Installation - General Information

An excerpt from the *Dimension Stone Design Manual*, Version VIII (May 2016)

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INSTALLATION – GENERAL INFORMATION

1.0 INSTALLATION OF DIMENSION STONE

1.1 This chapter of the Marble Institute of America's Dimension Stone Design Manual includes general notes and references that apply to the installation of natural stone in both horizontal (walking surfaces, interior and exterior) and vertical (cladding, interior and exterior) applications. Chapter 14 references issues specific to the installation of horizontal surfaces, and chapter 15 references issues specific to the installation of vertical surfaces. This chapter should be used in conjunction with either chapter 14 or 15 to provide a complete discussion of the process if installing natural stone in a particular application.

2.0 STONE PRODUCT DEFINITIONS

2.1 Tile. A stone tile is a thin, flat piece of natural stone used as finishing material, with a thickness ranging from ¼" to $^{5}/_{8}$" (6 to 16 mm) inclusive, and having no dimension greater than 2'-0" (610 mm). Tiles are normally supplied in typical sizes, with all atypical pieces being field cut to fit.

2.2 Cut-to Size. Cut-to-size stone products, also referred to as "slab stock" stone products, are custom fabricated pieces of natural stone with any dimension exceeding the limits defined in the tile definition above. Fabrication of these products normally occurs in a shop setting, where each piece is custom fabricated to fit, but partial fabrication can also occur in the field at the time of installation.

2.3 Tolerances. Natural stone tiles and cut-to-size products may have different fabrication tolerances due to their different methods of fabrication. Refer to the specific stone description chapter for fabrication tolerances.

2.4 Labor Assignment. In most regions of the United States, the labor body responsible for installing a stone product will change pending if the stone product is a tile or a cut-to-size product. Labor jurisdiction practices vary regionally and locally, so research is encouraged to ascertain which labor group is assigned the field installation of a given product.

3.0 RELATED MATERIALS

3.1 Setting Bed Mortars

3.1.1 Portland Cement Mortar (Thick Bed)

3.1.1.1 Portland cement mortar is a mixture of portland cement and sand, roughly in proportions of 1:3 for floors, and of portland cement, sand, and lime in proportions of 1:5:½ to 1:7:1 for walls.

3.1.1.2 Installation Methods. Portland cement mortar is suitable for most surfaces and ordinary types of installation. The thick bed, 3/8" to 1½" on walls and nominally 1¼" on floors, facilitates accurate slopes or planes in the finished work. There are two equivalent methods recognized for installing stone tile with a portland cement mortar bed on walls, ceilings, and floors:

3.1.1.2.1 The method (ANSI A108.1A) that requires that the stone be set on a mortar bed that is still plastic.

3.1.1.2.2 The method (ANSI A108.1B) that requires the stone to be thin set on a cured mortar bed with dry set or latex portland cement mortar or a two-part, 100% solids epoxy.

3.1.1.3 Suitable Backings. Portland cement mortars can be reinforced with metal lath or mesh, backed with membranes, and applied on metal lath over open studding on walls or on rough floors. They are structurally strong, not affected by prolonged contact with water, and can be used to plumb and square surfaces installed by others. Suitable backings, when properly prepared, are brick or concrete masonry unit, concrete, wood or steel stud frame, rough wood floors, plywood floors, foam insulation board, gypsum board, and gypsum plaster. The one coat method may be used over masonry, plaster, or other solid backing that provides firm anchorage for metal lath.

3.1.1.4 Installation and Material Specifications. Complete installation and material specifications are contained in ANSI A108.1 for installation when bed is still plastic, and for cured float bed and thin set applications.

3.1.2 Thin-Set Mortar [Thin Bed (ANSI A118.1)]

3.1.2.1 Thin-set mortar is a mixture of portland cement with sand and additives providing water retention, and is used as a bond coat for setting stone.

3.1.2.2 Installation Methods. Thin-set mortar is suitable for use over a variety of surfaces. The stone should be properly tamped in place into the mortar, which will be one layer as thin as 3/32" after tamping. Thin set mortar has excellent water and impact resistance, can be cleaned with water, is nonflammable and good for exterior work.

