SECTION 04200

CONCRETE MASONRY UNIT

PART 1 - GENERAL

1.01 DEFINITIONS

A. This Section includes materials, and application of concrete masonry units (CMUs), mortar and grout, reinforcing steel, control joint materials, masonry joint reinforcement, ties and anchors, embedded flashing, and miscellaneous masonry accessories. Provide materials to achieve the net compressive strength of concrete unit masonry equal to or greater than the f'm as indicated.

1.02 RELATED SECTIONS

A. Section 01300 – Record Drawings and Submittals

B. Section 03200 – Steel Reinforcement

C. Section 03300 – Cast-in-Place Structural Concrete

D. Section 05500 – Miscellaneous Metalwork

1.03 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the Contractor shall comply with the Standard Specifications for Public Works Construction (SSPWC).

1.04 REFERENCES

A. TMS 602/ACI 530.1/ASCE 6 2011 Specification for Masonry Structures

B. ASTM International (latest versions)

1. ASTM A36/A36M Standard Specification for Carbon Structural Steel

2. ASTM A82/A85M Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

3. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ASTM A185/A182M Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

5. ASTM A307 Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

6. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

7. ASTM A641/A641M Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

8. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process

9. ASTM A884/A884M Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement

10. ASTM A899 Standard Specification for Steel Wire Epoxy-Coated

11. ASTM A951 Standard Specification for Masonry Joint Reinforcement

12. ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

13. ASTM C90 Standard Specification for Loadbearing Concrete Masonry Units

14. ASTM C140 Standard Test Method for Sampling and Testing Concrete Masonry Units

15. ASTM C150 Standard Specification for Portland Cement

16. ASTM C270 Standard Specification for Mortar for Unit Masonry

17. ASTM C476 Standard Specification for Grout for Unit Masonry

18. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete

19. ASTM C989 Standard Specification for Slag Cement for Use in Concrete and Mortars

20. ASTM C1019 Standard Test Method for Sampling and Testing Grout

21. ASTM C1314 Standard Test Method for Compressive Strength of Masonry Prisms

22. ASTM C1586 Standard Guide for Quality Assurance of Mortars

23. ASTM C1611/C1611M Standard Test Method for Slump Flow of Self-Consolidating Concrete

24. ASTM C1714/C1714M Standard Specification for Preblended Dry Mortar Mix for Unit Masonry

25. ASTM D2000 Classification System for Rubber Products in Automotive Applications

26. ASTM D2287 Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

1.05 RELATED SECTIONS

A. Section 01300 – Record Drawings and Submittals

B. Section 03200 – Steel Reinforcement

C. Section 03300 – Cast-in-Place Structural Concrete

D. Section 05500 – Miscellaneous Metalwork

1.06 SUBMITTALS

A. The following shall be submitted in compliance with Section 01300:

1. Samples of concrete masonry unit colors with texture ranges as specified under products shall be submitted to the Engineer for selection of color. Full size samples of the blocks selected shall be submitted for final approval by the Engineer after color and texture selection. Samples of mortar colors shall be submitted for color selection by the Engineer.

2. Certification shall be submitted showing material compliance with these Specifications. The Engineer's approval shall be obtained prior to delivery of concrete masonry units to the job site.

3. A 4-ft minimum square free-standing sample panel shall be prepared for approval by the Engineer before starting masonry work and shall remain at the work site for reference until all masonry work is completed.

4. Mill Certificates: Steel producer's certificates of mill analysis, tensile and bend tests for reinforcement steel.

5. Drawings shall be submitted for fabrication, bending, and placement of reinforcement bars. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures." Bar schedules, diagrams of bend bars, stirrup spacing, lateral ties and other arrangements and assemblies shall be shown as required for fabrication and placement.

