Dimension Stone Selection

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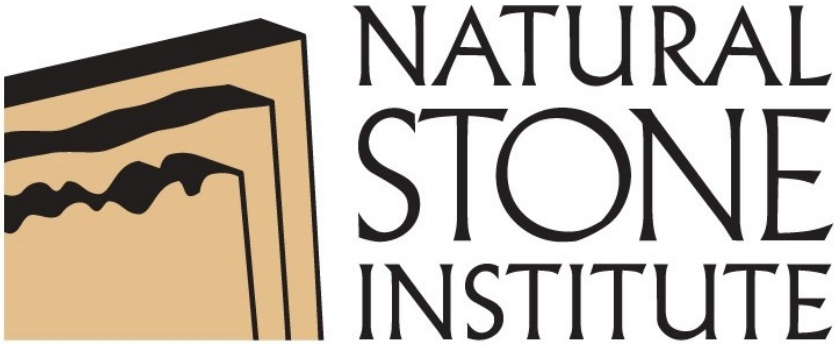

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DIMENSION STONE SELECTION

1.0 INTRODUCTION

1.1 Stone Selection Options. Architects and builders throughout the ages have chosen stone for its permanence and beauty. Where selection was once limited mainly to what was locally available, today's stone marketplace is virtually worldwide. With the broad and growing array of options, the stone selection process has become more complex under the weight of multiple considerations.

1.2 Stone Is A Product Of Nature. Dimension stone has its own unique qualities that not only distinguish it from man-made materials, but also should be considered in selecting it for a particular project. Stone is not manufactured; it is a product of nature. Blocks are removed from the quarry, slabs are cut from these blocks, and the slabs are further fabricated into the final stone to be installed. Each block is different; each slab is different. Skillful blending or matching of the dimension stone blocks, veneer panels, tops, etc., results in a beautiful blending of nature's variety and man's design. In contrast to the uniformity of materials produced by machine or assembly line, dimension stone's naturally varied appearance has wonderful character. "Uniformity of material," when applied to natural stone, is a term of relative value that needs to be understood when making a selection.

1.3 Exterior vs. Interior Installations. The factors to be weighed in selection may not be equally applicable to exterior and interior installations. The following discussion is therefore divided, as appropriate, between exterior and interior uses if the factors do not readily apply to both.

1.4 Selection Influencers. While any number of stipulations may direct selection of a particular stone for a specific application, there are several significant influencing factors. Among them are aesthetics, color, strength, durability, design, texture, finish, size, thickness, availability, stone testing, stone sampling, and cost. The effects any of these factors may have on another can influence the final choice. But aesthetic considerations nearly always drive the selection process.

2.0 AESTHETICS & APPEARANCE

2.1 Factors beyond Appearance. A palette of colors and a variety of textures provide ready options in the aesthetic choices among dimension stones. Yet, as the following pages suggest, it is advisable to examine and apply other factors that may recommend alternatives to a selection based purely upon aesthetic appeal, particularly on exterior applications. A stone that is most desirable in appearance, for example, may lack needed strength or durability for a particular application.

2.2 Exterior Cautions. The cautions regarding exterior applications are of far less concern when considering interior installations. Aesthetics can be allowed much freer rein for stone that is not subjected to the elements.

2.3 Variegated or veined materials, especially marbles, that offer interesting colors and patterns and that are by their nature "faulted" and not generally suitable for exterior use are often highly valued for their decorative qualities in interior installations.

2.4 Translucence occurs in some white or very lightly colored marbles and onyxes having a crystal structure that will transmit light to varying degrees depending upon stone thickness and finish. Translucence can be an aesthetically intriguing decorative attribute.

2.5 Sample Variations. Assuming that all critical factors support the desired choice in a given application, expectations as to final

appearance must be realistic. Unless a choice is made and marked on an actual slab, variation from a submitted sample is a fact and should not come as a surprise.

2.6 Fleuri Cut Stones. Many dimension stones today are being cross cut or fleuri cut. This is true in travertines and some granites, for example. Many times, the reason this is done is to avoid a directional vein and achieve a more "cloudlike" effect. In any case, the Specifier and the Stone Supplier should know if this is done and investigate the test data, as it may change from normal, conventional means. See illustration at the close of chapter 7.

2.7 Filling Might Be Required. Another issue is where cross cut (fleuri cut) stones are used. As in the case of travertine, a limestone, it may require filling with cement or epoxy, which may or may not hold up under heavy traffic conditions, and the fills may come out.

