Standard Specification for Architectural Cast Stone

Section 04-72-00

Revised and Approved 07/2022

This specification provides basic requirements for Cast Stone, a refined architectural concrete building unit manufactured to simulate natural cut stone, used in Division 4 masonry applications. Cast Stone is a masonry product, used as an architectural feature, trim, and ornament or facing for buildings or other structures.

Materials and processes used for manufacturing Cast Stone vary according to the aggregates locally available to the manufacturers and the processes and techniques used by the manufacturers to obtain the desired appearance and physical properties. Of paramount importance in molding Cast Stone is the need to use a properly proportioned mixture of white and/or grey cements, manufactured or natural sands, carefully selected crushed stone or well graded natural gravel and mineral coloring pigments to achieve the desired appearance while maintaining durable physical properties.

Although a variety of casting methods are used, production conforming to this standard will exceed minimum requirements for compressive strength and weathering qualities essential for normal installations as a suitable replacement for natural cut limestone, brownstone, sandstone, bluestone, granite, slate, keystone, travertine and other natural building stones. The specifier should not prescribe the casting method.

It is hoped that this specification may be helpful to the specifiers in understanding the inherent qualities of Cast Stone and its use. For details and samples of finishes available in your project area, contact your nearest Cast Stone Institute® Producer Member.

Part 1 General

1.1. Section Includes - Architectural Cast Stone.

Scope - Cast Stone shown on architectural drawings and as described in this specification.

- Manufacturer shall furnish Cast Stone covered by this specification.

1.2. Related Sections

Section – 01 33 00 – Submittal Procedures.

Section – 04 05 13 – Masonry Mortaring.

Section – 04 05 16 – Masonry Grouting.

Section – 04 05 19 – Masonry Anchorage and Reinforcing.

Section – 04 20 20 – Unit Masonry.

Section – 07 90 00 – Joint Protection.

1.3. References

ACI 318 – Building Code Requirements for Reinforced Concrete.

ASTM A615/A615M – Standard Specification for Deformed and Plain Billet-Steel Bars for Reinforced Concrete.

ASTM A1064 / A1064M – Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

ASTM C33 – Standard Specification for Concrete Aggregates.

ASTM C150 – Standard Specification for Portland Cement.

ASTM C595/C595M – Specification for Blended Hydraulic Cements

ASTM C1157/C1157M – Performance Specification for Hydraulic Cement

ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volume Method.

ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

ASTM C260 – Standard Specification for Air-Entrained Admixtures for Concrete.

ASTM C270 – Standard Specification for Mortar for Unit Masonry.

ASTM C426 – Standard Test Method for Linear Shrinkage of Concrete Masonry Units.

ASTM C494/C494M – Standard Specification for Chemical Admixtures for Concrete.

ASTM C618 – Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as aMineral Admixture in Concrete.

ASTM C666/666M – Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.

ASTM C979 – Standard Specification for Coloring Pigments for Integrally Colored Concrete.

ASTM C989 – Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete.

ASTM C1116 – Standard Specification for Fiber Reinforced Concrete and Shotcrete.

ASTM C1194 – Standard Test Method for Compressive Strength of Architectural Cast Stone.

ASTM C1195 – Standard Test Method for Absorption of Architectural Cast Stone.

ASTM C1364 – Standard Specification for Architectural Cast Stone.

ASTM D1729 – Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials.

ASTM D2244 – Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

ASTM D7957/D7957M – Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement

TMS 404-504-604 – Standards for Architectural Cast Stone Design – Fabrication - Installation

1.4. Definitions

Cast Stone - a refined architectural concrete building unit manufactured to simulate natural cut stone, used in Division 4 masonry applications.

- Dry Cast – manufactured from zero slump concrete.

  Vibrant Dry Tamp (VDT) casting method: Vibratory ramming of earth moist, zero-slump concrete against a rigid mold until it is densely compacted.

  Machine casting method: Manufactured from earth moist, zero-slump concrete compacted by machinery using vibration and pressure against a mold until it becomes densely consolidated.

- Wet Cast – Manufactured from measurable slump concrete.

  Wet casting method: Manufactured from measurable slump concrete and vibrated into a mold until it becomes densely consolidated.

- Specifier Note: Slump, manufacturing method, and apparatus shall be selected by the manufacturer and not specified by the purchaser.

1.5. Submittal Procedures

Comply with Section 01 33 00 – Submittal Procedures.

Samples: Submit pieces of the Cast Stone that are representative of the general range of finish and color proposed to be furnished for the project.

Test results: Submit manufacturers test results of Cast Stone previously made by the manufacturer.

Shop Drawings: Submit manufacturers shop drawings including profiles, cross-sections, reinforcement, exposed faces, arrangement of joints (optional for standard or semi-custom installations), anchoring methods, anchors (if required), annotation of stone types and their location.

Warranty: Submit Cast Stone Institute® Member Limited Warranty.

Certification: Submit valid Cast Stone Institute® Plant Certification.

1.6. Quality Assurance

Manufacturer Qualifications:

- Cast Stone shall be produced in a plant certified by the Cast Stone Institute®.
- Manufacturer shall have sufficient plant facilities to produce the shapes, quantities and size of Cast Stone required in accordance with the project schedule.
- Manufacturer shall submit a written list of projects similar in scope and at least three (3) years of age, along with owner, architect and contractor references.

Standards: Comply with the requirements of the Cast Stone Institute® Technical Manual and the project specifications. Where a conflict may occur, the contract documents shall prevail.

Mock-up (Optional) Provide full size unit(s) for use in construction of sample wall. The approved mock-up shall become the standard for appearance and workmanship for the project.

Warranty Period: 10 years.

Part 2 Products

2.1. Architectural Cast Stone

Comply with current version ASTM C1364

Physical properties: Provide the following:

- Compressive Strength - ASTM C1194: 6,500 psi minimum at 28 days.
- Absorption – ASTM C1195: 6.0% maximum at 28 days.
- Air Content – Provide sufficient air content to meet the freeze-thaw requirements for wet cast products, when the air content is tested in accordance with Test Method C173/C173M or Test Method C231/C231M. Air entrainment is not required for Vibrant Dry Tamp (VDT) products.
- Freeze-thaw – ASTM C666/C666M in accordance with ASTM C1364. The CPWL shall be less than 5.0% after 300 cycles of freezing and thawing.
- Linear Drying Shrinkage – ASTM C426: Test and report in accordance with ASTM C1364.

Job site testing – One sample from production units may be selected at random from the field for each 500 cubic feet (14 m 3) delivered to the job site.

- Three field cut cube specimens from each of these samples shall have an average minimum compressive strength of not less than 85% with no single specimen testing less than 75% of design strength as allowed by ACI 318.
- Three field cut cube specimens from each of these samples shall have an average maximum cold-water absorption of 6.0%.
- Field specimens shall be tested in accordance with ASTM C1194 and C1195.

2.2. Raw Materials

Portland cement – Type I or Type III, white and/or grey, ASTM C150 or ASTM C595 Blended Hydraulic Cement (Type 1L).

Coarse aggregates - Granite, quartz or limestone, ASTM C33, except for gradation, and are optional for the Vibrant Dry Tamp (VDT) casting method.

Fine aggregates - Manufactured or natural sands, ASTM C33, except for gradation.

Colors - Inorganic iron oxide pigments, ASTM C979 except that carbon black pigments shall not be used.

Admixtures - Comply with the following:

- ASTM C260 for air-entraining admixtures.
- ASTM C494/C495M Types A - G for water reducing, retarding, accelerating, and high range admixtures.
- Other admixtures: Integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
- ASTM C618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.
- ASTM C989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.

Water – Potable

Reinforcing bars:

- ASTM A615/A615M: Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 1.5 in.
- ASTM D7957/D7957M: Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement
- Welded Wire Fabric: ASTM A1064 / A1064M where applicable for wet cast units.

Fiber reinforcement (optional): ASTM C1116

All anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in a non-corrosive material such as zinc plated, galvanized steel, brass, or stainless steel Type 302 or 304.

2.3. Color And Finish

Match sample on file in architect's office.

All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 in. and the density of such voids shall be le ss than 3 occurrences per any 1 $in.^2$ and not obvious under direct daylight illumination at a 5 ft distance.

Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 ft distance.

- ASTM D2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.
    - Total color difference – not greater than 6 units.
    - Total hue difference – not greater than 2 units.

Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under direct daylight illumination from a 20-ft distance.

The occurrence of crazing or efflorescence shall not constitute a cause for rejection.

Remove cement film, if required, from exposed surfaces prior to packaging for shipment.

2.4. Reinforcing

Reinforce the units as required by the drawings and for safe handling and structural stress.

Minimum reinforcing shall be 0.25 percent of the cross section area.

Reinforcement shall be noncorrosive where faces exposed to weather are covered with less than 1.5 in. of concrete material. All reinforcement shall have minimum coverage of twice the diameter of the bars.

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

Welded wire fabric reinforcing shall not be used in dry cast products.

2.5. Curing

Cure units in a warm curing chamber approximately 100ºF (37.8ºC) at 95 percent relative humidity for approximately 12 hours, or cure in a 95 percent moist environment at a minimum 70ºF (21.1ºC) for 16 hours after casting. Additional yard curing at 95 percent relative humidity shall be 350 degree-days (i.e. 7 days @ 50°F (10°C) or 5 days @ 70°F (21°C)) prior to shipping. Form cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

2.6. Manufacturing Tolerances

Cross section dimensions shall not deviate by more than ±1/8 in. from approved dimensions.

Length of units shall not deviate by more than length/ 360 or ±1/8 in., whichever is greater, not to exceed ±1/4 in.

Maximum length of any unit shall not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.

Warp, bow or twist of units shall not exceed length/ 360 or ±1/8 in., whichever is greater.

Location of dowel holes, anchor slots, flashing grooves, false joints and similar features – On formed sides of unit, 1/8 in., on unformed sides of unit, 3/8 in. maximum deviation.

2.7. Production Quality Control

Testing:

- Test compressive strength and absorption from specimens taken from every 500 cubic feet of product produced.
- Perform tests in accordance ASTM C1194 and C1195.
- Have tests performed by an independent testing laboratory every six months.
- New and existing mix designs shall be tested for strength and absorption compliance prior to producing units.
- Retain copies of all test reports for a minimum of two years.

2.8. Delivery, Storage And Handling

Mark production units with the identification marks as shown on the shop drawings.

Package units and protect them from staining or damage during shipping and storage.

Provide an itemized list of product to support the bill of lading.

3. Part 3 Execution

3.1. Examination

Installing contractor shall check Cast Stone materials for fit and finish prior to installation.

Unacceptable units shall not be set.

3.2. Setting Tolerances

Comply with Cast Stone Institute® Technical Manual.

Set stones 1/8 in. or less, within the plane of adjacent units.

Joints, plus - 1/16 in., minus - 1/8 in.

3.3. Jointing

Joint size:

- At stone/brick joints 3/8 in.
- At stone/stone joints in vertical position 1/4 in. (3/8 in. optional).
- Stone/stone joints exposed on top 3/8 in.

Joint materials:

- Mortar, Type N, ASTM C270.
- Use a full bed of mortar at all bed joints.
- Flush vertical joints full with mortar.
- Leave all joints with exposed tops or under relieving angles open for sealant.
- Leave head joints in copings and projecting components open for sealant.

Location of joints:

- As shown on shop drawings.
- At control and expansion joints unless otherwise shown.

3.4. Setting

Drench units with clean water prior to setting.

Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

Set units in full bed of mortar, unless otherwise detailed.

Rake mortar joints 3/4 in. in for pointing.

Remove excess mortar from unit faces immediately after setting.

Tuck point unit joints to a slight concave profile.

3.5. Joint Protection

Comply with requirements of Section 07 90 00.

Prime ends of units, insert properly sized backing rod and install required sealant.

3.6. Repair and Cleaning

Repair chips with touchup materials furnished by manufacturer.

Saturate units to be cleaned prior to applying an approved masonry cleaner.

Consult with the manufacture for appropriate cleaners.

3.7. Inspection and Acceptance

Inspect finished installation according to Cast Stone Institute® Technical Bulletin #36.

Do not field apply water repellent until repair, cleaning, inspection and acceptance is completed.

3.8. Water Repellent (Optional)

Apply water repellent in accordance with Cast Stone Institute® Technical Bulletin #35 or water repellent manufacturer's directions.