

SECTION 04 22 13 – STRUCTURAL REINFORCED CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 CODES AND STANDARDS

- A. All concrete masonry construction shall conform to the requirements of the local building code and the Specification for Concrete Masonry Structures, ACI 530.1/ASCE 6/TMS 602.

1.3 DESCRIPTION OF WORK

- A. Extent of each type of reinforced unit masonry work is indicated on the architectural and structural drawings and in schedules. Provide all labor, materials, equipment, and services necessary for and incidental to the installation of all reinforced masonry construction as indicated on the drawings and specified herein and in Section 04 22 00.
- B. Reinforced unit masonry construction includes reinforced concrete masonry including concrete filled masonry beams, columns, pilasters, lintels, and soffits.
- C. Accessories include, but are not necessarily limited to ties, horizontal and vertical reinforcement, anchors to the structure, and control joints.
- D. The masonry contractor shall install all accessory items that are required in the work and supplied by others, including: bolts, nailing blocks, inserts, anchors, flashing, steel lintels, expansion joints, conduits, cast-stone trim, hollow-metal door frames, etc.
- E. Types of masonry work required include Concrete unit masonry (CMU).

1.4 ENVIRONMENTAL OBJECTIVES

- A. The Owner has established environmental goals and strategies for achieving them for this project based upon the LEED[®] Green Building Rating System for New Construction & Major Renovations Version 2.2 dated October 2005, as developed by the U.S. Green Building Council. Refer to Division 01 Section "Sustainable Design Requirements."
- B. Manufacturer to supply documentation of level of compliance or non-compliance with the following requirements before consideration as an "acceptable manufacturer:"
 - 1. The following are mandatory requirements for the overall project:
 - a. The material(s) in the product(s) supplied should have a recycled content such that the sum of the post-consumer recycled content plus one-half of the pre-consumer content constitutes at least «Percentage of required recycled materials»% of the total value of the material in the project.
 - b. «Percentage of close proximity material»% of the product(s) supplied is extracted, processed, and manufactured regionally within a radius of 500 miles of this Project.

- c. Paints and coatings must meet or exceed the VOC and chemical component limits of Green Seal requirements.
- d. The VOC content of adhesives and sealants must be less than the current VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule #113, Architectural Coatings, rules in effect on January 1, 2004.

1.5 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Where indicated, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E 119 by a recognized testing and inspecting organization or by another means, as acceptable to authority having jurisdiction.
- B. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
- C. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.
- D. Masonry Preconstruction Testing Service: Employ and pay for the services of an independent testing laboratory acceptable to Architect and experienced in performing types of preconstruction masonry tests indicated. The testing laboratory shall meet the basic requirements of ASTM E 329 and have current accreditation from either the American Association for Laboratory Accreditation, the AASHTO Accreditation Program, or the "NIST" National Voluntary Laboratory Accreditation Program..
 - 1. Preconstruction Verification by Unit Strength Method
 - a. Concrete Masonry Units: For each type of concrete masonry wall construction shown on the structural or architectural drawings, submit results of tests conducted in accordance with ASTM C140 that demonstrate that the strength of the concrete masonry units are consistent with required compressive strength of the masonry construction shown on the drawings.
 - b. Mortar: Submit the proportions of the mortar mix to verify compliance with the specified type.
 - 2. Preconstruction Tests by Prism Methods for multi-story, load bearing masonry:
 - a. For each type of wall construction, test masonry prisms per ASTM C 1314 and as follows:
 - (1) Prepare three sets of prisms for testing at 7 days and three sets for testing at 28 days.
 - (2) Build prisms on job using same materials and methods as for wall construction. Mark each test prism for identification. Construct, store, transport, cure and test prisms according to the requirements of ASTM C 1314.
 - b. For each type of wall construction, test masonry per ASTM E518 for Flexural Bond Strength.

