Restoration / Refinishing

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Setting the Standards for Natural Stone

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RESTORATION/ REFINISHING

1.0 INTRODUCTION

1.1 Basic Methods. The ancient Greeks and Romans used crushed salt, sand, and fibers to grind, hone, and polish stone. Today, we use diamonds and specially formulated polishing powders to accomplish the same tasks, yet the fundamentals remain the same.

1.2 The fundamental goal of restoring stone is to replicate the look and feel of the newly installed material. This can involve several different processes. In these processes, the field technician is attempting to perform tasks that were originally completed in a factory setting, using high powered, stationary machinery without the encumbrances of adjacent building components, scaffolding, weather, etc. Execution of the intended tasks using portable tools in a field setting are normally the domain of highly trained and skilled mechanics.

1.3 The three basic steps in the stone refinishing process are still grinding, honing, and polishing. When a stone surface is rough and uneven, it may require grinding. If a stone needs to be smoothed, honing may be all that's necessary. To produce a shiny surface on stone, polishing will accomplish the task. Each of these steps can be performed alone or in combination with one another. The following section defines these steps.

2.0 GRINDING, HONING, AND POLISHING

2.1 Grinding is the process by which a stone's surface is aggressively sanded to remove large stocks of material. This process is usually recommended, for example, when stone tiles are uneven. *Lippage* is the term given to describe stone tiles that have raised, uneven edges.

2.1.1 Grinding is recommended when the lippage exceeds 1/32", or if a completely flat floor is specified.

2.1.2 There are some very good reasons for grinding a stone floor flat. A flat floor is easier to maintain because there is no lippage where dirt can accumulate. The grinding process, if performed correctly, will also eliminate depressed grout joints—the grout will be even with the tile's surface so that dirt and grime are not deposited in the recessed joint.. A completely flat floor also gives the illusion of being monolithic (consisting of a single stone), and can enhance safety by reducing potential tripping hazards.

2.1.3 However, there are also some disadvantages to grinding. It is very time-consuming and expensive. With some hard stones, like granite, it can take an entire day to grind 50 square feet, depending on the type of equipment used. The grinding process is very messy. A large amount of water is needed to grind a stone floor, and it produces a heavy slurry of stone and water. If adjacent areas such as carpet, wallpaper, baseboards, etc., are not protected properly, water damage may occur.

2.1.4 A stone floor does not necessarily have to be ground to remove scratches. A skilled craftsman can repair it without grinding.

Before deciding on grinding, all the above considerations must be carefully weighed.

2.2 Honing is the process of smoothing stone with the use of abrasives. Although not as aggressive as grinding, it does require the use of water, and can also be quite messy. Honing is performed to remove scratches, and will not remove lippage. It can, however, round the edges of the stone, giving a smoother finish to the edges. The honing process is usually achieved with the use of diamond abrasives, although some contractors prefer silicon-carbide bricks or screens. Which abrasive is used is not as important as the skill level of the craftsmen. Honing can leave a stone with very little shine, although some stones will acquire a satiny luster at very high hones.

2.3 Polishing produces a highly reflective finish on the surface of stone. Polishing is usually accomplished with superfine abrasive powders, but can also be achieved with superfine diamond abrasive discs.

2.4 Basic Floor Machine Tool Options:

2.4.1 Mono-rotary Head Machines. This is a single head machine that usually holds between three and six diamond abrasives. More diamonds results in less force being applied to each diamond pad, which can slow the process. Fewer diamonds results in greater force being applied to each diamond pad, but reduces balance and control, which can result in a wavy finished floor. Operator skill and machine balance are both influential in the quality of the finished product. These machines usually turn in one direction at speeds of 150 to 320 rpm.

2.4.2 Planetary Head Machines. These machines utilize gears and higher horsepower to operate anywhere from three to nine or more diamond abrasives in a planetary motion in speeds in excess of 600 rpm. The added weight from the chassis and the larger motor (typically 220V/4HP or greater) provide more force per diamond pad and the high power overcomes the drag resulting from the additional diamonds. Because the heads are counter-rotating (spinning in opposite directions) the resultant finish is more uniform with less chance of swirl marking in the floor. Visible levels of gloss in the stone flooring may be visible at coarser grit sizes using this machine than when using a mono-rotary head machine.

While planetary head machines are effective and efficient for big, open areas, the mono-rotary machine may be a better choice for smaller areas like a residential foyer.

2.4.3 Hand Tools Supply of compressed air in residential or office settings is rare, so restoration tools are most commonly powered electrically. Grounding protection is required due to the wet slurries used in restoration. Hand tools typically spin between 600 and 3,500 rpm. Higher speeds will generally require less force to be applied to the tool when working on the stone.

