

# MARBLE

## 1.0 GENERAL

### 1.1 Related Documents

Drawings and general provisions, including General and Supplementary Conditions of the Contract and Division I Specification sections, apply to this section.

### 1.2 Applicable Publications

The following publications listed here and referred to thereafter by alphanumeric code designation only, form a part of this specification to the extent indicated by the references thereto:

1) **ASTM International (ASTM):**

C503-99e1 Standard Specification for Marble Dimension Stone (Exterior)

C97-02 Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone

C99-87(2000) Standard Test Method for Modulus of Rupture of Dimension Stone

C170-90(1999) Standard Test Method for Compressive Strength of Dimension Stone

C241-90(1997) Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic

C880-98 Standard Test Method for Flexural Strength of Dimension Stone

2) **Marble Institute of America (MIA):**

Membership, Products, and Services Directory, Dimension Stone Design Manual, Dimension Stones of the World, Volumes I and II (includes color plates, ASTM test data, and other technical information). Additional publications may be available from the MIA Bookstore—go online at [www.marble-institute.com](http://www.marble-institute.com).

### 1.3 Scope of Included Work

The work to be completed under this contract includes all labor and materials required for the furnishing and installation of all marble work shown or called for on the contract drawings, specifications, and addenda.

### 1.4 Definition of Terms

The definitions of trade terms used in this specification shall be those published by the MIA or ASTM International.

### 1.5 Source of Supply

All marble shall be obtained from quarries having adequate capacity and facilities to meet the specified requirements and by a firm equipped to process the material promptly on order and in strict accord with specifications. The Specifying Authority (architect, designer, engineer, contracting officer, end user etc.) reserves the right to approve the Material Supplier prior to the award of this contract. Stone and workmanship quality shall be in accordance with Industry Standards and Practices as set forth by the MIA.

### 1.6 Samples

The Marble Contractor shall submit through the General Contractor, for approval by the Specifying Authority, at least two full range sets of samples of the various kinds of marble specified. Sample submittals shall represent the full range of color and markings inherent in the material proposed for fabrication of the project. Full range sample sets must be reviewed and approved as a

complete set and not as individual pieces. Full range sample sets shall be indicative of the true character, including any natural variation in background and foreground color, veining or graining, of the material currently available and proposed for use on the project. The sample size shall be 1'-0" x 1'-0" minimum, 2'-0" x 2'-0" minimum for heavily veined or varied stones, and shall represent approximately the finish, texture, and anticipated range of color to be supplied. Where necessary to show variations in color and markings, larger samples or range sets of samples should be submitted. If marble is to be matched, a minimum of two sets each containing four matched samples showing proposed veining and range of color in each set must be supplied. Samples designating finished face shall be clearly labeled on the back with the name of the marble, the group classification for soundness, and the use for which the marble is intended. One set of samples shall be retained by the Specifying Authority, and one set shall be returned to the Marble Supplier for his/her record and guidance. It is noted herein that marble is a natural material and will have intrinsic variations in color, markings, and other characteristics. Depending on the marble selected and quantity required, a range mockup may be used to further define the characteristics of the material. Cost of mockup, if required, shall not be included in this section. Prior to fabrication, and to assure the end user's needs will ultimately be met and to fully understand the finish and full range of the material, an inspection and approval by the Specifying Authority and/or General Contractor and/or End User of the material is recommended. Costs for an initial inspection of the quarried blocks before slabbing, and a second inspection of the finished material slabs before fabrication shall be stipulated and included in the overall contract requirements.

