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DIVISION 04 - MASONRY

SECTION 04200

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SECTION 04200

MASONRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI SP-66 (1994) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (1995a) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 153 (1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 615/A 615M (1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 55 (1996a) Concrete Brick

ASTM C 90 (1996a) Loadbearing Concrete Masonry Units

ASTM C 91 (1996) Masonry Cement

ASTM C 140 (1996b) Sampling and Testing Concrete Masonry Units

ASTM C 270 (1996a) Mortar for Unit Masonry

ASTM C 476 (1995) Grout for Masonry

ASTM C 494 (1992) Chemical Admixtures for Concrete

ASTM C 780 (1996) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

ASTM C 1019 (1989a; R 1993) Sampling and Testing Grout

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Brick; FIO.

Manufacturer's descriptive data.

#### SD-04 Drawings

Masonry Work; GA.

Drawings shall be submitted showing layouts; reinforcement details, including bending and splicing details; control joint treatment; and details of positioning devices used to hold reinforcement in proper position. Reinforcement bending details shall conform to the requirements of ACI SP-66.

#### SD-08 Statements

Cold Weather Installation; GA.

Cold weather construction procedures.

### 1.3 DELIVERY, HANDLING, AND STORAGE

#### 1.3.1 Masonry products

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material. Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C 90 when delivered to the jobsite. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

#### 1.3.2 Steel

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

#### 1.3.3 Cementitious Materials

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

### 2.2 CONCRETE BRICK

Concrete brick shall conform to ASTM C 55, Type I, Grade N-I. Concrete brick may be used where necessary for filling out concrete masonry unit construction.

### 2.3 CONCRETE MASONRY UNITS (CMU)

Concrete masonry units shall conform to ASTM C 90, Type I. Units shall be of dimensions that will lay up to 8 inch modules. Units shall include closer, jamb, header, lintel, and bond beam units, and special shapes and sizes required to complete the work indicated. All exposed-to-view or painted units shall be of the same appearance. Units required to provide fire-resistive values shown shall conform to TABLE 1. Concrete masonry units used in one-hour fire-rated walls shall conform to the requirements for two-hour fire-rated masonry units.

TABLE I  
FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

Aggregate Type	Minimum equivalent thickness inches for fire rating of:		
	4 hours	3 hours	2 hours
Pumice	4.7	4.0	3.0
Expanded slag	5.0	4.2	3.3
Expanded clay, shale, or slate	5.7	4.8	3.7
Limestone, scoria, cinders or unexpanded slag	5.9	5.0	4.0
Calcareous gravel	6.2	5.3	4.2
Siliceous gravel	6.7	5.7	4.5

(a) Minimum equivalent thickness shall equal net volume as determined in conformance with ASTM C 140 divided by the product of the actual length and height of the face shell of the unit in inches. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; the thickness of plaster or brick or other material in the assembly will be included in determining the equivalent thickness.

### 2.4 PRECAST CONCRETE ITEMS

Precast concrete items shall be factory-made units from a plant regularly engaged in producing such items. Units shall have beds and joints at right angles to the face, with sharp true arises, and shall be cast with drip grooves on underside where units overhang walls. Unless otherwise indicated, concrete shall be 4,500 psi minimum conforming to SECTION: CONCRETE FOR BUILDING CONSTRUCTION using ½ inch to No. 4 nominal-size coarse aggregate. Exposed-to-view surfaces, unless otherwise specified,

shall have smooth, dense finish, free of surface voids, spalls, cracks, and chipped or broken edges. Unless precast concrete items have been subjected during manufacture to saturated-steam pressure of 120 pounds or more per square inch for five hours or more, the items after casting shall be either damp-cured for 24 hours or more or steam-treated and shall then be aged under cover for 28 days or longer. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, excessive crazing, or having surfaces treated with a coating will be rejected. Precast concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Reinforcement splices are not permitted.

#### 2.4.1 Lintels

Precast lintels, unless otherwise shown, shall be of a thickness equal to the wall and reinforced with two No. 4 bars for the full length. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure. Reinforced lintels shall be used to span all openings over 12 inches wide in masonry. A minimum clearance of 3/4 inch shall be maintained between reinforcement and faces of units.

