

Specifiers Guide to Polished Concrete in Greater Kansas City

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Provision:

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About Polished Concrete

Definition

Polished Concrete is mechanically treated concrete, treated with diamond grinding tools. Typically polished concrete is defined as treated with 800 grit up to 3,000 grit levels. (Anything ground below 400 grit levels is not technically considered polishing.) Grinding tools are progressive pads building to the desired polish level. Polishing often includes using liquid hardeners and/or densifiers to add durability and serviceability to the surface. Colors and dyes can be used in conjunction with the polished system to further enhance the aesthetics. Now having said that, there are other methods to meet client desires for a polished concrete look. These other methods depend on the existing concrete profile, the contractors experience and expertise, the equipment and the supplies used.

Polished concrete is not to be confused with “stained” concrete, “epoxy” concrete, “terrazzo” concrete or “sealed” concrete. Sealers or epoxies are applied over plain concrete or stained concrete. These sealers/epoxies can produce a flat finish or a high gloss finish. Polished concrete is actually changing the surface of the concrete physically by using pads, grits and buffing materials to achieve the finish mechanically.

Polishing Benefits

- A sustainable design flooring option.
- Uses materials already present.
- Eliminates the energy and additional materials to apply other flooring options such as carpet, wood, tile, etc.
- Low maintenance.
- More durable and easier to clean than many other flooring options.
- Increased slip resistance (vinyl composite tile (VCT) standards typically are a minimum of .5 SCOF, polished concrete is typically .7 to .9 SCOF).
- Reduces the opportunity for dust and dust mites for asthma and allergy sufferers.
- Improves natural lighting with the reflective surface bouncing light around the room.
- Potentially reduces the need for additional interior lighting.
- Hard wearing surface has less opportunity for chipping, denting and wear and tear.
- Cleaner, healthier atmosphere for restaurants, hospitals and medical clinics, etc.

Types

- New (construction of a new floor can have a huge effect on the final polished product).
- Retrofit (either with an overlay that is polished or by “cutting” and sanding the existing floor).

Aggregate Exposure

As defined by Concrete Polishing Association of American, CPAA

Class	Name	Surface Cut Depth	Appearance
A	Cream	Very little	Little aggregate exposure
B	Fine Aggregate (Salt & Pepper)	1/16 th inch	Fine aggregate exposure with little or no medium aggregate exposure at random locations
C	Medium Aggregate	1/8 th inch	Medium aggregate exposure with little or no large aggregate exposure at random locations
D	Large Aggregate	1/4 th inch	Large aggregate exposure with little or no fine aggregate exposure at random locations

Note: FF #'s effect consistency of aggregate exposure

Reflective Clarity and Reflective Sheen

Modified version of the Concrete Polishing Association of American, CPAA Chart

Gloss can be measured with a Gloss Meter

Level	Name	Reflective Clarity	Reflective Sheen	Grit Range
1	Ground	Flat appearance with no to very slight diffused reflection	None to very low	Below 100
2	Honed	Matte appearance with or without slight diffused reflection	Low to medium	100-400
3	Semi-Polished	Objects being reflected are not quite sharp and crisp but can be easily identified	Medium to high	800-3000
4	Highly-Polished	Objects being reflected are sharp and crisp as would be seen in a mirror-like reflection	High to highest	

Reflective Clarity: When viewed 5 feet above and perpendicular to a surface, the degree of sharpness and crispness of the reflection of the overhead objects.

Reflective Sheen: When viewed at 20 feet from and at an angle to a surface, the degree of gloss reflected from the surface.

Highly-polished concrete is when the concrete is polished to the degree where the reflective clarity should be good enough to see a near perfect reflection of the overhead lighting.

Burnished Concrete is an alternative to the 4 grades above identified by the CPAA. The burnished

concrete option is not technically polished concrete, but it might be the solution depending on the floor condition and the expectations by the owner. Burnished concrete is done by simply utilizing diamond impregnated pads and using a propane powered burnisher.

