

SECTION 04 27 00.00

MULTI WYTHE MASONRY ASSEMBLIES (CAVITY WALL: VENEER WYTHE W/CMU BACKUP)

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Concrete masonry units (CMU).
2. Decorative concrete masonry units (DCMU).
3. Brick.
4. Mortar and grout.
5. Flashing.
6. Insulation materials.
7. Masonry accessories.
8. Cleaning materials.
9. Post-cleaning field-applied water repellants.

B. Related Work:

1. Division 01 Section ALLOWANCES for testing and inspection allowances, masonry unit allowances.
2. Division 04 Section CAST STONE and/or NATURAL STONE for stone veneers.
3. Division 05 Section METAL FABRICATIONS for steel lintels.
4. Division 07 Section JOINT SEALANTS for sealants and backer rods.

C. Products furnished but not installed

1. Dovetail anchor slots installed under Section 03 30 00 – Cast-in-Place Concrete.

D. Products installed but not furnished.

1. Steel lintels and shelf angles for unit masonry are specified in Section 05 50 00 – Metal Fabrications.
2. Hollow metal frames are specified in Section 08 10 13 – Hollow Metal Doors and Frames.

1.2 SUBMITTALS

A. Product Data: For each indicated product.

B. Samples: For types and colors of masonry units (including standard gray block) and pigmented mortar.

C. Material Certificates: For each type of indicated product (including self-consolidating grout), include statement of properties and compliance with these Specifications. Include mix design for mortar and grout.

- D. Masonry Material Cleaning Plan: Include products and techniques for each masonry product of the assembly and the combined masonry assembly. Prior to submission, the plan shall be signed and approved by:
1. General Contractor/Construction Manager
 2. Mason Contractor
 3. All Masonry Unit Manufacturers
 4. Cleaning Materials Supplier and Manufacturer
 5. Cleaning Subcontractor
- E. Construction procedures for cold and hot weather.
- F. Wall Bracing Plan showing braces and delineating the restricted zones.

1.3 QUALITY ASSURANCE

- A. Masonry Inspection: **<Review Quality Assurance Section of Project Manual. Consult ACI 530/ASCE 5/TMS 402, Section 1.15 for Quality Assurance Program requirements, and Tables 1.15.1, 1.15.2, & 1.15.3. Also, review Michigan Building Code, Chapter 17, Section 1704.5 and Tables 1704.5.1 & 1704.5.3. Edit below as required.>**
1. Level C. Continuous inspection. **<Essential facilities with engineered design.>**
 2. Level B. Periodic inspection. **<Essential facilities with empirical design/veneers/or glass units; Non-essential facilities with engineered design.>**
 3. Level A. Submission review only. **<Non-essential facilities with empirical design/veneers/or glass units. >**
- B. Masonry construction and materials shall conform to the requirements of “Specifications for Masonry Structures (ACI 530.1/ASCE 6/TMS 602)” published by The Masonry Society, the American Concrete Institute, and the American Society of Civil Engineers, except as modified by the requirements of these contract documents.
- C. **<Coordinate with 01400>** Pre-construction Testing: Owner shall employ a qualified independent masonry testing agency to perform the following tests. The Owner shall pay testing agency. Contractor shall provide materials in reasonable quantities for testing. Laboratory Technician shall be certified per ASTM C 1093.
1. Grout: Compressive strength tests per ASTM C 1019. Additionally, grout samples shall be obtained using molds that simulate the units used in the construction (cardboard forms shall not be utilized). **<NOTE: Only required when the grout mix is specified by the “Specified Compressive Strength” method in section 2.8C2b.>**
 2. Self-consolidating grout: Compressive strength tests per ASTM C1019 and slump flow and visual stability index per ASTM C1611.
 3. **<NOTE: The following item shall be included or deleted at the discretion of the specifier.>** Mortar: Mortar aggregate ratio tests per ASTM C780, Annex 4.
- D. Fire Ratings: Fire rated masonry units shall be in compliance when:
1. The masonry has been certified through the equivalent thickness method contained in Chapter 3 of ACI 216.1 for concrete masonry, Chapter 4 for clay masonry, and Chapter 5 for effects of finish materials.
- E. Mock-Up Panels: Construct mock-up panels for each type of masonry construction of a typical wall for Architect’s approval. Size shall be not less than 48 inches wide by at least 48 inches high. Include flashing details, reinforcements, weeps, vents, cleaning techniques, etc. Panels shall establish the minimum quality for the project. Panel shall be removed upon approved acceptance

of masonry work or if panel is not approved. Panels may be a permanent part of the walls if approved, coordinate locations with Architect.

