



---

---

## GUIDELINE FOR EXPOSED AGGREGATE FINISHES

---

---

*Guidelines for a successful exposed aggregate finish on fresh concrete. This guide is for use by experienced concrete finishers, architects, owners, and new concrete contractors wanting to expand their work. Decorative Concrete Supply highly recommends that concrete finishers consider both ACI 640 & 601-D certification.*

Exposed aggregate has been a popular technique with homeowners, architects and contractors for decades, although this look has been overtaken in popularity by new finishes such as stamped, stenciled, colored and other types of decorative finishes in recent years. Exposed aggregate continues to offer a durable and aesthetically pleasing look for concrete. This method has withstood the test of time and has been successfully placed for over a century.

New types of surface retardants allow for many varied looks, from deeper exposures to a light sandblast look. This provides a wide range of colorful looks and will help provide a slip resistant surface that is ideal for:

- Driveways
- Patios
- Walkways
- Pool decks
- Entryways and courtyards
- Tilt-up panels

**Exposure can be achieved in several looks**

<b>Sandblast finish-</b>	Only sand is revealed
<b>Light exposed finish-</b>	The edges and the very top of the aggregate are revealed
<b>Medium exposed-</b>	Finish where the exposed rocks and cement are about 50/50 revealed
<b>Full exposed-</b>	The aggregate is revealed as the main part of concrete surface

New types of surface retardants, which are more environmentally friendly, allow for several in-between looks, however depth should never exceed 1/3 of the diameter of the largest size aggregate or 1/2 the size of the smallest (ACI 303).

When picking surface retarders, it is recommended that you choose one that has a dye that can be seen to ensure even coverage. When using plastic, it is advisable to pre-roll the plastic on PVC pipes of the proper length. This will allow the plastic to be both placed and removed easier. Carefully read directions even if you have worked with exposed concrete for years. Both gradation and soundness of aggregates selected cannot be over overstated. Avoid flat stones as they do not bond as well as round and cube sized aggregates.

## PLACEMENT OPTIONS

Three methods of exposed have been successfully used over several decades: **seeding the pre-picked aggregate, mixed in a ready mix truck** or **exposed later by mechanical means**.

**1) Seeding the pre-picked aggregate**-- the aggregate is stock piled at the job site and broadcast into the fresh concrete. Experienced concrete finishers should be used to seed. Seeding can be accomplished by using a shovel (a square point shovel offers the most even approach). Use of seeding by hand methods can also be used. This method is best done along hard to reach areas like walls and some edges. New mechanical methods can also be effective. Coverage can vary depending upon aggregate size. Smaller sized stones will yield approximately 2 1/2 – 3 1/2 lb per/sf. Larger sizes may require up to 6 lb/per /sf or more. It is very important to carefully weigh and measure forms and have an ample supply on site during the pour. If a mechanical method is used, the material should be stored where it will be easy to re-load the spreader. When the seeding method is being used, the base course of the concrete mix should have aggregates of 3/8” to 5/8” diameter, but don’t exceed 3/4” as this can make it more difficult to seed in the aggregate. When seeding, it is critical that the finishers have proper access as well as the experience to provide an even broadcast. Care needs to be taken with heavily cast areas as not to “clump” which could result in a birdbath. Concrete mix designs for freeze/thaw areas should contain 6-8% of an air entraining admixture. These mixes not only help in harsh climates, but can improve workability and reduce bleeding of the concrete mix

### PLACEMENT METHODS FOR EXPOSED SEEDING METHODS

Check forms and screeds before placement begins and ensure sub grade is firm and properly compacted. Once aggregate is properly seeded it will need to be worked into the fresh concrete paste. Time is of the essence in this critical step.

- The slab is screeded off in the same manner as normal concrete. Leaving the concrete 1/8-3/8” low in the seeding is fine as the aggregate will increase the thickness at the surface. The concrete is then smoothed with wood Darby’s and bull floats. Wood is the recommended choice for the initial finish.
- NOTE: the larger the aggregate size in the seeding method, the deeper the concrete level should be below the form. The forms should be set so that the final slab will be both drained well and level.
- The seeding or broadcasting can usually begin right after the final initial bull float application.
- The aggregate is then uniformly broadcast onto the concrete surface.
- The aggregate is then worked into the concrete surface. This may be done by screeding with a sawing motion, use of tamping tools or Darby’s, and bull floats. Some newer type roller screeds are effective, but when using this method, concrete needs to be 1/8-3/8 inch lower than the forms.
- When this is accomplished, a final pass is made with the bull float to ensure 100% paste coverage over the embedded aggregate. About 1/16th of an inch is needed. Magnesium and aluminum tools work well for the final pass.
- Avoid overworking the surface, as this may work the coarse aggregate into the concrete too deep.
- Small amounts of water may be added during placement, however if color is used in the mix, all water must be added before placement begins. For large pours, with or without color, consider use of set delays instead of adding water.