Sustainability & Green Building

Many current green building certification programs and construction guidelines for achieving green points or credits can be attained by using polished concrete. The reasons are listed above in the benefits section, i.e., less energy use, more natural light, less construction materials needed, low maintenance, etc. Some examples of the programs are:

- LEED® by the U.S. Green Building System, USGBC
- Green Building Standards, National Association of Home Builders, NAHB
- National Green Building Standard, International Code Council, ICC
- Green Globes, ECD Energy and Environment Canada

Polished concrete can achieve LEED®NC credits:

- Materials & Resources (MR) Credit 1.1- Building Reuse, Maintain 75% of Existing Walls, Floors and Roof.
The intent is to extend the lifecycle of materials to prevent waste and reduce the environmental impact that is caused by harvesting and manufacturing new material. Reusing the concrete slab as part of the building helps to achieve this point if the total amount of reused materials in the project meets or exceeds 75% as calculated by square footage.
- Materials & Resources (MR) Credit 1.2- Building Reuse, Maintain 95% of Existing Walls, Floors and Roof.
The intent is the same as above in MR Credit 1.1 except it must meet the criteria of 95% reuse of building materials on the project.
- Materials & Resources (MR) Credit 3.1- Materials Reuse, 5% reused items.
Polishing the slab instead of harvesting additional materials to cover the slab prevents waste and reduces the impact on the earth's finite resources. Reusing the slab as a finished floor, instead of covering it up with carpet, tile or other materials helps to meet this objective.
- Material & Resources (MR) Credit 3.2- Material Reuse, 10% of reused items.
If the amount of materials reused exceeds 5% and meets or exceeds 10% then this point can be attained in addition to MR 3.1.
- Indoor Environmental Air Quality 4.2- Low Emitting Materials, Paints and Coatings.
Indoor air quality effects the quality of life and well being of the occupants of a building considering the amount of time spent indoors at work, home or school. Materials that emit odors or VOCs (volatile organic compounds) should be eliminated. By using a low VOC or no VOC sealer on the polished floor or by eliminating the sealer altogether, polished concrete can meet this requirement.
- Energy & Atmosphere (EA) P2 – Minimum Energy Performance (Mandatory Prerequisite).

All buildings must comply to a minimum energy efficiency level overall as established by the local building codes, the Dept. of Energy Standards or by complying with ASHRAE/IESNA 90.1-2004 regulations. The reflective nature of polished concrete reduces the amount of artificial light needed. This helps to maximize the natural and artificial lighting already in use, improving energy efficiency of the lighting system as a whole. The insulation gained from the thermal mass of constructing with concrete, including walls and exposed slabs, used with passive solar design principals, helps retain the internal temperature of the building. Using thermal mass as a design element will moderate the daily temperature fluctuations and reduce the HVAC load.

- Energy & Atmosphere (EA) 1- Optimize Energy Performance 1-10 points.

If the energy efficiency exceeds the energy savings required in the baseline in prerequisite EA P2, an additional ten points can be achieved through EA1. Polished concrete can assist through increased ambient lighting and thermal mass for these items.

Table of Contents

1. References
2. Flatwork Contractor
 - a. Submittals
 - i. Materials
 - ii. Mix Design
 - iii. Mock-Ups
 - iv. Quality Assurance
 - b. Construction
 - i. Materials
 - ii. Project Conditions
 - iii. Weather
 - iv. Storage
 - v. Subgrade
 - vi. Mix Design
 - vii. Jointing
 - viii. Curing
 - ix. Flatness/Levelness Tolerances
3. Polished Contractor
 - a. Submittals
 - i. Materials
 - ii. Equipment
 - iii. Flatness/Levelness Tolerances
 - b. Equipment
 - c. Polishing Process
 - d. Maintenance
4. Pre-Construction Conference

This guide does not contain any proprietary brand names or systems as part of the recommendations. This is a generic concrete industry suggestion for best practice use. Please recognize that manufacturers have their own proprietary training and certifications for good reasons. While we do not recommend one over the other, they are recognized as good educational opportunities and contractors are encouraged to participate in them. There is also industry training and certification that are not proprietary and are outstanding programs. The Concrete Polishing Association of American is a national trade association for the polishing industry that offers such programs.