## **1.7 Shop Drawings**

The Marble Contractor shall submit through the General Contractor, for approval by the Specifying Authority, sufficient sets of shop drawings showing general layout, jointing, anchoring, stone thickness, required setting spaces and such other pertinent information. These drawings shall show all bedding, bonding, jointing, and anchoring details along with the net piece dimensions of each marble unit. Due to tight fabrication tolerances of dimensional stone (see "Dimensional Tolerances" in this section) special attention must be paid to those areas where associated trade's work abuts or is integral with the stone installation. Additional notes calling out required set backs, setting space allowances below and behind floor and wall installations, critical "hold-too" dimensions, or any other specific conditions requiring strict coordination with other trades work should be incorporated into the shop drawings. Coordination of approved shop drawings with all affected trades is the responsibility of the General Contractor. One copy of approved drawings shall be retained by the Specifying Authority, one copy shall be retained by the General Contractor, and one copy returned to the Marble Contractor for fabrication. NO FABRICATION OF MARBLE SHALL BE STARTED UNTIL SUCH DRAWINGS HAVE BEEN FULLY APPROVED AND MARKED AS SUCH. The General Contractor shall furnish all field dimensions necessary for fabrication. If measurements are not established and guaranteed in advance, the Marble Contractor shall obtain and verify measurements at the building. The General Contractor shall be responsible for all reasonable assistance to the Marble Contractor, including the services of an Engineer, if required, for the establishment of levels, bench marks, and the like. The Marble Contractor shall not be responsible for determining, making, or verifying (1) design, structural, wind, seismic, or other design loads; (2) engineering estimates; (3) plans or specifications; or (4) the types, sizes, or locations of anchors, unless specifically added to the scope of work.

## 1.8 Defective Work

Any piece of marble showing flaws or imperfections upon receipt at the storage yard or building site shall be referred to the Specifying Authority for determination as to responsibility and decision as to whether it shall be rejected, patched, or redressed for use.

## 1.9 Repairing Damaged Stone

Small chips at the edges or corners of marble may be patched provided the structural integrity of the stone is not affected and the patch matches the color and finish of the marble so that the patch does not detract from the stone's appearance. More extensive repairs may be required for certain Class C & D marbles and are acceptable pending above stipulations.

## 2.0 MATERIALS

### 2.1 Marble

**General:** All marble shall be of kind or kinds shown on the Architect's drawing or as specified herein, conforming to or within the range of approved samples and in accordance with the characteristics and working qualities set forth under their respective Soundness Group Classifications, A, B, C, or D, as defined by the Marble Institute of America. Some Class C & D marbles, while prized for their vibrant colors and bold veining, are more apt to require patching and repair due to the physical limitations of these highly veined materials. Care shall be taken in selection to produce as harmonious effects as possible. Patching and waxing, where permitted under the Marble Institute of America Group Classifications, shall be carefully done to conform to the marble's general character and finish. Texture and finish shall be within the range of sample(s) approved by the Specifying Authority. ASTM C503 [C97] [C99] [C170] [C241] [C880]. See the chart of applicable ASTM standards and tests in the Appendix.

**Schedule:** Marble shall be provided as follows:

1) For (*state location on building*) (*state name and color*) marble with a (*type*) finish, supplied by (*name company or list several approved suppliers*). 2) Provide information as in (1) for each different marble/finish combination in the project.

**Finishes:** Finishes listed in the schedule shall conform with definitions by MIA or ASTM International.

**Polish finish:** A mirror like, glossy surface which brings out the full color and character of the marble. This finish is not recommended for exterior or commercial floor use.

**Honed finish:** A velvety smooth surface with little or no gloss.

**Abrasive finish:** A flat, nonglossy surface usually recommended for exterior use.

### 2.2 Setting Mortar (and Adhesives)

All proposed setting materials shall be tested by the Marble Contractor to assure that there is no staining to the specified stone. Light colored and green marbles are typically more susceptible to staining and require additional consideration to avoid damage to stone during installation.

**Portland cement** shall conform to the requirements of the Standard Specifications for Portland Cement, ASTM C150-02a. White Portland cement is recommended for white or light-colored marble. Nonstaining cement shall conform to the requirements of the Standard Specifications for Masonry Cement, ASTM C91-03. Molding plaster (plaster of Paris) shall conform to the requirements of the Standard Specifications for Gypsum Molding Plaster, ASTM C59/C59M-00.

**Sand.** All sand shall be clean, free from organic and other deleterious matter likely to stain the finished work, and shall be screened as required for the desired results.

**Portland cement shrinkage-reducing accelerator** used with Portland cement to give it the quick-setting characteristics of plaster of Paris, shall be a nonstaining admixture that will not corrode anchors or dowels.