2.8 Choosing a Finish. Choosing the manner in which stone will be finished is an integral part of the selection process. Finish can be anything from saw cut to high polish. A high polish will bring out the color of the stone to its fullest, because it will optimally reflect the light. Conversely, a textured finish will always appear lighter. A combination of finishes can add interest to a chosen stone. New finishes are appearing on the market yearly, so check and investigate all finishes available with your Stone Supplier.

2.9 Finishes commonly available are:

2.9.1 Polished: Mirror gloss, with sharp reflections.

2.9.2 Honed: Dull sheen, without reflections, achieved by abrasive heads. The degree of honing depends on the stone, but may vary from light to heavy.

2.9.3 Fine Rubbed: Smooth and free from scratches; no sheen.

2.9.3.1 Flamed or Thermal: Plane surface with flame finish applied at high temperature by mechanically controlled means to ensure uniformity; changes the color of the stone.

2.9.3.2 Water-jet Flamed Finish: Gives a more uniform, textured finish and allows more of the natural color to show.

2.9.3.3 Sandblasted: Coarse plane surface produced by blasting an abrasive, allowing a fine-textured finish; may lighten the color.

2.9.3.4 Bush-hammered: Coarsely textured surface produced by hammering, and may vary according to the metallic head used, from fine point to very coarse, and may leave high, lighter-colored markings.

2.9.3.5 Natural Cleft: A cleavage face formed when the stone is split into any thickness.

2.9.3.6 Picked, Hand-hewn Rock Face: Using a chisel or other metallic object that gives deeper indentations and cleavage to the stone.

2.9.3.7 Sawn: Usually refers to slabs coming from a gang saw, with blades that are applied to the block of stone using water and fine grit.

2.9.3.8 Gauged: Done by a machine, usually with circular abrasives to grind the material to a specific thickness.

2.9.3.9 Planed: Usually refers to slate, where a metallic scraper peels a layer of stone, making the stone flat and smoother.

2.9.3.10 Acid Washed: Usually applied to a sawn finish to lower the degree of sawn marks showing, yet maintain a natural textured finish.

2.9.3.11 Tumbled: Method of putting tiles in a mixing container with sand and rotating them, allowing the edges and corners of the tiles to chip.

NOTE: Many new finishes are being applied to stone as the market demand increases and new uses for stone are being conceived. In some productions, combinations of finishes on the same stone are being made. Check with the Supplier to verify the finish and how it was made in order to specify properly.

3.0 DESIGNING WITH DIMENSION STONE

3.1 Design Considerations are nearly equal among the factors of aesthetics, strength and durability. This is particularly true of interior applications. The imagination of Designers is boundless, and it is the Fabricator or Supplier who must counsel the design professionals as to what is feasible and what is not. Stone is not a plastic material. It is rigid and breakable when handled in fabrication.

3.2 Yield. Before making final selection of a stone, particularly on a larger project, take wastage into account to make certain there will be enough material to complete the project. An often-forgotten fact is that the material from a quarry today may be different from what was available six months ago. Further, there may be more than one quarry of the material. The criteria of the Producer to select stone also vary from quarry to quarry.

3.3 Modular Stone Tiles. For ease and economy, modular stone tiles offer a good alternative to stone panels for walls and level floors. Thin stone tiles, varying in thickness from 1 cm to 1.5 cm, are available in modular sizes of 12" x 12", 16" x 16", 18" x 18", and other sizes, up to a maximum of 24" x 24". The proper tile thickness for the installation will depend upon the stone type selected and the modular size of the tile specified.

3.4 Mixing Tiles. The final look of mixed tiles may fall short of appearance expectations, especially if the stone is variegated and veined. The Installer should mix tiles from different boxes during the installation to achieve a more even, visually pleasing result in the finished surface.

3.5 Matched-vein Patterns. In contrast to modular tiles, panels cut from the slab usually will give the best results aesthetically. There are different ways that veined dimension stones or other stones can be matched to form a pattern, and stones must be of types that lend themselves to specific pattern arrangement. Patterned and matched panels require that the material be selected and thus, often increases the cost of the stone. See diagrams at the close of chapter 7 for a detailed description of vein patterns.

3.6 Mixing Types of Materials. Designs calling for a mixture of stones with different physical properties, while aesthetically interesting, can give rise to problems of wear and of maintenance, mainly on floor areas. Re-polishing will pose problems, should that need arise. The Specifier should be aware that mixing types of stones means there will be different abrasion resistance levels as well as different densities of stones that must be considered in the long-term maintenance of the stone and its wearability.

4.0 EXTERIOR APPLICATIONS

4.1 Strength. A most important concern when selecting stone is strength. This is particularly true in cases of exterior stone cladding for buildings over two stories high. Strength in those situations should be the determining factor in the final selection of the stone.