3. Preconstruction Tests for Shear.
 - a. Test masonry assemblages for diagonal tension (shear) per ASTM E 519.
4. Preconstruction Strength Tests
 - a. Test building panels for strength per ASTM E 72.
5. Grout Demonstration Panel: If the proposed grouting procedures, construction techniques, and grout space geometry, including such items as maximum grout pour and grout lift heights and consolidation techniques, do not conform to the requirements of ACI 530.1/ASCE 6/TMS 602, construct a grout demonstration panel prior to masonry construction.
6. Masonry work will not begin until test results are submitted to and approved by the Architect/Engineer.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements. Provide certification of pull-out strength of all masonry ties and anchors. Submit certification of compliance with required standards for all masonry units.
- B. Shop Drawings: Show fabrication and installation details for the following:
 1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars and for templates for layout of dowels for columns and pilasters. Comply with the fabrication tolerances of ACI 315, "Details and Detailing of Concrete Reinforcement." Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.
- C. Formwork Design Calculations: Prepared and sealed by a professional engineer licensed in the state where the project is located.
- D. Mix Designs:
 1. Mortar mix proportions for type of mortar required to achieve specified compressive strength of masonry.
 2. Mix designs and mortar tests performed in accordance with ASTM C 270
 3. Grout mix proportions according to ASTM C476 for the types of grout required for the work.
 4. Mix designs and grout tests performed in accordance with ASTM C 476.
- E. Certificates: Prior to delivery, submit to Architect/Engineer certificates attesting compliance with the applicable specifications for grades, types or classes of all products included in these specifications.

1. All materials required for mortar and grout including type, source, brand, and name of manufacturer.
2. Each combination of masonry unit type and mortar type. Include statement of net area compressive strength of masonry units, mortar type and net compressive strength of masonry determined according to Table 2 in ACI 530.1/ASCE 6/TMS 602
3. Mill Certificates: Steel producer's certificates of mill analysis, tensile and bend test for reinforcing steel required for project

F. LEED Submittals

1. Recycled Content- Credit MR4.1/MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar value of the recycled content compared to the total dollar value of the product or assembly containing the product.
2. Material Proximity- Credit MR 5.1/MR 5.2: Where the distance to the project site is 500 miles or less, indicate location and distance to project site of extraction, harvesting, recovery and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry materials to project in undamaged condition.
- B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes. During freezing weather, protect masonry units with tarpaulins or other suitable material. If units become wet, do not install until they are dry.
- C. At the time of delivery, the linear shrinkage of masonry units shall not exceed 0.065 percent.
- D. Store cementitious materials and masonry units off the ground, under cover and in dry location. All materials must be protected from wetting by capillary action, rain, or snow, and protected from mud, dust, or other materials and contaminants likely to cause staining or defects.
- E. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying in dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- F. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- G. Store masonry accessories, including metal items, in such a way as to prevent corrosion or accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

- A. Protection of Work: The Contractor shall construct and maintain temporary protection as required to permit continuous progress of the work. During erection, cover top of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.
1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 2. Where one wythe of multiwythe masonry walls is completed in advance of the other wythes, secure cover a minimum of 24 inches down the face next to unconstructed wythe and hold cover in place.
- B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- C. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
1. When ambient temperature exceeds 100 deg F or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.
 2. Comply with hot-weather preparation and construction provisions of ACI 530.1/ASCE 6/TMS 602

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. See Section 04 22 00 for the specifications for concrete masonry units.
- B. Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.
- C. Provide special shapes where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions. All special shapes provided shall match approved samples available for inspection at the Architect's office.
- D. Provide square-edged units for outside corners, except where indicated as bullnose.
- E. Provide units complying with the characteristics indicated below for type, size, strength, and weight.
1. Hollow Loadbearing Block: ASTM C 90 Lightweight
 2. Solid Loadbearing Block: ASTM C 90 Lightweight

3. Unit Compressive Strength: Provide units with a minimum average net-area compressive strength of 1900 psi.
4. Unit Compressive Strength: Provide units with a minimum net area compressive strength sufficient to produce masonry assemblies having the required strength as determined by Prism Tests but not less than 1900 psi.
5. Size: Manufacturer's standard units with nominal face dimensions of 16" long x 8" high (15-5/8" x 7-5/8" actual) x thicknesses indicated unless shown otherwise on the drawings

2.2 CONCRETE AND MASONRY LINTELS

- A. General: Provide one of the following consistent with the span and reinforcing tables on the drawings:
- B. Manufactured Concrete Masonry Lintels: ASTM C 1623, matching Concrete Masonry Units in color, texture and density classification.
- C. Precast Concrete Lintel Units: Solid or U-shaped, grout-filled. Comply with the requirements of Division 03, "Cast-in-Place Concrete", reinforced with mild reinforcing steel or prestressed with prestressing cables.
- D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam Concrete Masonry Units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.3 STRUCTURAL STEEL LINTELS

- A. Wide-flange: ASTM A 992.
- B. Channels: ASTM A 36.
- C. Plates: ASTM A 36.
- D. Rectangular HSS: ASTM A 500, Grade B.