3.1.2.3 Thin-set mortar is available as a factory-sanded mortar to which only water need be added. Cured thin set mortar is not affected by prolonged contact with water, but does not form a water barrier. It is not intended to be used in trueing or leveling the substrate surfaces as tile is being installed.

3.1.2.4 Suitable backings. When properly prepared and in sound structural condition, suitable backings include plumb and true masonry, concrete, gypsum board, cementitious backer units, terrazzo, cured portland cement mortar beds, brick, ceramic tile, and dimension stone. Existing control joints including divider strips shall be maintained. Polished, glossy, honed, or smooth backup surfaces shall be roughened by sanding or scarifying. See ANSI A108.01 General Requirements: Subsurfaces and Preparations by Other Trades.

3.1.2.5 Installation and Material Specifications. Complete installation and material specifications are contained in ANSI A108.5 and A118.1.

3.1.3 Latex-Portland Cement Mortar [Thin Bed (ANSI A118.4)]

3.1.3.1 Latex-Portland cement mortar is a mixture of portland cement, sand, and special latex additives which is used as a bond coat for setting stone tile.

3.1.3.2 Installation Methods. The uses of latex-portland cement mortar are similar to those of thin-set mortar. It is less rigid than portland cement mortar.

3.1.3.3 When latex-portland cement mortar is used to install stone in a wet area that may not thoroughly dry out in use (e.g., swimming pools and gang showers, etc.), it is recommended that the complete installation be allowed to dry out thoroughly (cure) before exposure to water. Consult the thin-set manufacturer for curing instructions. Latexes vary considerably, and the directions of the latex Manufacturer must be followed explicitly.

3.1.3.4 Suitable backings (See 3.1.2.4 above).

3.1.3.5 Installation and Material Specifications. Complete installation

specifications and material specifications are contained in ANSI A108.5 and ANSI A118.4.

3.1.4 Epoxy Mortar (ANSI A118.3)

3.1.4.1 This is a thin bed mortar system employing epoxy resin and epoxy hardener portions. A two- part, 100% solid epoxy is to be used as the setting bed for green colored marbles, serpentine stones susceptible to warping and for any fiberglass mesh-backed tiles.

3.1.4.2 Suitable Backings. Acceptable substrates, when properly prepared and structurally sound, include concrete, APA rated Exposure 1 underlayment grade plywood*, steel plate, and ceramic tile. Application is made in one thin layer. Pot life, adhesion, water cleanability before cure, and chemical resistance vary with manufacturer.

3.1.4.3 Installation and Material Specifications. Complete installation and material specifications are contained in ANSI A108.6 and ANSI A118.3.

3.1.5 Limestone Setting Mortar. Cement used with limestone shall be white portland cement, ASTM C150, or white masonry cement, ASTM C91. Nonstaining cement shall contain not more than 0.03% of water-soluble alkali when determined in accordance with procedure 15, calculation 16 of ASTM C91 or Federal Specification SS-C181C. However, if a large amount of normal cement has been used in the backup material, and if an effective water barrier has not been provided between the stone and the backup, the use of nonstaining cement may not prevent all discoloration. Discoloration will disappear as the stone dries. The Indiana Limestone Institute recommends a 1:1:6 (portland: lime: sand) or Type N mortar be used with Indiana Limestone. At the present time, there are few masonry cement mortars produced labeled "nonstaining."

3.1.6 Setting Bed. White portland cement with low alkali content is required for all light colored stone varieties.

3.2 Grouts Between Stones

3.2.1 Commercial Portland Cement Grout ("Unsanded Grout")

3.2.1.1 Commercial portland cement grout is a mixture of portland cement and other ingredients, producing a water-resistant, dense, uniformly colored material. There are two types: white and gray. Damp curing is advantageous for both wall and floor types.