1.07 DISTRICT'S MANUAL

A. The following shall be included in the District's Manual in compliance with Section 01300:

1. Test reports of mortar and grout.

2. Test reports of masonry prisms.

1.08 FACTORY TESTING OF MASONRY UNITS

A. Concrete block masonry units shall be sampled and tested for compressive strength, absorption and moisture content in accordance with ASTM C 140

1.09 TESTING OF MORTAR AND GROUT

A. The Engineer will have the mortar and grout tested in accordance with CBC to assure compliance with the Specifications and the governing codes. Test samples shall be stored in a moist environment until tested, unless directed otherwise by the Engineer or the testing laboratory. Tests shall be in accordance with CBC Standard No. 21 16 for mortar. The grout and mortar strengths shall be not less than the minimum strengths indicated herein.

B. Tests will be taken at the following times:

1. At the commencement of the masonry work, at least 2 test samples each of mortar and grout taken on 3 successive working days.

2. At any change in materials or job conditions, at least 2 samples of each modified material, grout and mortar.

3. 3. Four random tests each of mortar and grout. The random test samples shall be taken when requested by the Engineer.

4. 4. Additional samples and tests may be required whenever, in the judgment of the Engineer, additional tests (beyond the random tests) are necessary to determine the quality

C. The Contractor shall store the test samples in a moist environment until tested, unless directed otherwise by the Engineer.

D. The grout and mortar strengths shall be not less than the minimum strengths specified herein.

1.10 TESTING OF MASONRY PRISMS

A. The Engineer will have masonry prisms tested to assure compliance with the Specifications and the governing codes.

B. Tests will be taken at the following times:

1. At the time of construction of the sample panel, as indicated herein, at least five masonry prisms shall be made for each type of block indicated herein; except separate prisms are not required for block which only varies by texture.

2. At any change in materials during construction, at least five masonry prisms shall be made for each type of block affected.

3. One set of at least five masonry prisms shall be made for each masonry structure, besides the structure that the sample panel is part of, or for each week in which block is laid, for each type of block involved, whichever occurs first.

4. Additional sets of at least five masonry prisms may be required whenever, in the judgment of the Engineer, additional tests are necessary to determine the quality of the materials.

C. The prisms shall be constructed by the Contractor in the presence of the Engineer or the Engineer's representative. The same personnel who are laying the block in the structure shall construct the masonry prisms.

D. The masonry prisms shall be constructed and will be tested as specified in "Test Methods for Compressive Strength of Masonry Prisms" ASTM E 447-84, Method B, except as modified herein. The prisms shall be composed of one complete cell using full-size blocks which are saw-cut. The minimum ratio of height to smaller width dimension shall be 1.5. The prism shall be at least 15 inches high. A minimum of two horizontal bed joints shall be used to form the prism. The prism shall be grouted, after the required 24-hour minimum cure period, using the same grout used in the walls.

E. Compression tests will include two prisms tested at 7 days after grouting and three prisms tested at 28 days after grouting.

F. The average compressive strength of prisms tested at 28 days after grouting, multiplied by the appropriate correction factor as given in the California Building Code, shall not be less than the indicated masonry compressive strength.

G. If the compressive strength of the prisms, made during the construction of the sample panel and tested as indicated herein, fails to meet the requirement, adjustments shall be made to the mix designs for the mortar, or grout, or both, as needed to produce the specified strength. The masonry units shall also be retested to verify compliance with the requirements of ASTM C 90, Grade N-1.

H. If the compressive strength of the prisms, made during construction of the WORK and tested as indicated herein, fails to meet the requirement, prisms or cores shall be cut from the walls in sufficient numbers and in sufficient locations to adequately determine the strength of the walls. Those portions of the walls represented by specimens failing to meet the required compressive strength shall be subject to removal and replacement.

1.11 SPECIAL INSPECTION

A. Continuous inspection by a special inspector approved by the local building department having jurisdiction will be required where necessary to conform with code requirements. Special inspection shall be provided by the District.

1.12 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Cement, lime, and other cementitious materials shall be delivered to the site and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other containers, plainly marked and labeled with the manufacturers' names and brands. Mortar and grout shall be stored and handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness. Masonry units shall be handled with care to avoid chipping and breakage, and shall be stored as directed in the Concrete Masonry Handbook. Materials stored on newly constructed floors shall be stacked in such manner that the uniformly-distributed loading does not exceed 30

psf. Masonry materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used.