2.4 MORTAR AND GROUT MATERIALS

- A. Do not use calcium chloride in mortar or grout.
- B. See specification section 04 22 00 for mortar specifications.
- C. Mortar: ASTM C 270, Proportion Specification, Type S, limiting cementitious materials to those described below:
 1. Portland Cement-Lime
 2. Mortar Cement
- D. Grout: Provide grout that conforms to either of the two requirements below:
 1. ASTM C 476, Proportion Specification

2. The material requirements of ASTM C 476; attains the specified compressive strength or 2000 psi, whichever is greater, at 28 days when tested in accordance with ASTM C 1019; has a slump flow of 24 in. to 30 in. as determined by ASTM C 1611; and has a Visual Stability Index (VSI) less than or equal to 1 as determined in accordance with ASTM C1611.
3. Grout consistency is to be coarse grout unless fine grout is required by ACI530.1/ASCE6/TMS602 based on minimum grout space dimensions coupled with maximum pour heights or unless a stricter requirement is defined by the local code.

2.5 REINFORCING STEEL

- A. Uncoated Steel Reinforcing Bars: ASTM A 615, Grade 60.
- B. Epoxy-Coated Steel Reinforcing Bars: ASTM A 615, Grade 60, epoxy coated to comply with ASTM A 775.
- C. Galvanized Steel Reinforcing Bars: ASTM A 767, Grade 60.

2.6 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES

A. General:

1. Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics.
2. Manufacturers:
 - a. Subject to compliance with requirements, provide products of one of the following:
 - (1) AA Wire Products Co.
 - (2) Dur-O-Wall, Inc.
 - (3) Hohmann & Barnard, Inc.
 - (4) National Wire Products Corp.
 - (5) Heckman Building Products
 - b. Other manufacturers shall be used only with Engineer approval. The Contractor shall submit technical literature for all reinforcing units.
3. Finishes: Provide reinforcement, ties, and anchors specified in subsequent paragraphs that are made from materials or that have the finishes that comply with the subparagraphs below, depending on the finish specified, unless otherwise indicated.
 - a. Mill Galvanized Finishes
 - (1) Joint Reinforcement: ASTM A 641 (0.1 oz/ft²)
 - (2) Sheet-metal ties and anchors: ASTM A 653 G60
 - b. Hot-Dip Galvanized Finishes
 - (1) Joint Reinforcement, Wire Ties, Wire Anchors: ASTM A 153, (1.5 oz/ft²).
 - (2) Sheet-metal Ties and Anchors: ASTM A 153, Class B
 - (3) Steel Plates and Bars: ASTM A 123 or ASTM A 153, Class B