3.2.2 Sand-Portland Cement Grout ("Sanded Grout")

3.2.2.1 Sand-portland cement grout is an on the job mixture of one of the following proportions: one part portland cement to one part clean, fine-graded sand (ASTM C144) used for joints up to 1/8" wide; 1:2 for joints up to ½" wide; and 1:3 for joints over ½" wide. Up to 1/5 part lime may be added. Damp curing is necessary. Sand-portland cement grout should be applied with caution over softer varieties of stone with honed or polished finishes because it may scratch the stone surface.

3.2.3 Polymer Modified Portland Cement Grout (ANSI A118.7)

3.2.3.1 Polymer modified portland cement grout is a mixture of any of the preceding grouts with polymer admixtures. The common polymer types are latex and acrylic. This grout is suitable for all installations subject to ordinary use and for most commercial installations. The use of

* APA- The Engineered Wood Association, Voluntary Production Standard PS 1-07 Structural Plywood.

polymer additives in portland cement grout increases the flexibility of the grout and reduces the permeability. Consult the grout and polymer manufacturers for specific instructions. It is less absorptive than regular cement grout.

3.2.4 Colored Grouts

3.2.4.1 Many manufacturers offer grouting materials in colors. Architects and Designers find them pleasing for aesthetic reasons. Since some stones are more porous than others, test to determine the stability of the relationship between the colored joint filler and the stone before proceeding. Make certain pigments contained in the colored grout do not stain the stone.

3.3 Sand. Sand should comply with ASTM C144.

3.4 Water. Mixing water must be potable quality.

3.5 Stone Sealants, Backing Rods, and Caulking

3.5.1 Building sealants are normally covered as a separate section in project specifications, and in most trade areas the installation of sealants is not in the trade jurisdiction of Marble Mechanics and Stonemasons. Grouting is almost always in the stone specification.

3.5.2 Silicone Sealants. Some grades of silicone sealants are not recommended by their manufacturers for application on high calcite content materials. Consult the Sealant Manufacturer's technical recommendation before applying a given sealant to calcite materials.

3.5.3 Severe service areas (patios, decks, traffic surfaces) should be caulked with materials having sufficient abrasion resistance. Consult Sealant Manufacturer's technical recommendations for sealants in these areas.

3.5.4 Oil based organic sealants should not be used in conjunction with natural stone products because they may stain the stone.

3.5.5 Sealing the Face of the Stone. Nothing in this section is intended to imply that actual sealing of the faces of the stones is a recommended practice. If any sealer coating is specified for any natural stone material, advice should be sought in detail from qualified Stone Suppliers or Installers (See Ch 3, pg. 3-5, section 5.10).

3.5.6 Joint Filler. An important feature in the determination of the joint sealant is the selection of the joint filler. The joint filler, or backing rod, performs three functions:

3.5.6.1 Controls both the depth and shape of the sealant.

3.5.6.2 Provides support for the caulking sealant when it is being compressed during tooling.

3.5.6.3 Acts as a bond breaker for the sealant to prevent three sided adhesion. (Three-sided adhesion can result in failure of the sealant.)

3.5.7 Waterproof sealant is applied in joints that have backing rods inserted. The backing rods can be porous (open cell), or nonporous (closed cell), and are typically made of polyethylene or polystyrene rope.

3.5.8 Consult the Sealant, Waterproofing, and Restoration Institute guidelines for further information on proper joint sealant design, selection, and installation.

3.6 Expansion Joints

3.6.1 Design and Location. Expansion and/or movement joints are essential for the success of stone installations. Various methods require proper design and location of expansion joints as shown in "Method EJ171," from the Tile Council of North America

Installation Handbook. Because of the limitless conditions and structural systems in which stone can be installed, the Specifying Authority shall show locations and details of expansion joints on project drawings.

3.6.2 Final Design. It is not the intent of this manual to make control and expansion joint recommendations for a specific project. The Architect must specify control and expansion joints and show location and details on drawings.

3.6.3 Sealants. Where so specified, joints shall be pointed with the sealant(s) referred to in this section, 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.

3.6.4 All sealants shall be tooled to ensure maximum adhesion to the contact surfaces.

3.6.5 Expansion joint sealants include silicone, urethane, and polysulfide. Generally, urethane sealants are recommended for horizontal stone surfaces because of their resistance to abrasion and penetration.