**Nonstaining adhesive** shall be of a type that will not stain the marble, that is not affected by temperature changes or moisture, and that adheres with strong suction to all clean surfaces.

## 2.3 Pointing Mortar

Mortar for pointing shall be Type N, as defined in ASTM C270-03 (Standard Specification for Mortar for Unit Masonry). All mixing, handling, and pacing procedures shall be in accordance with ASTM C270-03.

## 2.4 Sealants and Backup Material (if applicable)

Where specified (*state type or name of sealant*) shall be used for the pointing of joints. The backup material used with the sealant shall be (*identify material*). Sealants, used for pointing to exclude moisture and provide a joint that will remain plastic for many years, shall be nonstaining.

## 2.5 Anchors, Cramps, and Dowels

Anchors, cramps, and dowels shall be made of corrosion-resistant metals. Special cramps, dowels, and the like shall be used where shown on shop drawings, but elsewhere, #8 copper or stainless steel wire anchors shall be used. It shall be the responsibility of the Marble Contractor to anchor all marble securely. For standing marble, the following practices usually prevail:

A minimum of four anchors should be provided for pieces up to 12 square feet, with two additional anchors for each additional 8 square feet of surface area. Shims used to maintain joints shall be plastic. Use of copper wire for anchors to be installed over 12' off the ground is not recommended.

## 3.0 FABRICATION

### 3.1 Dimensional Tolerances

Panel thickness of 3/8" or 1/2" .....  $\pm 1/32$ "

Panel thickness of 3/4" to 1-5/8" ....  $\pm 1/8$ "

Panel thickness >1-5/8" .....  $\pm 1/4$ "

Panel face dimension .....  $\pm 1/16$ "

Face variation from rectangular .....  $\pm 1/16$ "

(maximum out of square) (noncumulative)

Heads/calibrated edges .....  $\pm 1/16$ "

Quirk miters (width of nose):

Up to 1/4" ..... -0; +25% of dim

Over 1/4" ..... -0, +1/16"

Location of back anchors .....  $\pm 1/8$ "

Depth of back anchors ..... -0, +1/16"

Location of holes for precast anchors. ....  $\pm 1/4$ "

Hole depth for precast anchors .....  $\pm 1/16$ "

Anchor Slots:

From face to C/L of slot .....  $\pm 1/16$ "

Lateral placement.....  $\pm 1/4$ "  
Width.....  $\pm 1/16$ "  
Depth at maximum.....  $\pm 1/8$ "

Anchor Holes:

From face to C/L of slot .....  $\pm 1/16$ "  
Lateral placement.....  $\pm 1/8$ "  
Diameter .....  $\pm 1/16$ "  
Depth .....  $\pm 1/8$ "

Anchor Sinkages:

Depth.....-0,  $+1/8$ "

Continuous Kerfs:

From face to C/L of kerf.....  $\pm 1/16$ "  
Maximum bow in 4'-0".....  $\pm 1/16$ "  
Width.....  $\pm 1/16$ "  
Depth.....- $1/16$ ";  $+1/8$ "

Rebated Kerf:

Elevation of bearing surface..  $\pm 1/16$ "

Bearing Checks:

Elevation of bearing surface .  $\pm 1/16$ "

Bearing/Clearance Checks:

Lateral location .....  $\pm 1/2$ "  
Setback from face.....  $\pm 1/16$ "

### **3.1.1 Typical Unit Sizes**

Tile stock- 12" x 12", 16" x 16", & 18" x 18" nominal. Thickness of tile stock is typically 3/8" thick for most polished and honed surfaces. Large format tile stock (16" x 16" and larger) may only be available in 1/2" thickness and is dependant on the specific stone's properties and the material supplier.

Dimension Stone Slab Stock- Industry standard slab stock available in 2 cm & 3 cm (3/4" & 1 1/4" nominal) thickness. Typical slab sizes vary by material, but average 4'-0" x 8'-0" for marble. For specialty thicknesses or extremely large piece size requirements, the Marble Contractor should be consulted in the design phase to assure the design intent can be met. Typical maximum finished piece size is 3'-0" x 3'-0" +/-.