1. References

AASHTO M 194	Chemical Admixtures
ACI 301	Specification for Structural Concrete for Buildings
ACI 302	Practice for Concrete Floor Construction
ACI302.1R	Guide for Concrete Floor and Slab Construction
ACI 303	Specification for Cast in Place Architectural Concrete
ACI 304	Practice for Measuring, Mixing, Transporting and Placing of Concrete
ACI 305	Hot Weather Concrete
ACI 306	Cold Weather Concrete
ACI 360R-10	Guide to Design of Slabs-on-Ground
ANSI B101.1	Standard for Walkways (benchmark for wet tile and concrete floors)
ASTM 1028	Co-Efficient of Friction
ASTM C 33	Aggregate Conformity
ASTM C 150	Type I, II Portland Cement Conformity
ASTM C309	Liquid Membrane Curing Compounds
ASTM C1315	Liquid Membrane Curing Compounds
ASTM C494	Chemical Admixtures for Concrete
ASTM C1028	Static Coefficient of Friction Values (SCOF)
ASTM C779	Test Method for Abrasion of Horizontal Concrete Surfaces.
ASTM C805	Impact Strength
ASTM C979	Pigments for Colored Concrete
ASTM E1155	Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers
CPAA 03 3543	Concrete Polishing Assoc. of America Specification Diamond Polishing
CPAA	Recommendations for the Design, Specification and Placement of Concrete Floor Slabs for Polished Concrete
ICRI	Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, G03732P
PCA PA/124	Finishing Slabs with Color and Texture
PCA SP/021	Color and Texture in Architectural Concrete

2. Floor Contactor

a. Submittals

i. Materials

1. Provide data sheets for integral color.
2. Provide data sheets for curing compounds used.
3. Provide data sheets for sealing compounds used.
4. Provide data joint and crack fillers and the certification for using this product.

5. Provide a concrete mix design for the concrete mix to be used (the mix design should be created by someone with experience in polished floors).
6. Provide mock up sample of slab.
7. Review flatwork contractor qualifications, certifications (ACI Flatwork Finisher Technician) and experience.

ii. Concrete Mix

1. Submit concrete mix design with appropriate testing data, and data sheets for all the materials in the mix including: sand, large aggregates, cement, and all admixtures, etc.
2. It is highly recommended that an experienced mix designer very familiar with polished concrete create the desired mix design. There are some schools of thought that are extremely wary of using supplementary cementitious materials in the mix.

iii. Mock-ups

1. Mock-ups shall be submitted for color, aggregates, etc. prior to construction and accepted/rejected by owner/architect/representative
2. When planning the schedule to do mock-ups and the approval process, realize the mock-up must cure for a minimum of 28 days prior to the polished contractor conducting his/her finish on the test panel.
3. Mock-up approval process can be just for the flatwork contractor or for both flatwork contractor and polished contractor, depending on the specifics for the job.