3.0 GRIT

3.1 Grit is any of various hard, sharp particles used as abrasives. Grit size is the number value designated for the size of these particles. The size is determined by passing the particles through a screen that has a set number of holes per square inch. For example, 400 grit is the size of abrasive particles that can pass through a screen with 400 holes per square inch. A 60 grit screen has sixty holes per square inch. The more holes per square inch, the smaller the holes are, and the finer the grit size. The following table shows some of the most common grit sizes available in the stone-refinishing industry, from coarse to fine.

Grit Size	Screen Holes Per Square Inch
16	16
24	24
36	36
60	60
120	120
220	220
400	400
600	600
800	800
1,800	1,800
2,000	2,000
3,000	3,000
8,500 fine	8,500

Generally, grinding uses any grit of 60 or below; honing begins at 120 and proceeds upwards and a skilled craftsman will generally stop at an 800 or 1500 grit on marble before polishing. To polish granite, it is usually necessary to proceed through to the highest grit size. Some craftsmen may choose to polish with diamond abrasives to the highest grit, producing a very high polish, while others may choose to switch from a diamond to a powdered abrasive (see next section). Whichever method is chosen, the final result is what counts.

4.0 ABRASIVES

4.1 Abrasive Types. The two primary types of grit used in the stone industry are silicone carbide and diamond. These abrasives can be attached to backing in various ways like sandpaper, or they can be added to a mixture and formed into a solid block. Most stone refinishers today use diamond abrasives.

4.1.1 Brick abrasives are composed of silicon carbide as the abrasive and magnesite or polyester as the bonding agent. The abrasive and the bonding agent are mixed together and poured into a mold. The mold is then cooled and forms a solid brick of the abrasive material. The bricks are produced in various shapes. The most common bricks are known as "Frankfurt" and "Cassini."

4.1.2 Modern **diamond abrasives** are commonly metal bonded for grinding and resin bonded for honing and polishing.

5.0 HOW STONE SHINES

5.1 Overview. When stone becomes dull and scratched, it obviously loses its shine and luster. The stone then needs to be refinished and polished to restore the shine it had originally. How does stone shine, and can a lost shine be recovered?

The deep shine we see on polished stone is achieved by rubbing the stone with a series of abrasive materials. The process is very similar to sanding a piece of wood. The stone is rubbed with a coarse abrasive grit, followed by finer and finer grits until the stone becomes smooth. The scratches left behind from one grit are removed by the next, creating finer and finer scratches. The process continues until the scratches are microscopic, at which point the surface becomes extremely smooth and starts to develop some reflectivity. The shine on the stone is thus a product of optics. In Diagram A on the following page we see a rough or scratched piece of stone. When light is reflected from the stone, the light rays become scattered producing a dull, flat appearance to our eyes. In Diagram B, a very smooth stone, the light is reflected on the surface and the light rays return in a parallel pattern producing a deep, reflective appearance. This same optical property can be observed on a pond. When the wind is blowing and the surface of the pond is wavy, it becomes difficult to see a reflection; when the air is still and the pond is calm, a deep reflection can be observed.

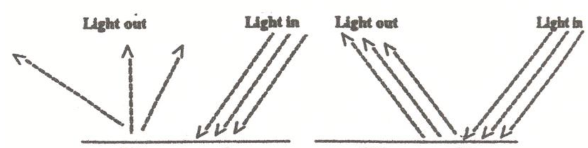

Diagram A
Rough Surface

Diagram B
Polished Surface

Thus, in order to produce or restore a deep shine on stone, all that needs to be done is to smooth it with the correct series of abrasives.

6.0 ACHIEVING A POLISHED SURFACE

6.1 Basic Techniques. A shine can be produced on stone with three basic techniques: coatings, crystallization, and polishing. Let's take a look at each in detail.

6.2.1 Coatings are commonly waxes, acrylics, floor finishes, urethanes, etc., that are applied on top of the stone surface. They are designed to provide a sacrificial layer that will take the abuse that stone receives. Coatings have been used by the janitorial industry for many years on tile and other surfaces and are used on stone the same way.

6.2.2 Coatings are generally economical, easy to apply, and will provide stain resistance, slip resistance, and add luster or shine to the floor surface. But coatings are much softer than stone and will scratch, scuff, and mar very easily. They require frequent buffing, burnishing and/or reapplication. They can also build up, causing an unnatural, plastic appearance. Poor quality coatings will yellow and can cause permanent staining to some stone types. The necessity for stripping also makes coatings an undesirable choice for stone for several reasons. The chemical strippers can be very highly alkaline, which can cause spalling.

6.2.3 The stripping pads used are very abrasive and will often scratch the stone surface. Some brands of strippers will attack the plastic matrix in agglomerate stones, eating away at the polyester binders.