- F. Temporary Bracing: Comply with Mason Contractors Association of America's Standard Practice for Bracing Masonry Walls Under Construction, and Masonry Wall Bracing Design Handbook, published by the Mason Contractors Association of America. (www.masoncontractors.org)
- G. **<NOTE: The following section shall be included or deleted at the discretion of the specifier>**
Workshop Certificates: Tradesmen performing flashing operations, placement of grouted reinforced masonry, and masonry cleaning shall hold current workshop certificates from the Masonry Institute of Michigan (www.mim-online.org) or the International Masonry Institute (www.imiweb.org), and an awareness certificate for MV-Tech (www.mvtechonline.com).

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store aggregates on grades such that site drainage will not contaminate aggregates.
- B. Store masonry units, cementitious materials and accessories on elevated platforms in a dry location. Materials shall be kept covered with weatherproof sheeting and secured from the wind. Do not use saturated concrete masonry per NCMA TEK Note 3-1B.

1.5 PROJECT CONDITIONS

- A. Cold Weather Requirements: When ambient temperature is below 40 degrees Fahrenheit, implement cold weather procedures. Comply with ACI 530.1/ASCE 6/TMS 602 Specification requirements. Provide approved admixtures only.
- B. Hot Weather Requirements: When ambient temperatures during construction or during the protection period are greater than 100 degrees Fahrenheit, or are greater than 90 degrees Fahrenheit with a wind velocity greater than 8 miles per hour, comply with ACI 530.1/ASCE 6/TMS 602 Specification requirements. Provide approved admixtures only.

1.6 MASONRY PRE-CONSTRUCTION CONFERENCE

- A. Masonry Pre-Construction Conference Requirements: **<Edit for GC or CM; Architect or Engineer>**
 - 1. The **[General Contractor] [Construction Manager]** in conjunction with the **[Architect] [Engineer]** shall schedule a Masonry Pre-Construction Conference at the jobsite at approximately 3 weeks prior to start of masonry work at the site.
 - 2. All contractor submissions shall be submitted to the **[Architect] [Engineer]** and reviewed prior to this conference.
 - 3. Responsible assigned parties of the participants shall attend the conference. The **[General Contractor] [Construction Manager]** shall prepare and issue minutes of the meeting to all parties concerned.
 - 4. Masonry work may not proceed without the Masonry Pre-Construction Conference.
 - 5. Participants, representatives from: **<Edit as required.>**
 - Owner
 - [Architect] [Engineer]**
 - [General Contractor] [Construction Manager]**
 - Project Superintendent
 - Mason Contractor Mason Foreman
 - Masonry Inspector **<See MBC, Ch. 17, Special Inspection>**
 - Self-Consolidating Grout Supplier
 - Testing Laboratory

- B. The following is the agenda for the Masonry Pre-Construction Conference:
1. Review Contract Documents for Mason's clarifications, [Architect's] [Engineer's] intent, and Masonry Inspector responsibilities. <See Project Manual's Section "Quality Assurance">
 - a. [Architect's] [Engineer's] summary for typical/atypical aspects of the Project.
 - b. Locations of shear walls.
 - c. Locations of CMU control joints and brick expansion joints.
 - d. Contractor's concern for missing/incomplete details.
 - e. Verify use of up-to-date plans/specifications.
 - f. Contractor's responsibility for temporary wall bracing.
 - g. Installation procedures.
 - h. Integral water repellants and post-cleaning field-applied water repellants
 - i. Coordination issues with other trades.
 - j. Protection of and scheduling of non-masonry construction that will interfere with masonry work.
 - k. Open issues/concerns.
 - l. Job-Site storage and staging areas.
 2. Submittal issues. <NOTE: All of these items supposedly have already been reviewed, approved, or approved as noted. Intent is to only re-hash the submittal items and clarify any areas of confusion.>
 - a. Mortar type, proportions and mix design.
 - 1) Specific locations/applications for different mortars.
 - 2) Regional and recycled content credits (LEED®) or other green building rating programs.
 - b. Grout type, proportions and mix design.
 - 1) Specific locations/applications for different grouts.
 - 2) Regional and recycled content credits (LEED®) or other green building rating programs.
 - c. Review manufacturer's literature for special requirements and conditions of use.
 - d. Review joint reinforcement and accessories shop drawings.
 - e. Review Vertical and Horizontal Reinforcing Steel shop drawings, splice lengths, column reinforcement and ties, and bar positioners.
 - f. Lintels, door frames and other 'built-ins' materials status.
 - g. Review shelf angle shop drawings.
 - h. Review flashing details.
 - i. Review certificates of compliance.
 - j. Review each type and size of anchor, tie, and metal accessory.
 - k. Review specific ASTM Standards.
 - l. Review certificate(s) for flashing, grouting and cleaning masonry workshops.
 - m. Review the approved masonry material cleaning plan.
 3. Verify material samples that have been reviewed/accepted.
 - a. Color ranges.
 - b. Textures.
 - c. Finishes.
 - d. Dimensions of units.
 - e. Mortar (pigmented).
 4. Review/critique [Mock-up] [Sample] Panel.
 - a. Dimensions.
 - b. Flashings details.
 - c. Joint details.
 - d. Bond pattern(s).
 - e. Mortar spreading procedures.
 - f. Workmanship and detailing.
 - g. Cleaning.
 5. Review grout demonstration panel (if applicable).

