

# Writing quality stone specifications

With stone continually being used in new and unique applications, writing quality specifications is critical to ensure a successful installation

BY DONATO POMPO

Even though natural stone consumption is down due to the soft economy, it has continued to grow in overall popularity. Natural stone is being used in more and more applications, and there are an abundance of products emulating natural stone. As the usage of natural stone increases, and its installation products and methods change, it is very important for natural stone specifiers to be current and accurate in their specifications.

It is important to note that not all stone materials are suitable for all applications. New installation products for these materials are changing rapidly, so it isn't a simple process to determine what stone should be used and where — or how it is to be installed. In addition, the labor factor is of vital concern, since most failures are generally related to installer error. The solution to all of these potential challenges has not changed. It is still as important as ever for the specifier to have good quality specifications with detailed, thorough and clear quality assurance and quality control sections in their specifications to achieve good quality stone installations.

## SELECTION AND SPECIFICATION PROCESS

Quality control begins with the selection process. First you need to understand the application. Next you need to understand

the recommended usage and limitations of the intended products that you want to use. Obviously, as a finish material, aesthetics will play a major part in the selection process, but only those products suitable for the intended use should be considered. This is where qualified consultants and reliable suppliers should be utilized not only to obtain information, but to help qualify and substantiate that the products are suitable for the intended application. High-risk applications such as exterior veneers, ceilings, exterior decks over occupied space, high-traffic or heavy-duty applications, showers, swimming pools and other water features should require the services of a qualified consultant to help the architect understand their options and to avoid potential problems.

Next is to write a thorough and clear specification, so as to avoid the all-too-common ambiguities found in many stone specifications. Some architects feel reference standards are the best approach, and they are certainly easier for the specifier, so they then only make reference to those general standards. Although listing industry standards is important, it is necessary to have a performance specification to ensure the products used are suitable for the intended application and will perform as intended. Many standards are very broad and result in products that can vary substantially in performance, but still meet

the standard. Considering the relatively high replacement costs for stone installations due to the high material and labor costs, the delays and loss of use, it justifies specifying better quality products to be used on projects to help compensate for other potential imperfections and deficiencies during the installation process. It is also important for the same reasons to have a detailed, clear and thorough quality assurance section and field quality control plan to be implemented by someone other than the installer.

Whether you are the architect, owner, general contractor or the installer, it is in everyone's best interest to make sure that the building stone being used is suitable for the intended application, that the configuration and method of installation is suitable for the application, and that the stone is installed correctly. When there is a problem with a stone installation, it doesn't matter who's at fault, because everyone will end up paying either in their time defending their position, or in contributing to a settlement, or in reputation by having been involved with a failed stone installation.

## TESTING

There are a number of relatively common types of failures in stone applications that can easily be avoided by preparing proper installation specifications that include



The installation products and methods for natural stone are continually changing, and it is very important for natural stone specifiers to be current and accurate in their specifications.

complete and detailed quality assurance and quality control sections. For example, some types of stone don't hold up to various levels of acid rain and/or freeze-thaw conditions, so there are accelerated weathering tests (modified ASTM C666) that can be performed to replicate those expected conditions to verify how the stone will hold up over time and whether it is suitable for the intended application.

Some stones are moisture sensitive and can result in curling or doming when adhered, so there is a moisture sensitive test (EN 14617-12) that can be performed to determine what type of adhesive to use.

Depending on the application, the amount of pedestrian and/or vehicle traffic a stone is subjected to can wear and show traffic patterns that can also effect the stone's slip resistance, so there is an

abrasion test (ASTM C1353) and coefficient of friction test (A137.1- DCOF AcuTest) that can be performed.

If a stone is not adhered correctly it could result in a Life and Safety problem, particularly for a vertical or ceiling application. Improper adhesion can also mean that a stone will not perform as it should for a floor application. For adhered applications there are bond tests (modified ASTM C482 and modified ANSI A118.4-5.1) that can be performed to make sure the stone is bondable, particularly when the stone has a resin backing.

There are anchor tests (ASTM C1354) for stone to ensure that the type and configuration of stone and anchor you intend to use will perform as designed. On stone slab applications for exterior facades, which are being mechanically anchored, the thickness of the respective preferred

stone can be increased in order meet the design and performance requirements. Performing quality assurance testing before the stone is installed provides an opportunity to adjust the specification and avoid costly delays and problems.

