



TECHNICAL DATA - PRODUCT INFORMATION

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How to Stamp Concrete

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Stamping Concrete 101: THE BASICS

by Susan Brimo-Cox

Demand for decorative concrete is booming. Potential customers are learning about it in consumer magazines, on HGTV and at home and garden shows, inspiring them to think of adding features such as stamped driveways, faux rock walls or polished concrete floors to their homes or businesses. If you haven't received a request for decorative concrete yet, chances are you soon will.

And if you are thinking about expanding into this lucrative niche, stamped concrete is a good place to start. There is a learning curve, but the techniques of imprinting can be mastered if you have a good grasp of the placing and finishing skills needed for basic concrete.

Start off on the right foot

Site preparation and placement of concrete is the same for stamped concrete as it is for any slab. "The base preparation should be the same as for any concrete application," observes Clark Branum, area manager for Raeco Products. But remember, your sub-base is an important foundation to your decorative work. You want a "compacted crushed rock base with no standing water," Branum says.

The type of mix and aggregate will vary with the regional requirements for freeze and thaw, as well as structural requirements. Don't feel shy about asking the experts. "Most people do not realize how many experts they have available to them," says Steve Johnson, director of marketing for new product development at Solomon Colors. "The first person you should talk to is your ready mix producer."

The thickness of the slab depends on the intended use, but typically it is at least 4 inches. Reinforcements should be placed according to standard concrete practices.

Placing the concrete

The framework for stamped concrete should be installed the same way as for traditional concrete, with a couple extra considerations, says Richard Cofoid, national sales manager for Increte Systems Inc. If you are stamping a square pattern, make sure your framework is square. Be sure to drive the tops

of stakes even with or below the top of the framework so your stamping tools don't get hung up. And, very importantly, protect all adjoining areas by masking them off with duct tape and plastic. Then place, screed and float the concrete as you would a standard slab.

If you're new to stamping concrete, be careful not to bite off more than you can chew. While an experienced crew can stamp 800 to 1,000 square feet in a day, novice stamping



crews should limit their pours to no more than 400 square feet on average. "Skill, job access, weather conditions, manpower, stamp pattern and color hardener choice are all considerations," says Doug Carlton, owner of Carlton Concrete L.L.C.

Also, keep in mind that walls and protruding obstacles will slow the process down.

Start with simple patterns

The easiest stamps to start out with are borders along a broom finished job, Johnson says.

If the whole surface will be textured, choose random patterns. "Beginners should start out with textured stone or larger patterns with no detail," says Russell Rodoni, owner of Sierra Design Concrete.

Texture mats that leapfrog over each other are easier than ridged tools that fit together like a puzzle. Most experienced contractors say to avoid interlocking patterns until you get a feel for the imprinting process.

Renting imprinting tools is a good option if you're just starting out, because some patterns and tools can be costly. "Rent twice the amount you think you will need," Carlton recommends.

Coloring the concrete

Does integral color add value to the stamped concrete job? It depends who you talk to. On one hand, integral color offers limited color choices, and it is hard to match from pour to pour and day to day. But, on the other hand, it is faster and less messy than other coloring techniques. In addition, contractors just starting out in stamping may find imprinting colored concrete is easier. "Not because it is better, but there are fewer steps to be concerned with," observes Scott Thome, director of product services with L. M. Scofield Co.

What it seems to boil down to is personal preference. "Beauty is in the eye of the beholder," Johnson says. "Realistic to one may look eclectic to another."

Most contractors use dry shake color hardener to add color to their stamped concrete. Available in a wide variety of colors, it is easy to match if repairs are needed, and it increases the surface strength of the concrete. But be aware that use of color hardener adds time to a job, requires more labor and can be messy.

Color hardeners are typically applied in several passes after the bleed water has evaporated. Many contractors broadcast by hand, though Rodoni recommends broadcasting with a splash brush to avoid streaking. Broadcast the powder evenly, allowing it to wet up, and work it in with a bull float. After the final pass has been applied, finish-trowel the surface.

According to Cofoid, a 60-pound bucket of color hardener will generally cover 80 to 100 square feet; for lighter colors you'll need to use more. Make sure you follow the manufacturer's recommendations, as each manufacturer has a prescribed rate of application for certain colors.

Another method of coloring the surface is to use chemical stains, but this is "definitely not for beginners," Rodoni says.

The importance of release agents

The primary purpose of release agents, which come in powder and liquid formulations, is to ensure your imprinting tools do not stick to the concrete. Liquid releases are clear and not all can accept color, so they are not used as frequently as powdered releases.

"Powder antique release is the most popular method of releasing the tools from the fresh concrete," Thome reports. "It also offers you the option of adding one or multiple colors into your work."

R. Michael Potts, owner of Ideal Construction Inc., says the release should go on very thin. "You are just looking to make a barrier between the concrete and the stamp. Don't put too much down, or your pattern will only be in the release powder and not in the concrete."

Don't work too far ahead either. Cofoid recommends broadcasting only one or two rows ahead of stamping and cautions, "Never trowel release agent."



Photographs courtesy of Rafco



Your Stamping Concrete Toolkit

You'll need basic concrete finishing tools as well as tools for stamping. Here's a look at what you should have on hand:

- Well-constructed forms
- Strike-off tool
- Bull floats, wood and magnesium
- Fresno
- Edging tools
- Hand tools and trowels
- Joiners
- Stamping and texturing tools
- Small texture skins
- Tampers
- Detail tools, S-tool, chisels and touch-up wheels
- Soft bristle broom
- Water hose
- Pump sprayer

Don't forget safety equipment:

- Rubber gloves
- Latex gloves
- Dust masks
- Plastic sheeting and duct tape

Photographs courtesy of Increte

Stamping the concrete

When do you begin stamping? The concrete has to be firm enough to support the weight of the stamper and the tools, but plastic enough to accept the imprint. With rigid tools you can usually start sooner. Soft tools will require you to wait a bit longer, and then you'll likely need to use tamping tools. Some contractors say you can judge the concrete by pushing your finger into the slab. If it goes in about ¼-inch, it should be ready to stamp.

Typically, you begin stamping where you began the pour. But there may be exceptions. For example, Branum says he prefers to start against a wall line or edge that is adjacent to any structures.

It's also important to know what parts of the pour are in the sun and shade. Concrete in the shade takes longer to firm up, while areas in the sun will stamp sooner.