- c. Epoxy Coatings:
 - (1) Joint Reinforcement: ASTM A 884, Class A, Type 1 - ≥ 7 mils.
 - (2) Wire Ties and Anchors: ASTM A 889, Class C – 20 mils.
 - (3) Sheet-metal Ties and Anchors: 20 mils per surface or manufacturer's specification.
 - d. Stainless Steel: AISI Type 304 or Type 316
- B. Joint Reinforcement: ASTM A 951: Welded-wire units prefabricated with deformed continuous side rods and plain cross rods in straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with the requirements indicated below:
- 1. Materials and Finishes:
 - a. Galvanized: ASTM A 82
 - b. Epoxy: ASTM A 82
 - c. Stainless Steel: ASTM A 580
 - 2. Width: Fabricate joint reinforcement in units with widths a minimum of 2" less than nominal width of walls. Provide mortar coverage over joint reinforcement of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.
 - 3. Wire Size for Side and Cross Rods:
 - a. 9 ga. diameter for both side rods and cross rods
 - b. 0.1875" diameter (W2.8) for side rods and 9 ga. diameter for cross rods
 - c. 0.1875" diameter (W2.8.) for both side and cross rods
 - 4. For single-wythe masonry provide either ladder or truss type with single pair of side rods and cross wires in ladder-type or points of connection in truss-type reinforcement spaced no more than 16 inches o.c. horizontally.
 - 5. For multi-wythe masonry provide ladder type with cross rods spaced not more than 16" o.c., horizontally, and number of side rods as follows:
 - a. One side rod for each face shell of concrete masonry units in either wythe more than 4 inches in thickness plus one side rod for each wythe of concrete masonry units 4 inches or less in width.
 - b. Adjustable (two-piece) type, ladder design, with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties have two hooks that engage eyes or slots in reinforcement and resist movement perpendicular to wall. Ties extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. The maximum clearance between connecting parts of the ties is 1/16".
- C. Bent Wire Ties: Provide individual prefabricated bent-wire units complying with requirements indicated below:
- 1. Materials and Finishes:
 - a. Galvanized: ASTM A 82
 - b. Epoxy: ASTM A 82
 - c. Stainless Steel: ASTM A 580
 - 2. Wire Size: 0.1875" diameter.

3. Length: Provide units of length indicated but not less than that required for embedment of at least 1 ½ " into the mortar bed of solid units or solid grouted hollow units and for a minimum of 1/2" embedment of tie end into outer face shells of hollow units, with not less than 5/8" mortar cover on exterior face joints, 1/2" elsewhere.
 4. Tie Shape for Hollow Masonry Units Laid with Cells Vertical: Rectangular with ends welded closed and not less than 4" wide.
 5. Tie Shape for Solid Masonry Units or hollow units laid with cells horizontal: Z-shaped ties with ends bent 90° to provide hooks not less than 2" long.
 6. Type for Masonry Where Coursing Between Wythes Align: Unit ties bent from one piece of wire.
 7. Type for Masonry Where Coursing Between Wythes Does Not Align: Adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 ". The maximum clearance between connecting parts of the tie shall be 1/16".
- D. Adjustable Anchors: Where adjustable anchors are indicated for connecting masonry to structural framework, provide 2-piece assemblies as described below which permit vertical or horizontal differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall.
1. Materials and Finishes
 - a. Galvanized: ASTM A 82 for wire and ASTM A 1008 for sheet metal
 - b. Epoxy: ASTM A 82 for wire and ASTM A 1008 for sheet metal
 - c. Stainless Steel: ASTM A 580 for wire and ASTM A 480 and ASTM A 240 for sheet metal
 2. For anchorage to concrete framework, provide manufacturer's standard anchors with dovetail anchor section formed from 0.0966" thick sheet metal and triangular-shaped wire tie section sized to extend within 1" of masonry face.
 3. For anchorage to steel framework provide manufacturer's standard anchors with crimped 1/4" diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 1" of masonry face.
 4. Wire Size for triangular section: 0.1875" diameter.
- E. Rigid Anchors: Provide straps of form and length indicated, fabricated from sheet metal strips of following width and thickness, unless otherwise indicated. Typical length to be 24" plus 2" long, 90° bends at ends.
1. Material and Finishes
 - a. Galvanized: ASTM A 1008
 - b. Epoxy: ASTM A 1008
 - c. Stainless Steel: ASTM A 480 and ASTM A 240
 2. Width: 1-1/2".
 3. Thickness: 1/4".