#### 2.4.2 Splash Blocks

Splash blocks of the size indicated shall be formed with depressions in top surface to drain away from building and shall be reinforced as standard with the manufacturer.

#### 2.5 MORTAR

Mortar shall conform to ASTM C 270, Type S, except as otherwise specified. Mortar mix shall be based on laboratory-proportioned and tested mix. Laboratory testing of mortar shall be in accordance with the preconstruction evaluation of mortar section of ASTM C 780. Mortar mix shall be such that the mortar will develop a minimum laboratory compressive strength of 1,800 psi at 28 days. Laboratory-proportioned mortar shall be mixed to an initial flow of 100 to 115 percent and shall retain a flow after suction of at least 70 percent when tested for water retention in accordance with ASTM C 91. Cement shall be of one brand. Aggregates shall be from one source.

#### 2.6 GROUT

Grout shall conform to ASTM C 476. Grout shall be laboratory-proportioned for a 2000 psi mix when tested in accordance with ASTM C 1019. Grout slump shall be between 8 and 10 inches. Except as otherwise specified, fine grout shall be used to fill spaces where the smallest dimension is 2 inches or less. Coarse grout shall be used to fill spaces where the smallest dimension is greater than 2 inches.

#### 2.7 ADMIXTURES

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

#### 2.8 Water

Water for mixing shall be free from sewage, oil, acid, alkali, salts, and objectionable quantities of silt, organic matter, and other deleterious substances. Water shall be potable. River water shall not be used.

## 2.9 ANCHORS AND TIES

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82.

Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

### 2.9.1 Rigid Steel Z-Anchors

Rigid steel anchors shall be 1-1/4 inches wide by 1/8 or 3/16 inch thick, with ends turned in opposite directions not less than 3 inches and of length required for the application indicated; however, length between turned ends shall not be less than 24 inches.

### 2.9.2 Rigid Steel U-Anchors

Rigid steel anchors shall be 1-1/4 inches wide by 1/8 or 3/16 inch thick, with ends turned in same directions not less than 3 inches and of length required for the application indicated; however, length between turned ends shall not be less than 24 inches.

## 2.10 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

## 2.11 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60. Centering clips or caging devices shall be formed from not lighter than 9 gauge wire and shall be of a design that will prevent displacement of reinforcing steel during construction.

## 2.12 SAND FILL

Sand fill shall consist of well-graded sand composed of hard, tough, and durable particles and shall contain not more than 5 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the No. 8 size sieve. The maximum allowable aggregate size shall be 1/8 inch.

## 2.13 LOOSE FILL INSULATION

Refer to section 07220: Insulation.

## PART 3 EXECUTION

### 3.1 ENVIRONMENTAL REQUIREMENTS

#### 3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

#### 3.1.2 Cold Weather Installation

Temperature of masonry units shall not be less than 40 degrees F when laid, and the temperature of the mortar and grout used shall be between 40 degrees F and 120 degrees F. When the ambient temperature is 32 degrees F or less, masonry work under construction shall be protected and maintained at a temperature greater than 32 degrees F during installation for a period of 48 hours after installation. Heating devices shall not discharge products of combustion into enclosure. The proposed method of maintaining the temperature within the specified range shall be submitted for approval prior to implementation.

### 3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

#### 3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch.

#### 3.2.2 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs.

Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

### 3.2.3 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

#### TOLERANCES

Variation from the plumb in the lines  
and surfaces of columns, walls and arises

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In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from horizontal lines

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In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations in cross sectional dimensions of  
columns and in thickness of walls

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Minus	1/4 inch
Plus	1/2 inch

### 3.2.4 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will

completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

### 3.2.5 Jointing

Joint widths shall be uniform and such that the specified widths are maintained throughout. Joints in concealed masonry surfaces and joints at top of electrical boxes in wet areas shall be cut flush with the masonry surfaces. Joints indicated to be caulked shall be raked a depth of 3/4 inch. Interior control joints shall be raked to a depth of 1/4 inch. All other joints shall be tooled slightly concave. Tooling shall be accomplished when mortar is thumbprint hard and in a manner that will compress and seal the mortar joint and produce joints of straight and true lines free of tool marks. Joints in concrete masonry unit construction shall be 3/8 inch wide.

