

# Standard Specification for Milestone® Lightweight Architectural Concrete Unit Masonry

*Revised 15/05/05*

This specification encompasses basic requirements for Lightweight Architectural Concrete Unit Masonry (LAM) manufactured to simulate natural stone, used in masonry applications. Lightweight Architectural Concrete Masonry is a masonry product (as specified by Construction Specifications Institute - CSI code 04 22 23), used as an architectural feature, trim, ornament or facing for buildings or other structures.

Important value-adding feature of Lightweight Architectural Masonry is its reduced weight, by 30-40% when compared with conventional concrete (i.e. less than 105 lb/ft<sup>3</sup>). This advanced product, analogous to lightweight concrete masonry, provides quite valuable benefits due to simplified installation, shipment and handling without compromising its performance. LAM's reduced material consumption and reduced loads on the structure contributes to sustainability and green construction.

Materials and processes used for manufacturing Lightweight Architectural Masonry vary according to the resources locally available to the manufacturers and the processes and techniques used by the manufacturers to meet the requirements of the particular project and to obtain the desired appearance and physical properties. Of paramount importance in production of LAM is the need to employ a properly proportioned mixture of white cements, manufactured or natural sands, lightweight aggregates, mineral coloring pigments and chemical admixtures to achieve the desired appearance while maintaining durable physical properties. The considerable weight reduction of LAM is achieved with incorporation into concrete mix of tiny (less than 1/5 in) bubbles of preformed foam. Besides this, an addition of aggregates with low density (such as some natural rocks or artificial granular materials) helps to maintain high performance standard of LAM. Although a variety of casting methods can be used, LAM production conforming to this specification will provide adequate qualities essential for normal installations as a suitable replacement for architectural ornamentation made of natural limestone, brownstone, sandstone, bluestone, slate, keystone, travertine and other natural building stones.

It is anticipated that this specification may be helpful to the specifiers in understanding the inherent qualities of Lightweight Architectural Masonry and its use. For details and samples of finishes available in your project area, contact your nearest Milestone® distributor.

## **1. PART 1 – GENERAL**

### **1.1. SECTION INCLUDES - Lightweight Architectural Concrete Unit Masonry (LAM).**

- A. Scope - All labor, materials and equipment to provide the LAM shown on architectural drawings and as described in this specification.
  - 1. Manufacturer shall furnish LAM covered by this specification.
  - 2. Installing contractor shall unload, store, furnish all anchors, set, patch, clean and seal (optional) the LAM as required.

### **1.2. RELATED CONSTRUCTION SPECIFICATIONS INSTITUTE (CSI) SECTIONS**

- A. Section – 01 33 00 – Submittal Procedures
- B. Section – 03 33 16 – Lightweight Architectural Concrete
- C. Section – 04 05 13 – Masonry Mortaring
- D. Section – 04 05 16 – Masonry Grouting
- E. Section – 04 05 19 – Masonry Anchorage and Reinforcing
- F. Section – 04 21 13 – Brick Masonry
- G. Section – 04 22 00 – Concrete Unit Masonry
- H. Section – 04 22 23 – Architectural Concrete Unit Masonry
- I. Section – 04 42 00 – Exterior Stone Cladding
- J. Section – 04 57 00 – Masonry Fireplaces
- K. Section – 07 90 00 – Joint Protection

### **1.3. REFERENCES**

- A. ASTM C 33 Standard Specification for Concrete Aggregates
- B. ASTM C 39 Test Method for Strength of Cylindrical Concrete Specimens
- C. ASTM C 62 Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)
- D. ASTM C 67 Test Methods of Sampling and Testing Brick and Structural Clay Tile
- E. ASTM C 90 Standard Specification for Load-Bearing Concrete Masonry Units
- F. ASTM C 129 Standard Specification for Non-Load-Bearing Concrete Masonry Units
- G. ASTM C 140 Methods of Sampling and Testing Concrete Masonry Units
- H. ASTM C 150 Standard Specification for Portland Cement
- I. ASTM C 216 Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
- J. ASTM C 331 Specification for Lightweight Aggregates for Concrete Masonry Units
- K. ASTM C 426 Test Method for Drying Shrinkage of Concrete Block
- L. ASTM C 595 Specification for Blended Hydraulic Cements
- M. ASTM C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
- N. ASTM C 270 Standard Specification for Mortar for Unit Masonry
- O. ASTM C 426 Standard Test Method for Linear Shrinkage of Concrete Masonry Units
- P. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
- Q. ASTM C 567 Test Method for Determining Density of Structural Lightweight Concrete
- R. ASTM C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Concrete
- S. ASTM C 979 Standard Specification for Coloring Pigments for Integrally Pigmented Concrete
- T. ASTM C 1116 Standard Specification for Fiber-Reinforced Concrete and Shotcrete