PART 2 - MATERIALS (NOT USED)

2.01 CONCRETE MASONRY UNITS

A. Concrete masonry units shall conform to ASTM C 90, hollow open-end load bearing units with maximum linear shrinkage of 0.06 percent from standard to oven-dried condition. Units shall be medium weight units with a net area compressive strength of 2,800 psi unless indicated otherwise.

B. Concrete masonry units shall be 12-inch by 8-inch by 16-inch modular size, with [smooth] [split] [slump] [fluted] faces. Units shall be [integrally-colored with color selections from light and medium color range (white, black and dark green not included in color range)] [of natural gray color].

C. All bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided and used where required or necessary. Specially shaped non-structural blocks may be constructed by saw cutting. Color and texture shall match that of adjacent units.

D. Concrete masonry units hidden from view entirely may be natural color units the same size as other adjacent masonry units.

E. Concrete masonry units at interior walls shall be medium weight block 12-inch by 8-inch by 16-inch modular size of [color matching the integrally colored block] [natural color].

2.02 MATERIALS FOR MORTAR AND GROUT

A. Portland cement shall be Type II, low alkali, conforming to ASTM C 150.

B. Lime paste shall be made with pulverized quicklime, or with hydrated lime, which shall be allowed to soak not less than 72 hrs before use; except, that hydrated lime processed by the steam method shall be allowed to soak not less than 24 hrs and shall be made by adding the lime to the water. In lieu of hydrated lime paste for use in mortar, the hydrated lime may be added in the dry form. Hydrated lime shall be Type S, conforming to ASTM C 207. Pulverized quicklime shall conform to ANSI/ASTM C 5, shall pass a No. 20 sieve, and 90 percent shall pass a No. 50 sieve.

C. Sand shall conform to ASTM C 144. Coarse aggregate shall conform to ASTM C 404.

D. Water for mixing shall be clear potable water.

E. Reinforcing steel shall be deformed bars conforming to ASTM A 615, Grade 60 for bars No. 3 to No. 18, except as otherwise indicated.

F. Admixture for mortar shall not be detrimental to the bonding or help the process of efflorescence.

2.03 MANUFACTURERS

A. Products shall be per the Approved Materials List or of the following manufacture and type (or equal):

1. Admixture for Mortar:

    a. Master Builder's "PS 235 or Rheomix 235"

    b. Sika Chemical Co. "Sika Red Label"

2. Admixture for Grout:

    a. Sika Chemical Co. "Sika Grout Aid" Type II

    b. Master Builder's "Pozzolith" normal

PART 3 - EXECUTION

3.01 GENERAL

A. Concrete masonry units shall not be placed when air temperature is below 40 degrees F (4 degrees C) and shall be protected against direct exposure to the wind and sun when erected when the ambient air temperature exceeds 99 degrees F (37 degrees C) in the shade with relative humidity less than 50 percent.

B. Concrete masonry shall conform to the California Building Code, the Masonry Design Manual published by the Masonry Industry Advancement Committee, and other applicable codes and standards of governing authorities.

C. All work shall conform to the standard of quality established by the Engineer's acceptance of the free-standing sample panel required to be constructed prior to starting the masonry work.

D. Tolerances for concrete masonry units shall conform to the following:

1. Maximum variation from plumb:

    a. In walls and corners: 1/4-inch in 10 feet; 3/8-inch in any story or 20 feet maximum; 1/2-inch in 40 feet.

    b. For external corners and other conspicuous lines: 1/4-inch in any story or 20 feet maximum; 1/2-inch in 40 feet.

2. Maximum variation from level or indicated elevations: 1/4-inch in any bay or 20 feet; 1/2-inch in 40 feet.

3. Maximum variation from plan position indicated on the Drawings: 1/2-inch maximum.

E. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.

3.02 INSPECTION

A. Contractor shall thoroughly examine all substrates, areas and conditions under which installation Work of this Section is to be undertaken and notify Engineer in writing of conditions detrimental

to proper, timely, and successful completion of the installation. Installation shall not proceed until unsatisfactory conditions have been corrected.

