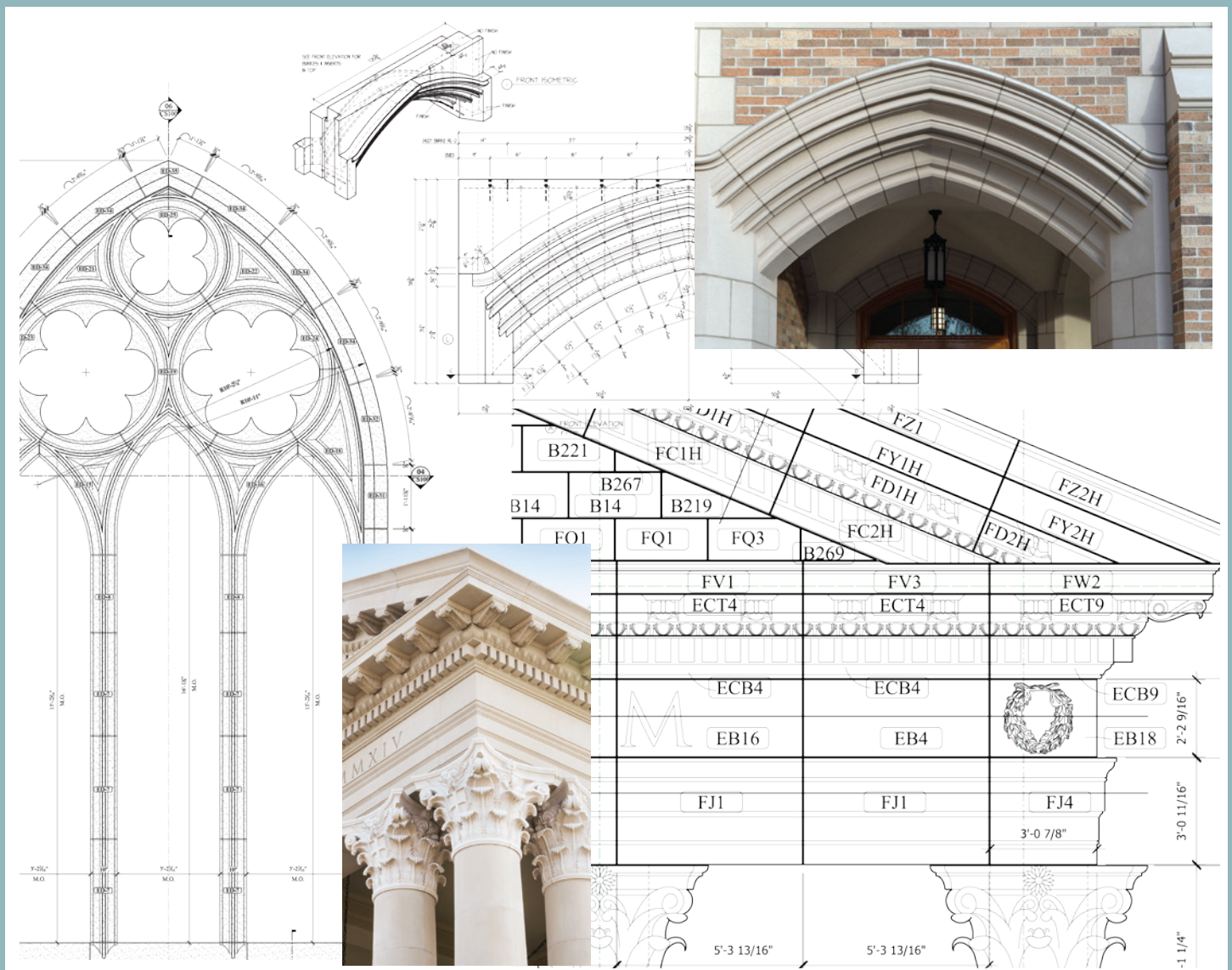




Architectural Cast Stone TECHNICAL RESOURCES AT A GLANCE

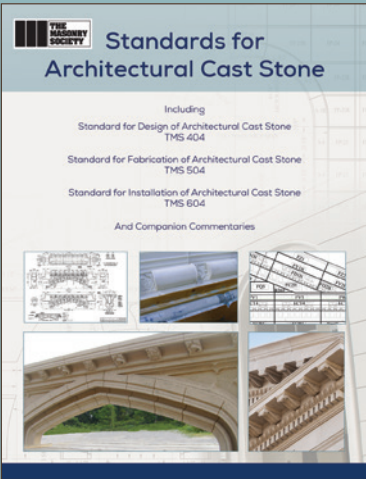
Specification ■ Standards ■ Technical Bulletins

The purpose of this publication is to assist the architect and engineer by providing up to date information for the proper use, design and specification of Architectural Cast Stone.



PRIMARY REFERENCE DOCUMENTS

- **ASTM C1364-17 Standard Specification for Architectural Cast Stone**
This is considered the master document for cast stone and can be purchased through the ASTM website at www.astm.org. This is the current version of the document which could be updated by ASTM in the future. Therefore you will want to check on their website astm.org for any updated information.

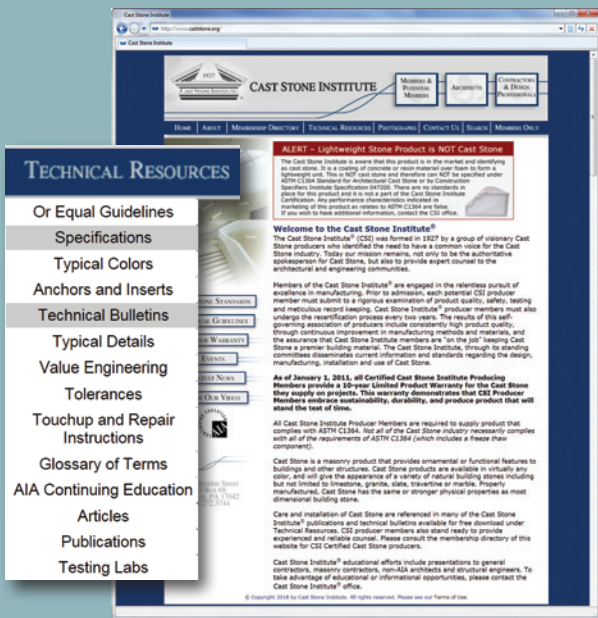


- **TMS 404-504-604**
Architectural Cast Stone Standards developed through The Masonry Society TMS 404 Design, 504 Fabrication and 604 Installation in one standards publication. These new standards were finalized in October 2016 and adopted into the 2018 version of the International Building Code.

This can be purchased through The Masonry Society - masonrysociety.org/product/tms-0404-16

- **Cast Stone Institute Specification 047200**
- on website for free download at caststone.org/specifications.htm

- **Cast Stone Institute Technical Bulletins**
- on website for free download at caststone.org/bulletins.htm



MORTARS FOR CAST STONE INSTALLATION

Selecting the appropriate type of mortar for setting cast stone is perhaps the most important factor in the performance of a masonry wall. The mortar must have sufficient strength, be durable, resist rain penetration as much as possible and yet be flexible enough to accommodate slight movement within the wall assembly. As noted in TMS 604-16, Standard Specification for Installation of Architectural Cast Stone, mortars used in the setting of cast stone should meet the requirements of ASTM C270, Type N mortars.

Included in this Bulletin is information on proper mortar mixing, wetting, head and bed joints, the proper specification of mortar/pointed joints and sealant joints, raking and pointing of joints, lug sills, selection of joint types, and more.