Keeping grout lines crisp and eliminating squeeze lines is a matter of properly placing, aligning and lifting the tools. But Cofoid says not to worry if things aren't always perfect. "The stamping process is not perfect. Slight imperfections make it look more natural — stones are not perfect, bricks are not perfect."

Plan the job out in advance. For example, if you have a crew of five (three finishers and two laborers), Thome says, "During the imprinting process you will need one person moving the imprinting tools, one person tamping or walking the tools in, one person on each side of the pour handing the tools to the tool setter and cleaning the tools as needed. The final person is probably the most important person — the detailer."



Photographs courtesy of Solomon Colors

Finishing the job

Many experienced stampers recommend waiting until the next day to wash off excess release agent. Many caution against beginners using pressure washers, especially if you want some release agent to remain in the grout lines for additional color. (But be advised that release agent needs to be removed completely from the wear surface for a sealer to bond properly.)

"I like to first broom off the excess release, cut all my joints, and then wash it down with water from a hose," Potts says.

Cofoid likes to rinse off release before cutting joints.

Like traditional concrete, stamped concrete needs control joints. In order to hide them you can try to line them up with grout lines in the pattern. With random stone patterns you might consider incorporating accent strips to accommodate the joints. If you use embossing skins for a continuous texture, joints usually are not distracting.

Proper curing time before applying a sealer is important. Follow the directions provided by the manufacturer.

Getting the right training pays for itself

Contractors and experts agree that practice, practice, practice is the way to go. Working alongside an expert is a great way to get comfortable with stamping, and having your

crew practice in sand is a good way to familiarize them with a new pattern.

Carlton suggests that contractors take advantage of training seminars. "Paying for training by someone with 10 years-plus experience is money in the bank," he says, "and creates a list of satisfied customers."

Training satisfies several needs, Thome points out. "As someone interested in obtaining a better understanding of the business and how it can fit into their marketing program, the demo or introduction workshop might be enough. ... To become familiar with the process and actually imprint a slab, the comprehensive workshop is the one to attend."

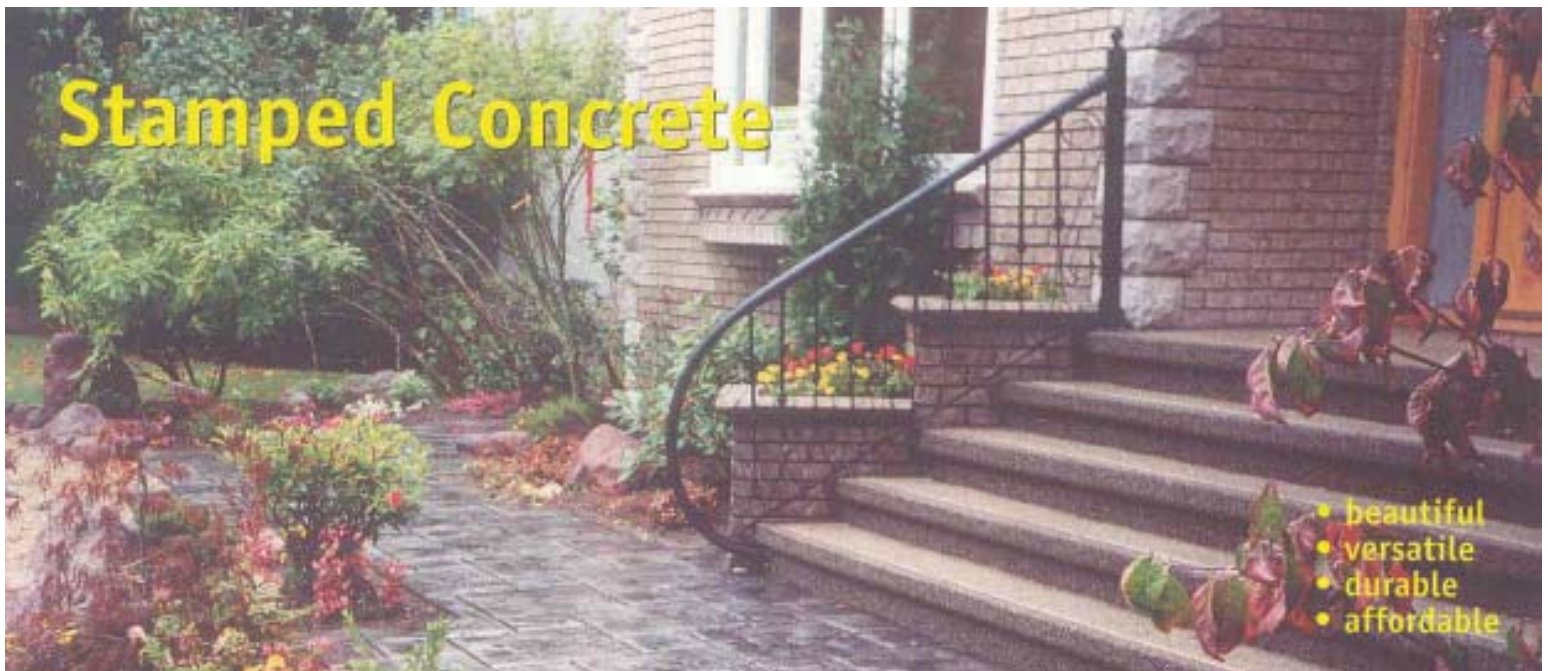
Training classes are offered by manufacturers, independent schools and industry organizations. "Organizations such as the ASCC Decorative Concrete Council are an excellent training resource for contractors looking to improve their business and their skills," Branum says.

One other piece of advice comes from Cofoid, who says to sell your work using actual samples. Form up 12-inch by 12-inch samples, but don't worry about them being perfect. "A perfect sample may give you trouble because the customer will expect perfect color. ... [and] if you sell off photos you may have trouble because the color may not match up," he says.



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Stamped concrete

Careful construction provides attractive surfaces at reasonable cost

A growing number of architects and owners are opting for concrete flatwork that resembles slate, brick, tile, stone or even wood. Stamped concrete creates an illusion of expensive slate or tile at a fraction of the cost. Cost for the illusion varies; contractors report a typical price of \$3.00 per square foot in the Sun Belt, and double that in metropolitan areas such as Chicago and New York City. Real slate or tile surfaces can cost from \$8.00 to \$13.00 per square foot.

There are other economic advantages. A public works department in California used stamped concrete to replace grass in median areas for city streets. Cost for the

entire project was less than the money that had been spent annually to water and mow the grass.

