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USACE / NAVFAC / AFCEC / NASA | **UFGS-04 20 00 (November 2015)**
Change 2 - 05/19

Preparing Activity: USACE | **Superseding**
UFGS-04 20 00 (February 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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DIVISION 04 - MASONRY

SECTION 04 20 00

UNIT MASONRY

11/15, CHG 2: 05/19

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SECTION 04 20 00

UNIT MASONRY

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NOTE: This guide specification covers the requirements for reinforced and nonreinforced masonry. This includes reinforced single wythe masonry walls, cavity walls, masonry veneer, composite walls, partition walls and other masonry wall types.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

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NOTE: This guide specification covers reinforced and unreinforced masonry and must be tailored to reflect the type of construction used in the design.

In general, reinforced masonry is defined as masonry construction which contains vertical bar reinforcement, horizontal bar or joint reinforcement, mortar, and grout combined in a manner that the component materials will act together (where masonry resists the compression and reinforcement resists the tension) to resist the design loading conditions. Design will conform to

TMS MSJC, Masonry Standard Joint Committee's (MSJC) Book.

Masonry not meeting the above definition but bonded together with mortar and containing, if necessary, the minimum amount of reinforcement for crack control and vertical stiffeners, is classified as unreinforced masonry.

Masonry design must comply with UFC 3-301-01 Structural Engineering. Following are some pertinent modifications to the 2012 ICC IBC from that UFC standard.

a. Masonry may be designed by allowable stress design or strength design, but empirical design is not permitted.

b. Masonry must be designed as reinforced unless the element is isolated from the structure so that vertical and lateral forces are not imparted to the element.

c. Coupling beams must be designed in accordance with paragraph 14.4.5.3 of ASCE 7-16.

d. Shear walls are required to be in running bond construction.

e. Below-grade masonry walls and elevator shaft masonry walls must be grouted solid.

f. Corrugated metal brick ties are not permitted.

g. Horizontal joint reinforcement is required to be continuous around corners and through wall intersections, unless the intersecting walls are separated. Splicing of joint reinforcement in accordance with TMS MSJC provides continuity.

h. Concrete masonry control joint spacing and placement are required to comply with NCMA TEK 10-2C or 10-3.

i. Clay brick masonry expansion joint spacing, placement, and size are required to comply with BIA Technical Notes 18 and 18A.

j. The lateral deflection for framing supported brick veneer is required to be limited to L/600.

k. Details for masonry veneer/steel stud wall assemblies should comply with BIA Technical Note 28B.

UFC 3-301-01 Appendix B also provides the following "best practices".

a. The base of masonry veneer should be placed on a shelf angle or a foundation ledge that is at least

100 mm 4 inches lower than the base of the steel stud wall. The width of this shelf angle or foundation ledge must accommodate the masonry veneer and cavity, and should not be less than two-thirds of the veneer thickness plus the minimum air space.

b. Shelf angles should be hot-dip galvanized structural steel members. Angles should be provided approximately 3 m 10 feet long segments, with gaps between segments. Gaps should be detailed to allow for thermal expansion and contraction of the steel in angle runs and at building corners. At building corners, corner pieces with each leg no less than 1.2 m 4 feet in length should be detailed, where possible. Limit deflection of horizontal legs of shelf angles to 1.6 mm 1/16 inch at the end of the horizontal leg. Include rotation of the shelf angle support in the deflection limit calculation.

Masonry design in DOD buildings must comply with UFC 3-301-01, Seismic design of Buildings. Following are some pertinent modifications to the 2012 ICC IBC from that UFC standard.

a. Anchors in masonry shall be designed in accordance with TMS MSJC. Additionally, at least one of the following must be satisfied.

b. Anchors shall be designed to be governed by the tensile or shear strength of a ductile steel element.

c. Anchors shall be designed for the maximum load that can be transmitted to the anchors from a ductile attachment, considering both material overstrength and strain hardening of the attachment.

d. Anchors shall be designed for the maximum load that can be transmitted to the anchors by a non-yielding attachment.

e. Anchors shall be designed for the maximum load obtained from design load combinations that include E, with E multiplied by $Omega_0$.

f. Post-installed anchors in masonry shall be prequalified for seismic applications in accordance with approved qualification procedures.

g. Reinforcement shall be continuous around wall corners and through wall intersections, unless the intersecting walls are separated. Reinforcement that is spliced in accordance with applicable provisions of TMS MSJC shall be considered continuous.

h. Only horizontal reinforcement that is continuous in the wall or element shall be included in computing the area of horizontal reinforcement. Intermediate bond beam steel properly designed at control joints shall be considered continuous.

i. Where concrete abuts structural masonry, and the joint between the materials is not designed as a separation joint, the joint shall conform to the requirements of ASCE 7-16 Section 14.4.3.1.