3.6.6 Silicone sealants may be used in expansion joints on both exterior and interior vertical stone surfaces. Some one part, mildew-resistant silicone sealants are formulated with fungicide for sealing interior joints in showers and around tubs, sinks, and plumbing fixtures.

3.6.7 Sealants should comply with ASTM C920.

3.7 Substrate Limitations

3.7.1 Moisture Penetration. The performance of a properly installed stone installation is dependent upon the durability and dimensional stability of the substrate to which it is bonded. The user is cautioned that certain substrate materials used in wet areas may be subject to deterioration from moisture penetration.

3.7.1.1 Wet Areas. "Wet areas" are stone surfaces that are either soaked, saturated, or subjected to moisture or liquids (usually water), e.g., gang showers, tub enclosures, showers, laundries, saunas, steam rooms, swimming pools, hot tubs, and exterior areas.

3.7.2 Self Leveling Underlayments. Gypsum-based and self-leveling underlayments are not recommended for use with stone paving, except in conjunction with an approved water-proofing/crack isolation membrane (See ANSI A118.10-118.12). If using this method, extreme caution in following the Manufacturer's recommended procedure is required.

3.7.2.1 Installation of stone paving directly over gypsum based underlayment is not recommended.

3.8 Deflection of Surfaces

3.8.1 General Contractor Responsibility. It is the responsibility of the General Contractor to provide a rigid, code-compliant structure that is adequate to accommodate the stone and its anchorage including all associated loads and forces.

3.8.2 Cast-in-Place Concrete Floors. Design substrate for total load deflection not exceeding L/360, as measured between control or expansion joints.

3.8.3 Frame Construction. The subfloor areas over which stone tile is to be applied must be designed to have a deflection not exceeding L/720 of the span. In calculating load, the weight of the stone and setting bed must be considered.

3.8.3.1 Strongbacks, cross-bridging or other reinforcement shall be used to limit

differential deflection between adjacent framing members.

3.8.4 Maximum variation of a concrete slab or subfloor shall not exceed 1/8" in 10' from the required plane when thin set systems are applied.

3.8.5 Allowance should be made for live load and impact, as well as all dead load, including weight of stone and setting bed.

3.8.5.1 Mortar Bed Weight. For estimating purposes, mortar bed weight can be approximated as 0.75 lb per square foot per each 1/16" of thickness.

3.8.5.2 Stone Weight. For estimating purposes, stone weight can be approximated as 1 lb per square foot per each 1/16" of thickness.

4.0 SAMPLES

4.1 The Dimension Stone Contractor shall furnish samples of the various dimension stones to be used. Samples shall indicate the extremes of color, veining, and marking the stone supplied to the project will have. Samples must be approved or rejected in their entirety, without stipulation.

4.2 Pending the scope of the installation and the variability of the stone product, a full-sized mockup may be required to adequately demonstrate the range of the material's color and character.

4.3 Inspection of supplied material to evaluate compliance with approved samples shall be done at a viewing distance of not less than 6'-0" with natural lighting.

5.0 CARVING

5.1 All carving called for shall be performed by skilled workmen in strict accordance with approved full-size details or models. Architectural drawings will show approximate depth and relief of carving. Carving shall be left as it comes from the tool, unless otherwise specified.

6.0 FIELD REPAIR

6.1 During the progress of construction, changes are often necessary to accommodate other trade and design revisions. These changes may require job site cutting and some finishing of stone, and this can be executed satisfactorily by qualified mechanics.

6.2 Repair or patching is sometimes necessary due to damage of material either on-site or in transit. By allowing these repairs to be made on-site, progress of the job can be maintained, thus aiding the successful completion of the work. Repairs should not detract from the desired appearance or strength of the completed installation.

7.0 STONE TILE INSTALLATION REFERENCES.

The Marble Institute of America has participated in the Tile Council of North America's (TCNA) development of the Handbook for Ceramic, Glass, and Stone Installation. This document is reprinted every year, although the handbook committee meets only biennially, so substantial revisions are likely to appear only biennially. This handbook includes a section dedicated to the installation of stone tile products. The details are not duplicated in the Marble Institute of America publications. Contact the TCNA (www.tcnatile.com) or the Marble Institute of America's Book Store to obtain a copy of the handbook.

