

Revised 2/2017

[NOTE TO SPECIFIER: PLEASE ENABLE VIEWING OF HIDDEN TEXT. Notes are interspersed throughout to offer explanations or guidance, and indications on whether to keep certain items.]

***** This Guide Specification is particular to projects under the jurisdiction of DSA or OSHPD 1 and 4. For brevity, 'DSA' is used within specifier notes to reference code modifications adopted by DSA-SS, DSA-SS/CC, and OSHPD 1 and 4, except where specific DSA publications are cited. *****

Abbreviations used in notes:

CBC: 2016 California Building Code

TMS 402: TMS 402, 2013 Building Code Requirements for Masonry Structures and Commentary

TMS 602: TMS 602, 2013 Specification for Masonry Structures

This guide specification is based upon TMS 602, a CSI-format, three-part specification as adapted by ACI, and incorporated by reference in the CBC.

Notes appearing in green are related to sustainable design.

Replace the term “Design Professional” with the identity of the design professional as defined in the General and Supplementary Conditions.

SECTION 04 22 00 – CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Division 01 Sections, Drawings, General Conditions, Supplementary Conditions, and Special Conditions apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units (CMUs).
 - 2. Mortar and grout.
 - 3. Reinforcing steel.
 - 4. Masonry joint reinforcement.
 - 5. Ties and anchors.
 - 6. Embedded flashing.
 - 7. Control joint materials.

- B. Products installed, but not furnished, under this Section:

Edit the following as needed

1. Section 05 50 00 Metal Fabrication for steel lintels and shelf angles for unit masonry.
2. Section 07 62 00 Sheet Metal Flashing and Trim.

C. Related Requirements:

Edit the following list as needed.

1. Section 04 05 13 Masonry Mortaring.
2. Section 04 05 16 Masonry Grouting.
3. Section 04 05 19 Masonry Anchorage and Reinforcing.
4. Section 04 05 23 Masonry Accessories.
5. Section 04 22 00.13 Concrete Unit Veneer Masonry.
6. Section 04 22 23.23 Prefaced Concrete Unit Masonry. for [Astra-Glaze-SW glazed masonry units](#)
7. Section 04 23 00 Glass Unit Masonry.
8. Section 07 19 00 Water Repellents for application to unit masonry assemblies.
9. Section 07 62 00 Sheet Metal Flashing and Trim for exposed sheet metal flashing.
10. Section 07 84 13 Penetration Firestopping for firestopping at openings in masonry walls.
11. Section 07 84 43 Fire-Resistive Joint Sealants for fire-resistive joint systems at heads of masonry walls.
12. Section 07 92 00 Joint Sealants for sealing control and expansion joints in unit masonry.
13. Section 32 14 13.13 Interlocking Precast Unit Paving.

1.3 REFERENCES

A. TMS 602 2013 Specification for Masonry Structures.

B. ASTM International (latest versions)

1. ASTM A36/A36M Standard Specification for Carbon Structural Steel.
2. ASTM A82/A82M 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/A185M 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/A615M 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/A951M 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/C140M Standard Test Method for Sampling and Testing Concrete Masonry Units.
15. ASTM C150/C150M 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 C595/C595M Standard Specification for Blended Hydraulic Cements.
19. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete. [Include only if specified in 2.3B](#)
20. ASTM C989/C989M Standard Specification for Slag Cement for Use in Concrete and Mortars. [Include only if specified in 2.3B](#)
21. ASTM C1019 Standard Test Method for Sampling and Testing Grout.
22. ASTM C1314 Standard Test Method for Compressive Strength of Masonry Prisms.
23. ASTM C1586 Standard Guide for Quality Assurance of Mortars.
24. ASTM C1611/C1611M Standard Test Method for Slump Flow of Self-Consolidating Concrete. [Include only if specified in 2.3](#)
25. ASTM C1714/C1714M Standard Specification for Preblended Dry Mortar Mix for Unit Masonry.
26. ASTM D2000 Classification System for Rubber Products in Automotive Applications. [Include only if specified in 2.6](#)
27. ASTM D2287 Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

1.4 SYSTEM DESCRIPTION

f'_m is the design strength of the masonry wall. It is not the individual cmu strength. Please see <http://www.angelusblock.com>, CMU Basics, Strengths, for more information on the relationship between unit strengths and the design strength.

Specification of Quality Assurance items is dependent on the f'_m value.

Coordinate with Structural documents. Either insert design strength (e.g., 2000 psi f'_m) in section A below as stated in structural documents (edit as necessary), or insert a reference to its location within such documents in section B. Keep only one of these.