- F. Unit Type Masonry Inserts in Concrete: Furnish cast iron or malleable iron inserts of type and size indicated.
- G. Dovetail Slots: Furnish dovetail slots, with filler strips, of slot size indicated, fabricated from 0.0336" (22 gage) sheet metal, ASTM A 1008, Hot-dip galvanized.
- H. Anchor Bolts: Provide steel bolts with hex nuts and flat washers complying with ASTM A 307, Grade A, hot-dip galvanized to comply with ASTM A 153, Class C, in sizes and configurations indicated.
- I. Postinstalled Anchors:
 - 1. ICC Approval: Only anchors evaluated by the ICC Evaluation Service, Inc. (ICC-ES) with a published Evaluation Report specifically addressing anchorage to hollow or fully grouted concrete masonry shall be approved for use.
 - 2. Type:
 - a. Hollow Concrete Masonry: Anchors into or through hollow concrete masonry units shall be the chemical type used with a galvanized or stainless steel screen tube that allows the chemical adhesive to create a key within the hollow cell of the unit.
 - b. Fully Grouted Concrete Masonry: Anchors into fully grouted masonry shall be either chemical anchors or expansion anchors specifically approved by ICC-ES for use in fully-grouted concrete masonry.
 - 3. Finish:
 - a. Interior Exposure: All anchors, nuts and washers for use in interior environments free of potential moisture shall be manufactured from carbon steel, zinc plated in accordance with Federal Specification QQ-Z-325C, Type II, Class 3.
 - b. Exterior or Exposed Use: All anchors, nuts, and washers for use in exposed or potentially wet environments, or for attachment of exterior cladding materials shall be galvanized or stainless steel. Galvanized anchors, nuts and washers shall conform to ASTM A 153. Stainless steel anchors shall be manufactured from 300 series stainless steel and nuts and washers from 300 series or Type 18-8 stainless steel.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Non-Metallic Expansion Joint Strips: Premolded, flexible cellular neoprene rubber filler strips complying with ASTM D 1056, Grade RE 41E1, capable of compression up to 35%, of width and thickness indicated.
- B. Premolded Control Joint Strips: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
 - 1. Premolded PVC Control Joint Strips. Strips shall be polyvinyl chloride complying with ASTM D 2287, Type PVC 654-4 with a durometer hardness of 90.
- C. Weepholes: Cotton Cord: Sash cord of length required to produce 2" exposure on exterior and 18" in cavity between wythes.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Inspect surfaces that are to support masonry work to assure completion to proper lines and grades and are free of dirt and other deleterious material. Do not begin work until surfaces not properly prepared have been satisfactorily corrected.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance
 2. Verify that foundations or other supporting surfaces are within specified tolerances.
 3. Verify that reinforcing dowels are properly spaced.
 4. Examine rough-in and built-in construction to verify actual locations of piping connections.
- B. The horizontal and vertical spacing between anchors tying the masonry wall to the structural frame shall be as indicated on the drawings. Intersecting walls may substitute for an anchor.
- C. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.
- D. Installation of Masonry, General:
1. Build cavity and composite walls, floors and other masonry construction to the full thickness shown. Build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness indicated.
 2. Build chases and recesses as shown or required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
 3. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.
 4. Cut masonry units using motor-driven dry-cutting or water-cooled saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous patterns and to fit adjoining work. Use full-size units without cutting where possible.
 5. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Do not install cracked, broken, or chipped masonry units exceeding ASTM allowances.
- F. Protect sills, ledges, and offsets from mortar droppings or other damage during construction. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface. Remove misplaced mortar or grout

immediately. Protect face materials against staining. Protect door jambs and corners from damage during construction.

- G. Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Immediately remove grout or mortar in contact with such masonry.
- H. Matching Existing Masonry Work: Match coursing, bonding, color and texture of new masonry work with existing work.
- I. Mixing Mortar and Grout: Comply with the requirements of ACI 530.1/ASCE 6/TMS 602.

3.2 CONSTRUCTION TOLERANCES

- A. Comply with tolerance in ACI 530.1/ASCE 6/TMS 602 and the following.
- B. For conspicuous vertical lines such as external corners, reveals, expansion and control joints, do not exceed 1/4" in any story or 20 feet maximum, nor 1/2" maximum.
- C. For vertical alignment of exposed head joints do not vary from plumb by more than 1/4" in 10 feet, nor 1/2" maximum.
- D. Variation from Level: For conspicuous horizontal lines such as exposed lintels, sills, parapets, and reveals, do not exceed 1/4" in any bay or 10 feet maximum, nor 1/2" maximum. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10 feet or 1/16" within width of a single unit.