6. Verify that any specified pre-construction tests have been performed and are acceptable to the [Architect] [Engineer].
 - a. Mortar and grout tests.
 - b. Masonry units.
 - c. Prism testing.
7. Review contractor's proposed cold and hot weather construction procedures and Project Specification requirements.
8. Review masonry inspection requirements and level.

PART 2 – PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Concrete Masonry Units (CMU): ASTM C 90, lightweight, medium weight, and normal weight.
 1. Size: Specified size to be 3/8 inches less than the nominal width, height and length.
 2. Provide special shapes for lintels, corners, jambs, sashes, movement joints, bond beams, and other special conditions as indicated on the Drawings.
- B. Decorative Concrete Masonry Units (DCMU): ASTM C 90, normal weight.
 1. Size: Specified size to be 3/8 inches less than the nominal width, height and length.
 2. Provide special shapes for lintels, corners, jambs, sashes, movement joints, bond beams, and other special conditions as indicated on the Drawings.
 3. Integral Water Repellant: Provide units made with integral water repellant admixture for exposed exterior units. DCMU manufacturer shall be certified by the water repellant manufacturer to produce water repellant DCMU. DCMU manufacturer shall certify that the DCMU has been manufactured with integral water repellant at dosage rate proportioned per integral water repellant manufacturer's recommendations to achieve moisture control.
 4. Integral Color: ASTM C 979, as selected by Architect from manufacturer's full range. <NOTE: Make color selection(s)> All like units shall be supplied from a single run for color consistency.
 5. Pattern and Texture for DCMU:
 - a. Standard, smooth finish.
 - b. Split-faced.
 - c. Fluted.
 - d. Scored.
 - e. Striated.
 - f. Ground-Face (burnished).
 - g. Other. <Specify>
- C. Masonry Lintels: Field assembled CMU in color, pattern, size and texture matching adjacent CMU wall with reinforcing bars as indicated, placed and filled with grout; or as otherwise noted.
- D. Precast Masonry Lintels: Precast units matching concrete unit masonry and with reinforcing bars indicated or required to support intended loads, ASTM C1623.
- E. Precast Concrete Lintels: Precast concrete lintels with reinforcing bars indicated or required to support intended loads, ACI 318.

2.2 BRICK (VENEER WYTHE)

- A. General: Provide shapes as indicated on the drawings and as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide solid units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Brick: ASTM C 216, Grade SW, Type [FBX] [FBS] [FBA].

1. Initial Rate of Absorption: Less than 30 grams/30 square inches (30 grams/194 square centimeter) per minute when tested per ASTM C 67.
2. Efflorescence: Provide brick that is rated “not effloresced.”
3. All brick units shall be produced from single runs and factory blended for specified color range.
4. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finished when viewed from 10 feet (3 meters).
5. Size (Specified Dimensions):
 - a. Modular: 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
 - b. Economy (Closure): 3-5/8 inches wide by 3-5/8 inches high by 7-5/8 inches long
 - c. Utility: 3-5/8 inches wide by 3-5/8 inches high by 11-5/8 inches long.
 - d. Norman: 3-5/8 inches wide by 2-1/4 inches high by 11-5/8 inches long.
 - e. Meridian: 3-5/8 inches wide by 3-5/8 inches high by 15-5/8 inches long.
 - f. Other: <user to specify dimensions>

2.3 MORTAR AND GROUT MATERIALS

A. Contractor shall select one of the following cement options for mortar:

1. Masonry Cement: ASTM C 91.
2. Mortar Cement: ASTM C 1329.
3. Portland Cement-Lime:
 - a. Portland Cement: ASTM C150, Types I or II, except Type III may be used when temperature is below 40 degrees Fahrenheit during construction. Provide natural (gray) or white colored cement as required to produce mortar color indicated.
 - b. Blended Cement: ASTM C595, Types IS(<70) or IP.
 - c. Hydraulic Cement: ATM C1157, Type GU, except Type HE may be used when temperature is below 40 degrees Fahrenheit during construction.
 - d. Hydrated Lime: ASTM C 207, Type S.