► *Reference Technical Bulletin #42.*

SEALANT JOINTS



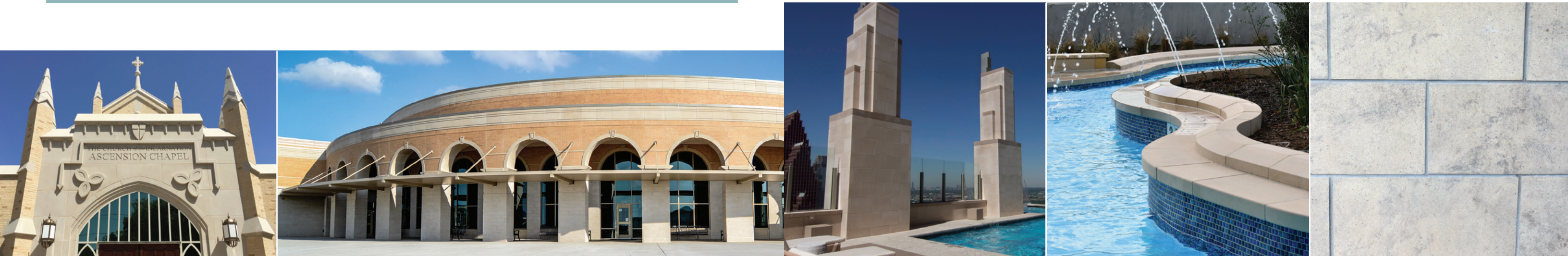
The decision to use a mortar or sealant joint can impact the success of the masonry project so this bulletin provides guidelines for the designer to assist in this determination. In general, all cast stone sections with projecting profiles, exposed top joints or rigid suspension connections to the supporting structure should be "soft" sealant joints. Sealant systems are not intended to bear weight, so plastic setting pads or lead shims are required when setting the cast stones. Thermal and other movement should be considered by the design engineer.

► *Reference Technical Bulletin #43.*

POINTING OF JOINTS

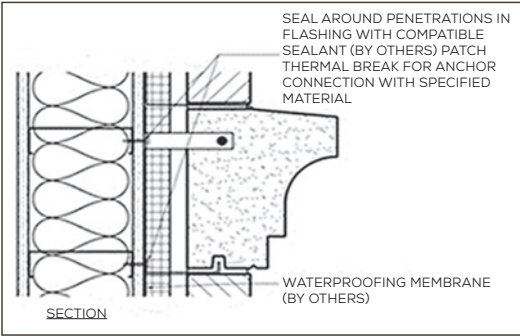
Tooled mortar joints are best suited for masonry-bound trim items such as belt courses, lintels, window surrounds, date stones, inscription blocks, quoins, keystones and similar applications. The mortar must be raked out of the joint to a minimum depth of 3/4 inch of the face joint material. A concave joint is recommended for the best protection against leakage. Pointing mortar should be softer than the stone so that thermal stress will not cause spalling at the edges of the joints. Coloring may be added to achieve almost any hue, however possible cast stone staining may occur. Always specify a mockup wall when approving final colors and be sure that it has been properly cleaned because cleaning will usually affect the color of pigmented masonry materials.

► *Reference Technical Bulletin #44.*



■ FLASHING, WEEP HOLES AND RELATED ANCHORAGE

This eight page bulletin details recommendations on design of a drainage/cavity wall – flashing at bases, over openings, at coping and caps -- anchor penetrations through flashing – flashing materials. It also highlights several pages of detail drawings for typical connections for anchoring and flashing details including anchor straps, split tail anchors, dowel pins, typical anchorage at a cornice, and field cut reglet.



► [Reference Technical Bulletin #47.](#)

■ USE OF REINFORCEMENT

Cast stone is an architectural element and should not be used to support the building structure or load bearing elements, yet a structural engineer should design reinforcement for structural or unusual situations. Requirements of the reinforcing material as well as guidelines for the possible use and placement of the reinforcing are outlined in this bulletin. In general, steel should be added to the design only when necessary for safe handling, setting and structural stress.

One important misconception about reinforcement in concrete is that it will prevent cracking, but reinforcing steel will only serve to control cracking from extending and limiting its width. No amount of conventional reinforcing will reduce the likelihood of cracking when units are designed excessively long and thin. To prevent cracking the Cast Stone Institute suggests that designers consult with the manufacturer before drawing units that exceed fifteen (15) times their average effective thickness.