Stamped concrete can brighten a poolside, enhance an entrance and even glamorize a driveway with color, pattern and texture. Colors range from bright reds, oranges, and greens to more subdued browns, tans, and grays. There are also many different imprint patterns to choose from (Figure 1). If texture is desired on patterned surfaces, it can be achieved through use of stamping mats that simulate slate, granite pavers, used brick and wood. Regardless of the color or pattern chosen, successful results require use of the right tools, good concrete and correct finishing and stamping procedures.



Figure 1. Four of the most common patterns are shown here: hexagonal tile, running bond brick, cobblestone and Ashlar slate. The slate pattern is made with a rubber mat, the other three with plastic or aluminum stamping tools.

Stamping tools

Tools for producing only a pattern are made of aluminum or plastic. Plastic tools are less expensive—about one third the cost of aluminum. They also weigh less and because of this, production rates are usually higher when plastic tools are used. They can be ganged by using 2 by 4's to hold them together (Figure 2). With aluminum tools, however, it's easier to achieve the desired imprint depth in concretes that have stiffened appreciably due to setting. The tool must be struck with a sledge and plastic tools may bounce or crack. Aluminum tools can also be repaired if they crack.

The basic stamping tool is typically 2 to 3 feet long and 16 to 24 inches wide. Fan cobblestone patterns (photo on page 775) require a right and left stamp. Size of the



Figure 2. Plastic stamping tools can be ganged using 2 by 4's to increase production rates.

stamp must be known to aid in planning how many tools are needed for a particular job. Enough tools are needed to stamp one row across the complete width of the pour and still have an extra tool to line up the next row. Smaller hand tools are used for touch-up work and for filling in the pattern near the edge of a form or building.

Stamping mats that impart texture as well as pattern are made of synthetic rubber (Figure 3). The pattern doesn't cut as deeply. One advantage of using the mat tool is that controlling texture and depth of the impression doesn't require a great deal of skill. Another advantage is the longer time period during which concrete can be imprinted. Workers can get on the concrete sooner because the mats act in a manner similar to snowshoes, spreading weight over a larger area. Contractors also report that mats allow them time to get a good impression in the concrete long after it would be too hard for an aluminum or plastic tool. However, because the entire mat surface is in contact with the concrete, it will stick when the mat is removed. To prevent sticking, a water-repellent, colored powder is used as a release agent.

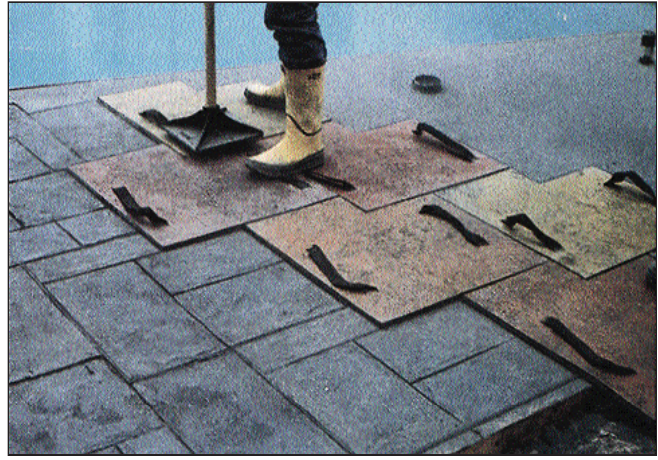


Figure 3. Interlocking rubber stamping mats imprint both pattern and texture. A tamping tool is used to embed the mats which are flexible enough to imprint even when the mat over the edge of the form as seen at the lower right.

The contractor's required investment in stamping tools depends on how many patterns he wants to offer. Most specialty contractors will have tools for 5 or 6 patterns and occasionally for as many as 15 patterns. Some contractors in the business offer just three of the most common patterns: running bond brick, cobblestone and hexagon. Plastic stamps cost about \$60 each, so a set of 12 for each of the three patterns can be purchased for less than \$2500. The \$2500 will buy just one set of aluminum tools which cost about \$200 to \$300 each. Rubber mats cost between \$150 and \$325. They are quite durable and Georgia contractor Jim Moye says they hold up better than metal tools. He has stamped over 60,000 square feet with his mats which are still like new.

Concrete requirements for stamping

The concrete mix needed depends on depth of the stamped pattern. If an area is intended primarily for vehicular traffic or if the grooves are to be grouted, the desired pattern penetration may be as much as $\frac{3}{4}$ inch. Embedding a stamping tool to a depth of $\frac{1}{4}$ inch or more requires minimal interference from coarse aggregate. Concrete with a $\frac{3}{8}$ -inch maximum size aggregate (pea gravel) works best and enables workers to achieve a uniform imprint depth. More mixing water is needed for small-sized aggregate than for large sizes and a minimum cement content of 565 pounds per cubic yard (a 6-bag mix) is recommended. The slump shouldn't exceed 4 to 5 inches.

Sidewalks or other areas with a lot of pedestrian traffic shouldn't be stamped as deeply because the grooves are a tripping hazard. In these areas, and in slabs textured with rubber mats, concrete with $\frac{3}{4}$ - or 1-inch-maximum-size aggregate can be used. Less mixing water and entrained air are needed with the larger aggregate.

Entrained air is required for concrete that will be ex-

posed to freezing and thawing. An air content as high as 7.5 percent may be needed for pea gravel concrete and this can cause problems because it makes the surface sticky. When deeply grooved patterns are cut without using a thin polyethylene film between the tool and concrete, tools must be cleaned frequently with water to prevent concrete from sticking to them. Spraying tools with a release agent may also help. Air content should be held to the minimum amount needed to ensure a durable surface.

Retarders are sometimes used to extend the period during which concrete can be stamped and increase daily production. One tool manufacturer recommends a maximum pour of 500 square feet which works out to about 6 cubic yards of concrete for a 4-inch-thick slab.

TOPPINGS CAN BE PATTERN STAMPED TOO

During renovation of the Holiday Inn West Holidome in Bridgeton, Missouri, the existing concrete slab could not be removed. Management debated whether to leave the floor around a swimming pool and lounge area as it was, or to install a more attractive flooring. When they finally decided, there was little time left to finish the project. However, Ahal Contracting Company, Inc. was able to install a 3000 square foot stamped topping in less than two weeks.



The topping was 2 inches thick and was placed over a high-density foam pad that served as a bond-breaker. Joints were cut at a maximum spacing of 20 feet. The river rock pattern was stamped using plastic tools to give deep joints that were grouted several days after the slab had cured. These types of toppings work well for interior jobs where temperature and moisture changes are small.