There are field tests that can be performed to determine if the stone being installed is meeting the building code requirement for shear bond strength as is described in ASTM C1242-12a. Performing quality control testing during the stone installation process provides an opportunity to catch mistakes early on and avoid costly problems.

#### **SETTING EXPECTATIONS**

In some cases there are false expectations. The specifier and/or client might have certain unrealistic expectations of what they are getting. Stone is a natural product



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For high-risk applications like adhered exterior veneers, field shear bond testing should be required as stated in ASTM C1242-12a.

and can have various natural inclusions and other characteristics. How a countertop is fabricated from a slab of stone has limitations as well, so it is important to have shop drawings and require the client, or their representative, to approve the layout using the actual stone being used.

The Construction Specification Institute (CSI) MasterFormat and Section-Format provides the structure for good quality specifications, which if used correctly and thoroughly, will produce good quality stone installations.

## **PART 1 - GENERAL SECTION**

Part 1 - General Section of the CSI document is important for several reasons. First, it is important to reference the key and relevant standards for the stone industry.

Recommended Practices for the Use of Natural Stone in Construction from the Building Stone Institute (BSI) is a good reference document. So is the Indiana Limestone Handbook from the Indiana Limestone Institute (ILI) and the Dimension Stone Design Manual from the Marble Institute of America (MIA). These publications should always be referenced for any stone application. MIA references the key ASTM standards that apply to stone.

In particular, the ASTM standards relative to the physical properties of the various geological classifications of stone should be referenced. Since natural stone is just that, a natural product, the physical properties and visual characteristics of a stone can vary significantly in any particular geological classification. Depending on where the stone quarry is located geographically and which part of the quarry is mined, the physical properties and visual characteristic of stone can differ substantially. The MIA Design Manual shows that each classification of stone, such as



Mock-ups can serve as a critical component in the specification process. Pictured is an adhered veneer mock-up.

granite, marble, limestone, travertine, slate, etc., has its own ASTM material specification, which basically defines the benchmark for being a standard-grade material. It states what the minimum/maximum requirements are for each relevant key physical property and specifies the appropriate ASTM test protocol for measuring it.

ASTM C1528 Standard Guide for the Selection of Dimension Stone should also be referenced for any type of a stone application. The C18 ASTM Stone Committee just updated this standard to include interior applications of stone as well as exterior applications. This guide presents a cursory review of the different stone types commonly used in construction, common applications, available finishes and factors affecting product costs.

ASTM C1242-12a Standard Guide for Selection, Design, and Installation of Dimension Stone Attachment Systems should be referenced whether it is a stone mechanical anchored application or a stone adhered application.

For adhered applications of stone tile, the Tile Council of North America (TCNA) Handbook for Ceramic, Glass, and Stone Tile Installation should be referenced. In the past, the TCNA Handbook only referenced ceramic tile, although many of the details and applications were recommended by the MIA and commonly used for stone applications. The current TCNA Handbook now has a very large selection on stone tile, along with an installation guide with specific installation details for stone in all of the various applications. MIA collaborated with TCNA in standardizing this stone tile information for both the TCNA Handbook as well as for the MIA Dimension Stone Design Manual tile standards. The ASTM C1242 standard also covers adhered applications of natural stone.

ANSI A108, A118, & A136, the American National Standards Specifications for the Installation of Ceramic Tile should be referenced in all ad-



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Mechanical-anchored applications need a quality control process as well to make sure the anchors are being installed and adjusted correctly.


detailing the installation of various methods and materials.

The National Stone Council, with the help of NSF International, is in the process of creating the NSF International and National Stone Council Standard for the Sustainability Assessment for Dimensional Stone. Natural stone has some huge features and benefits in terms of environmental sustainability, considering their material makeup, how they are produced, and their long life cycle. The ANSI A108 committee has recently created a new ANSI A138.1 Specification for Sustainable Ceramic Tiles, Glass Tiles and Tile Installation Materials, further


hered stone tile applications. This set of standards are referenced in the TCNA Handbook, and in the MIA Design Manual, which define the installation of stone tile as well as the test methods and physical properties for tile installation materials. Many of

these methods and materials apply to the installation of stone tile and should be followed. ANSI A108 not only provides standards for sub-surfaces and preparations by other trades, but it provides standards for materials and workmanship, as well as

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qualifying the LEED points earned by use of the tile installation products.