Masonry design shall meet the requirements of the following UFCs if applicable: UFC 3-340-01 "Design and Analysis of Hardened Structures to Resist conventional Weapons Effects; UFC 3-340-02 "Structures to Resist the Effects of Accidental Explosions"; and UFC 4-023-03 "Design of Buildings to Resist Progressive Collapse"

Show the following information on the project drawings:

1. Locations and dimensions of each type of masonry work; wall sections and anchor details.

2. Color, texture, and size of brick and color of mortar if other than natural gray.

3. Bond pattern if other than running bond.

4. All flashing locations and details.

5. Control joint and expansion joint locations and details.

6. Special brick shapes if required.

7. Compressive strength (f'm) of units, mortar, grout, or entire assembly and fy of reinforcement.

8. Reinforcement lateral tie, splice, and bond beam details.

9. Size and location of any pipes, ducts, door and window framing, or other embedded items.

10. Equivalent thickness, in accordance with ACI216.1, or UL assembly for fire rated walls.

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also

use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 216.1	(2014) Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI 318M	(2014; ERTA 2015) Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A951/A951M	(2011) Standard Specification for Steel Wire for Masonry Joint Reinforcement

ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1008/A1008M	(2020) 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
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM B370	(2012; R 2019) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C27	(1998; R 2008) Fireclay and High-Alumina Refractory Brick
ASTM C55	(2017) Standard Specification for Concrete Building Brick
ASTM C62	(2017) Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C67/C67M	(2020) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C73	(2017) Standard Specification for Calcium Silicate Brick (Sand-Lime Brick)
ASTM C90	(2016) Standard Specification for Loadbearing Concrete Masonry Units
ASTM C126	(2019) Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
ASTM C129	(2017) Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C207	(2018) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C216	(2019) Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C270	(2019) Standard Specification for Mortar for Unit Masonry
ASTM C315	(2007; R 2011) Clay Flue Linings
ASTM C476	(2020) Standard Specification for Grout

	for Masonry
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C586	(2011) Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks as Concrete Aggregates (Rock-Cylinder Method)
ASTM C616/C615M	(2011) Standard Specification for Granite Dimension Stone
ASTM C616/C616M	(2010) Standard Specification for Quartz-Based Dimension Stone
ASTM C641	(2017) Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates
ASTM C652	(2019b) Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
ASTM C744	(2016) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C780	(2020) Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C979/C979M	(2016) Standard Specification for Pigments for Integrally Colored Concrete
ASTM C1019	(2019) Standard Test Method for Sampling and Testing Grout
ASTM C1314	(2014) Standard Test Method for Compressive Strength of Masonry Prisms
ASTM C1384	(2012a) Standard Specification for Admixtures for Masonry Mortars
ASTM C1405	(2015) Standard Specification for Glazed Brick (Single Fired, Brick Units)
ASTM C1611/C1611M	(2014) Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM C1634	(2011) Standard Specification for Concrete Facing Brick
ASTM D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2287	(2019) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E514/E514M	(2014a) Standard Test Method for Water

Penetration and Leakage Through Masonry

THE MASONRY SOCIETY (TMS)

TMS MSJC (2016) Masonry Standard Joint Committee's (MSJC) Book - Building Code Requirements and Specification for Masonry Structures, Containing TMS 402/ACI 530/ASCE 5, TMS 602/ACI 530.1/ASCE 6, and Companion Commentaries

1.2 SUBMITTALS

****
NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Cut CMU Drawings; G[, [_____]]

Reinforcement Detail Drawings; G[, [_____]]

SD-03 Product Data

Hot Weather Procedures; G[, [_____]]

Cold Weather Procedures; G[, [_____]]

Clay or Shale Brick; G[, [_____]]

Glazed Structural Clay Facing Tile; G[, [_____]]

Glazed Brick; G[, [_____]]

Salvaged Brick; G[, [_____]]

Cement; G[, [_____]]

Cementitious Materials; G[, [_____]]

Insulation; G[, [_____]]

SD-04 Samples

Mock-Up Panel; G[, [_____]]

Clay or Shale Brick; G[, [_____]]

Glazed Structural Clay Facing Tile; G[, [_____]]

Glazed Brick; G[, [_____]]

Concrete Masonry Units (CMU); G[, [_____]]

Concrete Brick; G[, [_____]]

Dimension Stone Units; G[, [____]]

Admixtures for Masonry Mortar; G[, [_____]]

Anchors, Ties, and Bar Positioners; G[, [_____]]