6.2.4 The most important reason coatings should be avoided is that they may block the breathing capability of the stone. Moisture can become trapped below the surface and lead to spalling.

6.2.5 However, there are several areas where the use of coatings on stone surfaces may be necessary. If a polished stone surface is very slippery, a coating may be necessary. A coating may also be necessary for extremely soft stone installed in high-traffic areas. These soft stones are very difficult to maintain with conventional polishing processes.

6.2.6 Coatings may also be necessary on certain finishes such as flamed granite. There are special coatings available for these surfaces that work effectively for oil and water repellency.

6.2.7 If a coating is necessary, make sure that it is designed for stone surfaces, is applied properly, and most importantly, that it is monitored for potential problems.

6.3 Crystallization. Another way to achieve a shine on stone surfaces is with a process known as *crystallization*. The term has entered the language of the marble polishing field to describe a process used to maintain a shine on marble surfaces.

6.3.1 Crystallization can also be called “vitrification” or “recrystallization.” The procedure has been used in the United States since the 1970s, and has generated controversy among experts. Both sides have put forward convincing arguments. If you opt for crystallization, as with any process, strict monitoring is necessary. The MIA neither condemns nor endorses this process. The information provided here is for review only, and does not constitute advice.

6.3.2 The crystallization process consists of spraying a fluid onto the marble floor and buffing it in with steel wool under a standard buffing machine. The steel wool generates heat through abrasion and the chemical reacts with the marble, producing a new compound on the surface of the stone.

6.3.3 Almost all crystallization chemicals contain three main ingredients: acid, fluorosilicate compounds[1], and waxes.

6.3.4 Crystallization can only react with calcium-based stones such as marble and limestones. Although the process can work on noncalcium-based stones such as granite, the reactions are entirely different. In the chemical reaction, acid attacks the calcium carbonate of the stone, leaving an etch mark on the stone surface.

[1] The fluorosilicate compounds found in crystallization fluids consist of three types: aluminum fluorosilicate, magnesium fluorosilicate, and zinc fluorosilicate. One or more may be found in crystallization fluids, depending on the brand.

6.3.5 When the crystallization fluid is sprayed on a marble surface, the acid attacks the calcium carbonate. The fluorosilicate compound then attaches itself to the calcium ion, forming a new compound called calcium fluorosilicate.

6.3.6 Simply put, the crystallization process works by forcing one ion from one molecule to another in the cement matrix that holds the crystals together. This forms a new cement matrix that can be harder than the original cement matrix of the stone. The newly hard and the preexisting softer structures form two layers, and thus a layer of separation is between them. In many stone varieties, especially those that contain carbon elements, this causes the stone to delaminate. In others, especially many low and medium density limestones, this causes iron (from the steel wool) to enter into the stone's chemistry. All stones that undergo this process have dramatic changes in their element construction. In order for this reaction to take place, frictional heat must be generated. This is the reason for using steel wool on the buffing machine.

6.3.7 The process must be performed by trained craftsmen who are familiar with the techniques of this process. Excessive moisture in the stone can hamper the crystallization reaction and cause problems.

6.3.8 Proponents of the crystallization process claim the new compound formed protects the surface of the stone, adds shine, and may even harden the stone, increasing its wear resistance. Opponents of the process claim that the new compound formed blocks the stone's ability to "breathe," traps moisture, and causes the stone to rot. It is important to note that there are many different formulations of crystallizers that vary in chemistry and performance. It is imperative to qualify the stone and match an appropriate formulation of crystallizer to achieve the desired result.

6.4 Powder polishing uses superfine abrasives and oxalic acid to achieve the deep shine on marble surfaces. Granite powders use only abrasives. The oxalic acid is used to accelerate the polishing process by reacting with the calcium carbonate of the stone. The combination of the abrasive and the reaction of the oxalic acid results in a polished surface. The use of oxalic acid as an accelerator allows the craftsman to polish most marble at a 800-1500 hone. Granite, because it does not react with acids, cannot be polished using this technique. Instead, smooth the stone using progressively finer abrasives. The final polish is achieved using superfine abrasive powders and special felt wheels or polishing discs.

6.4.1 Powder Polishing Abrasives. Most marble polishing powders use aluminum oxide as the abrasive, oxalic acid as the accelerator, and a combination of other ingredients such as shellac, sulfur, and salt that adds color and lubrication to the process. A "hot" powder is one that contains over 50% oxalic acid.

6.4.2 Caution: Oxalic acid, which is used to speed the polishing process, can burn marble. Burned marble has a dimpled appearance and a molten, plastic shine. This is commonly called "orange peel" for reasons that are obvious to anyone who sees it. Rehoning is necessary to remove the burnt surface.

NOTES:

