

## SECTION 047200 – ARCHITECTURAL CAST STONE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

##### A. RELATED DRAWINGS

All drawings, to include supplemental drawings, instructions and conditions of this contract.

##### B. RELATED SPECIFICATIONS

**Division – 01** – General Requirements – for specific contract practices and procedures.

**Division – 04** – Masonry Mortaring – for coordinating anchorage.

**Division – 04** – Masonry Grouting – for coordinating anchorage.

**Division – 04** – Masonry Anchorage and Reinforcing – for coordination of drawings, connection anchors and installation.

**Division – 04** – Unit Masonry – for coordination of drawings, intersection and installation.

**Division – 07** – Joint Sealants – for coordination of joint locations and conditions.

#### 1.2 SUMMARY

##### A. Scope

Include all labor, materials, design, supervision, tools and equipment required for the fabrication and delivery of the Architectural Cast Stone as shown on the drawings and as specified, in accordance with the Contract Documents.

#### 1.3 REFERENCES

##### Cast Stone Institute

<b>ACI 318</b>	Building Code Requirements for Reinforced Concrete.
<b>ASTM A 185</b>	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
<b>ASTM A 615</b>	Standard Specification for Deformed and Plain Billet-Steel Bars for Reinforced Concrete.
<b>ASTM C 33</b>	Standard Specification for Concrete Aggregates.
<b>ASTM C 150</b>	Standard Specification for Portland Cement.
<b>ASTM C 173</b>	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volume Method.
<b>ASTM C 231</b>	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
<b>ASTM C 260</b>	Standard Specification for Air-Entrained Admixtures for Concrete.
<b>ASTM C 270</b>	Standard Specification for Mortar for Unit Masonry.
<b>ASTM C 426</b>	Standard Test Method for Linear Shrinkage of Concrete Masonry Units
<b>ASTM C 494</b>	Standard Specification for Chemical Admixtures for Concrete.
<b>ASTM C 618</b>	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Concrete.
<b>ASTM C 666</b>	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
<b>ASTM C 979</b>	Standard Specification for Coloring Pigments for Integrally Pigmented Concrete.
<b>ASTM C 989</b>	Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete.
<b>ASTM C 1116</b>	Standard Specification for Fiber Reinforced Concrete and Shotcrete.
<b>ASTM C 1194</b>	Standard Test Method for Compressive Strength of Architectural Cast Stone.
<b>ASTM C 1195</b>	Standard Test Method for Absorption of Architectural Cast Stone.
<b>ASTM C 1364</b>	Standard Specification for Architectural Cast Stone.

## **1.4. DEFINITIONS**

### **A. Cast Stone**

An Architectural Prefabricated Concrete building component, manufactured to simulate natural cut stone, primarily used with Division 4 masonry applications.

- 1.) Dry Cast - Manufactured from a very low water to cement ratio (almost dry), true zero slump concrete.
- 2.) Vibrant Dry Tamp (**VDT**) - Method of compacting true zero slump concrete against a sturdy mold with a vibratory ramming hammer until the mix is densely compacted.
- 3.) Machine casting method - Method of compacting true zero slump concrete against a sturdy mold (generally steel), with a vibratory machine press, maintaining pressure and vibration until the mix is densely compacted.
- 4.) Wet Cast - Standard method of pouring cement, normal weight concrete with a measurable slump, poured into molds during casting.

## **1.5 SUBMITTALS**

### **A. Samples**

Provide preliminary samples to match Architects control sample, a minimum in size of 3"x 3"x 1" for basic color and texture. Once selected, provide 3 - 12"x 12" x 1 1/2" samples (minimum size for approval), representing selected color and finish texture for final approval.

### **B. Shop Drawings**

Detail fabrication and installation shop drawings for the Architectural Cast Stone units. Utilize elevations, plan views and cross-sections of each Architectural Cast stone unit, indicating its location, dimensions, shapes, and the relationship of each unit type to the adjacent materials. Include joints, drips, chamfers, rustications or reveals, along with the extent and location for each surface finish. Identify the separate face and backup mixture locations and thickness for wet cast. Indicate locations, tolerances, and details of anchorage devices in or attached to the structure or other construction. Coordinate, locate and detail openings or inserts required by other trades.