- A. Provide materials to achieve the net compressive strength of concrete unit masonry equal to or greater than 2000 psi f'_m .
- B. Provide materials to achieve the net compressive strength of concrete unit masonry equal to or greater than the f'_m as indicated [insert reference location].

1.5 SUBMITTALS

- A. Obtain written acceptance of submittals prior to use of the following:
 - 1. Submit mix designs and test reports:
 - a. Preblended mortar:
 - 1) Mix design indicating types and proportions of materials according to proportion specification of ASTM C270, or
 - 2) Mix designs and mortar tests performed in accordance with the property specification of ASTM C270.
 - b. Conventional grout:
 - 1) Mix design indicating types and proportions of materials according to proportion requirements of ASTM C476, or
 - 2) Mix design and grout strength test performed in accordance with ASTM C476.

Include the following if self-consolidating grout is specified.

- c. Self-consolidating grout:
 - 1) Compressive strength tests performed in accordance with ASTM C1019, and slump flow and visual stability index (VSI) as determined by ASTM C1611/C1611M.
 - 2. Submit material certificates for each of the following certifying compliance:
 - a. Concrete masonry units.
 - b. Steel reinforcing bars.
 - c. Anchors, ties, fasteners, and metal accessories.
 - d. Preformed control joint gaskets.

For samples required below, state quantity of each.

- B. Samples for Verification: For each face design, color, and texture of the following:
 - 1. Exposed concrete masonry units.

Include the following if colored mortar is specified.

- 2. Mortar, for color selection or confirmation.

1.6 SUSTAINABLE DESIGN SUBMITTALS

The EPD and HPDs for Angelus Block CMU cover the great majority of specified cmu and all core product lines. If this specification includes cmu with special aggregate blends or other characteristics not included in Angelus Block publications, please consult your Representative to review applicability of the EPD.

- A. Environmental Product Declaration (EPD) meeting the following criteria:
 - 1. Product-specific, Type III third party verified.
 - 2. EPD based upon ASTM International PCR005: Product Category Rules for Preparing an Environmental Product Declaration for Manufactured Concrete and Concrete Masonry Products.

- B. Health Product Declaration (HPD) for specified products meeting the following criteria:
1. Ingredients reported to 100 ppm.
 2. Conforming to Health Product Declaration® Open Standard Version 2.0

See notes for recycled content in Paragraph 2.2 A.3.b.

- C. Recycled Content
1. Manufacturer's certification of type and percentages of recycled content.
- D. Manufacturing and Material Source Locations: Include in manufacturer's certification for CMU supplied under this Section:
1. Location of CMU production plant.
 2. Locations of raw material sources for ingredients.

1.7 QUALITY ASSURANCE

The CBC incorporates TMS 402 and TMS 602 for inspections and verifications, as modified by DSA; each has three levels of Quality Assurance, but only two are utilized by DSA: Level B (for masonry veneer in Risk Categories II, III, or IV [see respective guide specification]), and Level C (for engineered masonry in all Risk Categories).

Verification of the strength of masonry, or f'_m (the design strength mentioned in notes for System Description above), is facilitated by the Unit Strength Method *OR* the Prism Test Method (CBC 2105A.2.2), plus additional means as specific to DSA-SS and OSHPD 1 & 4. f'_m values are allowed from a minimum 2000 psi to a maximum of 3000 psi.

Level C requires verification of f'_m prior to the start of masonry and for each 5,000 sq. ft. during construction. For the basic design strength of 2000 psi, the unit strength method is preferred.

However, when f'_m values exceed 2000 net psi, the following applies:

- Preconstruction verification of f'_m must be by the Prism Test Method.
- Mortar and grout tests are NOT required when prism tests are used.

In general, prism testing makes more sense as the values from the unit strength table – which are very conservative – may negatively impact the project. Excessively high strength requirements for cmu will typically require special order products with mix designs that may affect color and texture, altering the appearance versus originally selected samples. Exceptionally high cmu strength values may not be available in Medium Weight or Lightweight densities, or may not be available at all. The expense of prism testing could save overall costs by utilizing standard units (which typically test much higher than the minimum ASTM C90 strength), rather than more expensive special high-strength units, to achieve the specified strength of masonry.

- A. Preconstruction Testing.
1. Owner will select a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner.

If $f'_m = 2000$ psi, specify the unit strength method, or if $f'_m > 2000$ psi, specify prism testing, and delete the method not used. Specify only one verification method – either Unit Strength OR Prism Test – not both!

UNIT STRENGTH METHOD:

2. Determine the compressive strength of masonry by the strength of the unit and type of mortar specified (Unit Strength Method) per CBC Table 2105.2.2.1.2.
 - a. Concrete Masonry Units: Test per ASTM C140.