8.0 TRIPS AND TRAPS OCCURRING IN THE INSTALLATION OF NATURAL STONE

8.1 Stone Tiles with Fiberglass Mesh Backing. Producers frequently apply a fiber

mesh reinforcement to the back surfaces of stone tiles and slabs to reduce breakage and also increase safety when handling large slabs. Caution should be used when using a stone that has a fiberglass mesh backing applied on the back face. The fiberglass, having been bonded to the stone with a resinous (commonly epoxy) adhesive, will not bond adequately with cementitious products. Only epoxy products, or products specifically made for fiberglass by the manufacture, should be used when installing stone with fiberglass mesh backing.

8.2 Green Colored Stone. Avoid the use of water-based adhesive when installing certain green marbles and/or serpentines. Some of these stones may warp through absorption of water from the setting bed. (Water drawn into the stone is held to the crystals by surface energy. This force tends to widen the intercrystalline space and thereby expand the wet side.) TCA Methods F116 and F142 should be used with an adhesive that is not water-based.

8.3 Travertine Voids. Travertine flooring, particularly fleuri cut (also called "cross-cut) will have voids occurring just below the finished surface of the material. Since these voids are concealed by a thin shell of stone material, they do not get filled in the factory filling process. Once in service, concentrated loads (particularly from wheels or spike heels) will fracture the thin shell of stone, exposing the void below. Several iterations of re-filling travertine floors in place can be expected until these voids are all discovered. This is essentially a "break-in" process for this particular material.

8.4 Sealant Staining. Some elastomeric sealants contain oil-based plasticizers to reduce their modulus and increase their extension/compression capability. The plasticizers can wick into stone perimeters, causing darkening of the edge (picture framing) and accelerated dirt collection on the stone face. Caution should be used in specifying sealants to ensure compatibility with stone. It is recommended that either an exemplar project be identified using the same stone and sealant components with satisfactory results, or a testing regimen be employed to verify compatibility.

8.5 Efflorescence. Efflorescence is a salt deposit, usually white in color that appears on exterior surfaces of stone walls and floors. The efflorescence is produced by salts leached to the surface of the stone by water percolating through the stone backup and joints. The most feasible means of prevention is to stop the entrance of large amounts of water. If the conditions bringing about the efflorescence continue, scaling may occur and flake off successive layers. For this to happen, large amounts of water must continue to enter behind the stone and must contain large amounts of salts.

8.6 Down Washed Lighting. The use of down washed lighting, in which the path of light is nearly parallel to the face of the wall surface, is a popular choice in both interior and exterior designs. This lighting style will exaggerate lippage, textural surface variation, and even warpage due to the extremely elongated shadow lines caused by the slight angle of incidence. Material and installation which are within industry tolerances may appear to be outside of tolerances due to the accentuation of the lighting technique. Inspection of areas receiving down washed lighting shall be done with the down washed lighting turned off.

8.7 Reflection. It is almost impossible to uniformly read light reflection on a polished or high-honed-finish installation due to the natural characteristics of dimension stone. Due to the heterogeneous composition of natural stones, variable mineral hardness exists within the stone, producing variable reflectivity of light energy. Most stones, and especially travertine marbles and honed-finish surfaces, will appear to reflect light unevenly.

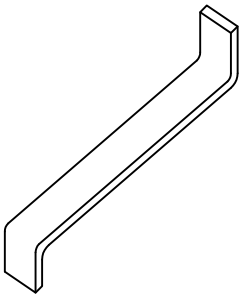
8.8 Polishing Wheel Marks. Polishing wheel marks or other scratches caused during fabrication are unacceptable on honed or polished stone.

9.0 NOTES REGARDING INSTALLATION CHAPTERS

9.1 Stone Detail Symbol. The details in this manual have been drawn to represent generic stone rather than a particular type of stone, and a symbol was used that makes the stone easily identifiable.