B. Contractor shall select one of the following cement options for grout:

1. Portland cement: ASTM C150, Types I or II, except Type III may be used when the temperature is below 40 degrees Fahrenheit during construction.
2. Blended cement: ASTM C595, Types IS(<70) or IP .
3. Hydraulic cement: ASTM C1157, Type GU, except Type HE may be used when the temperature is below 40 degrees Fahrenheit during construction.
4. Combinations of cementitious materials that include portland cement and supplementary cementitious materials (SCMs) in accordance with the following:
 - a. Ground Granulated Blast Furnace Slag (GGBFS or Slag Cement): ASTM C989. The cement slag replacement may be equal to up to 95% slag cement. The slag cement shall consist of either Grades 80, 100 or 120.
 - b. Fly Ash: ASTM C618. The fly ash replacement may be equal to up to 40% fly ash replacement. The fly ash shall consist of either Class C or F.
 - c. SCM's shall not be blended by the ready mixed grout supplier without the purchaser's approval. The SCM percentage(s) shall be indicated on the batch ticket(s).

<Note: Grout cement options 2 and 4 incorporate fly ash and slag cement, which are recovered industrial byproducts. Using recycled materials supports sustainable construction practices and contributes toward credits in LEED® or other green building rating programs. While such grouts may exhibit lower early compressive strengths (1-to7- day range), the strengths at 28 days and beyond are typically equal to or greater than those of grout containing portland cement as the only binder. Request information on C1157 cement from the manufacturer to document applicability toward LEED® or other green building rating programs.>

<Delete the following paragraph if no pigmented mortar is specified and natural color mortar is desired>

- B. Mortar Pigments: ASTM C 979, mineral oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
 - 1. Formulate blend as required to produce color [as selected by Architect] [to match Architect's sample].
- C. Aggregate for Mortar: ASTM C 144.
- D. Aggregate for Grout: ASTM C 404.
- E. Admixtures: Comply with ASTM C 1384, containing not more than 0.2 percent chloride ions, and as recommended by the manufacturer:
 - 1. Integral Water Repellant Admixture for Mortar: Water repellant mortar admixture intended for use with CMU with integral water repellant. Manufacturer shall be the same as that used for CMU integral water repellant as indicated above.
 - 2. Admixture for Grout: As approved by Architect.
 - 3. Other Admixtures: As approved by Architect.
- F. Water: Potable, clean and free of deleterious materials.

2.4 REINFORCEMENTS

- A. Deformed Reinforcing Bars: ASTM A 615/A 615M, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951
 - 1. Interior Walls: Mill galvanized, ASTM A 641 (0.10 ounces per square foot), carbon steel.
 - 2. Exterior Walls: Hot dip galvanized, ASTM A153 Class B-2 (1.50 ounces per square foot), carbon steel.
 - 3. Swimming Pool, Spa or other High Humidity Walls, and Chemical Storage Room Walls: Stainless steel, ASTM A 580 Type 304 or ASTM A153 Class B-2.
 - 4. Wire Size and Side Rods: W1.7 or 0.148 inch diameter (9 gauge).
 - 5. Wire Size for Cross Rods: W1.7 or 0.148 inch diameter (9 gauge).
 - 6. Wire Size for Veneer Ties: W2.8 or 0.1875 inch diameter (3/16 inch).
 - 7. Spacing for Cross Rods: 16 inches on center.
 - 8. Provide in lengths of not less than 10 feet.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
- D. Masonry Joint Reinforcement for Multi-Wythe Masonry:
 - 1. Ladder type with perpendicular cross rods spaced 16 inches on center and one side rod for each face shell of hollow masonry units.

2. Adjustable (two-piece) type, ladder type design, with one side rod at each face shell of backing wythe and with separate flush welded ties that extend into facing wythe. Ties shall have double hooks (or tab ties) that engage eyes (or slots) in reinforcement and resist movement perpendicular to wall. Tie length shall be sufficient to extend 1/2 inch minimum into the outer face shell for hollow units and 1 1/2 inches minimum into solid units, but with a minimum of 5/8 inch cover at outside face.