4.2 Exterior Stone Stresses. Exterior stones must be able to withstand the stresses that will be imposed upon them, such as the following:

4.2.1 Gravity load, which must be borne by the anchorage system.

4.2.2 Windload, which exerts both positive and negative pressure on the panels, and is

typically higher at building corners and other areas of discontinuity.

4.2.3 Water vapor, which must be released to prevent condensation and efflorescence problems.

4.2.4 Freeze/thaw cycles, which can cause stone to crack and joints to fail.

4.2.5 Structural contraction, which occurs during the curing stage of the concrete.

4.2.6 Creep, or permanent structural distortion, which takes place progressively over the years until the structure has settled.

4.2.7 Elastic distortion, which is caused by movement produced by load charges on the structure.

4.2.8 Thermal expansion and contraction, which affects stone and other structural elements

4.2.9 Absorption or porosity of the stone is a factor, as it will affect the durability and life of the stone, as well as its appearance.

Note: The durability of the installation method for walls is determined by the substrate it is being applied to and the anchoring method being used. Consult an engineer to evaluate all installation issues.

4.3 Test Data. Where structural capability is critical, test data for compressive strength, flexural strength, modulus of elasticity, and sheer strength should be studied. Where weather is a factor, absorption, porosity, and permeability studies should be made. Freeze/thaw compressive strength testing should also be carried out. For walls, the type of anchoring, and performing an anchorage pull-out test, are important.

4.4 High-traffic Floor Areas. For high-traffic floor areas, abrasive hardness testing should be a requisite. The absorption or porosity is important, as well as the density of the stone. The finish applied to the stone will be a factor in the slip resistance specified for the area.

4.5 Durability. For durability, exterior stone should be free from structural defects and varying characteristics of vein structure, scaling planes, hairline cracks, earthly parts, and cavities. Panel dimensions should be controlled in size for optimal results.

4.6 Granites have been historically favored for exterior use. Their composition makes them both resistant and stable, and surfaces will hold a high polish longer. As a rule, weaker stones require greater and more costly reinforcement.

4.7 In dry and temperate climates, softer stones like limestones can also be used successfully in thicknesses appropriate to the job. However, exteriors of gray or black limestones with a bituminous or carbon composition should be avoided because the action of atmospheric agents will rapidly cause the surface to deteriorate. Other stones considered inappropriate are the ophicalcites and the breccia in general, as well as all stone containing pyrites, which may produce rust spots when exposed to air and moisture.

5.0 INTERIOR APPLICATIONS

5.1 Selection Criteria. The fact that interior stone is sheltered from the action of the elements makes all types of stone, from the hardest granite to the softest limestone, suitable for application. Criteria for the selection of interior stone for both commercial and residential projects tend to be similar. Selection considerations focus on whether the application will be on vertical or horizontal planes.

5.2 Interior Vertical Surfaces. Nearly any stone may be chosen for interior cladding of commercial buildings. Practical considerations for highly used areas, however,

lead to stones that are dense, resistant, and easily maintained. These prove to be the best choice when aiming for a long-term investment.

5.3 Water Resistance. The action of water in areas such as fountains and showers is a factor to be reckoned with. Stones must be able to withstand frequent or continuous water projections, and in the case of showers, the presence of hot steam. Again, the best results are obtained with a dense, resistant stone, such as a granite, or a compact stone with a low absorption coefficient. The action of water on polished marble or limestone might cause surface dulling, spalling, warpage, or deterioration of stone over time.

5.4 Interior Horizontal Surfaces. Traffic is obviously a major consideration in selecting floor stone, whether for heavy, medium, or light duty. In heavy-traffic situations, floors need to withstand vehicles or carts, stiletto heels, mud and sand, salting compounds, spilled high-acidity liquids, and other pollutants and indignities.

5.5 Heavy-volume traffic and abuse require stone of maximum resistance–granite, quartzite, or highly compact marble, depending on the degree of punishment it must take. Testing for hardness as measured by ASTM C241 and discussed elsewhere in this manual can help in the selection process.

5.6 For medium-volume traffic, stones can be somewhat softer. Many dimension stones will perform well, if properly maintained. There are good methods and maintenance products available to preserve the stone's appearance. Generally, it is recommended that a dimension stone floor receive a honed rather than a highly polished finish in commercial applications. Etching, scratching, and traffic paths will be far less obvious on a honed surface, thus making for easier maintenance.

5.7 In light-volume traffic and residential areas, where problems of etching, scratching, and staining are minimal, it is quite acceptable to make a selection based mainly on aesthetics and choose a highly polished floor if desired. In all cases, proper maintenance must be done.