### **SUBMITTALS**

Submittals as a part of the quality assurance specification section are very important. Quality assurance is not a cut-and-paste section. This section needs to be project, product and application specific. The physical properties and suitability of products need to comply with standards, and they need to be verified. Too often, products like natural stone are imported without verifying physical properties and suitability, and they are sold based on price and appearance rather than standard grade requirements and suitability. Aesthetics are important, but suitability is critical. Samples representative of what will be supplied for the project need to be submitted and verified before they are delivered to the project site. Too often, owners are forced to live with something different from what was intended. By the time a product is delivered to the jobsite, the delays and

costs to replace it are prohibitive, and even more so if the product gets installed before a deficiency is noticed. Field mock-ups should be required and used as the quality control standard for color range and other visual requirements such as tile lippage, layout and other workmanship requirements. Required warranties should be specified, provided in writing and clearly stated. Warranties are never no-fault insurance; there are always conditions and limitations, so the warranty requirements must be incorporated within the quality control process to make sure the materials are being stored, prepared and used as required. Following industry standards is always a requirement of the warranty.

### **TRAINING**

A very important quality assurance requirement that is often left off is requiring and verifying that the installers understand the industry standards that they are expected to follow. Often, installers learn on the job and don't have any type of formal

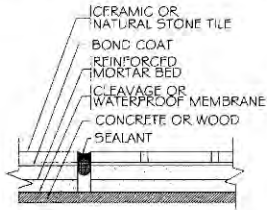
training. On larger jobs, a group of installers will likely have varying levels of skills and experience. They may have the mechanical skill set to do the work, but they are likely limited in fully understanding the complexity of the work or knowing the industry standards that they are expected to follow. Standards have been created by industry consensus committees to help avoid problems and ensure successful installations. If the installers don't know the standards, then how can they avoid those potential problems? It should be specified that the installers working on that project are required to verify that they went through a training program to review industry standards and the quality control plan for the project.

### **SUPERVISION**

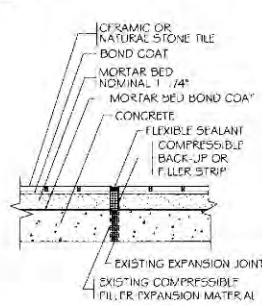
Compounding the lack of experience and lack of understanding the industry standards is the reality that subcontractors often don't provide enough qualified supervision to manage their work force. This applies to both mechanical-anchored stone applica-

## EJ171 MOVEMENT JOINT GUIDELINES FOR CERAMIC, GLASS, AND STONE

Expansion Joint

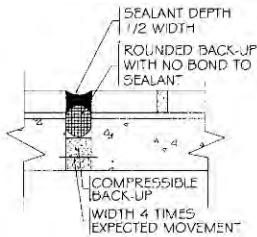


EJ171C-11 Expansion Joint, Cement Mortar Bonded



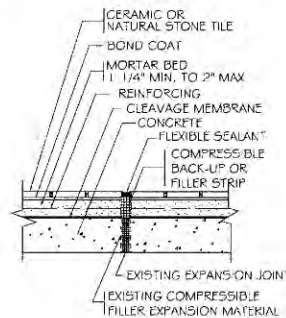
EJ171E-11

Expansion Joint



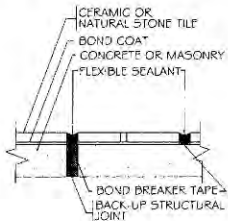
EJ171-11

Expansion Joint, Cement Mortar, Cleavage Membrane



EJ171H-11

Isolation/Expansion Joint



EJ171D-11

Guidelines for type and frequency of movement joints are listed in TCNA Handbook detail EJ171.

tions as well as adhered stone applications. There typically isn't enough full-time, non-working, supervisors managing workers. Supervisors normally don't have any formal training either, and they may be limited in their ability to manage the workforce. They should not only be managing the work, but they should be supervising the installers — making sure they are following (or teaching them to follow) the specifications and industry standards.