Mortar and grout tests are required for the unit strength method (Section 2105A.2.2.1.4).

- b. Grout: Test per ASTM C1019.

OR - PRISM TEST METHOD:

Although code does not require the prism test method for f'_m at 2000 psi there may be cost/benefit for prism testing vs. unit strength; see introductory notes to 1.7 Quality Assurance.

3. Determine the compressive strength of masonry by the prism test method in accordance with ASTM C1314. Schedule masonry procurement sufficiently in advance to allow for prism construction and curing.
 - a. Prism Test: For each type of construction required, construct and test three prisms per ASTM C1314.

- B. Sample Panels: Construct an approximate [Width:] wide by [Height:] high panel for representation of completed masonry, joint tooling, design details, and workmanship. Comply with requirements in Division 01 Section "Quality Requirements" for mockups.

If it is desirable to demonstrate particular units or areas of critical detailing, specify them in the following, otherwise delete it.

1. Install the following in the sample panel:
 - a. [Specify units]
 - b. [Specify details or conditions]

It is typically good practice to conduct preinstallation meetings to provide opportunity to clarify critical details, schedules, specification intent, inspections etc. If the work under this section is of a minor nature, the following may be deleted.

- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination".

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect all materials of this section to maintain quality and physical requirements.
- B. Store all masonry units on the jobsite so that they are protected from rain, stored off-ground and kept free of contamination.

- C. Store SPEC MIX preblended mortar mix in manufacturer's original, unopened, undamaged containers with identification labels intact, covered and protected from weather, or in a SPEC MIX dispensing silo.

1.9 FIELD CONDITIONS

- A. Cover top of unfinished masonry work to protect it from the weather.

Cold-weather and hot-weather masonry construction is addressed in TMS 602 Article 1.8 C and 1.8. Include and modify below as necessary.

- B. Cold-weather procedures when ambient temperature falls below 40°F (4°C) or the temperature of masonry units is below 40°F (4°C):
 - 1. Do not install wet or frozen units.
 - 2. Implement cold weather construction procedures in accordance with TMS 602 Article 1.8 C.
- C. Hot-weather procedures when ambient temperature exceeds 100°F (38°C), or exceeds 90°F(32°C) with a wind velocity greater than 8 mph:
- D. Implement hot weather construction procedures in accordance with TMS 602 Article 1.8 D.

PART 2 - PRODUCTS

Note: we often see specifications for a product covered by an ASTM standard also list its raw material constituents, along with their respective ASTM standards. This is not only redundant, it is not recommended as it may also be unnecessarily limiting. For example, CMU may be made with C150 Portland cement, or with C595 blended cement. Angelus Block is first in our region to move to a blended cement that reduces CO₂ impact. By stating presumed CMU ingredient ASTMs, specifically C150, the project has limited itself from a more eco-friendly product with equal or better characteristics.

TMS 602, Specification for Masonry Structures, is included by reference in the CBC. It does not list sub-ASTMs, simply stating the ASTM standard specific to the material discussed. Each ASTM standard lists within it all allowed ingredients and respective ASTMs.

2.1 MANUFACTURER

- A. Concrete masonry units:
 - 1. Angelus Block Co., Inc.
 - a. Sun Valley, CA (818) 767-8576
 - b. Orange, CA (714) 637-8594
 - c. Fontana, CA (909) 350-0244
 - d. Gardena, CA (310) 323-8841
 - e. Oxnard, CA (805) 485-1137

- f. Indio, CA (760) 347-3245
- 2. Desert Block Co., Inc.
 - a. Bakersfield, CA (661) 858-2848

B. Preblended mortar:

- 1. SPEC MIX Preblended Mortar Mix, by E-Z Mix, Inc.
 - a. Sun Valley, CA (818) 768-0568
 - b. Rialto, CA (909) 874-7686

Include the following if specified in 2.3 D.

C. Grout additive:

- 1. PRE-MIX Products Grout Additive, by E-Z Mix, Inc.
 - a. Sun Valley, CA (818) 768-0568
 - b. Rialto, CA (909) 874-7686

2.2 CONCRETE MASONRY UNITS

A. Concrete Masonry Units: ASTM C90.

The majority of structural design is based on the Medium Weight classification; therefore, the greatest availability in Southern California of architectural cmu is in Medium Weight. Edit below if structural design considers a different weight classification.

- 1. Weight Classification: Medium Weight unless otherwise indicated.

Although it is common to call out colors and textures on elevation drawings or legend tables within the drawings set, it is helpful to also coordinate and list them here. Examples of Color: Sandstone, Warm Gray. Examples of Texture: Precision, Split Face, Burnished. If compatible mortar color other than natural gray is intended, specify in paragraph 2.3 A.