Joint Reinforcement; G[, [_____]]

Clay Masonry Expansion-Joint Materials; G[, [____]]

Insulation; G[, [_____]]

SD-05 Design Data

Masonry Compressive Strength; G[, [_____]]

Fire-Rated Concrete Masonry Units

Bracing Calculations; G[, [_____]]

SD-06 Test Reports

Efflorescence Test

Fire-Rated Concrete Masonry Units

Field Testing of Mortar

Field Testing of Grout

Prism Tests

Single-Wythe Masonry Wall Water Penetration Test

SD-07 Certificates

Special Masonry Inspector Qualifications

Clay or Shale Brick

Glazed Structural Clay Facing Tile

Glazed Brick

Concrete Masonry Units (CMU)

Concrete Brick

Precast Concrete Units

Cementitious Materials

Admixtures for Masonry Mortar

Admixtures for Grout

Anchors, Ties, and Bar Positioners

Joint Reinforcement

Insulation

Insulation

SD-08 Manufacturer's Instructions

Admixtures for Masonry Mortar

Admixtures for Grout

SD-10 Operation and Maintenance Data

Take-Back Program

SD-11 Closeout Submittals

Recycled Content of Clay Units; S

Recycled Content of Cement; S

1.3 QUALITY ASSURANCE

1.3.1 Masonry Mock-Up Panels

****

NOTE: A sample panel is a small element of constructed masonry units, usually 1.22 m x 1.22 m 4 ft x 4 ft. A mock-up is a wall segment constructed to show all materials used in the construction as well as typical workmanship. Mock-up panels will be required for structures having over 185 square meters 2,000 square feet of exterior wall area, including openings, and for smaller structures where appearance is important. The list of items to be shown by the sample panel will be edited to provide only the representative items. Typical installation of electrical conduit and boxes may be illustrated by the sample panel when deemed appropriate.

****

1.3.1.1 Mock-Up Panel Location

After material samples are approved and prior to starting masonry work, construct a mock-up panel for each type and color of masonry required. At least 48 hours prior to constructing the panel or panels, submit written notification to the Contracting Officer. Do not build-in mock-up panels as part of the structure; locate mock-up panels where directed. Construct portable mock-up panels or locate in an area where they will not be disrupted during construction.

1.3.1.2 Mock-Up Panel Configuration

Construct mock-up panels L-shaped or otherwise configured to represent all of the wall elements. Construct panels of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. Provide a straight panel or a leg of an L-shaped panel of minimum size 2.5 m 8 feet long by [1.2] [1.8] m [4] [6] feet high.

1.3.1.3 Mock-Up Panel Composition

Show full color range, texture, and bond pattern of the masonry work. Demonstrate mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work during the construction of the panels. Also include installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weeps. Include a [a masonry bonded corner] [a stacked bond corner] [a bond beam corner] [and] [parging] [and] [installation of electrical boxes and conduit]. When the panel represents reinforced masonry, include a 610 by 610 mm 2 by 2 foot opening placed at least 610 mm 2 feet above the panel base and 610 mm 2 feet away from all free edges, corners, and control joints. Provide required reinforcing around this opening as well as at wall corners and control joints.

1.3.1.4 Mock-Up Panel Construction Method

Where anchored veneer walls or cavity walls are required, demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Demonstrate provisions to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. When water-repellent is specified to be applied to the masonry, apply the approved product to the mock-up panel. Construct panels on a properly designed concrete foundation.

1.3.1.5 Mock-Up Panel Purpose

The completed panels is used as the standard of workmanship for the type of masonry represented. Do not commence masonry work until the mock-up panel for that type of masonry construction has been completed and approved. Protect panels from the weather and construction operations until the masonry work has been completed and approved. Perform cleaning procedures on the mockup and obtain approval of the Contracting Officer prior to cleaning the building. After completion of the work, completely remove the mock-up panels, including all foundation concrete, from the construction site.

1.3.2 Special Masonry Inspector Qualifications

Refer to Section 01 45 35 SPECIAL INSPECTIONS for qualifications and responsibilities of the masonry special inspector.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, handle, and protect material to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

a. Pack glazed brick, glazed structural clay tile, and prefaced concrete masonry units in the manufacturer's standard paper cartons, trays, or shrink wrapped pallets with a divider between each unit. Do not stack pallets. Do not remove units from cartons until cartons are placed on scaffolds or in the location where units are to be laid.

b. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

1.5 PROJECT/SITE CONDITIONS

Conform to TMS MSJC for hot and cold weather masonry erection.