### **3.2 Flatness Tolerances**

Variation from true plane, or flat surfaces, shall be determined by a 4' dimension in any direction on the surface. Such variations on polished, honed, and fine rubbed surfaces shall not exceed tolerances listed below, or 1/3 of the specified joint width, whichever is greater. On surfaces having other finishes, the maximum variation from true plane shall not exceed the tolerance listed below, or 1/2 of the specified joint width, whichever is greater.

#### **Flatness Tolerances by Finish.**

Polished, honed, or fine rubbed..... $1/16$ "  
Sawn, 4-cut, 6-cut, and 8-cut ..... $1/8$ "  
Thermal and coarse stippled ..... $3/16$ "  
Pointed or other rough cut ..... $1$ "

Split face...dependent on piece size & stock

### **3.3 Beds and Joints**

Bed and joint width shall be determined by analysis of anticipated building movements and designed to accommodate such movements without inducing undue stresses in the stone panels or joint filler materials. Expansion joints shall be designed and located to accommodate larger movements.

### **3.4 Backs Of Pieces**

Backs of pieces shall be sawn or roughly dressed to approximately true planes. Back surfaces shall be free of any matter that may create staining.

### **3.5 Moldings, Washes, and Drips**

Moldings, washes, and drips shall be constant in profile throughout their entire length, in strict conformity with details shown on approved shop drawings. The finish quality on these surfaces shall match the finish quality of the flat surfaces on the building.

### **3.6 Back-Checking and Fitting to Structure or Frame**

The building design should incorporate stone installation requirements such as material thickness, setting space, and anchorage allowances. Maintain a minimum of 1 1/4" between stone backs and adjacent structure and allow for all components of the building structure (waterproofing, flashing, etc). (Note: many bolted connections will require more space than this; 2" space may be more desirable. Large-scale details should illustrate and control these conditions and be distributed by the General Contractor to the affected trades.)

### **3.7 Cutting for Anchoring, Supporting, and Lifting Devices**

Holes and linkages shall be cut in stones for all anchors, cramps, dowels, and other tieback and support devices per industry standard practice or approved shop drawings. However, additional anchor holes may be drilled at job site by Marble Contractor to facilitate alignment. No holes or linkages will be provided for Marble Contractor's handling devices unless arrangement for this service is made by the Marble Contractor with the Marble Fabricator. (NOTE: It is not recommended that Lewis pins be used for stones less than 3-1/2" thick.)

### **3.8 Cutting and Drilling for Other Trades**

Any miscellaneous cutting and drilling of stone necessary to accommodate other trades will be done by the Granite Fabricator only when necessary information is furnished in time to be shown on the shop drawings and details, and when work can be executed before fabrication. Cutting and fitting, due to job site conditions which are contrary to the dimensions and details shown on approved shop drawings are not the responsibility of the Marble Contractor and will be provided only by arrangement between the General Contractor and Marble Contractor.

### **3.9 Carving and Models**

All carving shall be done by skilled Stone Carvers in a correct and artistic manner, in strict accordance with the spirit and intent of the approved shop drawing, or from models furnished or approved by the Specifying Authority.

## **4.0 SHIPPING AND HANDLING**

### **4.1 Packing and Loading**

Finished marble shall be carefully packed and loaded for shipment using all reasonable and customary precautions against damage in transit. No material which may cause staining or discoloration shall be used for blocking or packing.

### **4.2 Site Storage**

It shall be the responsibility of the Marble Contractor to receive, store, and protect the marble from damage by others after it is delivered to the job site and prior to its erection in the building. All marble shall be received and unloaded at the site with care in handling to avoid damage or soiling. If marble is stored outside, it shall be covered with nonstaining waterproof paper, clean canvas, or polyethylene.

## **5.0 INSTALLATION**

### **5.1 General Installation**

Installation shall be accomplished with competent, experienced Stone Setters, in accordance with the approved shop drawings. All marble pieces shall be identified with a unique piece number corresponding with the number on the shop drawings. Interchanging of numbered pieces is not permitted as the pieces are generally blended for color and characteristic markings by the Marble Fabricator. Marble shall be free of any ice or frost at time of installation. Salt shall not be used for the purpose of melting ice, frost, or snow on the stone pieces. Adequate protection measures shall be taken to ensure that exposed surfaces of the stone shall be kept free of mortar at all times as elements in mortar may etch the polished surfaces of some stones. All setting materials shall be tested on the specified stone to assure there is no staining.