2.5 EMBEDDED FLASHING SYSTEM MATERIALS

- A. Metal Drip Edges: ASTM A 167, Type 304, stainless steel, 0.0156 inches thick.
 1. Metal Configuration: Extend at least 3 inches horizontally into wall and 1/2 inch out from exterior face of wall with outer edge bent down 30 degrees and hemmed.
 2. Sealant: One-part non-skinning butyl sealant conforming to ASTM C 1311.
- B. Flexible Membrane Flashing: For membrane flashing not exposed to the exterior, provide one of the following:
 1. Copper-Laminated Flashing: 5 ounces per square foot copper bonded with asphalt between 2 layers of glass-fiber cloth.
 2. Rubberized-Asphalt Flashing: Composite bonded flashing product of a rubberized-asphalt adhesive compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
 3. Elastomeric Thermoplastic Flashing: Composite of rubberized-asphalt adhesive, 0.025 inch thick, bonded to a polyester-reinforced ethylene interpolymer alloy.
 4. EPDM Flashing: ASTM D 4637, ethylene-propylene-diene terpolymer, 0.040 inches thick.
 5. Adhesives, Primers, Sealants, and Seam Tapes for Flexible Membrane Flashings: Provide manufacturer's recommended compatible products.
- C. Weep/Vent <Specify one of the following products/methods>:
 1. Fully Open Head Joint.
 2. Partially Open Head Joint.
 3. Rectangular Plastic Weep/Vent: Clear butyrate, 3/8 inch wide by 1-1/2 inches high by depth of outer wythe less 1/8 inch.
 4. Mesh Weep/Vent: Free-draining polyethylene strand mesh, veneer height and depth by 3/8 inch wide. Color to match mortar.
 5. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made of UV-resistant polypropylene copolymer, veneer height and depth by 3/8 inches wide. Color to match mortar.
- D. Cavity Drainage Material: Provide one of the following:
 1. Pea Gravel: Clean, hard, durable free-flowing naturally rounded particle of rock, free of clay, silt, and fine particles, with 100 percent passing a 3/8 inch sieve and not over 5 percent passing a No. 8 sieve.
 2. Free-Draining Mesh: Free-draining polyethylene strand mesh designed to catch mortar droppings and prevent weep holes from being clogged.

2.6 INSULATION MATERIALS

- A. Insulation for cavity:
 1. Extruded-Polystyrene Board Insulation: ASTM C 578, closed-cell product extruded with an integral skin.

- i. Type IV 2-1/8 inch thickness, R-12.
<Select either above or below>
- ii. Type X 2 inch thickness, R-10.

2.7 MISCELLANEOUS ACCESSORIES

- A. Connectors at Intersecting Shear Walls (not applicable at corners):
 1. Rigid Z-Strap Anchors: Fabricate from ASTM A 36 steel bars, 1-1/2 inches by 1/4 inch by 24 inches long with ends turned up 2 inches (total 28 inches in length).
- B. Connectors for Interior Non-Load Bearing Non-Shear Walls (not applicable at corners):
 1. Wire Mesh Ties: Fabricate from 1/2 inch by 1/2 inch mesh, 16 gauge, in width 2 inches less than nominal thickness of the CMU wythe and length not less than 14 inches. Hot dip galvanized, ASTM A 153 Class B-2.
- C. Flexible Anchors: Where masonry is to be laterally supported from structural steel provide flexible anchors consisting of two different components as follows:
 1. Receiver Component: 1/4 inch diameter steel rod with 3/8 inch offset or 12 gauge galvanized steel straps and 4 inch adjustment for ties specified below. Zinc coated, ASTM A 641 (0.10 ounces per square foot, carbon steel).
 2. Triangular Ties: 3/16 inch diameter steel wire, ASTM A 82. Tie length shall extend at least halfway through facing wythe but with at least 5/8 inch cover on outside face. Closed end shall be 1 inch wide and split-end opening shall be 1/2 inch. Hot dip galvanized, ASTM A 153 Class B-2 (1.5 ounces per square foot, carbon steel).
- D. Preformed Control Joint Gasket: Cross shape of flexible rubber or PVC with shear key to fit into sash block grooves and minimum 1 inch flanges.
 1. PVC complying with ASTM D 2287 (Type PVC 654-4).
 2. Rubber complying with ASTM D 2000 M2AA-805.
- E. Bond-Breaker Strips: Asphalt saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt). <As typically used in the “Michigan Control Joint”>
- F. Grout Retainer: Mesh screen, width of CMU less 1 inch. Use at bottom of horizontal grout cell to retain grout without the use of special shaped CMUs, and without breaking mortar bond.
- G. Post-Cleaning Field-Applied Water Repellant: Concrete Masonry Unit manufacturer’s recommended water repellant, compatible with integral water repellant.
- H. Field-Applied Surface Conditioner for Ground Faced (Burnished) Concrete Masonry Units: Ground-Face Concrete Masonry Unit manufacturer’s recommended surface conditioner, compatible with integral water repellant.
- I. Masonry Cleaners: Proprietary cleaner(s) for the appropriate masonry surface as recommended by the masonry material manufacturers and as stated in the approved Masonry Material Cleaning Plan.