3.3 LAYING MASONRY WALLS

- A. Do not wet concrete masonry prior to laying up units unless written permission is obtained from the Engineer.
- B. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate location of openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units, particularly at corners, jambs and wherever possible at other locations.
- C. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.
- D. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.
 - 1. One-half running bond with vertical joint in each course centered on units in courses above and below
 - 2. Stack bond
 - 3. One-third running bond
 - 4. As indicated on Drawings
- E. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.

- F. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third unit for one-third running bond. Do not tooth. Clean exposed surfaces at set masonry and remove loose masonry units and mortar prior to laying fresh masonry.
- G. Built-in Work: Install bolts, anchors, nailing blocks, inserts, frames, vent flashings, conduit, and other built-in items specified under this and other sections of these specifications as masonry work progresses. Avoid cutting and patching. Solidly grout spaces around built-in items. Provide joints around exterior framed openings 1/4" to 3/8" wide, raked and tooled smooth to a uniform depth of 3/4", ready for caulking by others. Build chases, do not cut. Consult other trades in advance and make provisions for installation of their work to avoid cutting and patching. Install chases minimum of one full masonry unit length from jambs.
1. Fill in space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
 2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core, unless detailed otherwise.
 3. Fill cores in hollow concrete masonry units with grout to supporting beam or slab below under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.
- H. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.
1. For horizontally reinforced masonry, provide continuity at corners with prefabricated "L" units, in addition to masonry bonding.
- I. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
1. Provide individual metal ties at not more than 16" o.c. vertically.
 2. Provide continuity with horizontal joint reinforcement using prefabricated "T" units.
- J. Intersecting Load-bearing Walls: If carried up separately, block or tooth vertical joint with 8" maximum offsets and provide rigid steel anchors spaced not more than 4'-0" o.c. vertically, or omit blocking and provide rigid steel anchors at not more than 2'-0" o.c. vertically. If used with hollow masonry units, embed ends in mortar-filled cores.

3.4 MORTAR BEDDING AND JOINTING

- A. Provide uniform nominal joint thickness of 3/8" for concrete masonry units, unless noted otherwise on the drawings.
- B. Lay solid masonry units and fully-grouted hollow CMU with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not furrow bed joints or slush head joints.
- C. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells of cavities to be reinforced or filled with

concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

- D. Joint Profile: Provide weather-proof, concave, tooled joints in exposed surfaces when mortar is thumbprint hard, using round jointing tool. Strike joints flush in surfaces to be plastered, stuccoed, or covered with other material or surface-applied finish other than paint. Concave tool exterior joints below grade. Remove mortar protruding into cells or cavities to be grouted. Do not permit mortar droppings to block weep holes. Do not fill horizontal joints between top of masonry partitions and underside of concrete or steel construction with mortar unless specifically shown on the drawings. If not shown otherwise, provide 1" clear joint to be filled with caulk. Keep movement joints clean of all mortar and debris. For tuckpointing, rake mortar joints to a depth of 1/2 to 3/4 in., saturate with clean water, fill solidly with pointing mortar, and tool to match existing joints.
- E. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners of jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.
- F. Collar Joints: Unless otherwise required, After each course is laid, fill the vertical longitudinal joint between wythes solidly with mortar (grout if walls are grouted) for the following masonry work:
 - 1. All multi-wythe walls of concrete masonry units in which the collar joint between wythes is less than 3/4".
 - 2. All below grade conditions.

3.5 CONSTRUCTION STABILITY

- A. Design, provide and install bracing that will assure stability of masonry during construction.
- B. Allow 16 hours to elapse after completion of masonry columns and walls before placing floor or roof construction loads. Allow an additional 48 hours before applying concentrated loads such as girders, beams, or trusses.

3.6 STRUCTURAL BONDING OF MULTI-WYTHER MASONRY

- A. Where Horizontal Joints Align:
 - 1. Tie wythes together with continuous horizontal joint reinforcing, installed in mortar joints at not more than 16" o.c. vertically.
 - 2. Alternatively, use bent wire ties, providing one for every 4.5 sq. ft. of wall area but spaced no greater apart than 36" horizontally and 24" vertically.
- B. Where Horizontal Joints do not Align:
 - 1. Tie wythes together with adjustable, two-piece, ladder-type horizontal joint reinforcing placed in the mortar joint of the thicker wall at no more than 16" vertically.
 - 2. Alternatively, use adjustable bent wire ties. providing one for every 1.77 sq. ft. and spaced no greater than 16" horizontally and vertically.