9.2 Guidelines. While every effort has been made to produce accurate guidelines, they should be used only with the independent approval of technically qualified persons.

NOTES:



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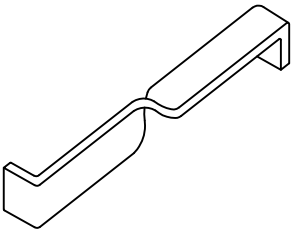
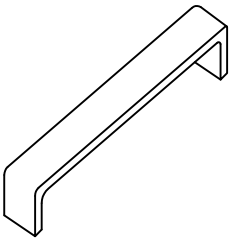


TWISTED STRAP
(FOR VERTICAL EDGE ANCHORS)



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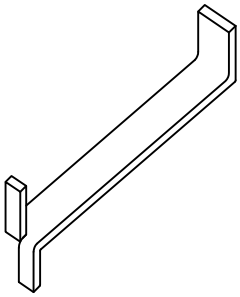
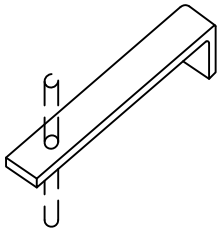
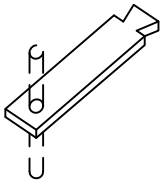


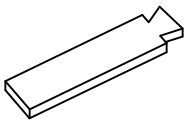
SPLIT-TAIL STRAP



"L" STRAP
(HOLE FOR DOWEL)



DOVETAIL STRAP
(HOLE FOR DOWEL)



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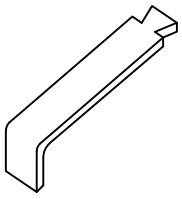

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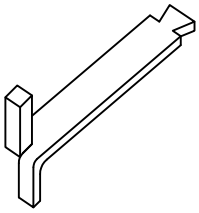

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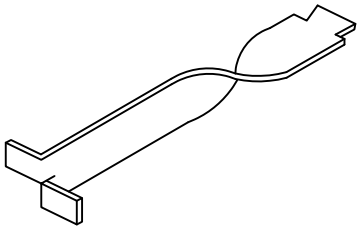

DOVETAIL TWISTED
(TWO WAY STRAP)

NOTE:
ALL ANCHORS AND ACCESSORIES
TO BE CORROSION RESISTANT METALS

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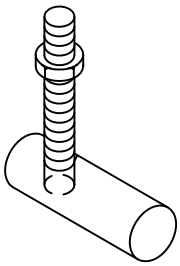
1	Oct 2006
2	Dec 2009

TYPICAL ANCHORS AND ACCESSORIES

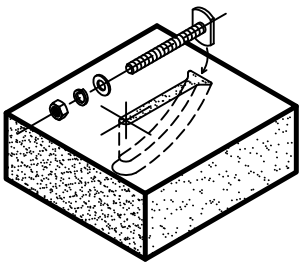
MIA DIMENSION STONE DESIGN MANUAL VIII

DRWG NO: 13-D-1

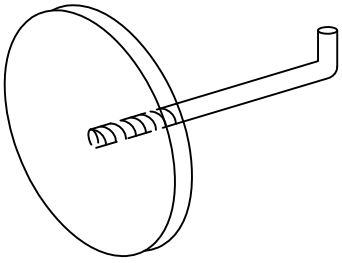
SCALE: Not to Scale



PLUG ANCHOR



T-31 BACK ANCHOR



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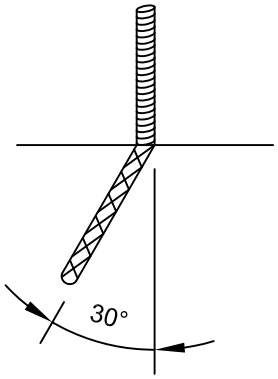
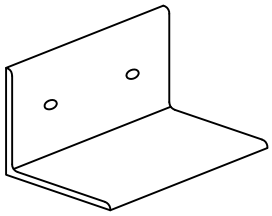
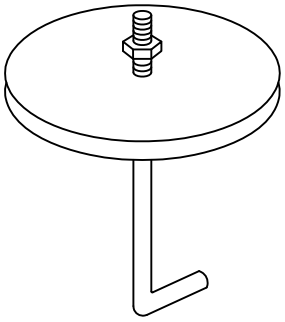


