



ARCHITECTURAL PRECAST CONCRETE FINISHES GUIDE

This document was created to provide a brief overview of the different types of finishes created for architectural precast concrete. Different finishes can be produced through the process used to cast the concrete, as well as the type of aggregates (if any), finishing techniques and materials (such as cement and pigment) used to make the product. This guide will provide the benefits, limitations and expectations for each finish type. We hope this provides insight for you to achieve the desired finish for your next project.

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I. EXPOSED AGGREGATE - CHEMICALLY RETARDED AND SANDBLASTED

Definition - This finish is achieved by casting against a form surface that has been painted with retarder which retards the set of the concrete at its surface.

After the panel is removed from the form, the retarder is removed by sandblasting.

The end result is a panel with coarse aggregate exposed to the degree called for by the design.

A. Reason for Use

- Sandblasting achieves an exposed aggregate finish as easily as possible.
- Sandblasting allows for the correction of many variations in exposure. This method will achieve a more uniform surface.

B. Positive Features

- This method will achieve a more uniform exposure of stone aggregate with minimum effort.
- Minor form imperfections do not impair the final surface.
- This method will achieve a more uniform surface.
- The variation in color choices are endless.

C. Limitations

- Any portion of the panel poured in a vertical position will not show the same concentration or positioning of aggregate as the flat surface. (This problem might be corrected by sequential casting which allows all surfaces to be cast flat.)

D. Expectations

- Color consistency is dependent on the consistency of the aggregate.
- Consistency of surface can be controlled reasonably well.
- Sandblasting will mute the finish and color of the aggregate to a degree, depending on the hardness of the aggregate.
- If a strong durable aggregate is used, the color and texture of this surface would not change over the years.

Summary - This finish should be used where the beauty of the aggregate or a textured surface is to be featured. The end result is a matte type of finish, as opposed to a brighter finish achieved with water washing.

II. EXPOSED AGGREGATE - CHEMICALLY RETARDED AND WATERWASHED

Definition - This finish is achieved by the application of a chemical retarder to the surface of the form. The retarder prevents the matrix from hardening at the surface of the panel to a specific depth, controlled by the strength of the retarder. After curing (normally overnight), the unhardened layer of matrix at the surface of the panel is removed by a high-pressure water washing, thus, exposing the aggregate used in the concrete.

A. Reasons for Use

- Exposed Aggregate displays the natural beauty of the stone aggregate in its natural colors and finish without damage.
- It is an economical finish to achieve.

B. Positive Features

- The aggregate is not damaged or changed in this cleaning method.
- Minor imperfections in the form do not affect the final product.
- This finish is relatively easy to patch.
- This finish tends to distribute water run off more evenly, thus reducing the streaking which appears on smooth surfaces.
- The variation in color choices is endless.

C. Limitations

- The end result of chemical retardation removed by water washing is controlled by the retarder. Therefore, any variations in the exposure are not as correctable as in sandblasting.
- Vertical, radius or complicated surfaces are difficult to cast with uniformity because the retarder is subject to movement during casting on these surfaces and variation in etch can result.
- Water washing can be a seasonal activity for some producers in Northern climates.

D. Expectations

- This finish will display the aggregate in its natural beauty.
- Control of mix, slump, retarder and the time of exposure is essential since there is very little correction allowed with the water washing method. Some variation will occur. Therefore, this should be minimized by having as little contrast between matrix and aggregate as possible.

Summary - If the bright, natural colors of the aggregate are the prime concern, water washing is the best way to achieve this result.

III. EXPOSED AGGREGATE - SANDBLASTED

Definition - This finish is achieved by casting concrete against a smooth hard surface. After removal from the form, the finished surface is sandblasted to remove the matrix and expose, as well as etch, the coarse aggregate. The depth of the blast is determined by the desired texture and the target color, as influenced by the color of the matrix and the coarse aggregate.

The three different types of exposures are:

Light Exposure - the surface skin of cement and sand is removed just sufficiently to expose the surface of the coarse aggregate.

Medium Exposure - a further removal of the matrix exposes approximately the same area of both coarse aggregate and matrix.

Deep Exposure - cement and fine aggregate are removed to a depth where the coarse aggregate becomes the dominant surface feature.

A. Reasons for Use

- Sandblasted finish can be used to achieve textured surfaces in which the coarse aggregate is exposed, as well as etched by the blasting.