- 2. Color(s) and texture(s):
 - a. [Color] [Texture]

In addition to the Sustainable Design Submittals in Article 1.6, which report the “as-is” state of submitted cmu, you may include specified green characteristics here. However, before doing so, please consult with your Angelus Block Representative to ensure the specified cmu will meet all other intended characteristics.

- 3. Sustainable Characteristics:

See discussion for paragraph 1.6 A.

- a. Concrete masonry units shall be included in a current Type III Environmental Product Declaration.

Recycled content: Though most production plants and products contain recycled content, the amounts vary by plant and product. Custom percentages may be possible depending upon size of the project; please consult your Angelus Block Representative.

Please note that as recycled content increases, the variations in color and texture may also increase. For architectural cmu, a balance must be reached between high recycled content and more pronounced variation. NOTE: higher value recycled content may be achieved by utilizing high cement replacement in masonry grout; see discussion for paragraph 2.3 B.

- b. Recycled content in specified CMU shall be [percentage or range] include range, minimum, or maximum after consulting with your Angelus Representative; multiple entries here may be appropriate depending on types of cmu specified.

Regional material criteria of “within 500 miles” under LEED v3 and other rating systems is a certainty with Angelus Block cmu. *Everything* – raw materials and production – is well within 500 miles of our service region.

LEED v4 changes applicability, definition, and distance. As of this specification update, current language and interpretation stipulates *ALL* raw material sources and production locations must be within 100 miles of the project, without any calculations for portions of raw materials. It’s all or nothing. Many product mix designs incorporate aggregates which simply are not available within 100 miles of the metroplex regions. Therefore, if this project is seeking certification under LEED v4, please consult your Representative before stating this as a required characteristic. Otherwise, it may be included for LEED v3 and other rating systems as follows.

- b. Obtain CMU produced, and with raw materials sourced, within 500 miles of the project site.

Concrete building brick, below, is listed by DSA for "reinforced grouted masonry", i.e., multiwythe composite masonry – two wythes tied together and the space between grouted. If that wall type is not applicable to this project, delete the reference; see also references to solid-unit multiwythe masonry in Articles 3.3 and 3.7, and delete those as well if not used.

- B. Concrete Building Brick: ASTM C 55.

2.3 MORTAR AND GROUT MATERIALS

The following items may instead be included in their respective specification Sections: 04 05 13 Masonry Mortaring, 04 05 16 Masonry Grouting. If so, replace details below with a reference to the appropriate Section.

Preblended mortar below provides greater control and consistency than field-mixed. SPEC MIX meets both proportion and properties requirements of ASTM C270.

NOTE TO USERS OF AIA MASTERSPEC 042000: This MasterSpec and its accompanying Evaluations, includes and discusses mortar types M, S, N, and O, and their applicability to a variety of conditions. This is problematic for projects in California under the 2013 CBC, and by reference, TMS 402. (See *Information for users of AIA MasterSpec 042000*, available from your Angelus Block representative, for specifics.)

Most of California is in Seismic Design Category D, for which “participating elements”, or structural elements, must utilize either Type S or Type M mortar ONLY. Therefore, to eliminate multiple mortar

types on the project, the pragmatic default mortar for our region is Type S, unless Type M is specified by structural design.

- A. SPEC MIX Masonry Mortar Type [S or M] preblended factory mix: ASTM C270 and ASTM C1714/C1714M. (or, if a separate Section is included for mortar, append the foregoing with ", in accordance with Section 04 05 13 Masonry Mortaring", and delete the following color specification)

Natural gray is often used, including use with colored cmu. If compatible mortar colors are desired, specify here. Consult your Angelus representative or www.angelusblock.com for current compatible Spec Mix mortar colors. For stock colors (Sandstone, Spice, and Harvest), specify the stock mortar color, "Medium Tan".

1. Natural gray color.

- B. Grout for masonry: ASTM C476. (or, if a separate Section is included for grout, append the foregoing with ", in accordance with Section 04 05 16 Masonry Grouting", and delete the following sections for grout constituents)

Fly ash, or fly ash combined with ground granulated blast furnace slag (GGBFS), may be used as a partial Portland cement replacement, and is a practical means of introducing significant recycled content into the masonry wall without adversely affecting aesthetic control of exposed masonry units. And, since grout is approximately 50% or more of the volume of solid grouted concrete masonry, the sustainability benefit is substantially greater than recycled content in cmu alone. Studies undertaken by numerous industry organizations have shown:

- Grouts with up to 30% by weight of Portland cement replaced with Class F fly ash can be treated as conventional masonry grout.
- Grouts with 40% to 50% by weight of Portland cement replaced with Class F fly ash are viable; compressive strength should be tested at 42 days, and should not have a significant effect on the overall project schedule.
- Grouts with 50% to 80% by weight of Portland cement replaced by fly ash (25%) and GGBFS (varying %) are also viable.
- These grouts have other benefits, such as increased workability.