- U. ASTM C 1157 Standard Performance Specification for Hydraulic Cement
- V. ASTM C 1194 Standard Test Method for Compressive Strength of Architectural Cast Stone
- W. ASTM C 1364 Standard Specification for Architectural Cast Stone
- X. ASTM D 2244 Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates
- Y. ACI 523.3R Guide for Cellular Concretes above 50 pcf and for Aggregate Concretes above 50 pcf with Compressive Strengths Less Than 2500 psi
- Z. Cast Stone Institute® Specification and Technical Manual

## 1.4. DEFINITIONS

- A. Lightweight Architectural Concrete Unit Masonry – an architectural concrete building unit manufactured to simulate natural stone, used in unit masonry applications.
- B. Types: Two types of LAM are covered by this specification as follows:
  - 1. Non-Load-Bearing Lightweight (less than 105 lb/ft<sup>3</sup>) Architectural Concrete Non-Moisture Controlled Units Type II according to ASTM C129.
  - 2. Load-Bearing Lightweight (less than 105 lb/ft<sup>3</sup>) Architectural Concrete Non-Moisture Controlled Units Type II according to ASTM C90.
- C. Production method of LAM includes wet-casting of flowable cellular lightweight concrete mix (optionally, self-compacting mix) into a mold with or without vibration until it becomes completely consolidated, finishing, curing, and, finally, demolding.

## 1.5. SUBMITTAL PROCEDURES

- A. Comply with CSI Section 01 33 00 - Submittal Procedures.
- B. Samples: Submit pieces of the Lightweight Architectural Concrete Unit Masonry that are representative of the general range of finish and color proposed to be furnished for the project.
- C. Test results: Submit manufacturers test results of LAM previously made by the manufacturer.
- D. Shop Drawings: Submit manufacturers shop drawings including profiles, cross-sections, reinforcement details (if required), exposed faces, arrangement of joints (optional for standard or semi-custom installations), anchoring methods, anchors (if required), annotation of stone types and their location.

## 1.6. QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  - 1. Manufacturer shall have sufficient plant facilities to produce the shapes, quantities and size of Lightweight Architectural Concrete Unit Masonry required in accordance with the project schedule.
  - 2. 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.
- B. Standards: Comply with ASTM C 90 / C 129, this specification and the project requirements.
- C. Mock-up (Optional): Provide full size unit(s) for use in construction. The approved mock-up shall become the standard for appearance and workmanship for the project.

## 2. PART 2 - PRODUCTS

### 2.1. LIGHTWEIGHT ARCHITECTURAL CONCRETE UNIT MASONRY

- A. Shall comply with:
1. ASTM C 129 for Type II Non-Load-Bearing Lightweight Architectural Concrete Non-Moisture Controlled Units.
  2. ASTM C 90 for Type II Load-Bearing Lightweight Architectural Concrete Non-Moisture Controlled Units.
- B. Physical Properties:
1. ASTM C 567 Oven-Dry Density: Shall be less than 105 lb/ft<sup>3</sup> (1680 kg/m<sup>3</sup>).
  2. ASTM C 39 / 140 / C 1194 Compressive Strength: At the time of delivery to the purchaser, LAM shall conform to the strength requirements set in Table 1.
  3. ASTM C 140 Water Absorption: At the time of delivery to the purchaser, LAM shall conform to the water absorption requirements prescribed in Table 1.
  4. ASTM C 426 Linear Shrinkage: Shrinkage of LAM shall not exceed 0.065%.
  5. Job Site Testing: One (1) sample from production units may be selected at random from the field for each 500 cubic feet (14 m<sup>3</sup>) delivered to the job site.

TABLE 1 - STRENGTH, ABSORPTION, AND WEIGHT CLASSIFICATION REQUIREMENTS  
(AS PER AS ASTM C 90 / C 129 FOR TYPE II UNITS)

Type of LAM	ASTM C567 Oven-Dry Density, lb/ft <sup>3</sup> (kg/m <sup>3</sup> )	ASTM C39/C140/C1194 Compressive Strength* min, psi (MPa)		ASTM C140 Water Absorption, max, lb/ft <sup>3</sup> (kg/m <sup>3</sup> )	Classification According to Governing ASTM Standard
		Average of 3 Units	Individual Unit		
Load-Bearing	< 105 (1680)	1900 (13.1)	1700 (11.7)	18 (288)	C90 Type II
Non-Load-Bearing	< 105 (1680)	600 (4.1)	500 (3.5)	-	C129 Type II

\* Higher compressive strengths may be specified where required by design. Consult with local Milestone® suppliers to determine availability of units of higher compressive strength.