### QUALITY CONTROL PLAN

Part of the quality assurance is to specify that a quality control plan is established and implemented by someone other than the installer. A qualified third party repre-

senting the owner is preferable. Part of the quality assurance is to verify that the product and application will perform as intended. For high-risk applications like adhered exterior veneers, field shear bond testing should be required as stated in ASTM C1242-12a. The ASTM C18 Stone committee is finalizing a new ASTM test protocol for field shear testing adhered stones so it can be used as a field quality assurance test method. Mechanical-anchored applications need a quality control process as well as to make sure the anchors are being installed and adjusted correctly.

### PART 2 - PRODUCTS SECTION

Part 2 - Products Section of the CSI docu-

ment is important for one primary reason. It gives the architect the opportunity to specify products that will not only perform as required, but can be competitively priced. Performance-based specifications allow quality and performance to be specified without being locked into a high-priced proprietary product. The reference standards allow the lowest acceptable performing product to be used, which is normally the cheapest and least-performing product. Some standards such as ANSI A118.4 for Latex-Portland Cement Mortar lists the minimum requirements for latex or polymer modified thin-set mortar adhesives. This standard doesn't discern between the least expensive/performing products and the more expensive/performing products, which is a huge gap in performance and price. If you simply specify meet ANSI A118.4 without qualifying performance, then some bidders will base their bid on the least expensive product rather than what is best for the intended application. The ANSI committee is working on adjusting the standard so a specifier can specify the level and type of performance required for the thin-set mortar. The TCNA Handbook has recently added the ISO 13007 Standards for Adhesives and Grouts as an appendix. Cementitious mortars can be designated and specified to clearly show the level of performance and type of performance required for a particular project to include level of bond strength, faster setting, extended open time, slip resistance (non-sag), level of deformability and suitability and level of performance for adhering to plywood.

### RESIN-BACKED STONE

Another relatively common issue that comes up today with natural stone tiles is that they may be supplied with a resin/fiberglass reinforced back. Stone processors will apply the resin/fiberglass on the back of



some relatively fragile stone tiles and slabs before they ship the material to avoid damage during the transportation and handling process. The problem is that there is no standard for these resins, and different stone processors use different resins. Some resins are not compatible with thin-set mortar adhesives and don't provide an adequate bond — even if they cut grooves into the back of the stone as some do. On their data sheets, thin-set adhesive manufacturers always state the need to use epoxy adhesives when adhering resin back stone, unless they have had a chance to test the resin back stone with their thin-set mortars to see if they are suitable for that particular stone.

### **PART 3 - EXECUTION SECTION**

Part 3 - Execution Section of the CSI doc-

ument is not only important, but critical. This is not a cut-and-paste section either. This is a section where the architect needs to clearly specify the appropriate details and steps for each type of stone application. Consistent with the ANSI A108 standards, the substrates to which the tile is attached need to meet requirements and tolerances in order for the installer to be able to provide a satisfactory installation. Proper preparation of the substrate needs to be clarified, which will always require cleaning, but may require scarifying the surface to remove any contaminants and opening of the concrete pores to allow for an adequate adhered attachment. Installing over cracks is never acceptable. Structural cracks need to be repaired by the general contractor and shrinkage

cracks need to be isolated with a membrane per TCNA detail "F125 Stone" for adhered applications. Substrates also need to be inspected and properly prepared for mechanical anchored applications. Expansion joints and control joints must continue through the stone assembly. Specific TCNA installation method details need to be specified for each adhered application, taking into consideration the type of substrate, whether it is on-ground or a suspended floor, a wall over solid or framed backing, interior or exterior, and whether it is a wet or dry application. Shop drawings that are code compliant and approved by a structural engineer are required for all stone mechanical anchored applications. Workmanship standards need to be specified in terms of proper stone layout,