Availability and specific mix designs will vary by local grout suppliers, who should be consulted for specifications. Please contact the Concrete Masonry Association of California and Nevada (CMACN), www.cmacn.org, or your Angelus Block representative for more information.

Include fly ash and/or GGBFS below if used in masonry grout.

1. Fly ash: ASTM C618.
2. Ground granulated blast furnace slag: ASTM C989/C989M.
3. Sustainable Characteristics

- a. Masonry grout shall contain [type and percentage] include type of SCM(s) and replacement percentages here.

Consult masonry grout producers for availability of recycled aggregates and applicability of regional criteria. Include below as appropriate.

- b. [Recycled aggregate content.]
 - c. [Regional material criteria.]
- C. Water: Potable.
- D. Admixtures:
1. Do not use admixtures except as specified herein, or as approved by the Design Professional and the Building Official.

The admixture below is of the type required for high-lift grouting (see specifier notes below related to grouting), to decrease grout shrinkage and compensate for volume loss due to water absorption. Field addition of admixtures is not permitted for self-consolidating grout.

2. PRE-MIX Products Grout Additive manufactured by E-Z Mix, Inc. Use per manufacturer's specifications.

2.4 REINFORCEMENT AND METAL ACCESSORIES

The following items may instead be included in their respective specification Sections: 04 05 19 Masonry Anchorage, 04 05 23 Masonry Accessories. If so, replace details below with a reference to the appropriate Section.

Items below are typically used. Revise as required by structural design.

- A. Provide metal reinforcement and accessories conforming to TMS 602 Article 2.4 (if separate sections are included for these items, append the foregoing with ", in accordance with Section 04 05 19 Masonry Anchorage and Reinforcing and Section 04 05 23 Masonry Accessories", and delete the remainder of this article).
- B. Steel Reinforcing Bars: ASTM A615/A615M.
- C. Masonry Joint Reinforcement: ASTM A951/A951M. Maximum spacing of cross wires in ladder-type and points of connection of cross wires of truss-type joint reinforcement shall be 16 in.
- D. Anchors, ties, and accessories:
 1. Plate and bent-bar anchors: ASTM A36/A36M.
 2. Sheet-metal anchors and ties: ASTM A1008/A1008M.
 3. Wire mesh ties: ASTM A185/A185M.
 4. Wire ties and anchors: ASTM A82/A82M.
 5. Headed anchor bolts: ASTM A307, Grade A.

- E. Coatings for corrosion protection: Unless otherwise required, protect carbon steel joint reinforcement, ties, and anchors from corrosion by galvanizing or epoxy coating in conformance with the following minimums:
 - 1. Mill galvanized coatings:
 - a. Joint reinforcement: ASTM A641/A641M (0.1 oz./ft²).
 - b. Sheet metal anchors and ties: ASTM A653/A653M Coating Designation G60.
 - 2. Hot-dipped galvanized coatings:
 - a. Joint reinforcement, wire ties, and wire anchors: ASTM A153/A153M (1.50 oz./ft²).
 - b. Sheet metal anchors and ties: ASTM A153/A153M Class B.
 - 3. Epoxy coatings:
 - a. Joint reinforcement: ASTM A884/A884M Class A Type 1 — ≥ 7 mils.
 - b. Wire ties and anchors: ASTM A899/ Class C — 20 mils.
 - c. Sheet metal anchors and ties: 20 mils per manufacturer's specification.

2.5 FLASHING MATERIALS

- A. Provide metal flashing in accordance with Section 07 62 00 Sheet Metal Flashing and Trim.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

- A. Rubber Preformed Control-Joint Gaskets: per ASTM D2000, Designation M2AA-805.
- B. PVC Preformed Control-Joint Gaskets: per ASTM D2287, Type PVC 654-4.

2.7 MASONRY CLEANER

- A. Use potable water and detergents to clean masonry unless otherwise approved.
- B. Do not use acid or caustic solutions unless otherwise approved.

2.8 MIXING

- A. Mortar:
 - 1. Mix SPEC MIX Masonry Mortar preblended factory mix per manufacturer's recommendations.
- B. Conventional grout:

Grout for masonry requires more water than other types of concrete. A significant amount of water is absorbed by the cmu; sufficient water must remain in the grout to facilitate flow, consolidation, and hydration.