2.8 MORTAR AND GROUT MIXES

- A. General: Specified admixtures may be provided as indicated below. If admixture is used, add at same rate for all exposed mortar to ensure consistent mortar color, regardless of weather. Test for compatibility with other products and assemblies.
- B. Mortar Mix: ASTM C 270, Proportion Specification.
1. Type M or S for masonry below grade or in contact with earth.
 2. Type S for unreinforced masonry.
 3. Type S for reinforced masonry.
 4. Type N for veneer masonry.
 5. Admixture: Specified mortar admixtures.
 4. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce selected color. Do not add pigments to colored cement products.
 - a. Pigments shall not exceed 10 percent of Portland cement by weight.
 - b. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
- C. Standard Grout Mix: ASTM C 476, slump of 8 to 11 inches measured per ASTM C 143.
1. Provide fine or coarse grout per ACI 530/ASCE 5/TMS 402, Table 1.15.1, Grout Space Requirements, based upon height and grout space.
 2. ASTM C 476 grout mix shall be determined by the following method:
 - a. Table 1 Grout Proportions By Volume.
<Select either above or below>
 - b. By specified compressive strength tested in accordance ASTM C 1019, minimum compressive strength of 2,000 pounds per square inch.
 3. Approved grout admixtures.
- D. Self-Consolidating Grout Mix: Conforms to material requirements of ASTM C 476.
1. Provide fine or coarse self consolidating grout.
 2. Attains the specified compressive strength or 2,000 pounds per square inch, whichever is greater, at 28 days when tested in accordance with ASTM C1019.
 3. Has a slump flow of 24 to 30 inches per ASTM C 1611.
 4. Has a Visual Stability Index (VSI) less than or equal to 1 per ASTM C 1611, Appendix X.1.
 5. Job-Site proportioning of self-consolidating grout is NOT PERMITTED.
 6. Field addition of water and admixtures NOT PERMITTED.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Inspect concrete foundations for compliance with tolerances of ACI 117, and verify reinforcing dowels are positioned in accordance with the Drawings.
- B. Foundation and/or Load-Bearing Masonry Wall Discrepancies: <Edit for GC or CM>
1. Notify the Architect/Engineer, [the General Contractor], [the Construction Manager] in writing of discrepancies.
 2. Do not proceed with masonry work until conditions have been corrected.

3.2 PREPARATION

- A. Contractor shall prepare the foundation surface for adequate masonry bond.
- B. Do not wet CMUs before placing.
- C. Place steel reinforcement free of mud and debris in grout spaces prior to grouting.
- D. Provide cleanouts in CMU walls to be grouted when height of constructed wall exceeds 5 feet in height.
- E. Protect non-masonry adjacent surfaces during construction until cleaned.

3.3 FIELD QUALITY CONTROL

- A. Testing for Grout: When the grout compressive strength is specified, test in accordance with ASTM C 1019.
- B. Testing for Self-Consolidating Grout:
 - 1. Grout compressive strength, test in accordance with ASTM C1019
 - 2. As delivered to site, verification of slump flow and Visual Stability Index (VSI) per ASTM C 1611.
- C. All Field Technicians sampling, making, and curing specimens for acceptance testing shall be certified by the National Concrete Masonry Association, Grade 1 certification, or equivalent.
- D. Testing for Mortar: Mortar aggregate ratio per ASTM C780.

3.4 PLACEMENT – GENERAL

- A. Place masonry units in running bond pattern unless otherwise noted.
- B. Construct 3/8 inch (plus or minus 1/8 inch) mortar bed joints when masonry units are compressed onto mortar.
- C. Construct 3/8 inch (minus 1/4, plus 3/8 inch) mortar head joints when masonry units are shoved into mortar.
- D. Construct full mortar bed joint on foundation. Joints shall not be less than 1/4 inch and not more than 3/4 inch when masonry units are compressed onto mortar.
- E. Tool mortar joints to a concave profile on interior face of wall when mortar is thumbprint hard. Mortar joints on exterior (cavity) face of backup wythe may be tooled or struck flush.
- F. Remove mortar joint protrusions extending 1/2 inch or more into CMU cells to be grouted.
- G. Place hollow CMU with mortared face shells on head and bed joints.
- H. Mortar bed joints on CMU cross webs where individual CMU cells are to be grouted, piers, columns and pilasters.
- I. Place solid masonry units with full-mortared head and bed joints.
- J. Retempering of non-colored mortar is permitted. Retempering of colored mortar is not permitted.