### **C. Product Data / Material Certificates**

- 1.) Qualification data for fabricator
- 2.) Form Materials
- 3.) Mold release agent
- 4.) For each Mix design provide
  - a. Cementitious materials
  - b. Aggregates both coarse and fine
  - c. Admixtures
  - d. Coloring
  - e. History for similar mix designs proving compressive strength and water absorption.
- 5.) For each type of reinforcing
- 6.) MSDS

## **1.6 QUALITY ASSURANCE**

### **A. Fabricator Qualifications**

A fabricator having been regularly and continuously engaged in the manufacture of Architectural Cast Stone units, similar to those required on the contract drawings, for a minimum of 5 years. Has sufficient production capacity to produce required units without delaying the work. This

responsibility includes preparation of shop (erection) drawings. Fabricator will perform quality control inspections during manufacturing and finishing, to ensure testing requirements, along with dimensional tolerances, for all units, conform to contract documents.

**B. Design Standards**

Comply with ACI 318, the Cast Stone Institute, ASTM C 1364 and the contract documents.

**C. Testing Agency Qualifications**

An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

**D. Mock-up**

After sample approval and before production, as indicated or directed by Architect, produce 2 full sized actual units for review, one to remain at the project site and the other to be maintained by the fabricator for control. These units will demonstrate aesthetic effects, verify sample selections made under sample submittals and be used to review quality standards for the balance of production. Upon substantial completion of production these mock up pieces can then be incorporated into the completed project.

**1.7 DELIVERY, STORAGE AND HANDLING**

**A. Delivery**

Deliver Architectural Cast Stone units in such quantities and at such times, to ensure compliance with the agreed upon project schedule. Provide support for units during shipment on non-staining material.

**B. Storage**

Insure all stored units at fabrication facility have identification marks which are clearly visible and adequate blocking or bracing to prevent contact with soil, prevent staining, prevent cracking, distortion, warping, or other physical damage.

**C. Handling**

Lift and support units only at designated points, handling and transporting units to avoid excessive stresses which could cause cracking or damage.

**PART 2 - PRODUCTS**

**2.1. ACCEPTABLE MANUFACTURERS**

**A.** Acceptable fabricators of Architectural Cast Stone are still subject to compliance with all project requirements. Provide products by one of the following:

- 1.) Artisan Stone Company, Inc. – Omaha Ne.
- 2.) .
- 3.) .

**2.2 FORM MATERIALS**

**A.** Build forms of wood, steel, fiberglass, rubber, plastic, plaster or concrete. Forms must be stable, constructed of or coated with a non-absorptive material, which will allow continuous and true surfaces. Form finish should not react with concrete and be suitable for producing required finishes without lines or blemishes.

- B. Form release agent should be a commercially produced product that will not bond with, stain, or affect the curing process of cast stone surfaces. Ensure release agent will become inert and not impair subsequent surface or joint treatments of finished Architectural Cast Stone.

## **2.3 REINFORCING MATERIALS**

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated steel wire into flat sheets.
- D. Fiber reinforcement (optional): ASTM C 1116
- E. Support, suspend hold or tie reinforcement in place. Use wire ties, plastic chairs, clips or other devices for spacing, supporting, and fastening reinforcing and welded wire reinforcement in its proper place.

## **2.4 CONCRETE MATERIALS**

### **A. Portland Cement: ASTM C150, Type I or III**

- 1.) For the exposed finish use gray or white portland cement to simulate Architects control sample. Utilize the same type, brand, and mill source of each type of cement, throughout the completion of the Architectural Cast Stone production.
- 2.) Standard gray portland cement may be used for any non-exposed finish.

### **B. Cement Supplements**

- 1.) Fly Ash: ASTM C 618, Class C or F.
- 2.) Metakaolin: ASTM C 618, Class N.
- 3.) Silica Fume: ASTM C 1240.
- 4.) Ground Granulated Blast Furnace Slag: ASTM C 989, Grade 100 or 120.

### **C. Normal weight Aggregates**

ASTM C 33, except for gradation, and are optional for the VDT casting method. Provide a hard and durable coarse aggregate material from a single source (pit or quarry). Select fine aggregates, generally a natural sand or manufactured sand from a single source (pit or quarry). Ensure all selected aggregate is free of material that reacts with cement or causes staining; along with the compatibility of the coarse and fine aggregate to match Architects required finish types and meet required design strength.

### **D. Water**

Potable, free from deleterious material that may affect color stability, setting, or strength of concrete.