iv. Quality Assurance

1. Flatwork contractors shall have ACI Certification for Concrete Flatwork Technician. Go to www.concrete.org to find out if the contractor has a valid certification.
2. Review flatwork contractor qualifications, length of time and experience placing slabs.
3. 3 local references.
4. **The polishing contractor and the concrete flatwork contractor IF they are not one in the same MUST have a pre-placement meeting. As the flatwork contractor placing the concrete has a heavy hand in the success of the polished finished product.**

b. Construction:

i. Materials

1. Materials should be consistent from the same lot and batch for the entire project.
 2. Light weight aggregates should not be used when exposed aggregates are the desired look.
 3. Concrete must be delivered from the same batch plant throughout the entire job.
 4. Calcium chloride additives should not be used with colored concrete or polished concrete.
- ii. Project Conditions
1. Concrete placement should be done:
 - a. Without intense hot sun.
 - b. Without high winds.
 - c. Never on frozen surfaces.
- iii. Weather
1. Follow Hot and Cold Weather Concrete in ACI 305 and 306.
- iv. Storage (On and Off Site)
1. Powdered color additives should be delivered in un-opened containers and stored in dry conditions.
 2. Liquid color additives should be protected from freezing and need to be remixed prior to use.
 3. Chemical admixtures should be properly stored and protected from elements that could affect their use.
- v. Subgrade
1. Subgrade for all concrete pavements must be uniform. Uneven locations or soft spots will cause cracks and/or deflections in the surface that will affect the finished polished product.
- vi. Concrete Mix Designs
1. Minimum 3500 psi (Typical strengths are 3500 psi to 5000 psi).
 2. Water/cement ratio ≤ 45 .
 3. Interior polished slabs should not be air entrained.
 4. < 15% total supplementary cementitious materials (SCM's - include fly ash & slag).
 5. Optimized aggregate gradations are beneficial in reducing bleed water and for other benefits. Seek advice from experienced ready mix producers and/or mix design engineers for help designing a concrete mix. Optimized mixes can often reduce the need for more joints.

6. Admixtures in moderation are very useful, especially in controlling the water/cement ratios.
7. If an integral color is used, the minimum batch size should be 3 cubic yards.
8. Target slump is 4 inches \pm 1 inch.

vii. Jointing and Repairs

1. Joints are always at right angles if possible.
2. Saw cutting should be done as soon as possible after the slab has been placed without causing raveling at the joint or premature micro-cracking.
3. Typical joints on interior slabs for polished floors:

Slab thickness in inches	Joint spacing in feet
4	10
6	12
8	15

4. Jointing concrete always creates curling slabs (often not visible to the eye). Curling creates highs and lows within each panel. Any “uneven” slab will polish differently in the high spots and the low spots.
5. Not jointing can be a problem because the slab is going to crack. At least with joints the “cracks” are aesthetically pleasing and usually acceptable to all. Random cracks are perceived as not acceptable most of the time.
6. Seek help from an experienced mix design engineer to optimize concrete mixes to reduce the need for as many joints or in some cases, no joints at all (with highly engineered designs with low shrink concrete, optimized gradations, etc.).
7. Know that jointing affects FF and FL numbers.
8. Repairs need to be completed before the polish. There are a multitude of products on the market to repair slab defects.

viii. Curing

1. Cure for a minimum of 28 days before starting polishing procedures.
2. Follow ACI 308R-01 Guide to Curing Concrete for evaporation control and wet curing.
3. **The Flatwork Contractor and the Polishing Contractor need to agree on the curing agent to be used on the actual slab pour, as it has a huge effect on the Polishing Contractors job.**

4. If using densifiers and hardeners, do not apply them at this time. The polishing contractor should handle this during his scope of work.
5. Flatwork Contractor signs off slab to Polishing Contractor.

ix. Flatness/Levelness Tolerances

1. Floors should be poured in accordance with ACI 301.
2. F_F numbers of at least 50. (See F_F and F_L section below.)
3. F_L numbers of at least 30. (See F_F and F_L section below.)
4. The F_F and F_L numbers specifications will vary greatly from polished concrete countertops to highly technical floor slabs with pneumatic tired computerized systems for filing and retrieval in many warehouse environments.
5. The F_F and F_L numbers herein refer to the not so technical jobs. For the very technical situations contact an experienced structural engineering firm/consultant.