- 1. Mix grout to a consistency that has a slump between 8 and 11 inches per TMS 602 Article 2.6 B.

- C. Self-consolidating grout:
 - 1. Job-site proportioning of self-consolidating grout is not permitted.
 - 2. Do not add water at the job site except in accordance with the manufacturer's recommendations.

2.9 Fabrication

- A. Fabricate reinforcement per TMS 602 Article 2.7 A.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to the start of masonry installation, verify all conditions pertinent to the performance of work in this Section are acceptable.
 - 1. Verify foundations are constructed within a level alignment tolerance of $\pm 1/2$ in.
 - 2. Verify that reinforcing dowels are positioned in accordance with Project Drawings.
- B. Proceed with masonry work only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean reinforcement and shanks of anchor bolts by removing mud, oil, or other materials that will adversely affect bond to mortar or grout.
 - 1. Reinforcement with rust and/or mill scale is acceptable provided attributes of a cleaned sample are in accordance with the applicable ASTM specification.
- B. Prior to laying masonry, remove laitance, loose aggregate, and any other material that would prevent mortar from bonding to the foundation.
- C. Do not wet units before laying, unless otherwise required. Wet cutting is permitted.
- D. Cut units as required to fit; use motor-driven masonry saw. Install cut units with cut surfaces concealed as much as possible.

3.3 INSTALLATION

- A. Select and arrange units for exposed masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- B. Comply with construction tolerances in TMS 602, Article 3.3F.

- C. Construct grout spaces free of mortar dropping, debris, and any material deleterious to grouting.
- D. Construct cleanouts in the bottom course of masonry for each grout pour when the grout pour height exceeds 5 ft-4 in.
 - 1. Hollow-unit masonry:
 - a. Create cleanout by cutting off entire face shell of the cmu. Replace face shell after inspection and before grouting.
 - 2. Solid-unit multiwythe masonry:
 - a. Create cleanout by leaving out every other unit. Install unit after inspection and before grouting.
 - 3. Brace cleanout closure to resist grout pressure.
- E. Lay all masonry true, level, plumb, and in accordance with the drawings.
- F. Ensure all vertical cells to be grouted are aligned and unobstructed openings for grout are provided in accordance with Project Drawings.

Running bond is the typical pattern. If stack bond or another pattern is to be used, edit the following item, or refer to drawings.

- G. Lay exposed masonry in running bond unless otherwise indicated in Project Drawings.
- H. Lay concealed masonry in running bond unless otherwise indicated.
- I. Brace masonry during construction to assure stability. Design, provide, and install bracing.

3.4 MORTAR BEDDING AND JOINTING

- A. Place mortar in accordance with TMS 602 Article 3.3 B (or, if a separate Section is included for mortar, append the foregoing with ", and with Section 04 05 13 Masonry Mortaring", and delete the remainder of this article).
- B. Initial bed joint shall not be less than 1/4 in. or more than 3/4 in.
 - 1. The maximum thickness of the initial bed joint in fully grouted masonry shall not exceed 1 1/4 in.
- C. Lay all head and bed joints, except initial bed joints, a nominal 3/8 in. thick, unless otherwise required.

If the unit strength method is used for verification of f'_m in paragraph 1.7 A, include the following provision for $5/8$ inch joint; if prism tests are used, delete it:

- 1. Do not exceed $5/8$ in thickness of bed joints.

- D. Lay hollow units with head and bed joints filled with mortar for the thickness of the face shell.
- E. Lay solid units with full head and bed joints. Do not fill head joints by slushing with mortar. Do not furrow bed joints deep enough to produce voids.
- F. Remove mortar protrusions extending 1/2 in. or more into cells to be grouted.
- G. Fully mortar webs in all courses of piers, columns and pilasters, in the starting course on foundations, and when necessary to confine grout.

If another joint profile is used, revise the following item or refer to Drawings. For example, flush joints may be used for masonry walls that are to receive plaster. Note that some decorative joint profiles are not recommended for weather exposure; consult your Angelus Block representative.

- H. Tool concave mortar joints on exposed walls, unless otherwise indicated, and strike to produce a dense, slightly concave surface well bonded to the surface of the masonry unit.
- I. Remove and re-lay in fresh mortar any unit that has been disturbed to the extent the initial bond is broken.