5.8 Countertops. Stones for kitchen and lavatory tops should be chosen with regard to functionality. Foods and their handling will affect long-term appearance as acids and grease come in contact with the surface. Not all stones are resistant to staining; therefore, selection should be carefully considered. In all cases and regardless of the type of stone, spills should be wiped up immediately and cutting knives not used directly on the surfaces. There are also nontoxic sealers (necessary in food preparation areas) that can improve the performance of a stone to a great degree.

5.9 Lavatory Tops. As a rule, lavatory tops in residential bathrooms can be chosen according to taste, since the surface receives little abuse other than pollutants that might be contained in cosmetics.

5.10 MIA Statement of Position on Sealing Natural Stone Countertops. Most granite countertops do not need to be sealed. Before 1995 there were very few quality penetrating sealers on the market and there were very few cases of staining. Both prior to and after the availability of penetrating sealers, no cases of food poisoning, radon, or food preparation issues associated with treated or untreated granites have been reported. If a homeowner cleans their countertops after each meal, they will rarely, if ever, have staining or cleanability issues with granite. All this being said, many granite countertops receive additional benefit from being sealed. That benefit is the further reduction of moisture migration into an already moisture resistant surface.

Should natural stone counters be sealed? In many cases it makes sense to seal marble and

granite countertops with a quality sealer. The product should have a life expectancy of ten to fifteen years and be of an oliophobic (resistant to water and oil based stains) nature. Once properly sealed, the stone will be more resistant against everyday dirt and spills.

In today's natural stone industry, many species of granite receive a resin treatment at the factory where the blocks of granite are cut into slabs and then polished. The treatment is used to fill microfissures, indentations and other minor characteristics that are found in many natural stones. The reason for the resin treatment is to address what most consumers consider as imperfections, but in reality are "birth marks." The consuming public gravitates to perfection, defined as no "birth marks," and so the marble and granite industry tries to fulfill the desire. Both resined as well as unresined slabs will outlast most of our lifetimes. Granite should, and in most cases will, be the last countertop surface a person will buy, providing a strong return on investment. The bottom line: Sealing resin treated countertops may increase the resistance of the already resistant nature of stone (adopted 11/8/06).

6.0 TESTING FOR PHYSICAL PROPERTIES

6.1 ASTM Tests. Stone is tested under a rigorous set of standards developed by the ASTM International, the world's largest voluntary standards development organization.

6.2 Purpose of Tests. The tests apply standard methods to uniformly evaluate stone characteristics and performance. ASTM standards are the recommended guidelines for installation in the stone industry. See Chapter 2 for more information about this organization and a list of ASTM specifications and standards.

6.3 Original Test Data. The Specifier has the right to request from the Supplier original test data on the stone to be used and verify the age of the test and its validity. In some cases historical data is sufficient on small jobs, but on larger jobs historical test data should only be taken as indicative, and new tests should be run on the specific stone from the specific quarry to be used.

7.0 SAMPLING

7.1 Stone Samples and Mockups. Preparation and supply of dimension stone samples and mockups are often expensive and time-consuming, but an essential part of stone projects. Samples and mockups help ensure that materials meet contract requirements.

7.2 Promotional samples are for color consideration only, but must be representative of the color and finish being proposed for use. They should be supplied in small sizes, such as 3" x 4", 4" x 6", or 6" x 6".

7.3 Project samples should be 1' x 1' in size or larger. Care must be taken to select samples that accurately reflect the shades, markings, and anticipated ranges of color, texture, finish, veining, filling, and other characteristics of the variety of stones specified.

7.4 Large Projects. For very large projects, multiple samples are needed in order to show the range of variations. These are normally assembled by selecting from the blocks that best meet the requirements at that point in time. Sometimes visits to the quarries become a necessary step in the selection process. Selecting slabs to be cut for the project is necessary to see the overall variation of the stone and finish to be used. In all cases, availability of the material should be secured.

7.5 Number of Samples. The number of sample submissions required on a specific project depends primarily on the amount and particular use of the stone required. However, there should never be fewer than two sets of samples submitted. Control samples should be kept by the Architect, Contractor, and

Producer for verification of the selection approved.

7.6 For stone that will be matched, prepare at least two sets of four matched samples each, showing proposed veining, flows, movements, texture, and range in each set.

7.7 Support Documentation. Depending on the stone selected and quantity required, a mock-up containing a full range of colors may be needed to further define the texture and characteristics of the stone. The Specifier or Buyer should request all samples and submission of stone be accompanied by the following in writing:

7.7.1 Actual name of stone and name of stone as applied by the Quarrier, as well as alternate names of stones in the marketplace, if any are known.