Joe Garceau, a Florida stamping contractor, orders a full 10-yard truckload of concrete, but adds a retarder to the second half of the load. He mixes liquid retarder with water in a pail then adds it to the concrete and mixes for 3 to 4 minutes. This slows the setting long enough to permit stamping, but Garceau warns that just the right amount of retarder is needed. If too much is used the surface may crust over and crack when it's stamped, even though it hasn't set completely. Some contractors try to slow the set, especially in hot weather, by using less cement and increasing the slump. Concrete quality suffers when this is done.

No admixture that contains calcium chloride should be used for colored stamped concrete. Calcium chloride causes discoloration.

Procedures for stamping concrete

Good quality stamped concrete requires dedicated craftsmen who consistently follow proper concrete placing and stamping procedures.

Planning and preparation—Ideally, stamping should be the last job done on site so the concrete isn't damaged or stained during other construction operations. If possible, lay out areas to be stamped in even multiples of the tool size to avoid excessive hand tooling. Add an additional $\frac{1}{8}$ inch per stamping tool to allow for movement of the tool during stamping.

Plan the layout to provide a pleasing appearance. When tile or brick patterns are used, no stamped line is perfectly straight. But deviations from straightness won't be as noticeable if long, straight grooved lines are at an angle to the line of sight and if they aren't parallel to existing walls or form lines.



Figure 4. Deviations from straightness won't be as noticeable if long, straight grooved lines are at an angle to the line of sight and if they aren't parallel to existing walls or form lines.

isting walls or form lines (Figure 4). Also plan the location of contraction and construction joints to minimize cracking and to control pour size. The novice pattern stamping contractor shouldn't plan to place and finish more than 400 square feet per pour with a five-man crew. Pours should be scheduled about 2½ hours apart. Experienced crews can stamp as much as 700 to 800

square feet per pour and achieve daily rates of 1500 square feet.

After the layout has been planned make a list of all the tools and materials needed. This may include stamps, hand tools, sledges, color hardeners, release agents, thin polyethylene film, and color waxes or sealers as well as the forming materials and finishing tools normally needed. Notify the ready mix producer of your special mix requirements.

Prepare subgrade, form slab edges and place reinforcing as for any slab on grade. Cover adjacent walls and surfaces with polyethylene sheets to protect against staining from color hardeners.

Initial finishing—After placement, concrete should be struck off and bullfloated. Vibrating screeds or hand tampers may be needed if aggregate larger than pea gravel is used in the concrete. These tools embed coarse aggregate below the concrete surface, making it easier to stamp deep patterns. No troweling should be done until after the coloring process is completed.



Figure 5. About half of the coloring compound is spread for the first application when no bleed water remains on the surface. Suppliers recommend using 60 pounds of coloring compound for each 100 square feet of finished surface.

Coloring concrete—After bleed water has disappeared, spread about one-half the color hardener on the surface (Figure 5) and float it into the concrete. Edge the concrete, and when no surface bleed water is visible, spread and float in more color. During this second application you'll be able to tell which areas are lighter colored and need more of the hardener. At least two spreading and floating operations are required, but some contractors spread hardener and float three or four times to achieve a surface of uniform color. Suppliers recommend using 60 pounds of color hardener for each 100 square feet of finished surface.



Figure 6. As concrete sets and stiffens, a sledgehammer may have to be used to produce the desired imprint depth.

Stamping—Judgment is required in deciding when to start stamping. The concrete must still be plastic. If a contractor is pushing for higher production rates he'll probably start stamping when the concrete is a little softer than ideal and will end when it's hard enough to require some effort to make the impressions deep enough. One supplier of stamping equipment recommends pushing a finger into the concrete to determine when to start. If the hole keeps its shape and does not fill with water, stamping can begin.

Concrete is frequently stamped through plastic sheeting (1 mil thick) laid on the surface. Thicker sheets will wrinkle and mar the surface. The sheeting prevents concrete from sticking to the tools and creates a rounded surface at the grooves. When placing plastic sheeting, use a soft broom or a trowel to smooth it over the concrete surface. When texturing is done with rubber mats,

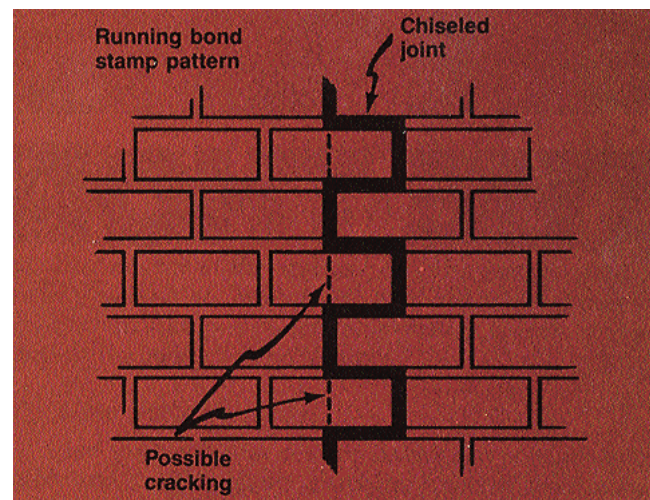


Figure 7. If the owner wants joints to match the pattern, warn him of possible cracking as shown in the sketch. Jointing methods should be considered early in the planning stage.

the powdered release agent is dusted on by hand. Don't cover the entire surface at one time. Apply the powder only to the area to be covered by one row of mats, put the mats down, then dust the next area. If color comes through to the mats, dust the mat surface as well as the concrete before stamping. The powder is extremely fine and workers should avoid breathing it by wearing double layers of painter's masks.

A string line and preliminary layout sketches will be helpful in maintaining a straight pattern and an efficient stamping operation. Walls and forms are never perfectly straight so a stringline should be used to establish a straight starting point. If the pattern runs parallel to a wall or form, stretch the line about 2 inches from the edge. Start the pattern by forcing a single stamping tool into the concrete surface using the stringline as a straight edge. Align each successive tool with the preceding tool and force it into the concrete to a uniform depth. Standing on the pattern tool will usually provide sufficient force to achieve desired imprint depth, but as the concrete hardens extra force may be required. Figure 6 shows a workman applying extra force with a sledgehammer. Have enough tools on hand to complete one row of the pattern with one left over to start the next row. Extra tools can make the job go faster because there's more room for the finishers to walk on the slab.