3.5 EMBEDDED ITEMS AND ACCESSORIES

- A. Construct control joints as detailed in the drawings as masonry progresses.
 - 1. Install preformed control-joint gaskets designed to fit standard sash block.
- B. Construct chases as masonry units are laid.
- C. Install pipes and conduits passing horizontally through nonbearing masonry partitions as indicated.
- D. Place pipes and conduits passing horizontally through piers, pilasters, or columns as indicated.
- E. Place horizontal pipes and conduits in and parallel to plane of walls.
- F. Install and secure connectors, flashing, weep holes, weep vents, nailing blocks, and other accessories as required.

3.6 INSTALLATION OF REINFORCING STEEL, WALL TIES, AND ANCHORS

- A. Install reinforcing steel, wall ties, and anchors in accordance with TMS 602 Article 3.4. (or, if a separate Section is included for reinforcement, append the foregoing with ", and with Section 04 05 19 Masonry Anchorage and Reinforcing", and optionally delete the remainder of this article)
- B. Place reinforcement as detailed on the drawings.

1. Support and fasten reinforcement to prevent displacement beyond specified tolerances during construction and grouting operations.
 2. Maintain clear distances between reinforcement and any interior face of masonry unit or formed surface, but not less than 1/4 in. for fine grout, or 1/2 in. for coarse grout.
 3. Completely embed reinforcing bars in grout.
 4. Place reinforcing bars maintaining minimum cover of:
 - a. Where masonry is exposed to weather, 2 in. for bars larger than No. 5, 1 1/2 in. for No. 5 or smaller.
 - b. Where masonry is not exposed to weather, 1 1/2 in.
 5. Embed joint reinforcement with minimum 5/8 in. cover to faces exposed to weather or earth, and 1/2 in. elsewhere.
 - a. Provide minimum 6-in. lap splices and ensure that all ends of longitudinal wires are embedded in mortar at laps.
 6. Place reinforcing bars in walls and flexural elements to a tolerance of $\pm 1/2$ in. when the distance from the centerline of reinforcing bars to the opposite face of masonry, d , is equal to 8 in. or less, ± 1 in. for d equal to 24 in. or less but greater than 8 in., and $\pm 1 1/4$ in. for d greater than 24 in.
 7. Foundation dowels that interfere with unit webs are permitted to be bent to a maximum of 1 in. horizontally for every 6 in. of vertical height.
- C. Install wall ties as detailed on the drawings and in accordance with TMS 602 Article 3.4 C.
- D. Install anchor bolts as detailed on the drawings and in accordance with TMS 602 Article 3.4 D.
1. Embed headed and bent-bar anchor bolts in grout. Anchor bolts of 1/4 in. or less may be placed in mortar bed joints at least 1/2 in. in specified thickness.
 2. Maintain clear distance between anchor bolts and any face of masonry unit or formed surface of at least 1/4 in. when using fine grout, and of at least 1/2 in. when using coarse grout.
 3. Maintain a clear distance between parallel anchor bolts not less the diameter of the anchor bolt, nor less than 1 in.

3.7 GROUTING

- A. Comply with grout placement requirements in TMS 602 Article 3.5 (or, if a separate Section is included for grout, append the foregoing with ", and in accordance with Section 04 05 16 Masonry Grouting", and delete the remainder of this article).
- B. Place grout within 1 1/2 hours from introducing water in the mixture and prior to initial set.
 1. Discard field-mixed grout that does not meet specified slump without adding water after initial mixing.
 2. For transit-mixed grout:
 - a. Addition of water is permitted at time of initial discharge to adjust consistency to a slump between 8 and 11 in.

- b. Discard transit-mixed grout that does not meet specified slump without adding water, other than as allowed in 3.7 B. 2.a above.
 - c. Transit-mixed grout may be used beyond the time limit as long as it meets the specified slump.
- C. Grout pour height: do not exceed maximum grout pour height as given in TMS 602 Table 7, or as otherwise specified.
- D. Grout pour height, unless otherwise required:
 - 1. Hollow-unit masonry:
 - a. Low-lift grouted construction per CBC 2104A.1.3.1.2.2:
 - 1) Maximum pour height is 4 feet.
 - b. High-lift grouted construction per CBC 2104A.1.3.1.2.3:
 - 1) Utilize method as approved by the enforcement agency.
 - 2) Cleanouts:
 - a) Every cell at bottom of grout pour, or
 - b) If inverted double open end bond beam units are used, at very reinforced cell at bottom of grout pour.
 - 2. Solid-unit multiwythe masonry:
 - a. Low-lift grouted construction per CBC 2104A.1.3.1.1.1.1.
 - b. High-lift grouted construction per CBC 2104A.1.3.1.1.1.2
- E. Grout space for multiwythe masonry: build vertical grout barriers of solid masonry across the grout space the entire height of the grout pour to control the flow of grout horizontally. Grout barriers shall not exceed 30 ft. apart.
- F. Grout lift height:
 - 1. Hollow-unit masonry:
 - a. Low-lift grouted construction per CBC 2104A.1.3.1.2.1:
 - 1) Grout each 4 feet of grout pour.
 - b. High-lift grouted construction per CBC 2104A.1.3.1.2.1:
 - 1) Grout full height of construction between horizontal cold joints in one operation.
 - 2. Solid-unit multiwythe masonry:
 - a. Low-lift grouted construction per CBC 2104A.1.3.1.1.1.1.
 - b. High-lift grouted construction per CBC 2104A.1.3.1.1.1.2:
 - 1) Place grout in lifts not exceeding 4 ft.
 - 2) Place successive lifts within 1 hour of preceding lifts.
- G. Grout consolidation:
 - 1. Conventional grout:
 - a. Consolidate grout pours 12 in. or less by mechanical vibration or puddling.
 - b. Consolidate grout pours exceeding 12 in. by mechanical vibration, and reconsolidate after initial water loss and settlement has occurred.
 - 2. Self-consolidating grout: consolidation or reconsolidation is not required.