B. Inspection by the Contractor shall be required during preparation of masonry wall prisms, sampling and placing of all masonry units, placement of reinforcement, and inspection of grout space immediately prior to closing of cleanouts and during all grouting operations

3.03 SHORING AND BRACING

A. All shoring and bracing shall be provided as required for the Work. Shoring and bracing shall be constructed to required shapes and sizes, capable of supporting and sustaining the loads to which they will be subjected without failure or deflection. Shores and bracing shall be left in place until concrete masonry can safely carry all required live and dead loads.

B. Concrete masonry walls shall be adequately braced to withstand all forces to which they will be subjected during construction. Walls are not designed to be self supporting for lateral loads until attached to floor and roof elements.

3.04 MORTAR

A. Mortar for concrete block masonry shall be Type S per Table 2 of TMS 602-13/ACI 530.1/ASCE 6-13, with a minimum 28-day compressive strength of 2500 psi. Proportions shall be one part portland cement, 1/4- to 1/2-part lime paste or hydrated lime, and damp, loose sand in an amount (by volume) of not less than 2-1/4 or more than 3 times the sum of the volumes of cement and lime used, with the precise amount of water required to produce the required workability and strength.

B. Mortar for use with colored masonry units shall have integral color as approved by the Engineer.

3.05 GROUT

A. Grout shall have a minimum 28-day compressive strength of 2800 psi. Proportions shall be one part portland cement, not more than 1/10-part lime paste or hydrated lime, 2-1/4 to 3 parts damp, loose sand, not more than 2 parts pea gravel, and water in the amount necessary to produce a consistency for pouring without segregation of components. Where the grout space is less than 4 inches, pea gravel shall be omitted.

B. Admixtures may only be used when approved by the Engineer. When it has been approved for use, admixtures shall be used in accordance with the manufacturer's published recommendations for the grout.

3.06 CONSTRUCTION - GENERAL

A. All work shall be performed in accordance with the provisions of the applicable code for reinforced concrete hollow-unit masonry.

B. The Contractor shall set or embed in his work all anchors, bolts, reglets, sleeves, conduits, and other items as required.

C. All block cutting shall be by machine.

D. Masonry units shall be supported off the ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated into the Work. Concrete masonry units shall not be wetted.

E. All reinforcing steel shall be cleaned of all loose rust and scale, and all oil, dirt, paint, laitance, or other substances which may be detrimental to or reduce bonding of the steel and concrete.

F. Immediately before starting work, the concrete upon which the masonry will be laid shall be cleaned with water under pressure.

G. A full mortar joint for first course shall be provided.

H. Units shall be shoved tightly against adjacent units to assure a good mortar bond.

3.07 EQUIPMENT

A. All equipment for mixing and transporting the mortar and grout shall be clean and free from set mortar, dirt, or other foreign matter.

3.08 MIXING

A. Mortar shall be mixed by placing 1/2 of the water and sand in the operating mixer, after which the cement, lime, and remainder of the sand and water shall be added. After all ingredients are in the mixer, they shall be mechanically mixed for not less than 5 minutes. Retempering shall be done on the mortar board by adding water within a basin formed within the mortar, and the mortar reworked into the water. Mortar which is not used within one hour shall be discarded.

3.09 ERECTION OF CONCRETE BLOCK MASONRY

A. Masonry work shall be erected in-plane, plumb, level, straight, and true to dimensions shown and executed in accordance with acceptable practices of the trade.

B. Concrete masonry units shall be laid with full-face shell mortar beds. Vertical head joints shall be solidly filled with mortar from face of unit to a distance behind the face equal to not less than the thickness of longitudinal face shells. Cross-webs of starting course courses shall be solidly bedded in mortar.