### **E. Admixtures**

- 1.) All chemical admixtures to be certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
- 2.) Coloring; ASTM C 979, synthetic or natural mineral-oxide pigments, temperature stable, and non-fading.
- 3.) Intrigal Waterproofing – Color Guard 2 as provided by Beton Chemie
- 3.) Air-Entraining, ASTM C 260
- 4.) Water-Reducing, ASTM C 494/C 494M, Type A.
- 5.) High-Range, Water-Reducing, ASTM C 494/C 494M, Type F.

6.) Super Plasticizer for Flowable Concrete: ASTM C 1017/C 1017M.

**F. Joint Materials**

Mortar, Type N, ASTM C 270.

**G. Anchors**

Provide standard commercially available masonry anchors in a non-corrosive finish, such as zinc or galvanized steel stone clips and fiberglass or stainless steel pins.

**PART 3 - MANUFACTURING**

**3.1 MOLDS**

- A. Build molds mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations, true to dimension and within fabrication tolerances indicated. Accurately place drips, chamfers, rustications or reveals, block-outs and edge treatments. Coat contact surfaces of molds with release agent before reinforcement is placed.
- B. Furnish, to their respective installer, all cast in structure and loose items including steel plates, clip angles, seat angles, anchors, dowels, hangers, and other shapes for securing cast stone units.
- C. Coordinate and cast in reglets, slots, holes or other accessories required by other trades, in cast stone units as indicated on Contract Drawings.

**3.2 REINFORCEMENT**

Reinforce cast stone units as required by the drawings. Minimum reinforcing shall be 0.25 percent of the cross section area. Non-corrosive reinforcement shall be used where faces exposed to weather or are covered with less than 1 1/2" of material. Any Architectural Cast Stone units greater than 24 in. (600 mm) in one direction shall be reinforced in that direction. Units having less than 24 in. (600 mm) in length and width shall not be reinforced unless otherwise specified. Welded wire fabric reinforcing shall not be used in VDT products.

**3.3 ARCHITECTURAL CAST STONE / WET CAST CONCRETE MIXTURES**

**A. VDT Dry Cast Stone**

Prepare VDT mix design by trial batch or field experience methods, to match Architect's sample for each type of dry cast stone required. Proportion mixtures with materials to be used on project, to provide VDT concrete with the following properties:

- 1.) Compressive Strength - ASTM C 1194 - 6,500 psi. minimum for products at 28 days.
- 2.) Absorption - ASTM C 1195 - 6% maximum by the cold water method, or 10% maximum by the boiling method for products at 28 days.
- 3.) Air entrainment is not required for VDT products.
- 4.) Freeze-thaw - ASTM C 1364 - The CPWL shall be less than 5% after 300 cycles of freezing and thawing.
- 5.) Linear Shrinkage - ASTM C 426 - Shrinkage shall not exceed 0.065%.

**B. Wet Cast Stone**

Prepare normal weight concrete face and backup design mixtures by trial batch or field experience methods, to match Architect's sample for each type of wet cast stone required. Limit the use of fly ash or ground granulated blast furnace slag to 20 percent replacement of portland cement by weight.

Limit the use of matakaolin or silica fume to 10 percent of portland cement by weight. Proportion mixtures with materials to be used on project, to provide normal weight concrete with the following properties:

- 1.) Compressive Strength (28 Days) - 6500 psi.
- 2.) Maximum Water-Cementitious Materials Ratio - 0.42.
- 3.) Water Absorption - 6 percent by weight or 14 percent by volume, tested according to ASTM C 642.
- 4.) Air Content - ASTM C 173 or C 231, for wet cast product shall be 4-8% for units exposed to freeze-thaw environments.

- C. Add all admixtures per manufacturers prescribed rate to result in concrete at point of placement having an air, slump and color dispersal conforming with the requirements of contract documents.

### **3.4 FABRICATION**

#### **A. Placement**

Thoroughly consolidate placed concrete by internal and or external vibration without dislocating or damaging reinforcement and built-in items, to minimize pour lines, honeycombing, or entrapped air voids on surfaces.

#### **B. Dry Cast Curing**

Place cast stone units in a warm curing room, maintaining a minimum ambient temperature of approximately 70°F (21.2°C) with a relative humidity of approximately 95 percent for a period of approximately 14 to 16 hours. Cast stone units left in a mold to cure must be protected from moisture evaporation with a curing blanket or curing compound.

#### **C. Wet Cast Curing**

Cure concrete by moisture retention without heat or by radiant heat and moisture. Cure units until the compressive strength is high enough to ensure that stripping does not have an effect on the performance or appearance of final product.