B. Positive Features

- Combining aggregate size and color and matrix color with texture from the blasting provides flexibility for the final finish.
- Textured surfaces tend to distribute water run off more evenly, thus reducing streaking from normal weathering patterns.
- Textured surfaces tend to forgive minor surface imperfections when observed at normal viewing distances.
- Damage is more easily repaired on textured surfaces than on smooth finishes.
- The surface of the coarse aggregate is etched at the same time that it is being exposed by the blasting operation.

C. Limitations

- Sandblasting hardened concrete is time consuming and expensive. The deeper the blasting, the higher the cost.
- Damage to sandblasted surfaces, while easier to repair than smooth surfaces, is more difficult to repair than chemically retarded surfaces.
- Air voids and uniformity of the aggregate density are difficult to control on vertical and sloped returns.
- Soft aggregates tend to erode at the same rate as the matrix and sometimes cannot be used.
- The exposure is influenced by the size of the sandblast sand and the skill of the sandblasting technician. Operating techniques must remain the same throughout the project to insure uniformity.

D. Expectations

- Good color uniformity can be achieved if care is taken in selection of the raw materials which contribute to the color of the product. Contrasting matrix and coarse aggregate colors should be avoided if uniformity of color is desired.
- The color of the finish will progressively change as the depth of the blast changes. The color will initially reflect the color of the matrix. As the coarse aggregate is exposed, the color will be influenced by the color of the coarse aggregate.

Summary - This finish is widely used for light and medium exposure. Labor expense increases for deep etches.

IV. SMOOTH - AS CAST

Definition - Concrete is placed against hard, smooth form work to achieve a smooth "as cast" finish on the precast element.

A. Reasons for use

- This method shows the natural beauty of concrete without trying to simulate any other building product.
- A very clean definition of profile can be achieved with this surface.
- If the surface is to be painted, this finish provides an excellent surface, while keeping cost. to a minimum.

B. Positive Features

- Cost is reduced by eliminating additional finishing steps after removal from the form.
- Sharp lines at intersecting planes can be achieved with this finish.
- The smoothness of this finish will self-clean accumulated dirt more readily than an etched surface. However, streaking may remain.

C. Limitations

- Resulting surface of concrete will mirror the surface of the form it is cast against, showing even minor imperfections of the form.
- Since color is basically controlled by the cement, variations between the pieces, and within pieces will be more pronounced.
- The surface is difficult to repair.
- Air voids show more (generally) on this surface.
- Surface crazing (fine spider lines) will develop on this surface.
- Some shadowing can occur with this finish. "Shadowing" is aggregate or reinforcing showing through the surface.
- Different form surfaces will affect surface color.

D. Expectations

- Some color variation can be expected with this finish, but the variation can be minimized with careful selection of mix ingredients, combined with close control of water/ cement ratio and mixing time.

- All vertical and some horizontal surfaces will have voids created by entrapped air or small water pockets. These voids can be minimized with proper mix design and casting procedures.
- Use of white cement will achieve a greater uniformity of color than grey cement. Allowable color variation in grey cement is enough to cause noticeable color differences in precast panels.

Summary - Successful completion of a project with this finish requires considerable involvement prior to signing a contract, including visiting existing projects. Mockups should be made representing configurations involved in the project. Mockups should be cast for approval for acceptance of color variation, quantity of voids, and overall appearance of architectural design by the client. This type of finish is strongly discouraged.

V. SMOOTH FINISHES - LIGHT SANDBLAST

Definition - This finish is achieved by casting concrete against a smooth hard surface. After removal from the form, the element is given a light sandblasting. This light sandblasting will remove the cement skin from the surface. The resultant finish is a smooth, sand-textured surface.

A. Reasons for Use

- Smooth cast, lightly sandblasted precast can achieve an appearance very close to natural stone.
- The smoothness of this surface will self-clean accumulated dirt more readily than an etched surface. However, streaking may remain.
- It is possible to achieve a clean definition of profile with this surface.

B. Positive Features

- This is a common finish within the capacity of most precast producers.
- Light sandblasting is good way to remove the appearance of the "poured" concrete look.
- It minimizes crazing by removing the cement skin at the surface of the concrete.
- It reduces color variation by removing the cement surface, allowing the sand to control the color to a greater degree.

