishing and gives the floor a very unique design.
61	The simplicity and beauty of polished concrete allows the amazing architecture and beauty of this church to shine through.
62	The art at this museum is visible on the wall and through the reflection on the floor. The polished concrete also shows off the crisp lines and beautiful architecture of the building.
63	<b>This college outside New York City used polished concrete for the look, sustainability, and ease of maintenance.</b>
64	Grocery stores have become big users of polished concrete both for their aesthetic purpose as well as their dramatic reduction of maintenance compared to tile.
65	This airport floor has integrally colored concrete and large exposed aggregate to create a very unique look that is easy to clean and handles the abuse and traffic of this environment. Along with the exposed timbers and stone, the polished concrete adds to the high-end, yet natural look of this airport.
66	An unique example of utilizing polished concrete outside the box – on these exterior walls. Natural light is reflected through the glass fins during the day and electric light shines through them during the night, reflected off the polished concrete, creating a rainbow effect at this Ohio State building.  There are many ways in which polished concrete can be used, but the durability and sustainability remain constant!
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