Units less than 24 inches (600 mm) in both their length and width dimension shall be non-reinforced unless otherwise specified. Units greater than 24 inches (600 mm) in one direction shall be reinforced in that direction.

► [Reference Technical Bulletin #51.](#)



■ ALLOWING FOR MOVEMENT OF MASONRY MATERIALS



Various building materials, brick, block and cast stone experience dimensional changes and movement differently on the wall. If this movement is restrained, cracking may result therefore movement joints are used. This bulletin explains the impacts of thermal movements, moisture movements, drying shrinkage, different materials, and horizontal joint reinforcement.

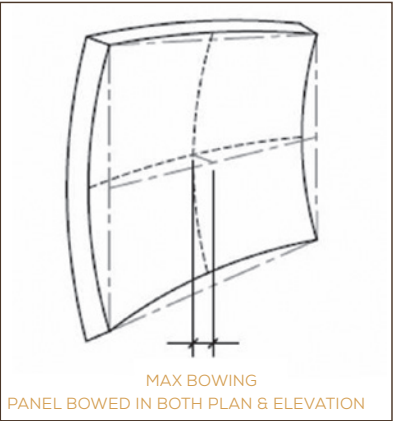
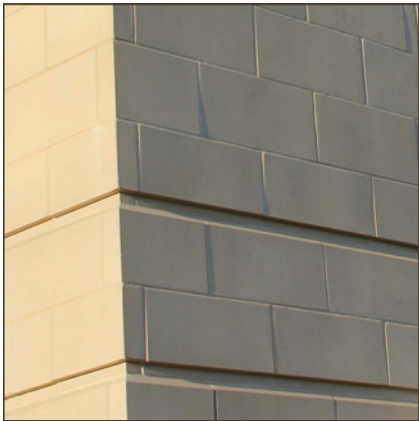
Recommendations for joint placement, crack control, linear shrinkage and curing of units is included in this bulletin.

► [Reference Technical Bulletin #52.](#)

■ BOW AND TWIST

This new technical bulletin was developed to review two unique possibilities: Bowing, an overall out-of-plane condition in which two opposite edges of a component fall in the same plane and the portion of the panel between the edges is out of plane AND twisting (or warping), a condition in which the corners of the panel do not fall within the same plane resulting in overall out-of-plane curvature of surfaces. While bow and twist are aesthetic and not structural issues, the Cast Stone Institute's Standard Specification defines strict limits for both conditions. This bulletin shows diagrams, how to measure, and the aesthetics under different lighting conditions.

► [Reference Technical Bulletin #55.](#)



■ ■ FREEZE/THAW DURABILITY

Regardless of the process to produce the cast stone, all must comply with the requirements of ASTM C1364 Standard Specification of Architectural Cast Stone which references ASTM C 666, Procedure A - Test Method for Resistance of Concrete to Rapid Freezing and Thawing as the testing procedure as modified by ASTM C1364. As per ASTM C1364, every 24 months or when changes to mixes or processes are made, the manufacturer must demonstrate through laboratory testing that their cast stone meets or exceeds the cumulative percentage mass loss less than 5% required for passing.

In order to reasonably assure that the cast stone performs over time, the manufacturer must first produce a quality product that passes the ASTM C666 testing, the designer must allow for adequate drainage of water that may breach the exterior, and the contractor must install the cast stone according to plans.

► [Reference Technical Bulletin #40.](#)

■ ■ AIR ENTRAINMENT REQUIREMENTS

Air content is determined by ASTM C173 or C231, for wet cast product which shall be 4.0-8.0% for units exposed to freeze/thaw environments as per ASTM C1364 Standard for Architectural Cast Stone. Air-entraining admixtures were developed for slump concrete to increase their resistance to freeze/thaw degradation. Air entrainment is not required for Vibrant Dry Tamp (VDT) products as it has the appropriate pore structure to accommodate the hydraulic pressure necessary to prevent distress during freezing and thawing cycles. Air entraining admixtures are an effective, low cost option to improving freeze/thaw durability of wet cast produced cast stone.