Hand stamping will be necessary near walls and forms and to touch up any errors or incomplete patterns. Plastic stamps are sometimes cut in half to facilitate this work. After completely stamping the pattern, remove plastic sheeting.

Jointing—One way to joint stamped concrete is with leave-in-place wood strips. Another way is to use cold chisels, hand stamping joints that conform to the pattern. When this is done, however, the owner should be alerted to the possibility that cracks won't always follow the joints (Figure 7). Leave-in-place headers can be used as construction joints between adjacent pours. Dominic Ingrassia, a California stamping contractor, has a different technique for adjacent pours made on the same day. When there are continuous straight lines in the pattern, such as with running bond brick, he uses no header; he simply runs his stamp up to the irregular edge of the pour. Then he cleanly cuts off excess concrete along the straight line. He places the next load of concrete against the line, applies color to blend with the previously placed concrete and aligns his stamp to match the pattern in the adjoining surface. The straight joint is later deeply tooled.

Final texturing—Wet surface brooming should eliminate most if not all stamping imperfections (Figure 8). Some contractors mix 20 parts of water with one part color hardener and dip the broom in this mixture before gently brooming the surface. Check with the color hardener manufacturer for recommendations concerning use of their product in this manner. Workers may have to walk on the concrete and should wrap their boots with polyethylene film so they don't mar the surface. Care

must be taken not to over-broom or to start brooming when the surface is too soft.

Any touch-up work should be done carefully on surfaces textured with rubber mats because troweling will remove the texture. Usually a misprinted pattern can be erased by making a new impression with the mat.

Curing and sealing—Colored wax curing agents must be used because other curing methods are likely to cause surface color variations. Use a color curing membrane that matches the color of the concrete. Otherwise you'll get a blotchy appearance when the membrane starts to wear off. Applying wax produces a shiny surface, promotes cement hydration and reduces shrinkage cracks. Periodic waxing is required to maintain a shiny surface, but many owners opt for the appearance of a naturally weathered surface after the initial coating has worn off.

When a powdered release agent is used, concrete curing operations must be delayed because the wax curing compound can't be applied until the release agent is removed. And the agent can't be removed until the concrete hardens sufficiently to withstand a pressure wash.



Figure 8. Wet surface brooming will remove minor stamping imperfections such as wrinkles left by the polyethylene film. Note that the worker has wrapped film around his boots to avoid marring the concrete.

But after the release agent is removed, a sealer may be applied to protect the surface from the environment or to provide a shine. In northern climates, a sealer may be sprayed on stamped concrete to protect it from scaling during the harsh winter months.

Possible problem areas

A few problems may develop during any concrete operation and stamping is no exception. Experienced contractors are aware of the problems and plan their operations to avoid or minimize them. Some of the problems include:

- excessive bleeding
- accelerated concrete set caused by hot weather
- color variations


Excessive bleeding slows the finishing process. If color is added too soon, bleed water coming to the surface washes it out and the surface will also be less durable. This problem can be particularly acute when indoor stamped concrete is placed over a vapor barrier. Always use the stiffest mix possible to minimize bleeding. A slump as low as 1 inch may be needed for concrete placed over a vapor barrier. Entrained air also helps to reduce bleeding.

As concrete sets, the stamping process slows because more effort is required to achieve an imprint pattern of uniform depth. Retarding admixtures are sometimes added to delay concrete setting and allow workers sufficient time to imprint the pattern. It may be necessary to make several smaller pours instead of one or two large ones to allow finishers adequate time for stamping.

Color variations are sometimes purposely achieved by combining two or more colored pigments to give a weathered appearance. A colored release agent may also

produce this effect. However, color variations are undesirable for many jobs. Here are some of the ways to avoid color variations:

- Don't mix concrete from different trucks in a single pour; plan the concrete placement to completely fill one area.
- Use the same cement type and brand throughout the project.
- Avoid using different curing compounds or methods.
- Use the same admixtures for each concrete batch.
- Don't trowel surfaces after a powdered release agent has been dusted on.

The key to avoiding color variation is consistency—in batching, placing, finishing, stamping, and in curing concrete. 

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PATTERN STAMPING

Avoid these common pitfalls on your first stamping job

BY WARD R. MALISCH

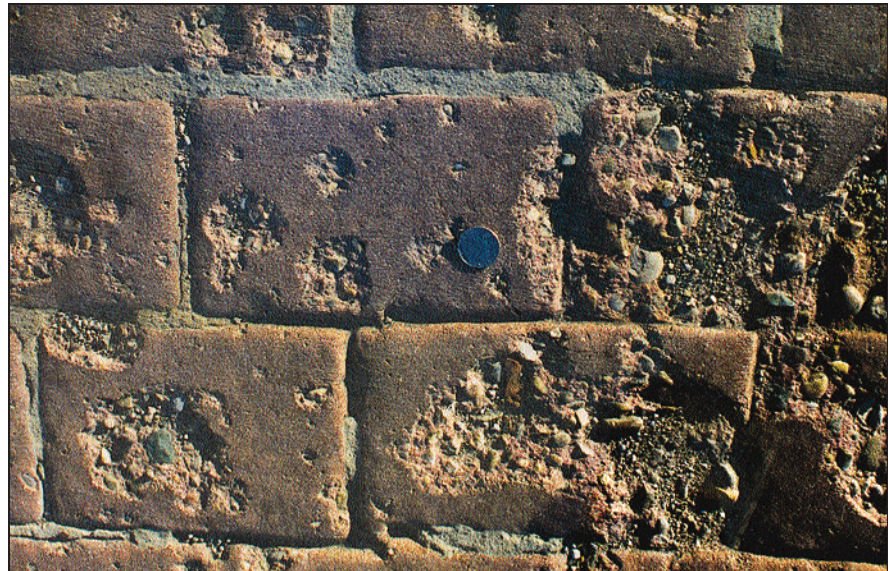
Experience is what you get when you don't get what you wanted. When you're imprinting concrete with platform tools or plastic mats, that kind of experience often results in a defective surface and an unhappy owner. If you make the following mistakes, you're certain to get experience—but not the decorative flatwork you wanted.

1. Order Too Much Concrete

An inexperienced stamping crew's most common mistake is ordering more concrete than can be properly finished, colored, and stamped before the concrete sets. When too much concrete is placed, it's hard to get uniform embedment depth with the stamping tools because workers must start stamping while the concrete is too soft and complete stamping when it's very stiff.