- H. Grout keys are required between grout pours, or between lifts when the previous lift is permitted to set prior to placement of the subsequent lift, or grouting has stopped for more than an hour.
 - 1. Form 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.
 - 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.

3.8 FIELD QUALITY CONTROL

The Statement of Special Inspections per CBC Sections 1704A.3 should specify tests, if any, required during construction.

- A. Inspection tasks and frequency shall be performed in accordance with the Statement of Special Inspections.[Reference may also be made to Section 01 43 00 Quality Assurance and/or 01 45 00 Quality Control, or their subsections as appropriate, as included in the Project Documents.]
- B. Tests
 - 1. Unless indicated otherwise, perform one set of tests for each 5000 sq. ft. of wall area or portion thereof.

Keep cmu test and mortar and grout tests below only if the Unit Strength Method is specified in Part 1 Quality Assurance. Delete if prism testing.

- 2. Concrete Masonry Units: test per ASTM C140.
- 3. Mortar and grout tests: At beginning of work, sample mortar and grout at one-week intervals per CBC Section 2105A.2.2.1.4.
 - a. Test mortar specimens per ASTM C1586.
 - b. Test grout specimens per ASTM C1019.

Retain the following only if prism testing. If the unit strength method is specified, delete 'Prism Test' below.

- 4. Prism Test: For each type of construction indicated, construct and test three prisms per ASTM C1314.
- C. Masonry Core Test: Core and test per CBC Section 2105A.4 from locations selected by the Design Professional.
 - 1. Minimum two cores for each 5,000 square feet of masonry wall area, or portion thereof.
 - 2. If approved, infrared thermographic survey, or other nondestructive test procedure may be used in lieu of core tests.
 - 3. Core sampling and testing is not required for non-bearing non-shear masonry walls with maximum height of 12 feet above its base, constructed of hollow unit cmu.

3.9 POINTING, AND CLEANING

- A. Point and tool holes in mortar joints to produce a uniform, tight joint.

- B. During construction, minimize any mortar or grout stains on the wall. Immediately remove any staining or soiling that occurs.
 - 1. For precision or textured units, except as noted below, clean masonry by dry brushing before tooling joints.
 - 2. For burnished, glazed, or pre-finished concrete masonry units, immediately remove any green mortar smears or soiling with a damp sponge.

Always utilize the mildest method possible to clean the masonry. Note that efflorescence is common to products containing cementitious and aggregate materials, and is typical to new construction. The darker the unit color, of course, the more visible it is. Typical cleaning, however, removes it.

Also note darker colors can be more sensitive to aggressive cleaning methods. It is important to test the proposed cleaning procedure prior to its implementation.

- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry surfaces of stains, efflorescence, mortar or grout droppings, and debris. Specify preferred cleaner below and edit as necessary.
 - 1. Use appropriate masonry cleaner as tested on the sample panel and as approved by the Design Professional, strictly following manufacturer's recommendations.
 - 2. Do not use acids.
- D. At completion of masonry work, remove all scaffolding and equipment used during construction, and remove all debris, refuse, and surplus masonry material from the site.
 - 1. Comply with Construction Waste Management plan.

An application of water repellent is a critical component of the masonry wall and may be included here for emphasis, coordinated with Section 07 19 00 Water Repellents.

3.10 WATER REPELLENT APPLICATION

- A. Cleaning shall be complete and accepted by the Design Professional, and wall surfaces shall be thoroughly dry.
- B. Apply water repellent in strict accordance with Section 07 19 00 and the water repellent manufacturer's instructions.

END OF SECTION