3. Bed joints of opposing wythes shall not be farther apart vertically than 1-1/2" either direction.
- C. Openings: Provide additional ties around openings greater than 16' in either direction within 12" of the opening and around the perimeter at a maximum of 3'-0" on center.
- D. Provide ties within 12" of unsupported edges at a maximum of 24" vertically.

3.7 CAVITY WALLS

- A. Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity flush.
- B. Provide weep holes in head joints in first course immediately above all flashing. Leave head joint free and clean of mortar or install weep hole tube in head joint. Space weep holes 32" on center maximum for concrete unit masonry. Keep weep holes and area above

3.8 HORIZONTAL JOINT REINFORCEMENT

A. General:

1. Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls, 1/2" elsewhere. Lap reinforcing a minimum of 6" at splices.
2. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
3. Reinforce walls with continuous horizontal joint reinforcing unless specifically noted to be omitted.
4. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
5. Space continuous horizontal reinforcement as follows:
 - a. For multi-wythe walls (solid or cavity) space horizontal reinforcement 16" o.c. vertically.
 - b. For single-wythe walls, space reinforcement at 16" o.c. vertically, unless otherwise indicated.
 - c. For parapets, space reinforcement at 8" o.c. vertically, unless otherwise indicated.
 - d. For perforated masonry screen walls, space reinforcement at every other course vertically, not to exceed 16" o.c., unless otherwise indicated.
 - e. For concrete masonry cantilever walls and fences, space reinforcement at 8" o.c. vertically, unless otherwise indicated.
 - f. For walls utilizing a stack bond pattern, space reinforcement at 8" o.c. vertically, unless otherwise indicated.
6. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in two horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening except at control joints. Horizontal joint

reinforcement interrupted by the jamb of an opening shall have the cross rod or side rod bent and hooked at the jamb. Provide an additional rectangular adjustable tie at the jamb for each joint not containing the normal horizontal reinforcing unit.

7. Provide reinforcement at openings in addition to other specified wall reinforcement.

3.9 PLACING REINFORCEMENT

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing indicated. Prior to grouting, support and secure vertical bars against displacement. Vertical bars shall be held in position at the top and bottom and at intervals not exceeding 8'-0" with a minimum clearance of 1/4" if fine grout is used or 1/2" if coarse grout is used from the face of the masonry and not less than one bar diameter or 1" (whichever is greater) between adjacent bars.
- C. For columns, piers and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2", whichever is greater. Provide lateral ties as indicated.
- D. All dowels shall be grouted into a cell even if the dowel is in an adjacent cell to the vertical steel. Unless detailed otherwise on the drawings, dowels shall be the same size and number as the vertical steel. Unless noted otherwise provide a lap length of dowels to vertical reinforcement equal to 50 times the nominal dowel diameter.
- E. All horizontal reinforcing steel shall be placed in continuous bond beam or lintel block units and shall be solidly grouted in place. Maintain a minimum of one bar diameter or 1" (whichever is greater) clearance between adjacent bars and a minimum of 1/4" clearance if fine grout is used or 1/2" if coarse grout is used from the face of the masonry. Horizontal reinforcement may be placed as the masonry work progresses.
- F. Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Engineer. Where splices occur, adjacent splices shall be staggered so that no more than 25% of the total number of bars are spliced at any one point with a minimum stagger between splices in adjacent bars of at least the lap length. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie. Minimum lap splice length shall be 50 bar diameters unless indicated otherwise.
- G. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.

3.10 FORMWORK AND SHORES

- A. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.
- B. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, tie and support as

required to maintain position and shape during construction and curing of reinforced masonry.

- C. Formwork shall be designed and shop drawings prepared by a registered professional engineer in the state where the project is located.
- D. Formwork shall not be removed until the reinforced masonry member has cured sufficiently to carry its own weight and any other loads that may be placed on it during construction. Allow not less than the following minimum time to elapse after completion of the member before removing shores or forms provided adequate curing conditions have been obtained during the curing period:
 - 1. Lintels and beams - 10 days.
 - 2. Reinforced masonry soffits - 7 days.