On your first stamping job, don't try to place and finish more than 400 square feet of concrete with a crew of four to five workers. For a 4-inch-thick slab, that means you'll order only 5 cubic yards of concrete.

If the job requires 10 cubic yards total, plan to install a construction



In a cold climate, surface deterioration of non-air-entrained decorative concrete is likely.

joint and take delivery of another 5 cubic yards two to three hours after the first truckload. This gives workers enough time to carry out all of their operations without getting on the concrete too soon.

As crews gain experience, they may be able to color and stamp as much as 700 to 800 square feet per pour. But starting with smaller areas helps give them the skills they'll need to handle bigger pours without getting into trouble.

2. Order the Wrong Concrete

Concrete that's too wet slows production while crews wait for the bleedwater to evaporate. There's also a good chance that finishers will get on the slab too soon, trapping bleedwater beneath the surface and causing blistering.

Concrete that's too dry or made with aggregate that's too large makes it difficult to maintain a consistent stamping depth. And using

Ward Malisch

non-air-entrained concrete in cold climates can cause scaling or other surface defects (see photo).

Assign one person on the crew to order all the concrete and to call in changes in quantities or delivery times. Most jobs require pea-gravel concrete if grooves from the stamping tool will be equal to or deeper than $\frac{1}{4}$ inch. The smaller aggregate also helps to reduce tearing. Concrete with $\frac{3}{8}$ - or 1-inch maximum-size aggregate can be used for surfaces that aren't stamped as deeply or for slabs textured with plastic mats.

Required slump is generally 4 to 5 inches, and in cold climates, 6% to 8% entrained air is needed. Entrained air slows bleeding, so there's a temptation to reduce the air content to speed up finishing. Don't do it. Freeze-thaw cycles and deicing agents can give patterned concrete a weathered look that's decidedly unattractive.

Remember too that fresh concrete properties change with the seasons. The water-reducing retarder that worked well last summer may excessively delay setting during cooler fall weather.

3. Forget to Square Up Form Corners

More hand tooling is needed

when formed corners for a rectangular pour are out-of-square. And when repeating patterns such as 6x6-inch tile are used, the pattern will look progressively worse as you move down the slab and away from the corner.

Check squareness at the form corners by measuring diagonals of rectangular sections (they should be equal) or by using a 3-4-5 triangle (see illustration). Adjust corners that aren't square.

4. Place Concrete Before Tools And Supplies Are Laid Out

There's a fairly short window of time during which concrete can be floated, colored, and stamped. In hot weather, the window is even shorter. When workers spend too much time walking back to the truck to look for tools or supplies, the concrete is less likely to get stamped at the correct time.

Before concrete arrives, screw the handles on the bull floats and lay out all the stamping tools, tappers, floats, and trowels the crew will be using. Make sure each finisher has an S-tool (brick mason's jointer) for dressing the joints in brick, stone, and tile patterns.

Calculate the number of color-hardener bags needed, based on

100 square feet of coverage per bag. Set out opened bags of all the color hardener that will be used. Be sure to have enough thin polyethylene sheeting and release agents on hand, plus curing compound and

DECORATIVE CONCRETE DO'S AND DON'TS

Jeff Gosch runs the decorative concrete crew for Groninger Construction Inc., Colorado Springs, Colo. A believer in the educational value of a do's and don'ts list, Gosch regularly updates his company's list by conducting a lessons-learned meeting with the entire crew after every project. Together, they review what went right, what went wrong, and what could have been done to avoid the wrong results. Constructive comments are then added to the list.

Most of the hints in this article are part of Gosch's list, but he and his crews also caution workers to pay attention to:

Planning

- Hold a prejob conference with the workers, general contractor, owner, and concrete supplier.
- Use a prejob checklist.

Safety

- Use respirators at all times when working with stains, sealers, and release agents.
- Use water-based stains or sealers indoors instead of solvent-based materials.

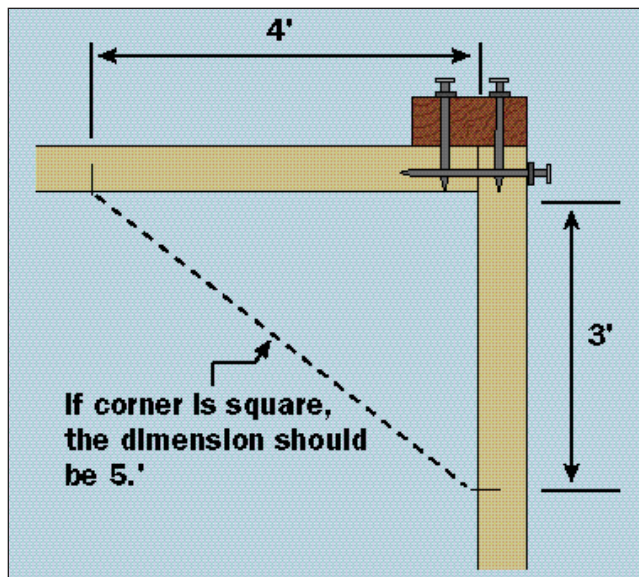
Crack Control

- Put a diagonal rebar across all re-entrant corners.
- Use welded wire fabric or synthetic fibers in all applications to help control random cracking.

Owner Relations

- Protect all walls and surfaces adjacent to the flatwork so they aren't stained by the color hardener.
- Flag off the work area before leaving the site.

As evidence of Groninger Construction's commitment to quality and customer service, the list Gosch has been compiling now features more than 40 items.



Check for 90-degree corners by placing marks 3 and 4 feet from the corner as shown, then ensuring that the third dimension is 5 feet long.



The reward for avoiding pattern-stamping mistakes is blemish-free decorative concrete.

sprayers or rollers.

If all the bags of color hardener for a job don't have the same lot number, some stamping contractors thoroughly blend materials from different lots to produce better color uniformity. This is also done with the colored release agents used as bond breakers for stamping mats. When setting out buckets of the hardeners and release agents, it helps to color code the buckets so workers can find the correct product quickly.

5. Lay Out Stamps After Concrete Arrives

Planning the stamping tool layout after concrete is on the ground burns up valuable time when you can least afford it. It also increases the chances of making a mistake or not having the number of stamps on hand that are needed to do the job most efficiently.

Do a dry-run stamp layout before concrete arrives. Mark stamp positions on the edge of the form to alert you if the pattern is starting to drift during stamping.