► [Reference Technical Bulletin #50.](#)

■ ■ WATER REPELLENT COATINGS

The purpose of a water repellent coating should be to minimize water intrusion through the outer surface of the cast stone or mortar, while allowing sufficient vapor transmission to let moisture out of the wall cavity, thereby improving weathering qualities. Proper application of water repellents can minimize efflorescence, mildew, staining and dirt. When a water repellent coating is desired, the Cast Stone Institute recommends using a silane or siloxane (or blends of each).

Water repellent coatings are not a remedy for moisture penetration problems caused by poor details such as the improper use of flashing, lack of weep holes, non-ventilated wythe, failure of joint materials or the use of hard mortar joints where sealant joints should be used.

Water repellents should be applied after all pointing repair, cleaning and inspection operations are completed. The application should be guaranteed by the water repellent manufacturer or the applicator not to discolor the cast stone.

► [Reference Technical Bulletin #35.](#)



■ ■ CRAZING

One of the most frequently asked topics is crazing, which is a naturally occurring phenomenon. The appearance of small cracks on the surface, especially when filled with water or dirt, can be alarming since it is assumed that the fissures are running through the entire cross section of the concrete. All cement based products and many natural stones are susceptible to crazing. In general, crazing does not affect the structural integrity of the concrete and should not by itself be cause for rejection.

Crazing can be caused by any factor which causes surface tension in excess of interior tension including manufacturing, design and/or installation. Design professionals should ensure that the wall section details provide adequate ventilation and drainage behind cast stone and above flashing. Sealant joints should be used in accordance with CSI specifications and wherever thermal movement is likely.

► [Reference Technical Bulletin #32.](#)

■ ■ EFFLORESCENCE

Efflorescence is a crystalline material, usually white, that forms on the surface of masonry walls and concrete products. While unsightly, it does not affect the structural integrity of the cast stone. It is generally caused by moisture related issues in the wall from a variety of sources. It is difficult to predict whether efflorescence will occur, but when it does, the sooner it is removed the better. For new building construction it is recommended that a cleaning procedure, using the appropriate cleaning agent and method, be performed to remove any debris and efflorescence.

► [Reference Technical Bulletin #33.](#)



■ ■ BASIC COMPARISONS AMONG VARIOUS MASONRY MATERIALS

Product	ASTM	PSI (minimum)	Absorption (maximum)	Freez-thaw (durability)
Cast Stone	ASTM C1364	6,500	6%	5% loss or less @ 300 cycles
Architectural Precast	APA 03 45 00	5,000	6%	NOT REQUIRED
Limestone Dimension Stone	ASTM C568	4,000	7.5%	NOT REQUIRED
Calcium Silicate	ASTM C73	Grade: MW 3,500 SW 5,500	14.0% 11.6%	NOT REQUIRED
Adhered Manufactured Stone Masonry Veneer	ASTM C1670	2,100	None as per ASTM	1.5% loss or less @ 50 cycles

All concrete products are not equal! Cast stone standards are designed to provide a product that is expected to perform exceeding 100 years. When determining masonry products to be used as an architectural trim, feature or ornament for buildings and other structures, a relative high compressive strength, relative low absorption, freeze/thaw testing as per ASTM C666 and the ability to include steel reinforcing should be considered.

Note that architectural cast stone is tested as per ASTM C1194 and ASTM C1195 which is testing of 2 inch cubes. Information and an easy to read table is included in the bulletin to assist in proper specification.

► *Reference Technical Bulletin #49.*



COMPRESSIVE STRENGTH TESTING

■ ■ SPECIFICATION OF CAST STONE PRODUCTION METHODS

As per ASTM C1364 Standard Specification for Architectural Cast Stone, the manufacturing method shall be selected by the manufacturer and not specified by the purchaser. The project specification should cover the performance criteria (i.e. compressive strength, absorption, freeze-thaw durability) and referenced standards as opposed to a specific production method as each production method is required to conform to the same ASTM C1364 properties.