3.11 GROUTING

- A. General: Where detailed, grout in reinforced masonry walls, columns, and pilasters. Fully grout vertical cells of concrete masonry containing steel reinforcement.
- B. Specification: Comply with the requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts, grout space preparation, and grout placement, including minimum grout space, maximum pour height, maximum lift height and consolidation.
 - 1. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
 - 2. Place grout in lintels or beams over openings in one continuous pour.
 - 3. Where bond beam occurs more than one course below top of pour and vertically reinforced cells are present above the bond beam, fill bond beam course to within 1-1/2" of the top of the bond beam.
 - 4. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2" of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

3.12 CONTROL AND EXPANSION JOINTS

- A. General: Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Build-in related items as the masonry work progresses.
- B. Where control joints are not indicated on the drawings the Contractor shall submit a proposed control joint layout for Architect and Engineer approval. General guidelines for control joint locations are as follows:
 - 1. At major changes in wall height
 - 2. At changes in wall thickness
 - 3. At corresponding control joints in foundations, floor, or roof construction

4. At one or both sides of wall openings (masonry veneer only)
 5. Near wall intersections
 6. At column centerlines.
- C. Maximum Spacing: Maximum control joint spacing in concrete masonry construction shall be such that the ratio of wall length to height shall not exceed 1.5 with a maximum spacing of 25 feet.
- D. Form control joints in concrete masonry as follows:
1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake joints in exposed faces.
 2. Install preformed control-joint gaskets designed to fit standard sash block.
 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake joint.
 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete.
- E. Build in horizontal pressure relieving joints where indicated; construct joints by inserting non-metallic compressible joint filler of width required to permit installation of sealant and backer rod.
- F. Provide continuous bond break at steel columns and members.
- G. Provide pressure-relieving joints by adhering a continuous 3/8" thick neoprene pad below shelf angles supporting masonry veneer.
- H. Leave joints around outside perimeters of exterior doors, window frames and other wall openings:
1. Depth: Uniform 3/4 in. (19mm).
 2. Width: 1/4 in. (6.4 mm) to 3/8 in. (9.5mm).

3.13 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and wherever openings of more than 2'-0" for block size units are shown without structural steel or other supporting lintels.
 1. For hollow concrete masonry unit walls, use specially formed U-shaped lintel units with reinforcement bars placed as shown filled with coarse grout.
- C. Provide minimum bearing as noted on the drawings.

3.14 PARGING

- A. Parge walls where indicated with Type S or N mortar, in thickness indicated. Thickness: Not less than 1/2".
- B. Trowel finish to a smooth, dense surface. Form a wash at top of parging and a cove at bottom. Where parging is applied in 2 coats, roughen first coat when partially set, let harden for 24 hours and moisten prior to application of second coat.
- C. Damp cure parging for at least 24 hours and protect until cured.

3.15 REPAIR, POINTING AND CLEANING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing:
 - 1. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Pointup all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants. If the repairs must be made after the mortar has hardened, the joint must be raked or chiseled out to a depth of about 1/2" thoroughly wetted, and repointed with fresh mortar.
 - 2. To prehydrate mortars, thoroughly mix all ingredients except water in proportions used for original mortar mix; then mix again, adding only enough water to produce a damp unworkable mix which will retain its form when pressed into a ball. After 1 to 2 hours, add sufficient water to bring it to the proper consistence; that is conventional masonry mortars.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film or waterproof masking tape.
 - 4. Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clean water.
 - 5. Clean concrete unit masonry to comply with masonry manufacturer's directions and NCMA Tek 8-2 bulletin.
- D. Protection and Cleanup:

1. Provide final protection and maintain conditions in a manner acceptable to Installer, which ensure unit masonry work being without damage and deterioration at time of substantial completion.
2. Leave work area and surrounding surfaces clean and free of mortar spots, droppings, and broken masonry.

3.16 QUALITY ASSURANCE TESTING AND INSPECTION DURING CONSTRUCTION

- A. See Testing Laboratory Services section of these Specifications for masonry work inspection and test requirements.

END OF SECTION 04 22 13