6. Do Too Much Hand Tooling

For most stamping jobs, some hand tooling is needed to fill in the pattern near the edge of a form or building. However, large amounts of hand tooling slow your crew and increase the chances of the concrete stiffening too much before all of the stamping is done.

Minimize time spent hand tooling by laying out dimensions of areas to be stamped in even multiples of the tool size, adding an additional $\frac{1}{16}$ inch per tool to allow for movement during stamping. This may require getting the owner to approve slight alterations in the flatwork dimensions, but the time savings are worth it, especially during hot weather when the concrete

is setting rapidly.

7. Fail to Joint the Slab

Even slabs with a deep-cut pattern must be jointed to control cracking caused by cooling or drying shrinkage. Unsightly cracks and unhappy owners are an almost certain consequence of failing to joint stamped slabs.

Sawed joints are least noticeable and should divide the stamped concrete into roughly square panels. Mid-panel cracking is likely if the panel length-to-width ratio exceeds 1.5. Joints should be continuous, not staggered or offset, since cracking is likely at T-intersections of joints.

Avoiding these seven mistakes won't guarantee that every job will be problem-free. But when unexpected problems do occur, an organized crew with a well-rehearsed plan will be much better equipped to successfully deal with them. 🏠

Stamping concrete: managing initial set times

Every time concrete contractors imprint concrete with patterns and textures there is a potential for problems in achieving uniform-depth impressions and surface textures. Overcoming these problems takes experience and careful planning—and having a little luck from time to time. One technique for solving uniformity problems in your stamping program is “step retardation.”

Stamping concrete is like riding a surfboard. When surfing, the board must be located at just the right place on the wave. When stamping concrete, the impression must be made just as the concrete under the stamp is beginning to harden. If the concrete is too soft, the impression is mushy; if it's too hard, the edges of the pattern break off and little texture is impressed on the surface. Ideally, workers start the stamping process where the concrete was placed first—and is still a little soft—and finish at the end of the placement just as the concrete there is almost, but not quite, too hard for a good impression. To consistently achieve this ideal setting time takes some understanding of mix designs and retarding admixtures—especially when concrete temperatures are 80° F or higher and you are placing and stamping an 8-yard load of concrete. Here's some information to get you started.

Monitoring temperature

First, you must know the temperature of the concrete being placed. It's a good idea to monitor concrete temperatures throughout the construction season. Using a concrete thermometer, take a concrete sample as soon as it arrives on the jobsite. If the temperature is 70° F, it's fairly easy to stamp 640 square feet (8 cubic yards of concrete at 4 inches thick) of pattern before the concrete gets too hard. But at 80° F or higher,

stamping 8 yards of concrete is nearly impossible.

Changing mix designs

It's good to have several mix designs to choose from after considering jobsite conditions. Always order concrete by using a mix number—one where you know the mix ingredients. Avoid ordering a “patio mix” or a “floor mix” or any other mix where you don't know the contents. In hot weather, replacing some of the portland cement with fly ash will increase the time available for stamping—by as much as 30 minutes. Try replacing 50 pounds of cement, in a 564-pound mix, with fly ash. Don't replace more than 100 pounds.

Step retarding

Another way to manage concrete setting time involves adding retarding agents (usually available from your ready-mix supplier) at the jobsite to regulate the rate of initial set. If you know, for instance, that a half hour will be required to place the concrete,

with additional time for coloring and finishing before the stamping process begins, mixing a retarding admixture into the entire load can provide the additional time needed. When concrete temperatures are 75° F and higher, you can “step retard” by adding retarder to portions, a third or a half, of a truckload of concrete in order to provide the time needed to complete the stamping process.

In liquid form, the quantity of retarding admixture is measured as liquid ounces per hundredweight of cement in the mix. For example, if you want to add 1 ounce of retarder per 100 pounds of cement and are using a six-bag mix, the amount of retarding admixture needed for 1 cubic yard of concrete is 5.6 fluid ounces. If the temperature of the concrete is 75° F, the initial set would be delayed approximately 30 minutes; 2 ounces per 100 pounds of cement, or 11.2 oz for 1 yard, would delay it 1 hour.

At cool temperatures the retarding effect releases slowly, providing



Fritz-Pak makes it easy



Fritz-Pak, located in Dallas, prepackages powdered retarding admixtures in dissolvable packets for addition at the jobsite. Each packet contains enough admixture to retard 1 cubic yard of concrete with a five-bag mix for 1 hour when the concrete temperature is 75° F. Packets are also available for four-yard mixes. Contractors need only place the packets in the back of the ready-mix truck and mix for 5 minutes. Charts are also available from the company to help determine dosage rates for different mix designs and concrete temperatures.

For information about Fritz-Pak retarder packets circle 1 on the Reader Service Card.

more time for the stamping process. But as concrete temperatures increase, the time available for stamping decreases. When concrete temperatures are between 70° F and the low 80s, adding 1 to 3.5 ounces of retarder per hundredweight of cement can provide the time needed for a good stamping program (don't exceed 3.5 ounces). As the concrete temperature approaches 85° F, retarding admixtures must be added at the batch plant first to stop hydration that might occur between the batch plant and the jobsite. If you don't do this, adding retarder at the jobsite can result in some places on the slab that are too hard to stamp and other places that are too soft. When retarder is added at the batch plant, additional retarder added at the jobsite at half the regular dosage, will provide the time needed for the stamping process. The addition of 0.5 ounce of retarder per hundredweight of cement will have the same result as 1 ounce per hundredweight when no retarder is added at the batch plant. When retarding admixtures are added at the batch plant, don't add more

than 1.5 ounces of retarder per hundredweight of cement at the jobsite.

Tips

- Lay out a tight line when concrete with a low dosage of retarder abuts concrete with a higher dosage.

- At lower concrete temperatures, retarding admixtures cause the concrete to slowly move toward initial set, creating the best conditions for stamping. At higher concrete temperatures, initial set occurs more quickly, as the effect of the retarding agent wears off.

- Avoid placing concrete or adding retarding admixtures when concrete temperatures reach 90° F. Initial set follows too quickly after the effect of the retarding agent wears off. It's best not to place concrete at all at this temperature.

- Try a sample area first. Local cements and conditions can vary results.

- Mix retarding admixtures with a couple gallons of water to facilitate dispersion during mixing (mix the batch for 5 minutes after adding the retarder).

— Joe Nasvik



STAMP CONCRETE PROCEDURES

These are recommended guidelines only. Specific sites or situations require a more in-depth approach.