► *Reference Technical Bulletin #54.*



■ ■ DEGREES OF CUSTOMIZATION

Cast stone projects will generally fit into one of the following categories: Standard, Semi-Custom or Custom. Depending on the category, the cast stone fabricator and designer have different time lines and responsibilities. Most projects tend to be custom cast stone as the architect can then put his/her signature on the building with beautiful custom cast stone accents. Custom units are generally not cut in the field which positively affects installation costs. The responsibilities of the designer for the specification are defined in the bulletin.

Standard cast stone jobs are best suited for designs that call for basic and popular items such as band courses and wall cap coping, pier caps, keystones, quoins and window sill units sized to replace brick. Semi-custom projects can include almost any application where the designer is willing to dimension the stone units on the contract documents.

► *Reference Technical Bulletin #45.*

■ ■ INSPECTION AND ACCEPTANCE

This bulletin focuses on inspection and acceptance of cast stone at time of delivery and prior to installation. The inspector should be familiar with the cast stone specification and contract documents then check the color and texture of the approved sample against the delivered product. The dry cast stone should approximate the color and texture of the approved sample when viewed under typical lighting conditions and show no obvious imperfections other than minimal color and texture variations from a 20 foot distance. Minor variations in color and texture should be expected within limits of the approved range of samples. Some projects will show more color variation than others depending on the type of cement, integral color and cleaning procedures.



DELIVERY SITE

Delivery: Cast stone units shall be marked as shown on the shop drawings and shall be packaged to protect them from staining and damage during shipping and storage.

In addition to color and texture, the inspector and/or mason should be familiar with the dimensional requirements of the installation as they pertain to joint sizes and interfaces with other materials. The cast stone should be true in shape, free of large cracks and ragged edges and within the tolerances specified in the contract documents.

Wherever possible, an investment should be made in mockup panels and/or sample units. The sample units should demonstrate a variety of shapes and casting configurations and include vertically cast surfaces if they are specified.

► *Reference Technical Bulletin #36.*

■ ■ JOB SITE HANDLING AND INSTALLATION

This bulletin was updated significantly to give the designer, mason and others proper guidance for delivery, storage, setting, touch-up and repair, cleaning, pointing, caulking and sealing work done on site. Where the project specification may not include a particular issue, the industry standards should be followed. Information on what should be completed prior to delivery as well as when the cast stone arrives to the job site, on site storage, setting recommendations, and more.

Examples of the recommendations include: alignment of trim items with control joints; bridge parapet coping over control and expansion joints; hardscape project guidance, wetting of cast stone prior to setting, anchors must meet specified standards and be non-corrosive and cast stone slots to receive anchors should be completely filled with project approved material usually mortar, non-shrink grout or epoxy.

Of all of the Technical Bulletins, this one gives numerous helpful hints to make your cast stone project successful.

► [Reference Technical Bulletin #37.](#)

■ ■ CLEANING



BEFORE CLEANING



AFTER CLEANING

Transportation and storage of the cast stone is important as it impacts the need for cleaning after construction. Recommendations on storage are included in this technical bulletin as well as protection after installation of the cast stone during construction.

The most common stains due to construction are dirt, mortar smears and efflorescence. A general rule of thumb is to use the least aggressive cleaning material and method to clean the building. Direct high pressure power washing and sandblasting are

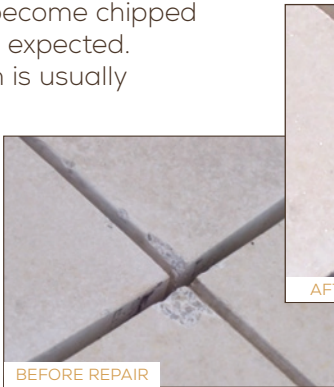
not recommended procedures for cleaning cast stone. Metal fiber brushes, rubbing stones and any tool or device that can scar the cast stone should not to be used for cleaning cast stone.

► [Reference Technical Bulletin #39.](#)

■ ■ TOUCH UP AND REPAIR

Even with special care and protection, cast stone may still become chipped from time to time and a certain amount of touch up is to be expected. Damage to stone either while in transit or during installation is usually classified as a repair. A properly executed repair will not match in color immediately. Dry tamp produced cast stone will appear lighter where repaired, while wet cast produced cast stone may appear darker. Repairs, matching immediately or in two or three days, have a tendency to change color later or after weathering.