- K. Where indicated, at integral corners, overlap units full width of wythe.
- L. Where indicated, at shear wall intersecting walls, provide metal straps at maximum vertical spacing of 4 feet. Grout ends of straps into CMU cells.
- M. Where indicated, at non-shear intersecting walls, provide mesh in joints at 16 inches maximum spacing. Grout mesh into CMU cells.
- N. Install connectors, and other accessories.
1. Embed wall ties 1/2 inch in outer faceshell of hollow units and 1-1/2 inches in solid units.
 2. Place connectors in accordance with the sizes, types, and locations indicated.
- O. Bracing of masonry walls shall meet the requirements of MIOSHA Construction Safety Standards, Part 2. Masonry Wall Bracing. This may be accomplished by using the Standard Practice for Bracing Masonry Walls Under Construction and the Masonry Wall Bracing Design Handbook. Refer to the MIOSHA Construction Fact Sheet: Bracing Tall Masonry Walls for more information (http://www.michigan.gov/documents/cis/wsh_constfact_masonry_180828_7.htm).
- P. Place masonry assembly within the following tolerances:
1. Bed joints and top of bearing walls can vary from level plus or minus 1/4 inch in 10 feet up to plus or minus 1/2 inch maximum.
 2. Variation from plumb and true to a line may vary from plus or minus 1/4 inch in 10 feet, plus or minus 3/8 inch in 20 feet up to plus or minus 1/2 inch maximum.
 3. Alignment of the bottom of the wall to the top may vary plus or minus 1/2 inch for load-bearing walls and plus or minus 3/4 inch for non-load-bearing walls.
 4. Do not tooth masonry unless specifically approved in writing.
- Q. Install flashings, on clean, solid and undamaged surface. Provide flashing at all locations indicated. Extend flashings to outside face of wall and terminate as indicated. Form end dams at horizontal terminations of flashings. All vertical legs at the backup shall be mechanically fastened. Lap joints a minimum of 6 inches and seal with compatible material.
1. At lintels and shelf angles, install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 2. Install weeps and cavity drainage material directly on top of flashing in a clean cavity.
- [Note: The MIM recommends flexible flashing at all accessible pedestrian locations (such as the base of a wall) to avoid injuries from exposed sharp metal on drip edges]**
- R. Construct expansion and/or control (movement) joints as indicated on the Drawings. **[Designer is responsible for locating all movement joints.]** Terminate horizontal reinforcing on both sides of the movement joint. Reinforcement for bond beams may be continuous or discontinuous depending upon indicated structural requirements.
- S. Keep masonry surfaces clean during construction. Remove all mortar drippings, tags and stains before they cure. Use a light brush sweep across the exposed masonry surfaces upon initial mortar set to minimize smearing.
- T. Cover tops of CMU walls at completion of each day's work as practicable as possible. Covering shall remain to minimize water and debris intrusion of ungrouted cells until permanent closure of walls occurs.

3.5 PLACEMENT – VENEER WYTHE

- A. Use full-size units without cutting if possible. If cutting is required, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying. Install cut units with cut surfaces concealed.
- B. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602, Section 3.3G. or as otherwise approved.
- C. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and where possible, at other locations.
- D. Bond Pattern: Unless otherwise indicated, lay masonry in running bond, do not use units with less than nominal 4 inch horizontal face dimensions at corners or jambs.
- E. Built-in Work: As construction progresses, build in items specified (door frames, window frames, fire extinguisher cabinets, etc.) as required. Fill in solidly with masonry around built-in items.
- F. Mortar Bedding and Jointing:
 - 1. Lay hollow units with face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
 - 3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together using horizontal masonry joint reinforcement as follows:
 - 1. Use adjustable (two piece) type reinforcement to allow for differential movement.
- B. Keep cavities clean of mortar droppings and other materials during construction. Batter mortar beds away from cavity, to minimize mortar protrusions into cavity. Do not deeply furrow mortar. Do not attempt to trowel or remove mortar fins protruding into cavity.
- C. Installing Cavity-Wall Insulation: Fit insulation between wall ties and other confining obstructions, with edges butted tightly. Press units firmly against inside wythe of masonry. Adhere insulation to the inside wythe following manufacturer's recommendations.