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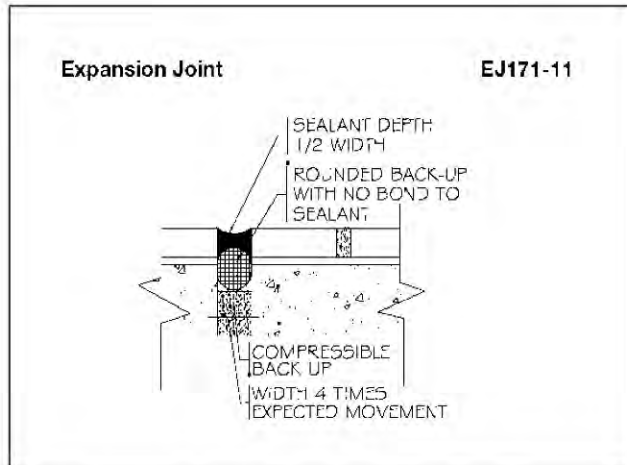
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Expansion joints and controls joints must continue through the stone assembly.

tolerances such as lippage, acceptable clean-up and safe and proper protection of work and adjacent areas.

### MOVEMENT JOINTS

Don't forget movement joints. These are often left out of projects and are always considered a contributing factor to many failures. The TCNA Handbook detail EJ171 states, "because of the limitless conditions and structural systems on which tile can be installed, the architect or designer shall show the specific locations and details of movement joints on project drawings." Tile installers are not engineers. They can follow specifications, but it is beyond the scope of their work to design movement joints for stone installations. TCNA EJ171 provides plenty of details and information as a guideline for architects to follow in their specification. Guidelines for type and frequency of movement joints are listed as well as type of sealant that should be used depending on the application. MIA also recommends that TCNA EJ171 is specified for stone installations.

### FIELD QUALITY CONTROL PLAN

Having a Field Quality Control Plan is critical. This is not a general cut and paste section. A quality control plan is project specific that thoroughly specifies, in detail, the quality control process, steps and testing that is required on the project during

the stone installation process. The objective is to avoid costly delays and problems and to catch problems before they become contributing defects in a costly failure. Remember, when there is a problem, it doesn't matter who is at fault. Everyone pays in one way or the other.

First, you need a good quality control plan, but second, and more importantly, you need to have a qualified inspector implementing the plan. A good, qualified inspector should have installation experience as well as being very knowledgeable of the stone industry standards. The quality control process

is actually a great training program for the installers working on the project. As the quality control inspector implements the plan, installers benefit by learning industry standards and the correct methods for installing the stone. The installers also benefit from the inspector's experience and knowledge that they gain from the inspector's input. At the end of a job with a good quality control plan, the stone installers are more knowledgeable and proficient at their work, and that should follow them to their next project.

The installing company should have their own internal quality control plan to limit their exposure and costs, and to perpetuate their reputation as a quality installation company. In the past, installers were not able to easily and affordably learn industry standards and acceptable installation methods. But now, with online courses available that teach and verify that the installers know the industry standards, it should be a requirement on every project. ■

### About the Author



Natural stone expert and consultant, Donato Pompo CTC CSI CDT MBA is the founder of Ceramic Tile and Stone Consultants (CTaSC) and of the University of Ceramic Tile and Stone (UofCTS). He has over 35 years experience in the ceramic tile and stone industry from installation to distribution to manufacturing of installation products. CTaSC provides forensic investigation services and quality control services for products and installation methods to include writing specifications, training programs, testing and on-site quality control inspection services. CTaSC is a professional consulting company of expert consultants comprised of accomplished ceramic tile consultants, stone consultants, ceramic tile and stone installers, architects, engineers, general contractors, construction scientists and other industry specialists located throughout the U.S. and Canada. The UofCTS offers a range of online courses, including the online Tile Installer Thin-set Standards (ITS) Verification course for tile installers, taught in either English or Spanish. For more information, visit [www.CTaSC.com](http://www.CTaSC.com), E-mail [Donato@CTaSC.com](mailto:Donato@CTaSC.com) or call 866-669-1550.

### Resources

The BSI reference documents can be obtained at [www.buildingstoneinstitute.org](http://www.buildingstoneinstitute.org). The ANSI and TCNA standards can be purchased at [www.TileUSA.com](http://www.TileUSA.com); The MIA Dimension Stone Design Manual can be purchased at [www.marble-institute.com](http://www.marble-institute.com). ASTM standards can be purchased at [www.astm.org](http://www.astm.org). The Indiana Limestone Institute references can be found at <http://www.ilial.com>.