7.7.2 Country or state of origin.

7.7.3 Quarrier, if known.

7.7.4 ASTM test data or European equivalent for first evaluation purposes.

7.7.5 Age of sample, if known.

7.7.6 References of where this stone has been used near where the job may be located.

7.7.7 Photos of slabs showing more range of the material and other finishes available. Define whether there is more than one quarry and bed level of quarry where this stone is located.

7.8 This information will assure the Specifier of writing a specification that will control that the material being specified will indeed be the stone to be used on the job.

Note: As an example, specifying White Carrara (a generic name with over 30 quarries, and each quarry having possibly 4 selections) is meaningless if all the other information is not supplied.

7.9 Viewing Samples. When natural stone samples are viewed for approval, the viewer should be no closer than 6 ft. (2 m) from the sample surface and viewing from an angle normal to the surface. Natural light is preferred, striking the samples at an angle normal to the surface.

8.0 COST

8.1 Pricing Stone for the Job. A key factor in determining which stone to use will be the price. Today, thanks to the development of new technologies, stone is plentiful and competitively priced. There are many alternatives in stone selection, with a range of prices to fit any budget. The Specifier should ask for a budget price when initially considering a stone for the stone only. In the final consideration and determination, the Specifier should know the real cost of the stone based on the design and its installation costs to see if the stone fits into the budget of the job.

8.2 Size of stone is also important. Not all stones are available either in the size being designed or to get the best yield from the blocks or boulders. Price will be determined many times by the size and waste factor of the blocks in relation to the finished project.

8.3 Stone Thickness. In the past, buildings were erected using blocks or thick slabs. Now, cladding systems make it possible to use panels only ¾" or 1¼" thick, and with a notable reduction in the cost of stone. The thickness of the stone will be determined by engineering and the anchoring system for the specific stone.

8.4 Modular thin stone tile, a product of modern technology cut to a thickness of only 1 cm, is suitable for many applications and is competitive in price. These panels and tiles compare very favorably with other natural and manufactured products available for

construction, and have the added advantage of conferring character and durability to the structure.

8.5 Multiple Factors Affect Price. Many factors determine the price of a particular stone. Availability, ease of extraction, market demand, quality, and transportation are a few of the variables that will affect the price. This is an advantage when cost is important, for there is always the possibility to select alternatives offering essentially the same desired characteristics. Availability is important to check to determine whether the stone is still quarried, is available in the quantity required, and in the time frame of installation of the project. Sometimes the more limited the availability, the higher the cost. If the stone is only available from one company, the Producer can demand a very high price and the Specifier should be made aware of this.

8.6 Other factors affecting the cost on large projects may include:

8.6.1 Quantity allowed for storage or attic material.

8.6.2 Extra material needed in the event of damages, improperly fabricated material, or other reasons replacement material might be needed.

8.6.3 Determination of who will pay taxes may be an issue and should be clarified.

8.6.4 Availability of a storage facility at the jobsite that is of adequate size to properly and securely store material until job is complete.

8.6.5 Consult with your local MIA Member to review these and other costs that factor into the overall project budget.

9.0 MAINTENANCE

9.1 General. Maintenance of the stone after it is installed is commonly forgotten. The Specifier should be aware of the maintenance required to maintain the color and finish of the stone for years to come. Ask the Stone Supplier and Salesperson for maintenance suggestions or requirements. Investigate with authoritative maintenance companies what they recommend for a specific stone and the cost factors involved in maintaining the stone. The more knowledgeable the Specifier and End Buyer are about stone maintenance, the longer and happier all parties will be in giving the Owner a quality finished job that will last for years to come.

9.2 Sealers. If sealers are to be used, have the stone tested to ensure in writing the sealer's performance for the stone and application of the stone intended. New surface and penetrating sealers are becoming available on the market every year.

9.3 Maintenance and Cost. The maintenance issues for a specific stone and the cost attributed to it can vary from one type to another, and may impact the decision to use that stone in a particular application.

MIA Bookstore Resources:

Reprints of this chapter, along with the Stone Testing chapter, can be purchased in a separate publication from the MIA Bookstore. The "Stone Selection & Stone Testing" technical module includes the contents of both chapters and additional illustrations and pictures.

Two MIA-produced, consumer-focused brochures are available on the use and care of natural stone: "Beautify Your Home with Natural Stone (A Guide to Choosing Natural Stone and a Qualified Stone Contractor)," and "Care & Cleaning of Natural Stone Surfaces." Stone professionals can purchase both of these brochures from the MIA Bookstore.