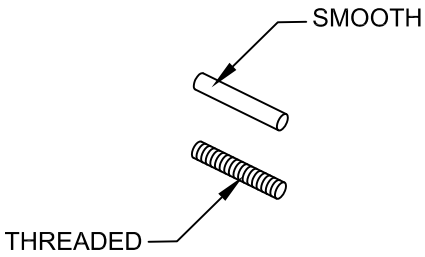
BENT ROD



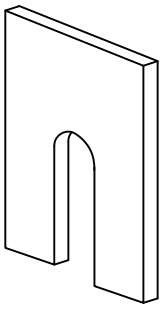
RELIEVING ANGLE-CLIP



SOFFIT HANGER



DOWELS



SHIM
(PLASTIC OR
STAINLESS STEEL)

NOTES: ALL ANCHORS AND ACCESSORIES TO BE CORROSION RESISTANT METALS.

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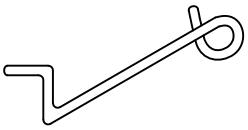
REV	DATE
0	Aug 2006
1	Oct 2006
2	Dec 2009

TYPICAL ANCHORS AND ACCESSORIES

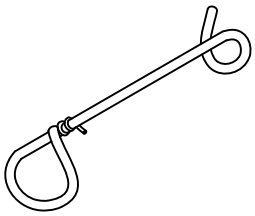
MIA DIMENSION STONE DESIGN MANUAL VIII

DRWG NO: 13-D-2

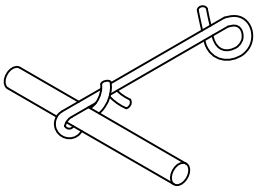
SCALE: Not to Scale



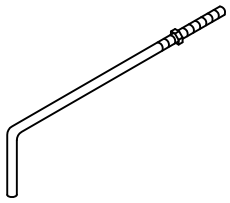
WIRE TIEBACK



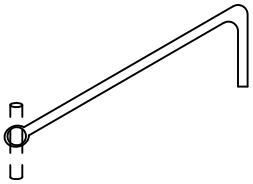
WIRE LACE
ANCHOR



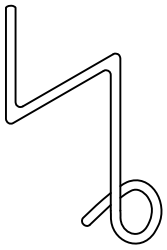
WIRE TIEBACK
(WITH DOWEL)



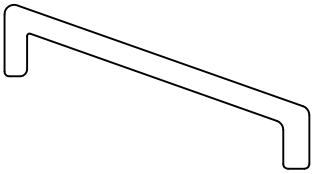
"L" BAR OR
HOOKED BOLT



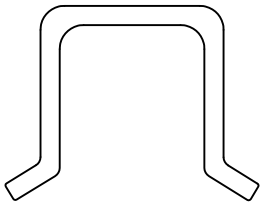
EYE ROD AND DOWEL



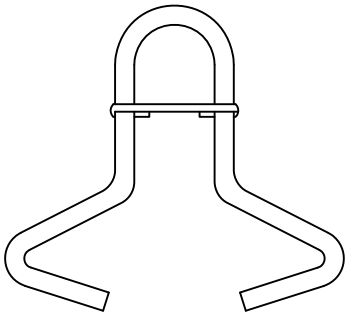
WIRE "GOOSE NECK"
ANCHOR



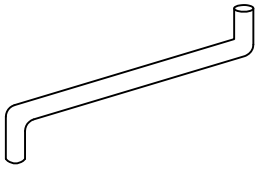
"U" CLAMP BAR



"HAIRPIN" PRECAST
ANCHOR



SPRING CLIP
(WITH COLLAR)



"Z" BAR

NOTE:
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TYPICAL ANCHORS AND ACCESSORIES

MIA DIMENSION STONE DESIGN MANUAL VIII

DRWG NO: 13-D-3

SCALE: Not to Scale

NOTES: