

SECTION 04 72 00
CAST STONE MASONRY

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Investigate use of natural cut stone before cast stone is used.
3. Current industry nomenclature is all precast architectural concrete is cast stone (wet- or dry-cast), and nomenclature precast architectural concrete is reserved for tilt-up panels.
4. Use this section for concrete building units to simulate natural stone; generally limestone, and used as unit masonry product such as trim, copings, sills, small panels, belt courses, stools, and quoins. Discuss the use of cast stone for caps and other elements with the Project Manager before selecting.
5. Cast stone, if approved for caps, or other elements with all exposed surfaces being finished surfaces must be by the wet cast process only.
6. Delete between // _____// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies concrete building units manufactured and installed to simulate natural cut stone. Cast Stone is made from fine and coarse aggregates, Portland cement, mineral oxide color pigments, chemical admixtures and water to simulate a natural stone.

SPEC WRITER NOTES:

1. Installation of the manufactured products is one of the major elements that impact the creation of the final product. For cast stone caps, or elements that are viewed up close by the public as part of the shrines being created, the installation procedures must be of the highest quality in order to create the final installation that is acceptable for the shrines being constructed.
2. Modify these specifications as required to produce contract bid documents that control the manufacturing, delivery, handling and

installation process for the cast stone products, especially caps, so the final product as installed does not have any damage and certainly any repairs to the visible portions of the caps.

- B. Unless specifically indicated otherwise, cast stone provided for this project is to be wet-cast type.

1.2 RELATED WORK

- A. Cast-in-place concrete //columbarium//memorial wall// complexes:
Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.
- B. Precast Concrete Columbarium Niches: 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS.
- C. Precast Memorial Wall Units: Section 03 48 26, PRECAST CONCRETE MEMORIAL WALL UNITS.
- D. Setting and Pointing Mortar: Section 04 05 13, MASONRY MORTARING / Section 04 05 16, MASONRY GROUTING.
- E. Joint Sealant and Application: Section 07 92 00, JOINT SEALANTS.
- F. Color and texture specified in Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project // local/regional materials, // low-emitting materials, // recycled content, // ____// requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

SPEC WRITER NOTES:

1. Coordinate and modify the samples submittal requirements in conjunction with the mockup construction, so that the intended products are submitted and approved prior to fabrication of the units to be installed in the final work product.
2. It is critical that the samples that are provided represent the configuration, color and finish of each of the products to be provided, and that the samples demonstrate the minimum acceptable quality for the work to be provided, with clear demonstration that all visible surfaces are manufactured as "finished" surfaces.

B. Samples:

1. Provide cast stone sample panel, minimum size 100 by 300 by 300 mm (4 by 12 by 12 inches), for each color and each finish.
2. Show finish on two 100 mm (4 inch) edges and 300 by 300 mm (12 by 12 inch) surface.
3. For caps, samples must demonstrate the color and finish for all exposed surfaces; include samples of edges and drip slots.

C. Shop Drawings:

1. Cast stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.
2. For any caps, the approved shop drawings must indicate which surfaces will be exposed in the final installation.
3. For caps, all exposed surfaces to be identified and manufactured as finished surfaces, including the overhang and the drip slots where caps overhang the precast concrete niche units or other elements.
4. Setting drawings with setting mark.

5. Lifting Devices:

- a. Submit design details for lifting devices (not straps or slings) that will support the pieces at vertical lifting points using protective pads of materials that won't damage the stone.
- b. Lifting devices are required for all cap stones.
- c. Design lifting devices that function to safely lift cap stones by contacting the stones on the bottom finished edges, where the drip slots are located, so the units can be set into position without causing any marking or damage to the stones.

D. Certificates: Test results indicating that the cast stone meets specification requirements and proof of plant certification; certification documents must be current within one year of preconstruction meeting.

E. Submit manufacturers test results of cast stone previously made by manufacturer, indicating compliance with ASTM C1364.

F. Laboratory Qualifications: Description of testing laboratories facilities and qualifications of its principals and key personnel.

G. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.

H. Installer Qualifications: Provide documentation of requirements specified herein.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Store cast stone under waterproof covers on planking clear of ground.
- B. Protect from handling, dirt, stain, and water damage.
- C. Mark production units with the identification marks as shown on the shop drawings.
- D. Package units and protect them from staining or damage during shipping and storage.
- E. Provide packaging and lifting devices from the manufacturer that are designed to permit the installer easy removal for inspection, or to handle the cast stone for installation without causing damage to the units.
- F. Provide an itemized list of product to support the bill of lading.

SPEC WRITER NOTES:

1. Review the warranty period with the Project Manager and adjust as required.

1.6 WARRANTY

- A. Warranty exterior masonry walls against moisture leaks, any defects and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be two years.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

SPEC WRITER NOTES:

1. Remove reference citations that do not remain in Part 2 or Part 3 of edited specification.
2. Verify and make dates indicated for remaining citations the most current at date of submittal; determine changes from date indicated on the TIL download of the section and modify requirements impacted by the changes.

- B. American Concrete Institute (ACI):

318/318M-11	Building Code Requirements for Structural Concrete and Commentary
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- C. Architectural Precast Association; certification program.

- D. American Society for Testing and Materials (ASTM):

A167-99(2009)	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
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A185/A185M-07	Steel, Welded Wire Reinforcement, Plain, for Concrete
A240/A240M-13a	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
A276-13	Stainless Steel Bars and Shapes
A615/A615M-12	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A666	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
C33/C33M-13	Concrete Aggregates
C150/C150M-12	Portland Cement
C260/C260M-10a	Air-Entraining Admixtures for Concrete
C426-10	Linear Drying Shrinkage of Concrete Masonry Units
C494/C494M-13	Chemical Admixtures for Concrete
C503/C503M-10	Marble Dimension Stone
C568/C568M-10	Limestone Dimension Stone
C615/C615M-11	Granite Dimension Stone
C616/C616M-10	Quartz-Based Dimension Stone
C618-12a	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C979/C979M-10	Pigments for Integrally Colored Concrete
C989/C989M-13	Slag Cement for Use in Concrete and Mortars
C1194-03 (2011)	Compressive Strength of Architectural Cast Stone
C1195-03 (2011)	Absorption of Architectural Cast Stone
C1364-10b	Architectural Cast Stone
D2244-11	Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

E. Cast Stone Institute Technical Manual and Cast Stone Institute standard specifications.

1.8 QUALITY ASSURANCE

A. Manufacturer:

1. Must have five years minimum continuous operating experience, and have facilities for producing cast stone of the shapes, quantities and size required for this project.

2. Must be a producer certified by the Cast Stone Institute or the Architectural Precast Association.
3. Producer assumes responsibility for engineering units to comply with performance requirements and use indicated, including a comprehensive engineering analysis by a qualified professional engineer who is licensed in their place of practice and who is experienced in providing engineering services of the kind indicated.
4. Shop drawings to bear seal and signature of professional engineer responsible for the design and preparation.

B. Installer:

1. Must provide documentation demonstrating that they have a minimum of five years' experience setting cast or natural building stone.
2. Provide written handling and installation procedures that will be followed for the installation of the work for cast stones lifted, moved, adjusted in any way, other than by hand. Describe procedure starting at the inspection of the products once delivered to the site, and continue through the final setting of the cast stone units with them being secured into place in the work. Include procedures with description of the equipment that will be used, as well as all protection procedures to be followed, to ensure that no exposed surfaces or edges of the cast stone are damaged during handling or installation.
3. Provide written procedures for removal and replacement of cast stone units that have been damaged on any edges or faces that will be visible in the final installation, including drip slots.
4. Provide procedures for inspection and identification of any exposed damage, with procedures for immediate marking of the units to be removed and replaced prior to grouting or sealing of joints.

C. Testing:

1. Follow the procedures in ASTM C1364.
2. One (1) sample from production units may be selected at random from the field for each 14 m³ (500 cubic feet) delivered to the job:
 - a. Three (3) field cut cube specimens from each of these sample to have an average minimum compressive strength of not less than 85 percent with no single specimen testing less than 75 percent of design strength as specified.
 - b. Three (3) field cut cube specimens from each of these samples to have an average maximum cold-water absorption of 6 percent.

- c. Test field specimens in accordance with ASTM C1194 and C1195.
 - d. Manufacturer to submit a written list of projects similar and at least three (3) years of age, along with owner, architect and contractor references.
- D. Pre-Installation Conference: Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include RE/COR and all parties whose work is effected or related to the work of this section.

1.9 MANUFACTURING TOLERANCES

- A. Cross section dimensions must not deviate by more than + 3 mm (1/8 in.) from approved dimension.
- B. Length of units must not deviate by more than length 3 mm (/360 or + 1/8 in.), whichever is greater, not to exceed 6 mm (+ 1/4 in.) Maximum length of any unit must not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.
- C. Warp bow or twist of units must not exceed length 3 mm (/360 or + 1/8 in.), whichever is greater.
- D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features - On formed sides of unit, 3 mm (1/8 in.), on unformed sides of unit, 9 mm (3/8 in.) maximum deviation.

SPEC WRITER NOTES:

1. Modify, expand and coordinate the following with information indicated on the drawings. NOTE: Mockup construction of columbarium and memorial walls, and those other walls in their respective complexes, are critical elements that are visible to the public close up and require more care to product desirable results.
2. Recommend expanding the mockup requirements to specifically demonstrate the quality of all of the materials and workmanship for the installation.
3. Unless specifically directed otherwise by the Project Manager, do not allow the mockups to become part of the finished project work.

1.10 MOCK-UP

- A. Provide full size unit(s) for use in construction of //columbarium wall//, memorial wall//, seating wall// as mockup sample wall(s); the mockup(s) becomes the standard of workmanship for the project.
- B. Coordinate the size and location for the mockup wall(s) with the RE/COR; //mockup wall(s) cannot become part of the final project work.// Mockup wall(s) may become part of the final project, discussed, coordinated and approved in advance by the RE/COR.//
- C. Demonstrate the construction tolerances for the construction of the foundations, as well as the quality of the exposed edges and the finish of the final exposed surfaces.
- D. Demonstrate the options for color selection for stain, paint, sealant, grout, etc. on the mockups so they can be judged against the various possible materials and their colors and finishes.
- E. Install precast niche units and demonstrate the construction tolerances, finish, placement of adjoining units, joints, surface treatment, attachment hardware, installed niche, rosette bolt alignment, washers, pins, shims, weep vents, backer rod and joint sealant.
- F. Install surface treatment, as indicated in the design, like veneer, brick, stone, exposed concrete, stucco, etc.
- G. Install caps, including the placement of shims, the alignment of the joints in relationship of cap joints compared to niche cover or marker placement, backer rod, joint sealant, weep vents, flashing, joint size, and any other elements needed to demonstrate the quality of the final product installation.
- H. When there are options or selections to be made for the final installation, the mockup must demonstrate the multiple options available for selection as the final product and installation.

1.11 PROJECT CONDITIONS

- A. Field Measurements: Verify actual conditions to receive cast stone components by field measurements before production.
- B. Dimensions on shop drawings to be based upon field measurements.

PART 2 - PRODUCTS**2.1 ARCHITECTURAL CAST STONE**

- A. Comply with ASTM C1364.
- B. Physical Properties: Provide the following:

1. Compressive Strength - ASTM C1194: 45 Mpa (6,500 psi) minimum for products at 28 days.
 2. Absorption - ASTM C1195: 6 percent maximum by the cold water method, or 10 percent maximum by the boiling method for products as 28 days.
 3. Air Content for Wet Cast Product - ASTM C173 or C231: 4-8 percent for units exposed to freeze-thaw environments.
 4. Freeze Thaw - ASTM C1364: The cumulative percent weight loss (CPWL) less than 5 percent after 300 cycles of freezing and thawing.
 5. Linear Shrinkage - ASTM C426: Maximum 0.065 percent.
- C. Job Site Testing - One (1) sample from production units may be selected at random from the field for each 14m³ (500 cubic feet) delivered to the job site:
1. Three (3) field cut cube specimens from each of these samples must have an average minimum compressive strength of not less than 85 percent with no single specimen testing less than 75 percent of design strength as allowed by ACI 318.
 2. Three (3) field cut cube specimens from each of these samples must have an average maximum cold-water absorption of 6 percent.
 3. Test field specimens in accordance with ASTM C1194 and C1195.

2.2 RAW MATERIALS

- A. Portland Cement: Type I or Type III, white and/or grey, ASTM C150.
- B. Coarse Aggregates: Granite, quartz or limestone, ASTM C33, except for gradation, and are optional for the vibrant dry tamp (VDT) casting method.
- C. Fine Aggregates: Manufactured or natural sands, ASTM C33, except for gradation.
- D. Colors: Inorganic iron oxide pigments, ASTM C979 except that carbon black pigments cannot be used.
- E. Admixtures: Comply with the following:
 1. ASTM C260 for air-entraining admixtures.
 2. ASTM C494/C495M Types A-G for water reducing, retarding, accelerating and high range admixtures.
 3. Other Admixtures: Integral water repellents and other chemicals, for which no ASTM Standard exists, must be previously established as suitable for use in concrete by proven field performance or through laboratory testing.

- a. Produce units with water repellent accepted by fabricator within mix design; product for mix design and setting mortar to be from same source.
- 4. ASTM C618; do not use mineral admixtures of dark and variable colors in surfaces intended to be exposed to view.
- 5. ASTM C989; granulated blast furnace slag may be used to improve physical properties, as verified by testing documentation.
- F. Water: Potable.
- G. Reinforcing Bars:
 - 1. ASTM A615/A615M, Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 37 mm (1.5 in.).
 - 2. Welded Wire Fabric: ASTM A185 where applicable for wet cast units.
- H. Provide anchors, dowels and other anchoring devices and shims that are 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

- A. //Match sample on file.//
- B. Provide fine-grained texture similar to natural stone, for surfaces intended to be exposed to view. Air voids are not permitted in excess of 0.8 mm (1/32 in.), and the density of such voids must be less than 3 occurrences per any 25 mm² (1 in²). Air voids are not permitted when obvious under direct daylight illumination at a 1.5 m (5 ft.) distance.
- C. Units must exhibit a texture //approximately equal to//of no less quality than// the approved sample when viewed under direct daylight illumination at a 3 m (10 ft.) distance.
- D. Units to comply with ASTM D2244 permissible variation in color between units of comparable ages subjected to similar weathering exposure.
 - 1. Total color difference - not greater than 6 units.
 - 2. Total hue difference-not greater than 2 units.
- E. Chipping on edges or surfaces of caps, where they will be visible in the final installation, whether resulting from shipment, delivery or other factors or causes is not acceptable, and the units must be removed and replaced with new units. //For units, other than caps, minor chips may be allowed if they are not obvious under direct daylight illumination from a 1 m (3 ft.) distance as determined by the RE/COR.//

SPEC WRITER NOTES:

1. Check with the Project Manager regarding following paragraph.
 2. Recommend modification to not allow this for caps, and is allowed at all, there needs to be a criteria established for measuring what is acceptable.
- F. The occurrence of crazing or efflorescence may constitute a cause for rejection, at the sole discretion of the RE/COR.
- G. Remove cement film, if required, from exposed surface prior to packaging for shipment.

2.4 REINFORCING

SPEC WRITER NOTES:

1. Modify the reinforcing requirements based upon the installation for the caps, to ensure that the caps will not crack due to loading conditions experienced during the life of the caps.
- A. Reinforce the units as required by the shop drawings, and prepared under direction of professional engineer, for safe handling and structural stress. For wall caps, include adequate reinforcing to prevent the caps from breaking when supported by shims at the ends of the units, and having workers on top of the units.
1. Reinforcing to be minimum 0.25 percent of the cross section area.
- B. Provide non-corrosive reinforcement where faces exposed to weather are covered with less than 38 mm (1.5 in.) of concrete material. Provide reinforcement with minimum concrete coverage of twice the diameter of the bars.

SPEC WRITER NOTES:

1. If anchors are used, epoxy adhesives are often used to improve seismic resistance.

2.5 EMBEDDED ANCHORS AND OTHER INSERTS

- A. Fabricate from stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304.

2.6 CURING

- A. Cure units in a warm curing chamber 537.8 C (1000 F) at 95 percent relative humidity for approximately 12 hours, or cure in a 95 percent moist environment at a minimum 371.1 C (700 F) for 16 hours after casting. Provide additional yard curing at 95 percent relative humidity and 350-degree-days (i.e. 7 days at 260.0 C (500 F) or 5 days at 371.1

C (700 F) prior to shipping. Protect form-cured units from moisture evaporation with curing blankets or curing compounds after casting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Check cast stone materials for damage, coloration, finish, crazing, efflorescence, fit and finish prior to installation. Do not set unacceptable units.

3.2 SETTING TOLERANCES

- A. Comply with the more stringent tolerances of the Cast Stone InstituteSM Technical Manual or this section.
- B. Set stones 3 mm (1/8 in.) or less, within the plane of adjacent units.
- C. Joints, plus - 1.5 mm (1/6 in.), minus - 3 mm (1/8 in.).

3.3 JOINTING

SPEC WRITER NOTES:

- 1. Modify joint sizes to match the intent on the Drawings and include allowable tolerances.

A. Joint Size:

- 1. At stone/brick joints 9.5 mm (3/8 in.).
- 2. At stone/stone joints in vertical position //6 mm (1/4 in.) //9.5 mm (3/8 in.)//.
- 3. Stone/stone joint exposed on top 9.5 mm (3/8 in.).

B. Joint Materials:

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

C. Location of Joints:

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

3.4 SETTING

A. Mortar Bed Setting:

- 1. Drench units with clean water prior to setting.
- 2. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3. Set units in full bed of mortar containing water repellent, unless otherwise detailed.
 4. Rake mortar joints 18 mm (3/4 in.) for pointing.
 5. Remove excess mortar from unit faces immediately after setting.
 6. Tuck point unit joints to a slight concave profile.
- B. Shim Setting:
1. Set each piece on shims as indicated, minimum of two for each piece and four for each cap piece.
 2. Set shims where located on the shop drawings.
 - a. Caps on Precast Niche Units:
 - 1) Place shims directly above the vertical webs below, where the web is not abutting an open ended unit.
 - 2) Install shims one full web back from any open ended joint in the precast niche units (approximately 12 inches back from the open ended joint).
 - b. Install shims on cast-in-place concrete or filled CMU as indicated on the shop drawings.
 3. Furnish and install cap supporting non-shrink grout as part of the shim type of cap installation, with the supporting non-shrink grout being installed as indicated on the shop drawings, only at locations that are directly over vertical webs below.

3.5 JOINT PROTECTION

- A. Comply with requirements of Section 07 92 00, JOINT SEALANTS.
- B. Prime ends of units, insert properly sized backing rod at the correct depth and install required sealant.

SPEC WRITER NOTES:

1. Repair for cast stone units is not recommended because the patch that is produced will not match the adjoining materials sometime during the life of the unit. The patch will be made with different materials than the original stone itself and will weather differently than the cast stone unit itself. This is acceptable according to the CSI, but their standards for viewing chips and patches are from a greater distance than is applicable for installations for the NCA shrine elements where the public will be viewing the units from about 3 feet.
2. Evaluate the project conditions and adjust the following paragraph accordingly.

3.6 REPAIR AND CLEANING

- A. Repair chips with touchup materials furnished by manufacturer.
- B. Saturate units to be cleaned prior to applying an approved masonry cleaner.
- C. Consult with manufacturer for appropriate cleaners.

3.7 INSPECTION AND ACCEPTANCE

- A. Inspect finished installation according to Bulletin #36 published by the Cast Stone Institute except distance for measuring acceptability to be reduced to 1 m (3 ft.).

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