C. Limitations

- Smooth surfaces show imperfections of surface more readily than on more deeply etched surfaces.
- Damage to smooth flat surfaces is more difficult to repair.
- Minor imperfections of the cast show more quickly on this surface than on deeper etched surfaces.
- Variations in color show more quickly on smoother surfaces and are more difficult to control depending on the depth of sandblasting.
- Air voids, especially in the vertical portion of any cast, show more on smooth flat surfaces.

D. Expectations

- All returns (turning vertically from a horizontal position while being cast) will have air holes and can be grouted if they are objectionable.
- Use of white cement will achieve a greater uniformity of color than grey cement. Allowable color differences in grey cement are enough to cause noticeable color differences in precast panels.
- Sand is a very important ingredient in a light sandblast finish, since it is the predominant surface.

Summary - This finish can be used to achieve a natural stone type finish. It will give you excellent detail, but it is subject to variation in color, as is seen in natural stone.

VI. SMOOTH - ACID ETCH

Definition - This finish is achieved by casting concrete against a smooth hard surface. After removal from the form the element is allowed to harden to a uniform hardness. The product is then washed with an acid solution and scrubbed to remove the cement surface to a sand surface level. The result is a smooth sand textured surface.

A. Reasons for Use

- Acid etching produces a surface closely resembling natural stones such as limestone, brownstone and sandstone.
- The "pre-weathered" surface will remain consistent for a very long period of time.
- Detail is not damaged with acid etching.
- Exposed sand retains more "sparkle" with acid etching than with sandblasting.

B. Positive Features

- A finer sand texture can be achieved than with sandblasting.
- Brighter, deeper colors are achieved with acid etching.
- Retention of detail is best achieved with acid etching.
- Acid etching minimizes surface crazing by removing the cement skin on the surface.

C. Limitations

- The method of applying and removing acid over a larger area is difficult to achieve with great consistency.
- This surface is not as easy to patch as deeper etches. (This does not apply to minor "bug" holes which are fairly easy to grout and refinish.)
- Imperfections in the form show more readily than on deeper etches.
- Return, or vertical, casts will have air-voids. If these are objectionable, they can be grouted and rewashed.
- Acid etching can be a seasonal activity in Northern climates with some producers.

D. Expectations

- As stated above, surfaces cast vertically will have minor air voids. These can be grouted and rewashed if they are objectionable.
- The color and texture of sand used is very important with acid etched elements. It is an important ingredient in controlling the appearance and color of the precast element.

Summary - This finish is used to achieve a bright, sparkling natural stone look. It is used successfully on smaller trim work such as sills, lintels, belt course and similar decorative elements. It is not recommended for large panel work.

VII. FORM LINERS FINISH

Definition - This finish is achieved using plaster, "rubber," grained wood, rope or most other material as a liner in the casting form to impart a particular finish to the face of the panel.

A. Reasons for Use

- Unlimited effects or textures can be achieved by use of liners.
- This method can be combined with sandblasting, etc. to achieve even greater variety of finishes.

B. Positive Features

- Form liners are extremely versatile.

C. Limitations

- Commercially available liners are fixed sizes. Joints from piece to piece are difficult to hide.
- The surface of the panel is usually difficult to repair.
- One-piece liners of plaster or "rubber" are expensive to produce.
- Each different liner material has its own strengths and weaknesses. The material and desired effect should be coordinated with the help of a precaster.

D. Expectations

- Since the detail of this finish is limited only by the imagination of the architect, it is hard to generalize on expectations.
- It is particularly important to spend all the necessary time even prior to bidding in making samples to be sure the desired result is achievable in a satisfactory manner.

Summary - Use of liners opens an unlimited number of options on finish. However, use of this type of finish requires close coordination between the architect and a precaster to be sure the desired end result will be achievable.

VIII. TOOLED FINISHES

Definition - This finish is achieved by casting concrete against smooth or specially textured or patterned form work. After removal from the form, the hardened surface is treated mechanically to create the desired effect. "Fractured Fin" and "Bush hammered" are two types of finishes which employ tooling.

A. Reasons for Use

- This method is used to achieve a very special effect.
- It is also used to obtain a finish that cannot be achieved by other means.