C. Unless noted or shown otherwise, masonry shall be laid up in straight uniform courses with running bonds.

D. All masonry shall be erected to preserve the unobstructed vertical continuity of the cells measuring not less than 3-inch by 3-inch in cross-section. Walls and cross webs shall be fully bedded in mortar. All head and end joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

E. Where horizontal reinforced beams are shown, special units shall be used or regular units shall be modified to allow for placement of continuous horizontal reinforcement bars. Small mesh expanded metal lath or wire screening shall be used in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or units shall be provided with solid bottoms.

3.10 JOINTS

A. Vertical and horizontal joints shall be uniform and approximately 3/8-inch wide. Exterior joints and interior exposed block joints shall be concave-tooled to a dense surface. Special care shall be used in tooling joints so as to match existing construction. Interior or exterior non-exposed masonry and masonry behind plaster shall have flush joints.

3.11 CLEANOUT

A. Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout, where such lift or pour is over 4 ft in height. Any overhanging mortar or other obstructions or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed before grouting and after inspection. Cleanout openings shall match the finished wall in exposed masonry

3.12 REINFORCEMENT

A. General: Reinforcement bars shall not be used with kinks or bends not shown on the drawings or final shop drawings, nor shall bars be used with reduced cross-section due to excessive rusting or other causes.

B. Reinforcement shall be positioned accurately at the spacing indicated. Vertical bars shall be supported and secured against displacement. Horizontal reinforcement shall be placed as the masonry work progresses. Where vertical bars are indicated in close proximity, a clear distance shall be provided between bars of not less than the normal bar diameter or 1-inch, whichever is greater.

C. Reinforcement bars shall be spliced where shown; bars shall not be spliced at other points unless acceptable to the Engineer. In splicing vertical bars or attaching to dowels, ends shall be lapped, placed in contact and wire tied. Not less than the minimum lap indicated shall be provided, or if not indicated, as required by governing code.

D. Splices shall be welded where indicated. Contractor shall comply with the requirements of AWS D1.4 for welding materials and procedures.

E. Prefabricated horizontal joint reinforcement shall be embedded as the work progresses, with a minimum cover of 5/8-inch on exterior face of walls and 1/2-inch at other locations. Units shall be lapped not less than 6 inches at ends. Prefabricated "L" and "T" units shall be used to provide continuity at corners and intersections. Units shall be cut and bent as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

F. Anchoring: Reinforced masonry Work shall be anchored to supporting structures as indicated. Where required, reinforced masonry walls shall be anchored to non-reinforced masonry walls where they intersect.

G. Deep cut bond beam blocks shall be used where horizontal reinforcing steel is embedded. H-block bond beams may be used at locations other than openings.

H. Knock-out openings shall have no steel or joint reinforcing running through the opening. Head, jambs, and sill blocks shall be used to provide an even finish surface to install the window unit when blocks are removed. Joints at head, jambs, and sills shall be stacked and continuous.

I. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement.

3.13 GROUTING

A. All cells and bond beam spaces shall be filled solidly with grout unless indicated otherwise. Grouting shall not be started until the wall has cured for 24 hours. Grout shall not be poured in more than 8-ft lifts.

B. All grout shall be consolidated at time of pouring by puddling or vibrating. Where the grouting operation has been stopped for one hour or longer, horizontal construction joints shall be formed by stopping the grout pour 1-1/2 inches below the top of the uppermost unit.

3.14 PROTECTION

A. Wall surfaces shall be protected from droppings of mortar or grout during construction.

3.15 FINISHING AND CLEANING

A. Masonry shall not be wet-finished unless exposed to extreme hot weather or hot wind and then only by using a nozzle-regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.

B. Finish masonry shall be cleaned and pointed in a manner satisfactory to the Engineer, based upon the standards established by the approved sample panel.

C. All exposed to view interior and exterior colored masonry work shall be cleaned by light sandblasting to remove all stains and other imperfections.

D. All exposed masonry surfaces of openings and window and door openings such as sills, heads, and jambs shall be finish block surfaces, not formed surfaces, unless indicated otherwise. Closed bottom bond beam blocks shall be used at heads and sills. Pour holes may be used at the sill under window frame and where approved by the Engineer.

END OF SECTION