► [Reference Technical Bulletin #38.](#)



BEFORE REPAIR



AFTER REPAIR

■ ■ COLD WEATHER SETTING PRACTICES

This technical bulletin provides guidelines based on the building code and industry recommendations for the setting of cast stone in cold weather conditions. Temperatures as well as installation, touch up and repair and admixture guidelines are included.

► [Reference Technical Bulletin #41.](#)

■ ■ HOT WEATHER SETTING PRACTICES

Temperatures above 90° F (32° C) are considered hot weather which creates a concern about the evaporation of water from the mortar. Cast stone is one of the materials in masonry construction that is least affected by hot weather. However, the interaction between the cast stone and mortar is critical. If sufficient water is not present, the strength of the mortar and bond between the cast stone unit and mortar may be compromised. A suggested list of guidelines for masonry construction using cast stone under these conditions is included in the bulletin.

► [Reference Technical Bulletin #48.](#)

■ ■ CAST STONE AND LEED® v4

This six page bulletin details the ways that cast stone complies with LEEDv4. Location and Transportation (LT), Sustainable Sites (SS), Energy and Atmosphere (EA), Materials and Resources (MR) and Indoor Environmental Quality (IEQ) are reviewed.

► [Reference Technical Bulletin #53.](#)

IMPORTANT MESSAGE

ALERT – Lightweight Stone Product is NOT Cast Stone!

The Cast Stone Institute is aware that this product is in the market and identifying as cast stone. It is a coating of concrete or resin material over foam to form a lightweight unit. This is NOT cast stone and therefore can NOT be specified under ASTM C1364 Standard for Architectural Cast Stone or by Construction Specifiers Institute Specification 047200. There are no standards in place for this product and it is not a part of the Cast Stone Institute Certification. Any performance characteristics indicated in marketing of this product as relates to ASTM C1364 are false. If you wish to have additional information, contact the CSI office.

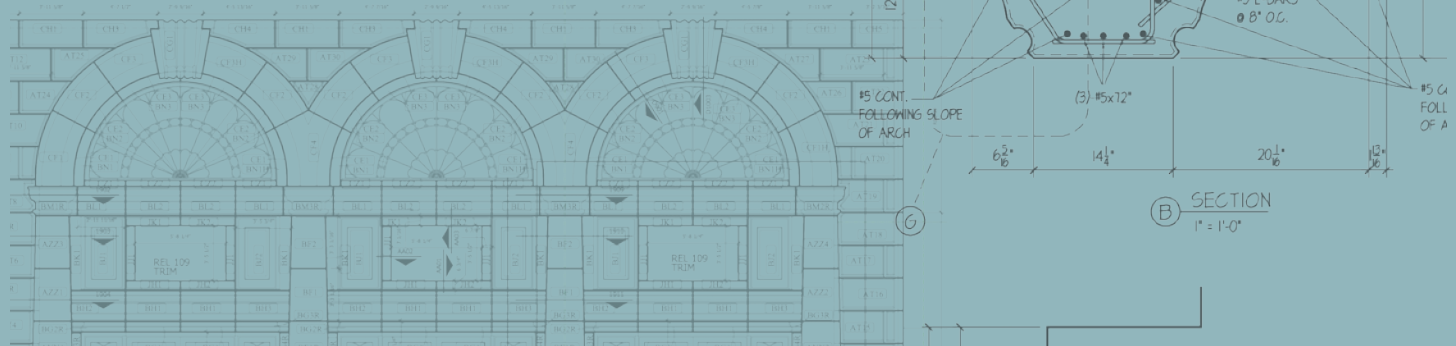




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Architectural Cast Stone TECHNICAL RESOURCES AT A GLANCE

The Cast Stone Institute has recently completed a major review and revision of all Technical Bulletins. They are featured in this brochure and available for free download at caststone.org.



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