**2) Mixed in a ready mix** --many ready mix suppliers now stock aggregate for exposed concrete. It may increase costs as the aggregate is throughout the entire pour. These costs may or may not be offset with reduced labor. With this method, there is no need to adjust the forms or grade as with the seeding method.

### PLACEMENT METHODS FOR MIXED IN A READY MIX

- Place the concrete as normal. Preparation of sub grade and strike off methods are the same, however, aluminum or magnesium tools will work fine for use after concrete is screeded.

- Careful screed operations are vital to control any birdbaths or low spots. Be sure that edges are properly leveled. It might be necessary to sprinkle extra concrete along edges so that they are level with the forms. This is done after the concrete has been screeded and floated.
- Avoid excess bull float lines and overworking the surface, especially on air entrained mixes.
- Be sure slumps do not exceed 5 inches and do not use jitterbugs or tamping tools.
- Concrete should be placed on a firm, compacted sub grade of uniform bearing capacity.
- It should be evenly graded and any lines should have a minimum of 2 inches of compacted fill.
- When no damage will be done to the concrete surface, apply the concrete surface retardant according to the manufacturer directions.
- This is especially true in non air-entrained mixes where there is usually more bleed water.
- Avoid pouring on wet/frozen sub grade and do not pour if rain is forecast within 8 hours of placement.

#### **FULL DEPTH POURS WITH SAND FINISHES**

New advances in surface retardants allow for placement of concrete with a sand exposed look. Finishing is different than normal procedures. Use of a roller bug is done after initial bull floating, followed by a light trowel finish and then the retardant is applied and washing as normal. Only the sand will be exposed when done. Trowel only enough to provide a smooth surface, using a steel Fresno trowel. This does not require a hard troweled surface. This method can produce a slip resistant surface and may be integrally colored at placement or stained after curing.

- Be sure the surface retarders are applied evenly with uniform coverage. Keep an extra sprayer and have spare parts. Pick a quality sprayer as cheap sprayers can ruin a job. Carefully read directions from the manufacturer on timing for washing and how long the set is delayed. Temperature may have a great effect on the set time.
- Check water source and pressure before placement begins and be sure to have enough hose to reach the entire area.
- Never use jitterbugs when aggregate is going to be exposed, however use of a roller bug is recommended when a light sand exposed look is done.
- Avoid pours when rain is forecast within 8 hours after placement

#### **WASHING OF EXPOSED CONCRETE**

The washing phase is very important as this determines the look of the concrete. The timing needs to be precise with the initial set and the length of time that the retardant works. A good rule of thumb for when to start is when the concrete finisher can be on knee boards without making an indentation. The workers can then begin to use a stiff bristle broom and remove some dry paste. When this has been done, the concrete can be brushed and lightly scrubbed with water using a softer broom. This will take a few passes. Be sure to keep a light mist to begin, and avoid power washers. Some brooms come equipped with water jets to aid in removal. If there are areas where the paste is hard to remove, it may be necessary to use a stiffer broom. This procedure should continue until the aggregate has a uniform look, the water is clear, and all unwanted paste is removed. This will normally take several passes depending on the size of the concrete slab and the degree of exposure desired. If aggregates start to become loose and pop out. Stop and wait for the concrete to become more firm. Use of low pressure washers or power washers is never recommended. Exposing of aggregate typically works best with 2-3 man crews.

#### **ACID WASHING WHEN CLEANING**

- It has often been a practice to use a mild solution of acid to aid in the breakdown of the paste. If this method is used, it should be done before the sealing application, which is usually 14-28 days. Utilize a solution of 10-15 parts water to 1 part acid. Apply while the concrete is damp. Use of a plastic type watering can has been a successful method. Never use metal cans. Work the solution in with an acid resistant broom and rinse completely clean. Care needs to be taken not to overdose the acid as this can have adverse effects on the alkalinity of the concrete. Always wear protective boots, gloves, and protect exposed skin and eyes from the acid.

## SAW CUTTING OF CONCRETE

- Follow normal rules of thumb spacing of 24 to 36 times the slab thickness and 1/4 of the slabs depth. On smaller jobs, joints may be tooled but on larger jobs a saw cut may be the more effective means. You do not want to delay application of surface retarders.

## CURING AND SEALING EXPOSED AGGREGATE

- Curing can be difficult on exposed aggregate as the paste is removed usually within 4-12 hours after initial finishing. Because of the large amounts of water used in removing paste, along with excess water accumulation in the joints, solvent or water membrane cures should not be applied the same day. It should be noted that a 28 day cure time should be observed. Because of the paste being removed, large amount of water used to wash paste off, and the abundance of coarse aggregate, along with low W/C ratios and slumps, curing is not as critical as it would be with a concrete floor or pavement.
- Hot and cold weather considerations should be taken into account. In hot weather, consider a soaker hose for curing or white poly to reflect the heat. In cold weather, do not pour if temperatures are expected to drop below 36°F for the 1st 48 hours after placement.
- There are sealers made specifically with a light tint added that highlights the stone and mortar. Consult manufacturer for coverage rates and application methods on sealers for exposed aggregate concrete. Sealers can preserve the aesthetic look and increase the longevity of the surface.