B. Positive Features

- Consistency (or lack of consistency if desired) is controlled by the craftsman that finishes the panel.
- Tooling is an effective way to achieve "broken stone" finishes.

C. Limitations

- Tooling is one of the most expensive of the precast finishes.
- Variations due to more than one craftsman working on the panel can show up with this type of finish.

D. Expectations

- This method allows the architect to use some very different type surfaces, such as "split rib," and "broken stone" faces.
- This is the best way to achieve surfaces closely resembling hand tooled natural stone faces.

Summary - Tooled surfaces allow a great variety of surfaces on precast panels. However, it is an expensive surface, and it is very dependent on the caliber of the artisans. The result from tooled finishes is much more individual in nature than many of the other more standard finishes.

IX. NATURAL STONE VENEER FINISH

Definition - Natural stone cladding or veneer finish is achieved by placing natural stone (limestone, granite, marble) pieces into a form and casting concrete behind it to achieve a large precast panel having a natural stone face.

Its purpose is to achieve a natural stone face on the building, while using the efficiency of precast concrete.

A. Reasons for Use

- To provide a natural stone face while using the efficient methods of precast panels.
- Stone-faced precast panels are far superior to individually set stone in achieving a watertight surface.
- Time and money are saved since the panels can be produced while the structure is being erected.

B. Positive Features

- Use of natural stone bonded to precast will achieve a safer, stronger application of the natural stone to the face of the building.
- Panels can be prepared prior to completion of the structure of the building.
- Damage to the stone is minimized since the handling is all done on the ground.
- Many smaller stone panels are incorporated into each precast panel achieving efficiencies of manufacturing and erection.

C. Limitations

- Some complicated involved shapes do not lend themselves to casting natural stone into precast panels.

D. Expectations

- Natural stone on precast will look like field set or frame set stone.

E. Summary

- Natural stone set on precast is an excellent option to achieve a natural stone building with greater efficiency, and achieve a far superior end result (safety, water tightness, etc.)

Almost without exception, time and money will be saved with this method.

X. BRICK FACE FINISH PANELS

Definition - This is a precast panel with a cavity cast in, or a plate cast in if the brick runs to the bottom of the edge so that the brick can be set in the panel after its removal from the form.

Thin brick or tile can also be set into a form and the concrete is cast behind it. In this case, the comments on natural stone panels would apply more closely.

A. Reasons for Use

- This is a method of achieving a brick building with the efficiency of precast concrete.
- It is more economical to lay brick at the ground level as opposed to working from a scaffolding.
- Panels can be prepared while the structure is being erected.

B. Positive Features

- This is an economical way to achieve an essentially brick building.
- This is a superior, watertight exterior when compared to a conventional set brick building.

C. Limitations

- Extreme care must be taken in design and detailing to assure proper coursing of brick when panels are installed in the building.

D. Expectations

- This method will deliver a brick building incorporating precast trim that is equal or superior to a conventionally set brick and trim building.

Summary - Brick set into precast will achieve equal or superior workmanship and economy over conventionally set brick.

The end result will be a more watertight building compared to handset brick.

Preparation of the panel while the structure is being erected will save time and money.

XI. CAST STONE - DRY TAMP FINISH

Definition - This finish is achieved by ramming moist zero slump concrete against smooth rigid formwork until the product is densely compacted and ready for removal from the form. After curing, the product can be hand rubbed or acid etched. The result is cast stone, an architectural precast concrete masonry product which simulates natural cut building stone and other masonry materials.

A. Reasons for Use

- To simulate other masonry materials, i.e., limestone, brownstone, unpolished granite, etc.
- Dry tamp guarantees that the finish will have no "bug holes."
- Economical repetition of form use is achieved when fabricating smaller elements.

B. Positive Features

- This finish produces a fine-grained texture, with no coarse aggregate exposed, to simulate natural stone.
- Due to lower mix water content, finer aggregates can be used.
- Vertical surfaces will always have the same finish as horizontally cast surfaces.

C. Limitations

- The process is limited to smaller "mason set" elements because consistency of finish is difficult to control in larger panels.
- Manufacturing tolerances are difficult to control in large elements.
- "L" shaped and "U" shaped returns and elements not having flat backs are both difficult and costly to produce.

D. Expectations

- Cast stone looks very similar to any natural cut building stone except polished granite or marble.
- The color of fine aggregate plays a predominant role in controlling the appearance of dry tamp cast stone.