6. F_F and F_L Tolerance Chart:

	Specified Overall Value	Minimum Local Value
F_F Floor Flatness	50	35
F_L Floor Levelness	30	20

7. Floor flatness and levelness should be tested within 8 hours after completion of the final troweling operation according to ASTM E1155-96(2008) by an independent testing agency.
8. In the pre-construction meeting a remedy should be set for out-of-tolerance work.

x. Finish

1. During the pre-construction meeting a goal should be agreed upon as to the desired finish appearance of the slab, set by measuring the gloss reflectivity from a gloss meter.

3. General Contractor or Owner

- a. The responsible party for the slab during the transition from the flatwork contractor until the polishing contractor commences work.
 - i. Keep other trades off the slab if possible.
 - ii. Cover the slab with a non-chemical laden cover to protect it from oil spills, gouges, contact with metals, protected from mastics/glues, etc.
 - iii. Keep chewing tobacco juice from contaminating the floor, especially if it is to be an architectural featured floor, as the tobacco will inhibit color, stains, hardeners, etc. from working properly.
 - iv. Keep vehicle traffic completely off the floor.

4. Polishing Contractor

a. Submittals

i. Materials

1. Provide data sheets for hardeners and densifiers.
2. Submit data sheets for joint and crack fillers and the certification for using this product.
3. Submit data sheets for any materials used in the coloring and polishing process.

ii. Equipment

1. Submit product data sheets for the polishing equipment:
 - a. Grinding machine
 - b. Metal bonded diamond tools
 - c. Resin bonded diamond tools
 - d. Burnishing pads
2. Submit data sheets on dust control and run-off for both dry and wet polishing systems.
3. If using a wet polishing system, submit a slurry disposal plan.
4. If using a dry polishing system, submit cfm's for vacuum.

iii. Mock-Ups

1. Provide mock-ups for all projects.
2. Provide color mock-ups for color approval.
3. Square footage or size of the mock up is between the architect/owner and the polishing contractor. Some estimates are: between 10 and 20 sq. ft. for small projects, 100-200 sq. ft. for larger warehouse or big box type floors. (Depends on job size)
4. Use the same personnel that will be doing the job, including the supervisor.
5. Install the mock-up in accordance with the specification using the same materials, staff and equipment.
6. Finish various levels to show the maximum final finish and a couple of options.
7. Approvals should be based on:
 - a. Complies with pre-submitted examples.
 - b. Uniformity of exposed aggregates.
 - c. Uniformity in sheen.
 - d. Desired color enhancement.
 - e. **Do not destroy or alter field mock-ups until after the entire project is completed** so they will always be around to make a

comparison. Sometimes mock-ups are needed to practice a “fix” later in the project for approval.

- f. Approval from the Architect/Owner is necessary BEFORE the job can be started.

iv. Quality Assurance

1. Review contractor qualifications, certifications and length of time and experience with polishing.
2. Certification from the Equipment Manufacturer being used on the job.
3. Check for certifications from Joint Filler Manufacturer and Densifiers/Hardener Manufacturer.
4. 3 local references for polished concrete.
5. The same personnel shall complete the entire job.
6. **The polishing contractor and the concrete flatwork contractor IF they are not one in the same MUST have a pre-construction and pre-polish meeting. As the flatwork contractor placing the concrete has a heavy hand in the success of the polished finished product.**
7. Testing Goals
 - a. Gloss Meter (60° angle meter)
 - b. SCOF (Static Coefficient of Friction Values) $\geq .5$
 - c. Free of scratches
 - d. No cloudy/haziness
 - e. Consistent look or sheen

b. Equipment

i. Polishing and Grinding Equipment:

1. Provide hook ups or generators with proper outlets.
2. Have the proper polishing machine with a proper amount of lbs per down pressure for the job.
3. Dust system for either dry or wet procedures (vacuum or squeegee).

ii. Metal Bonded Pads:

1. Use metal bonded pads - grit sizes vary with manufacturers. Metal bonded pad example: 16, 25, 40, 60, 150 and 300. **NOTE: Not all pads need to be used in sequential order on all concrete.**
2. Resin Bonded Pads-use resin diamond pads - grit sizes vary with manufacturers. Resin diamond pad example: 100, 200, 400, 800, 1500, and 3000. **NOTE: Not all pads need to be used in sequential order on all concrete. Note: the 1500 to 3000 range doesn't usually meet slip coefficient. If used for a floor with traffic, slip & fall options need to be discussed.**

c. Polishing Process

- i. Clean the slab thoroughly.
 1. Remove paint, mastics, oil spots (as best as possible), dirt, etc.
 2. Scrub slab with soft brush or pads.
 3. Use neutral pH detergent and rinse well.
 4. Protect adjacent areas to prevent damage by polishing machines and/or materials.
- ii. Repair and fill any surface cracks.
 1. Allow the crack repairs to cure thoroughly
- iii. Follow the recommendations of the equipment manufacturer in increments of various heads or pads for grinding, honing, and polishing to the desired level.
- iv. Apply the densifiers and hardeners as necessary for maximum performance
- v. Surface color application is debatable as whether to apply before or after the honing and/or polishing steps. This needs to be worked out in the mock-up stage for approval.
- vi. Cleanup the site.
- vii. General Contractor or Owner provides protection from construction trades until the project is turned over to the owner. This needs to be discussed in the pre-construction conference.
- viii. Edges are harder to polish because they are perpendicular to the wall. The corners are challenging to get into with large polishing equipment. As a result they rarely are polished to the same degree as the main part of the floor. Many contractors offer edging detail as an alternative to polish in the 45° corner. Discuss this ahead of time in the pre-construction conference and agree on an edge “solution” that satisfies all involved.

d. Maintenance

- i. Leave a Maintenance Protocol for the Owner
 1. Do not use high ph cleaners like “Mean Green”, use neutral ph cleaners
 2. Suggest cleaning pads/brushes (white or red pads).
 3. Clean with the same Brand as the “Guard” and/or densifier used in the polishing process, as they are made to be used together for a reason.

5. Pre-Construction Conference

a. Attendees:

- i. Concrete Sub-Contractor
- ii. Polishing Sub-Contractor
- iii. General Contractor
- iv. Architect/Owner
- v. Ready Mix Producer

vi. Testing Company Representative

b. Agenda Items:

- i. Review approved mock-ups (may include site visit).
- ii. Review contract documents.
- iii. Review substrate conditions.
- iv. Review surface preparations.
- v. Review sequence of procedures.
- vi. Set expectations for the surface appearance, as determined by a gloss meter.
- vii. Ensure proper ventilation when applying some liquid products for hardening and densifying.
- viii. Set protection for concrete floor after placement until polishing time.
- ix. Discuss and set edge treatment as mentioned in the Polishing Process above.
- x. Make it clear who is responsible for protection of the polished concrete until it is time to turn it over to the owner (damage from other trades during construction).
- xi. Set protection from damage or stains by:
 1. Parked vehicles over slab.
 2. Pipe cutting over slab.
 3. Storage of anything on slab for 28 days after placement.
 4. Petroleum products, oils, hydraulic liquids, acids, dyes, soaps, detergents, and paints all prior to polishing.
- xii. Provide a written maintenance care sheet to pass on to the owner, explaining the simple maintenance needed to keep the polished floor/slab.
- xiii. Set a remedy for out-of-tolerance work if, F_F and F_L numbers do not meet specification/tolerances.

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- Lavina SPS Polished Concrete
- Murray Decorative Concrete Supply's Guidelines for Polished Concrete Floors
- PROSOCO, Inc.
- Structural Services, Inc.

Updated August 30, 2011. The intention is that this document will be reviewed and updated periodically. The CPG website at www.concretepromotion.com will host the most current edition of the Guide.