**3) Mechanical means of exposing aggregate**--many mechanical methods will require the use of high voltage equipment and 3 phase electricity. It is a good idea to have a backup generator in place for these methods. Removal of paste should not be done until concrete has achieved at least 75% of its designed strength. In most cases this will be in 28 days. Several methods have been used over the years to expose aggregate in concrete. Over the past decade, interior concrete floors have had both coarse and fine aggregates exposed by the use of **polishing** machines. This method can densify the paste at the surface or expose both sand and aggregate and should be done over floors that are flat and level. It is vital that the contractor knows what the F# is, along with F/L. F numbers should be 50 or higher and F/L 30 or higher. This method may require as many as 9 steps and application of a liquid densifier may be needed.

**Sandblasting** has been done for years, but concerns about the environment and airborne dust issues should be looked at. This method has been used successfully for vertical applications, revealing aggregates in columns, beams and walls. Templates can be used to create unique designs and logos that are impossible to achieve with other flooring materials. Custom logos, graphics, works of art and others are all easily accomplished by simply removing the concrete paste and exposing aggregates. Sandblast looks are a popular choice for pool decks as they provide a slip resistant surface. Color may be added to the exposed area. Over exposed or heavily sand blasted areas can remove the luster from the concrete aggregate and dull its appearance. Workers doing this will need to wear eye protection, clothing, gloves and boots. Surrounding areas should also be protected.

**Water blasting** is done using high pressure washers with special tips and approximately 1500 PSI. This method requires large amounts of water and there may be runoff issues. This method should only be done by experienced workers as it can produce deep gaps and holes when not properly applied. This method will also require protective clothing, rubber boots and face shields.

**Shot blasting** propels steel balls into the concrete surface. When used aggressively, this method can expose aggregates but is best suited for a sand type exposure. Smaller machines only create light exposed looks while larger machines can expose aggregates.

**Scarifying** is done with a machine that has a roller or drum. It operates with a number of carbide shafts that chip away at the concrete. The carbide inserts rotate around the drum at high speeds.

**Bush hammering** involves use of air type pneumatic tools, equipped with a tool that has several points. The type of tooling used will determine the degree of concrete removed. This method usually removes about 1/8-1/4 inch of the concrete surface. This method has successfully exposed columns, beams and even walls to provide an architectural effect by exposing the concrete's aggregate. This method is commonly used in vertical applications.

Refer to ACI 303 guide to architectural concrete for more information on vertical exposed concrete. With all mechanical methods, proper safety procedures should always be in place and any gas powered equipment needs to be properly ventilated.

## AGGREGATE OPTIONS

Careful selection of the aggregates is vital to the appearance of this finish. Consult ASTM C 127 for detailed information on aggregate absorption.

Use of the following aggregates can create a rainbow of colors:

- River Rock
- Quartz
- Granite
- Trap rock
- Limestone
- Marble

Variations will occur, even in the same choice of aggregate, depending on which part of the country the aggregate is from. Quartz comes in several color shades: white, yellow, green, pink and rose tones. Clear quartz can be used in integrally colored concrete and added to give a glimmer look around other aggregates. Granite, long known for its hardness and durability, also offers numerous color shades: pink, gray, red, blue, black, and white. Limestone offers shades of white, gray, and pink. Trap rocks offer gray, black, and green tones. Many types of gravel offer several shades, ranging from reddish browns to yellow, sand, and vintage umber. These types will need to be carefully screened and washed. Marble offers the widest range of color looks with red, green, yellow, black, white, and gray in bright colors. The following chart offers some gradations that will give a good appearance:

- 1/2 to 3/4"
- 5/8 to 7/8"
- 3/4 to 1"
- 1 to 1&1/2"
- 1 1/4 to 2"

Selection of aggregate should be carefully reviewed by the contractor, ready mix supplier and aggregates supplier. If aggregate is to be seeded, all aggregates should be carefully washed and checked for impurities. Avoid aggregates or sand that may contain hazardous materials. When screening, keep aggregate within one screen size, either up or down, but never more in order to achieve the desired look. Use of grading sizes closest to each other will give the best look. Example 1/2 - 3/4 either size down to 1/2-3/4" or up to 3/4-1". Use of 1 1/4- 2" with 1/4-1/2" would probably not look good. This would also lead to more paste shown when the job is washed and exposed and could lead to segregation issues during placement.

**Aggregate classifications & colors:** The aggregate may be rounded river rock, crushed stone, cubical types, other certain stones such as granite, quartz or trap rock and may have slightly different dimensions. Avoid aggregates with high absorption as this can lead to pop outs, especially in hard freeze/thaw areas. On large jobs that might be done over time, consider stockpiling the aggregate for quality results. This is especially important when seeding methods are used. An almost unlimited supply of colored stones can be used, however, many will dramatically increase the cost of the concrete.