Summary - This finish is used successfully in masonry applications and is exemplary where small trim pieces are desired and natural stone could similarly be used. (i.e., sills, lintels, coping, belt course and various trim elements).

It is not normally recommended for large panel work. ***Not all producers are equipped to produce this finish.***

XII. MATERIALS - PORTLAND CEMENT

Definition - The cement used to make concrete is a combination of a variety of sands and stone containing calcium, silica, alumina, magnesium and other elements. The combination of raw materials is fired in a kiln to produce a "clinker." This clinker is then pulverized to a required fineness to become cement powder.

The sands and stones which contain the necessary raw material to make cement are not necessarily the same colors from area to area. Therefore, cements can come in colors from white to dark grey, depending on the area from which raw materials are drawn.

It is this resultant variation in color which allows the precaster to use cement as a controlling factor in coloring the final product. However, the complicated process of making cement and the variations in the natural materials used to make cement make it just about impossible to have absolute uniform consistency from one "grind" of cement to the next.

A. Effect of Cement on Finish

- Cement is a dominant factor in controlling color in "as cast" finishes since the outer surface of the panel is in large percentage cement particles.
- One brand and type of cement should be used throughout a project to minimize the variation in final color.
- Variation in production (slump, mixing time, weather, humidity, cold or heat of the day) will affect the color of the panel as well as variation in the cement itself. Therefore, it is strongly recommended that the surface of the panel always receive one of the surface finishing techniques described in this publication to achieve better uniformity.
- White and grey cements can be blended together to achieve any shade of color that falls between the two cements.
- White cement is much more consistent in color than grey cement.

Summary - Cement is the main coloring agent in finishes with little or no exposure. Some variation in color will result on smooth surfaces using grey cement.

XIII. FINE AGGREGATE

Definition - The fine aggregate used in concrete is usually a natural sand, or a manufactured sand made by crushing quarried stone, passing a #4 screen (roughly 3/16" or less). The consistency of color is in direct relationship to the consistency of color within a sand bank, or the rock from the stone quarry.

Fine aggregate combines with cement paste and water to make a matrix which fills all voids and ties the coarse aggregate together in the concrete.

A. Effect of Sand on Finish

- Sand particles are larger than cement particles, so in finishes which remove the cement skin but are not deep enough to expose the coarse aggregate, sand is a major factor in controlling color. This is especially true with white cement.
- Sand is available in infinite varieties of colors and is generally very reliable in controlling consistency of color.
- Light colored fine aggregates combined with light colored coarse aggregates will produce a more uniform colored surface than will light and dark combinations.

B. Summary

- Fine aggregates are very important in the coloring and texture of finishes such as acid etched and light sandblasted finishes. Fine aggregates are generally a reliable control of color.

XIV. COARSE AGGREGATE

Definition - The coarse aggregate which provides the mass or body of the concrete normally consists of natural gravel or pebbles manufactured by crushing quarried stone.

The function of coarse aggregate is to provide the mass or body to concrete. But, with the advent of exposed aggregate finishes, the coarse aggregate has become a means of achieving many effects in finish and appearance.

C. Effect of Coarse Aggregate on Finish

- Coarse aggregate comes in an unlimited variety of colors, shapes and sizes. Use of coarse aggregate to affect visual appearance allows a wide range of choice to the architect.
- Coarse aggregate becomes the dominant ingredient in controlling color once exposure passes the level of sand-textured panels.
- Texture as well as color can be controlled by the choice of the coarse aggregate.

Summary - By removing the matrix on the face of a panel and allowing the coarse aggregate to show, the architect can have a wide range of colors, textures and contrasts at his disposal to achieve the visual effect they seek.

Coarse aggregates provide an effective means for control of texture and color.

XV. COLORING PIGMENTS

Definition - Coloring pigments are available for use in precast concrete. They are usually natural or synthetic iron oxides which meet the latest PCI requirements.

Coloring pigments are added directly to the mix so that color is dispersed throughout the batch of concrete. Coloring pigments are normally used to achieve colors which are difficult to get with available sand and/or cement colors. Coloring pigments can be used with any finish described in this document.



2810 N. Bahnson Ave. ■ Sioux Falls, South Dakota 57104
Main Office: (605) 336-1180 ■ gagebrothers.com