- For proper preparation of ready mix concrete, add colour oxide, use accelerators or plasticizers as required to obtain proper slump.
1. Concrete to be placed on grade and screeded to desired level.
 2. Any slopes must be slightly exaggerated to allow for rougher surface texture.
 3. After screeding, a wood bullfloat is used to consolidate and float the surface.
 4. After wood float, apply steel trowel or fresno to seal off surface when concrete has set slightly.
 5. All edges must be sealed off or edged using minimum 3/8" radius edger.
 6. Allow concrete to set until all bleed water has evaporated. Absolutely NO stamping should take place with bleed water present.
 7. Concrete degree of set should be such that it has no surface water and will support your weight with indentations of only 1/4".
 8. Deeper cut patterns, or patterns with small stone configurations (ie European Fan), may require concrete to set less.
 9. These patterns, require more care in placement and do not allow for much movement by workers on the tools because of the risk of working on plastic concrete.
 10. With concrete ready, apply release agent. Broadcasting over the entire load if possible. If not, carry it with you and spread just ahead of you as you proceed.
 11. It is important to FLUFF or mix release well, before each application. This will make for an even spread on the surface and make the release cover twice as much area. This saves money.
 12. The mats are now placed on the slab.
 13. The most important mat on any job is always the first mat. From this mat all others are projected, if it is off they're all off.
 14. You must determine which direction of the pattern will be the most beneficial in appearance and practical.
 15. Most mat patterns should be placed in a double row. This reduces the movement of the tools on the surface when you're tamping.
 16. Lift the mats squarely off the surface so you don't tear any corners.
 17. Rollers and chisels are used after each mat is lifted to remove unwanted paste or to retool lines that require more depth.
 18. Once you have worked across the slab, secure the area so you have no damage from foot traffic.
 19. 24-48 hours should pass before pressure cleaning the slab to remove excess form release. You may remove as little or as much, it's up to you and the desired results.
 20. When the slab has dried thoroughly apply a low gloss acrylic based seal coat to protect colour, resist salts, acids, stains from oil, gas, etc.
 21. A second coat of sealer can be applied after 4 hours to bring out the colour, and produce a gloss. After 30 days a high gloss sealer should be applied.

To obtain custom colours in the finished product

BEIGE	60% Yellow oxide, 27% Brown oxide, 13% White oxide 9 bags PC-06, 4 bags PC-09, 2 bags PC-08 per 5 meter load	21 lb/m ³
BUFF	50% Brown oxide, 25% Yellow oxide, 25% White oxide 8 bags PC-09, 4 bags PC-06, 4 bags PC-08 per 5 meter load	22.4 lb/m ³
TERRA COTTA	50% Red oxide, 25% Brown oxide, 25% Yellow oxide 8 bags PC-01, 4 bags PC-09, 4 bags PC-06 per 5 meter load	22.4 lb/m ³
REDWOOD	35% Red oxide, 35% Brown oxide, 30% Black oxide 6 bags PC-01, 6 bags PC-09, 5 bags PC-07 per 5 meter load	23.8 lb/m ³
BRICK RED	95% Red oxide, 5% Super Black Oxide 20 bags PC-04, 7 lbs Super Black Oxide per 5 meter load	29.4 lb/m ³
LIGHT TAN	60% Yellow oxide, 40% Brown Oxide 6 bags PC-06, 4 bags PC-09 per 5 meter load	14 lb/m ³
DARK TAN	50% Yellow oxide, 50% Brown Oxide 8 bags PC-06, 8 bags PC-09 per 5 meter load	22.4 lb/m ³

Seller warrants that the product described on the face hereof has been manufactured of selected raw materials by skilled technicians. Neither seller nor manufacturer shall be responsible for any claims resulting from the failure to utilize the product in the manner in which it was intended and in accordance with instructions provided for use of product. The only obligation of either the seller or manufacturer shall be to replace any quantity of this product which proved to be defective. Neither seller nor manufacture assumes any liability, loss, or damage resulting from use of this product.



CONTROLLING COLOUR CONSISTENCY IN READY MIX CONCRETE

To determine the colour content and to control consistency of Ready Mix Concrete you must pay strict attention to cement/fly ash ratio and to the water/cement ratio. These two elements effectively control the colour shade. To provide consistent results, a good mix design should provide several key characteristics.

It should be a minimum 27 Mpa, 28 day strength.

Fly ash should be restricted to 20% by weight of the total cementitious material.

Maximum water/ cement ratio of 0.49.

Slump requirements in excess of 100mm should be provided only by using a high range superplasticizer.

Never under any circumstances should calcium chloride accelerators be used.

Good quality non-chloride accelerators should be used when necessity to increase set time.

Required amounts coloured oxides are always measured according to the percent(%) of the total cementitious material per meter of ready mix concrete.

Example:

285 kg cement powder plus 55 kg fly ash = 340 kg cementitious material

1.2 - 1.5% oxide requirement = 4 or 5 kg of oxide per cubic meter of concrete

In our extensive research we have found that our oxides provide acceptable colour beginning at 4 kg per meter of concrete based on 340 kg or cementitious material of 1.2% by weight. All colours of oxide have a saturation point or a point where more oxide will not produce any noticeable increase in shade or density. This point varies from colour to colour but is usually higher in the lighter colours.

This high oxide requirement for the lighter or pastel colours can be reduced by using white cement instead of grey. The use of white cement gives richer, clearer, brighter, more intense colour. Note that when mixing oxides, no fly ash whatsoever should be used in mixes with white cement powder. Fly ash reduces clarity of colour.

Light grey or shale coloured concrete can be achieved by using white cement but leaving 20% fly ash in the mix. This is recommended to truly imitate the colour of natural stone. Mix designs using white cement only should be increased slightly in cement content to compensate for the lower strength of white cements.

These guidelines will help control the colour shade in Ready Mix Concrete. External factors such as subgrade consistency, curing procedures, time and temperature of placement also play a significant role in the control of colour in the finished product. Good construction practices should always be adhered to in these areas. Coloured concrete requires more planning and quality control in the mixing and placing stages.

Seller warrants that the product described on the face hereof has been manufactured of selected raw materials by skilled technicians. Neither seller nor manufacturer shall be responsible for any claims resulting from the failure to utilize the product in the manner in which it was intended and in accordance with instructions provided for use of product. The only obligation of either the seller or manufacturer shall be to replace any quantity of this product which proved to be defective. Neither seller nor manufacture assumes any liability, loss, or damage resulting from use of this product.