### **5.2 Mortar Setting of Marble**

#### **A. Floor Marble**

**Floor Preparation.** It is the General Contractor's responsibility to clean all sub floor surfaces to remove dirt, dust, debris, and loose particles immediately prior to setting marble floor and to ensure that the area to receive the stone flooring meets the deflection standards of the industry.

**Curing Compounds.** Curing compounds of any kind shall not be used on the slab on which floor marble is to be directly set. If a curing compound is present, it is the General Contractor's responsibility to remove it by scarifying the slab. Before being set, all marble shall be clean and free of foreign matter of any kind.

**Cement Bed.** The cement bed to receive the marble tile shall consist of 1 part Portland Cement to not more than 3 to 5 parts of clean, sharp sand mixed quite dry for tamping. White Portland cement is recommended for light-colored marbles.

**Marble Tamped.** The marble shall be tamped with a suitable mallet until firmly bedded to the proper level of the floor.

**Marble Removed.** The marble shall then be removed and the back parged with wet cement or the bed sprinkled with water and cement. In the latter procedure, the back of the marble shall be wet. The method of fully buttering edges of the marble as it is laid is equally approved.

**Joints.** Joints between the marble pieces shall show an even width when laid and finished.

**Traffic After Installation.** The floor shall be roped off for 24 hours after installation and then grouted with water and white Portland cement grout or nonstaining dry-set Portland cement grout.

**Time-Line for Additional Cleaning.**

Cleaning or additional surfacing, if required, shall not be undertaken until the new floor is at least seven days old.

**Thin-Set Method.** The thin-set method of installing marble tile employing the use of dry-set Portland cement mortars is recommended for thin marble tiles (nominal 3/8" thick) where optimum setting space is not available. Sub floor shall be clean, smooth finished, and level. Stone dust must be washed off the back face of stone pavers prior to installation. Apply mortar with flat side of trowel over an area that can be covered with tile while mortar remains plastic. Within ten minutes, and using a notched trowel sized to facilitate the proper coverage, comb mortar to obtain an even-setting bed without scraping the backing material. Key the mortar into the substrate with the flat side of the trowel. Comb with the notched side of the trowel in one direction. Firmly press stone tiles into the mortar and move them perpendicularly across the ridges, forward and back approximately 1/8" to 1/4" to flatten the ridges and fill the valleys. Ensure a maximum mortar thickness of 3/32" between stone tile and backing after stone tile has been tamped into place. Stone tile shall not be applied to skinned-over mortar. Alternatively, back butter the stone tiles to ensure 100% contact. In either method, ensure 100% contact on 3/8" tile; not less than 80% contact on 3/4" or thicker material, noting that all corners and edges of stone tiles must always be fully supported, and contact shall always be 100% in exterior and/or water-susceptible conditions.

**B. Interior Veneer Marble**

The marble shall be set by spotting with gypsum molding plaster or cement mortar and the use of concealed anchors secured in the wall backing. Special consideration may be required for penetrations to fire rated walls.

**C. Marble Wall Tile**

Individually set thin tile (nominal 3/8" thick) on vertical surfaces exceeding 8' is not recommended. Where thin marble tile is installed, nonstaining adhesives or dry-set mortars may be used as setting beds.

**D. Toilet and Shower Compartments**

Stiles and partitions shall be assembled with concealed dowel fastenings or corrosion resistant angles, three in height of stall. For ceiling-hung units, metal supporting members in ceiling are to be furnished and installed by the General Contractor.

**5.3 Mortar Joints**

Mortar joints shall be raked out to a depth of 1/2" to 3/4". Apply pointing mortar in layers not exceeding 3/8" and allow each layer to get hard to the touch before the next layer is



applied. Tool finished joints with a concave tool having a diameter approximately 1/8" greater than the joint width. Care shall be taken to keep expansion joints free of mortar, which would compromise their function.