#### **D. Identification**

Identify pickup points of cast stone units and orientation in structure with permanent markings, complying with markings indicated on individual shop tickets. Imprint or permanently mark, casting date on each cast stone unit, on a surface that will not show in the finished structure.

#### **E. Finish**

All exposed faces have a fine-grained texture (acid etched) to simulate natural stone, with no air voids in excess of 1/32 in. and no more than 3 within any 1 square inch of the finished surface. Any such voids should not be obvious in direct sun light at a distance of 5 feet. All finished product shall maintain a finish and texture matching the approved sample in direct sun light from a distance of 10 feet.

#### **F. Repair**

Repair of minor damaged cast stone units to meet acceptability review by the Architect. These minor chips will not be grounds for rejection. All repairs should be reviewed in direct sunlight and shall not be obvious from a distance of 20-feet.

### **3.5 FABRICATION TOLERANCES**

- A. Cross section dimensions shall not deviate by more than  $\pm 1/8$  inch from approved dimensions.
- B. Length of units shall not deviate by more than length/ 360 or  $\pm 1/8$  inch, whichever is greater, not to exceed  $\pm 1/4$  inch.
- C. Maximum length of any unit shall not exceed 15 times the average thickness of such unit unless otherwise agreed to by the fabricator.
- D. Warp, bow or twist of units shall not exceed length/ 360 or  $\pm 1/8$  inch, whichever is greater.
- E. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features – On formed sides of unit,  $1/8$  inch, on unformed sides of unit, 1 inch maximum deviation.
- F. ASTM D 2244 Permissible variation in color between units of comparable age subjected to similar weathering exposure.
  - 1.) Total color difference – not greater than 6 units.
  - 2.) Total hue difference – not greater than 2 units.

### **3.6 QUALITY CONTROL**

#### **A. Testing**

Test compressive strength and absorption from specimens taken from every 500 cubic feet of product produced. Perform tests in accordance ASTM C 1194 and C 1195.

#### **B. Job site testing**

One (1) sample from production units may be selected at random from the field for each 500 cubic feet, 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%. Field specimens shall be tested in accordance with ASTM C 1194 and C 1195

#### **C. Acceptability**

Architectural Cast Stone units that do not fall within the acceptable requirements, including concrete strength, manufacturing tolerances, and color and texture range will be rejected. Replace unacceptable units with Architectural Cast Stone units that comply with the requirements.

- D. Retain copies of all test reports for a minimum of two years.

## **PART 4 - EXECUTION**

### **4.1 EXAMINATION**

Contractor / Installer will provide a sequence list of the cast stone for setting direction from starting point to completion. Installing contractor shall check cast stone materials for fit and finish prior to installation; unacceptable units shall not be set.

### **4.2 ERECTION**

- A. Saturate cast stone units with clean water prior to setting. Install cast stone units to include all loose clips, hangers, bearing pads, and other accessories required for connecting these units to supporting members and or backup materials. Fill dowel holes and anchor slots completely with mortar or non-

shrink grout. Set cast stone units in full bed of mortar, unless otherwise detailed. Rake mortar joints 3/4 inch back for pointing. Remove excess mortar from cast stone unit faces immediately after setting. Tuck point unit joints to a slight concave profile.

- B.** Contractor / Structural Steel Fabricator will supply and install any special supports, braces or seat stiffeners required by contract documents.
- C.** Erect Architectural Cast Stone units level, plumb, and square within the specified allowable erection tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed or grout has set-up.
  - 1.) Install temporary steel or plastic spacing shims as cast stone units are being erected.
  - 2.) Remove projecting lifting devices and use sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent cast stone surfaces when recess is exposed.
  - 3.) Unless otherwise indicated, provide for uniform joint widths of 3/8 inch

### **4.3 ERECTION TOLERANCES**

- A.** Set stones 1/8 inch or less, within the plane of adjacent units.
- B.** Joints, plus - 1/16 inch, minus - 1/8 inch.

### **4.4 JOINTING**

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.

### **4.5 CLEANING AND REPAIR**

Repair chips with touchup materials furnished by manufacturer. Saturate units to be cleaned prior to applying an approved masonry cleaner. Consult with manufacturer for appropriate cleaning procedures.

### **4.6 WATER REPELLENT (Optional)**

All repairs, cleaning, review and acceptance will be completed prior to any application of water repellent. Apply water repellent in accordance with manufacturers directions.

**END OF SECTION 047200**