### 3.2.6 Unfinished Work

When necessary to temporarily discontinue the work, masonry units shall be stepped back for joining when work resumes. Tothing may be resorted to only when specifically approved. Before resuming work, loose mortar shall be removed and the exposed joint shall be thoroughly cleaned. Top of walls exposed to rain or snow shall be covered with nonstaining waterproof covering or membrane when work is not in process. Covering shall extend a minimum of 2 feet down on each side of the wall and be held securely in place.

## 3.3 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be either by volume or weight. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

## 3.4 Positioning Bars

A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Reinforcement shall be held in place with centering clips or caging devices. Vertical bars shall be supported near each end and at intermediate intervals not exceeding 192 bar diameters. Horizontal reinforcement shall be set in a full bed of grout. Splices in adjacent bars shall be staggered.

## 3.5 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

## 3.6 JOINT REINFORCEMENT

Joint reinforcement shall be continuous, except at expansion or control joints. Splices in joint reinforcement shall be lapped at least 6 inches. Where walls or partitions intersect to form T-sections, the intersecting walls shall be anchored together with rigid steel anchors or joint reinforcement as indicated.

### 3.7 PLACING GROUT

Grout dry ingredients shall be mechanically mixed with sufficient water to bring the mixture to a pouring consistency for a least five minutes using the mix design established in the laboratory as specified in paragraph: GROUT. Areas to be grouted shall be cleaned of mortar droppings and other debris and cleanout holes shored or closed with masonry units to contain the grout. Grout shall be placed by hand bucket, concrete hopper, or grout pump. Each lift of grout shall be consolidated after water has left, but before plasticity is lost. Consolidation shall be accomplished by mechanically vibrating to ensure complete filling of the grout space. When consolidating successive lifts of plastic grout, the tip of the vibrator shall penetrate the preceding lift approximately 10 inches to ensure grout continuity in the wall section. Trowel blade shall not be used for consolidation of grout. If grouting operation is stopped for one hour or longer, the grout placement shall be stopped in a manner to provide a 1-1/2 inch keyway below the top of the masonry unit. Walls to be grouted shall be adequately shored or braced to prevent shifting, buckling, or blowouts. After grouting operations are completed, the faces of cleanout holes shall be patched to closely match the surrounding surfaces.

#### 3.7.1 Low-Lift Grout Placement

Hollow unit masonry shall be grouted by the low-lift method and shall be constructed and grouted in lifts not exceeding 4 feet. Slushing with mortar will not be permitted.

### 3.8 BOND BEAMS

Bond beams shall consist of concrete masonry bond beam units reinforced and filled with grout. Bond beams shall be continuous through control joints. Dummy joints shall be formed in structural bond beams at control joints. Where splices are required, reinforcement shall be lapped a minimum of 40 bar diameters or 24 inches, whichever is greater. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

### 3.9 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using either special control joint units, open-end stretcher units, metal sash jamb units on each side of joint and control joint key, or shear bars. Sash jamb units shall have a 3/4 inch by 3/4 inch groove near the center at end of each unit.

### 3.10 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

Brick expansion joints and concrete masonry veneer joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

### 3.11 LINTELS

Lintels shall be set in a full bed of mortar with faces plumb and true.

### 3.12 LOOSE-FILL INSULATION

Refer to section 07220: Insulation.

### 3.13 SAND FILL

Concrete masonry units surrounding Room 114: Generator Room shall be filled with sand for sound attenuation.

### 3.14 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

#### 3.14.1 Prefaced Concrete Masonry Unit Surfaces

Concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work after any required pointing has been done.

### 3.15 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

### 3.16 QUALITY CONTROL

Quality control shall be the responsibility of the Contractor. Tests shall be performed in sufficient number to ensure that materials meet the specified requirements. Sampling and testing required by the contract shall be performed by an approved commercial testing laboratory.

#### 3.16.1 Testing

Two samples of grout shall be taken for each 30 cubic yards of grout placed each day. Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019.

-- End of Section --