## **5.4 Anchorage**

All marble shall be anchored or doweled in accordance with the approved shop drawings. To the furthest extent possible, all anchor preparations in the marble units shall be shop applied. All anchorage devices and anchor hole/slot fillers shall be in accordance with ASTM C1242-02. Care must be taken to ensure that any holes capable of retaining water are filled after use to prevent water collection and freezing.

## **5.5 Sealant Joints**

Where so specified, joints requiring sealant shall be first filled with a closed-cell ethafoam rope backer rod. The backer rod shall be installed to a depth that provides optimum sealant profile after tooling per manufacturer recommendations. If recommended by the Sealant Manufacturer, primers shall be applied to the substrate surfaces according to the manufacturer's directions prior to application of the joint sealant. A test should be conducted to assure that the specified sealant will not stain the stone. Typically, Sample pieces of stone with kerf cuts applied to the sample face representing the typical joint size (1/4" x 1/4", 3/8" x 3/8", 1/2" x 1/2" etc.) are filled with the specified sealant and allowed to cure for 24 to 48 hours. Any potential staining should be apparent at this point. Fully cured sealant samples will be submitted to demonstrate no staining to stone by the specified sealant.

## **5.6 Expansion Joints**

It is not the intent of this specification to make control or expansion-joint recommendations for a specific project. The Specifying Authority must specify control or expansion joints and show locations and details on drawings. Typically, expansion joints are required at 20'-0" intervals and should be determined by the design professional and the Marble Contractor.

## **5.7 Caulking**

Where so specified, joints shall be pointed with the sealant(s) specified in Section 2.4, after first installing the specified backup material and applying a primer if required, all in strict accordance with the printed instructions of the Sealant Manufacturer. All sealants shall be tooled to ensure maximum adhesion to the contact surfaces.

## **5.8 Weep Tubes**

Plastic or other weep tubes shall be placed in joints where moisture may accumulate within the wall, such as at base of cavity, continuous angles, flashing, etc., or as shown on architectural drawings.

## **5.9 Installation Tolerances**

The quality of the stone installation relies greatly on the quality and accuracy of those trades preceding stone installation. After review and approval, shop drawings shall be distributed and coordinated by the General Contractor to all trades whose work abuts, or is integral with the stone installation.

Variation in plumb:

Lines and surfaces of walls and columns:

..... 1/4" in 10'-0"

..... NTE 3/8" in story height

..... 1/2" in 40'-0"

Exterior corners or other conspicuous lines:

..... 1/4" in 10'-0"

..... NTE 1/4" in story height

..... 1/2" in 40'-0"

Variation from level:

Lintels, parapets, rustications:

..... 1/2" in column bay

..... 3/4" in 40'-0"

Variation from linear building line:

1/2" in column bay

..... 3/4" in 40'-0"

## **6.0 CLEANING AND PROTECTION**

### **6.1 Cleaning**

All cleaning methods shall be tested on material samples prior to application to the stone installation to assure there are no adverse affects of the cleaning method or products to the stone surface. Marble shall be cleaned after installation and all pointing or caulking is complete. All dirt, excess mortar, weld splatter, stains, and other defacements shall be removed. All cleaning methods shall be in accordance with ASTM C1515-01.

Marble Contractor should be contacted before cleaners other than neutral detergents are used.

### **6.2 Protection of Finished Work**

After the marble work is installed, it shall be the responsibility of the General Contractor to see that it is properly and adequately protected from damage or stains until all trades are finished. This responsibility includes the stone cleaning costs prior to the required final inspection. The Marble Contractor will outline the needs for protection, in writing, to the General Contractor. For the protection of projecting members, corners, window stools, and saddles, wood guards using lumber that will not stain or deface with marble shall be supplied, installed, and maintained by the General Contractor. All nails used shall be galvanized or nonrusting. Damage to finished marble by other trades shall be repaired or replaced at the expense of the General Contractor. Marble flooring shall be adequately protected by the General Contractor against traffic and other damage with nonstaining materials, without cost to the Marble Contractor. All marble work in progress shall be protected at all times during construction by use of a strong, impervious film or fabric securely held in place as required.