3.7 REINFORCEMENT

- A. Place steel reinforcement in accordance with the sizes, types, and locations indicated.
 - 1. Lap splices as indicated.
 - 2. Install ties for vertical reinforcement in columns as indicated.
- B. Joint Reinforcement: Place joint reinforcing in bed joints of all CMU walls, including DCMU veneer, at not more than 16 inches on center vertically, and place in additional locations where indicated. Locate joint reinforcement so that longitudinal wires are embedded in mortar, including wires within the lap length. Place cross wire over webs of CMU (16 inches on center). Lap length

of joint reinforcement a minimum of 6 inches. Do not extend joint reinforcing through movement joint. Use separate continuous horizontal joint reinforcement in facing wythe with DCMU veneer.

C. Secure steel reinforcement to prevent displacement from the placement of grout and within the following tolerances:

1. Place steel reinforcement prior to grouting.
2. Maintain a clear distance between the reinforcement and the unit cell wall of at least 1/4 inch for fine grout and 1/2 inch for coarse grout.
3. Place joint reinforcement with at least 5/8 inch mortar cover when exposed to weather or earth and 1/2 inch when not exposed.
4. Place vertical and horizontal reinforcing bars within walls and flexural elements (beams and lintels) as follows:

[Note: “d” is the distance from the center line of the steel to the opposite face of masonry.]

- a. “d” less than or equal to 8 inches, within 1/2 inch (plus or minus).
- b. “d” greater than 8 inches but less than or equal to 24 inches, within 1 inch (plus or minus).
- c. “d” greater than 24”, within 1-1/4 inch (plus or minus).

[Note: Designer is responsible for locating all reinforcement bars on the drawings.]

5. Place vertical reinforcing bars within plus or minus 2 inches from the specified location along the length of the wall.

3.8 GROUT PLACEMENT

A. Place grout within 1-1/2 hours from mixing and prior to initial set of grout.

1. Do not exceed the grout pour heights of ACI 530.1/ASCE 6/TMS 602, Table 7.
2. Place grout in lifts not exceeding 12.67 feet high when the following conditions are met:
 - a. The masonry has cured for at least 4 hours.
 - b. The grout slump is maintained between 10 and 11 inches.
 - c. No intermediate reinforced bond beams are placed between the top and the bottom of the pour height.
3. If the conditions of 3.6A2 a and b are met but there are intermediate bond beams within the grout pour, limit the grout lift height to the bottom of the lowest bond beam that is more than 5 feet above the bottom of the lift, but do not exceed a grout lift height of 12.67 ft.
4. If the conditions of 3.6A2 a or b are not met, place grout in lifts not exceeding 5 feet.
5. Alternatively, place masonry units and grout using construction procedures employed in the accepted grout demonstration panel.

[Note: When a grout demonstration panel is to be utilized, the designer should establish criteria for the grout demonstration panel and establish inspection procedures to verify grout placement during construction. See 2008 MSJC commentary on specification for Masonry Structures, Section 3.5C for additional information.]

B. Consolidate grout at the time of placement.

1. Consolidate grout pours 12 in. or less in height by mechanical vibration or by puddling.
 2. Consolidate pours exceeding 12 in. in height by mechanical vibration, and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.
 3. Consolidation or reconsolidation is not required for self-consolidating grout.
- C. Grout Key – When grouting, form grout keys between grout pours. Form grout keys between grout lifts when the first lift is permitted to set prior to placement of the subsequent lift.
1. Form a grout key by terminating the grout a minimum of 1-1/2 in. below a mortar joint.
 2. Do not form grout keys within beams or lintels.
 3. At beams or lintels laid with closed bottom units, terminate the grout pour at the bottom of the beam or lintel without forming a grout key.
- D. Solidly fill cells below lintel or beam bearing minimum as noted on the drawings.
- E. Bond Beams and Masonry Lintels:
1. Allow masonry lintels to attain sufficient strength to support loads imposed during construction before removing temporary supports.

3.9 MASONRY CLEANING

- A. Keep masonry faces clean during construction whenever possible, i.e. remove all mortar tags and stains before they cure, a light brushing with a soft brush upon initial mortar set, minimize mortar run-down with wet masonry units, minimize water entry into constructed walls, remove mortar build up from scaffold, protect all wall projections from mortar splashes, turn over planks to avoid mortar splashes when not working, protect base of wall from all mortar and mud splashes and remove and clean grout spills immediately.
- B. Demonstrate cleaning methods using the selected materials per the approved cleaning plan on the mockup or on an inconspicuous area of the new masonry to determine the suitability of cleaning materials and methods.
- C. Before cleaning masonry, protect other masonry and other non-masonry surfaces as necessary to prevent damage
- D. Cleaning procedures shall not damage finished masonry.

3.10 CLEAN UP

- A. Remove mock-up panels upon completion and approval of all masonry.
- B. Remove all masonry related debris and properly dispose of off site.

END OF SECTION