### 2.2. RAW MATERIALS

- A. Portland Cement: White and/or gray cements conforming to ASTM C 150 or ASTM C 595 / C 1157.
- B. Coarse Aggregates: Natural rocks or artificial granular materials conforming to ASTM C 331.
- C. Fine Aggregates: Manufactured or natural sands, ASTM C 33, except for gradation.
- D. Colors: Inorganic iron oxide pigments, ASTM C 979.
- E. Admixtures: Comply with the following:
  1. ASTM C 494 Types A - G for water reducing, retarding, accelerating and high range water reducing admixtures.
  2. Other admixtures: foaming agents, 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.
  3. ASTM C 618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.

4. ASTM C 989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.
- F. Water: Potable
- G. Reinforcement:
1. ASTM C-1116 Type III Synthetic Fiber (required for Load-Bearing Units only).
  2. ASTM A 615 Grade 40 or 60 steel galvanized or epoxy coated (optionally).
  3. ASTM A 185 Welded Wire Fabric (optionally).
- H. 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

- A. Match sample on file in architect's office.
- B. All surfaces intend to be exposed to view shall have a texture similar to natural stone.
- C. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 ft (3 m) distance:
1. ASTM D 2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.
    - a.Total color difference – not greater than 6 units.
    - b.Total hue difference – not greater than 2 units.
- D. 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 (6 m) distance.
- E. The occurrence of crazing or efflorescence shall not constitute a cause for rejection.
- F. Remove cement film, if required, from exposed surfaces prior to packaging for shipment.

## 2.4. REINFORCING

- A. Lightweight Architectural Concrete Unit Masonry does not require structural reinforcement. However, to improve the performance, the Load-Bearing LAMs are reinforced with ASTM C-1116 Type III Synthetic Fiber.
- B. In case if steel reinforcement is required by the project specifications / drawings, provide the following:
1. Minimum reinforcement of 0.25 % of the cross section area.
  2. Reinforcement shall be non-corrosive (galvanized or epoxy coated).

## 2.5. CURING

- A. Cure LAMs in a warm curing chamber approximately 100°F (37.8°C) at 95 % relative humidity for approximately 12 hours, or cure in a 95 % moist environment at a minimum 70°F(21.1°C) for 16 hours after casting.
- B. Additional yard curing at 95 % 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. The cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

## 2.6. MANUFACTURING TOLERANCES

- A. Cross-sectional dimensions shall not deviate by more than ±1/8 in. (3 mm) from approved dimensions.

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

## 2.7. PRODUCTION QUALITY CONTROL

- A. Testing:
  - 1. Test compressive strength and absorption from specimens selected from plant production according to sampling plan.
  - 2. Samples shall be taken and tested from every 500 cubic feet (14 m<sup>3</sup>) of product produced.
  - 3. Perform the tests as specified in § 2.1. B.
  - 4. New and existing mix designs shall be tested for strength and absorption compliance prior to producing units.

## 2.8. DELIVERY, STORAGE AND HANDLING

- A. Mark production units with the identification marks as shown on the shop drawings.
- B. Package units and protect them from staining or damage during shipping and storage.
- C. Provide an itemized list of product to support the bill of lading.

## 3. PART 3 EXECUTION

### 3.1. EXAMINATION

- A. Installing contractor shall check Lightweight Architectural Concrete Unit Masonry materials for fit and finish prior to installation.
- B. Do not set unacceptable units.

### 3.2. SETTING TOLERANCES

- A. Comply with Masonry Institute of America and Cast Stone Institute Technical Manuals.
- B. Set stones  $1/8$  in. (3 mm) or less, within the plane of adjacent units.
- C. Joints, plus -  $1/16$  in. (1.5 mm), minus -  $1/8$  in. (3 mm).

### 3.5. JOINT PROTECTION

- A. Comply with requirements of CSI Section 07 90 00.
- B. Prime ends of units, insert properly sized backing rod and install required sealant.

### 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 Masonry Institute of America and Cast Stone Institute recommendations.
- B. Do not field apply water repellent until repair, cleaning, inspection and acceptance is completed.

### 3.3. JOINTING

- A. Joint size:
  - 1. At stone/brick joints 3/8 in. (9.5 mm).
  - 2. At stone/stone joints in vertical position 1/4 in. (6 mm) (optionally, 3/8 in. (9.5 mm)).
  - 3. Stone/stone joints exposed on top 3/8 in. (9.5 mm).
- B. Joint materials:
  - 1. Mortar, Type N, ASTM C 270.
  - 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 in copings 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. Drench units with clean water prior to setting.
- B. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
- C. Set units in full bed of mortar, unless otherwise detailed.
- D. Rake mortar joints 3/4 in. (18 mm) for pointing.
- E. Remove excess mortar from unit faces immediately after setting.
- F. Tuck point unit joints to a slight concave profile.