1.5.1 Hot Weather Procedures

When ambient air temperature exceeds 38 degrees C 100 degrees F, or exceeds 32 degrees C 90 degrees F and the wind velocity is greater than 13 km/h 8 mph, comply with TMS MSJC Article 1.8 D for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

1.5.2 Cold Weather Procedures

When ambient temperature is below 4 degrees C 40 degrees F, comply with TMS MSJC Article 1.8 C for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design - Specified Compressive Strength of Masonry

The specified compressive strength of masonry, f'm, is [_____] [as indicated for each type of masonry] [indicated in a schedule in this Specification].

2.1.2 Performance - Verify Masonry Compressive Strength

****

NOTE: The Unit Strength Method can be used for clay masonry with units conforming to ASTM C216, ASTM C62, or ASTM C652, with bed joints not exceeding 16 mm 5/8 inch, and with grout conforming to ASTM C476, where grout compressive strength is at least equal to f'm. It can also be used for concrete masonry with units conforming to ASTM C90 or ASTM C55, with bed joints and grout same as clay masonry. The Prism Test Method must be used when the Unit Strength Method, which is conservative, is insufficient to verify compliance and when the above-listed parameters are not met. The Prism Test Method may be used at any time, at the Contractor's option.

****

Verify specified compressive strength of masonry using the "Unit Strength

Method" of TMS MSJC. Submit calculations and certifications of unit and mortar strength.

Verify specified compressive strength of masonry using the "Prism Test Method" of TMS MSJC when the "Unit Strength Method" cannot be used. Submit test results.

2.2 MANUFACTURED UNITS

2.2.1 General Requirements

Do not change the source of materials, which will affect the appearance of the finished work, after the work has started except with Contracting Officer's approval. Submit test reports from an approved independent laboratory. Certify test reports on a previously tested material as the same materials as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2.2 Clay or Shale Brick

****

NOTE: The manufacturer's name and color number or color range will be indicated on the drawings along with the following note: "Colors or color ranges indicated are for identification purposes only and are not intended to limit selection of similar color or color range from other manufacturers."

Grade SW brick provides a high degree of resistance to frost action and deterioration by weathering. Grade MW brick provides a moderate degree of resistance and is only suitable for exterior use in certain parts of the country. Refer to ASTM C216.

Types FBS and HBS brick are for general use where normal size variation and chippage is acceptable. Types FBX and HBX permit less variation in size and chippage and are; therefore, more expensive. Types FBA and HBA permit larger variations for special architectural effect.

Bricks of various sizes are available and, if for architectural reasons, other sized bricks are included in the design, the size shall be specified by listing the specified (not nominal) dimensions and not by name because names can vary. If larger units are required, change the specified dimensions. Nominal dimensions should not be used as they may result in confusion with specified size.

****

2.2.2.1 General

2.2.2.1.1 Sample Submittal

Submit brick samples as specified, showing the color range and texture of clay or shale brick. Limit units used on the project to those that conform to the approved sample. Submit sample of colored mortar with

applicable masonry unit and color samples of three stretcher units and one unit for each type of special shape.

2.2.2.1.2 Uniformity

[Manufacture bricks at one time and from the same run.]Deliver clay or shale brick units factory-blended to provide a uniform appearance and color range in the completed wall.

[2.2.2.1.3 Recycled Content

****
NOTE: Use of materials with recycled content, calculated on the basis of post-industrial and post-consumer percentage content, contributes to meeting the requirements of Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. Designer must verify that products meeting the indicated minimum recycled content are available, preferably from at least three sources, to ensure adequate competition. Use this paragraph if choosing recycled content.
****

Provide clay units containing a minimum of [0] [5] [_____] percent post-consumer recycled content, and a minimum of [10] [20] [_____] percent post-industrial recycled content.

]2.2.2.1.4 Efflorescence Test

****
NOTE: Delete this paragraph in areas where efflorescence has not been a problem. Efflorescence is generally the result of poor design and detailing. Properly covered or flashed walls are generally free of efflorescence. Efflorescence testing is generally not required.
****

Test clay brick that will be exposed to weathering for efflorescence in accordance with ASTM C67/C67M. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Units meeting the definition of "effloresced" are subject to rejection.

2.2.2.2 Solid Clay or Shale Brick

****
NOTE: Specify ASTM C216 facing brick where aesthetic value is a prime consideration or to match existing construction. ASTM C216 may be replaced with ASTM C62 for projects where brick conforming to ASTM C62 provides aesthetic appearance that does not detract from the design, is generally available and predominantly used in the area, and the specific brick will blend with existing or adjacent architecture.

If larger units, such as closure size (92 mm x 92 mm x 194 mm3-5/8 inch x 3-5/8 inch x 7-5/8 inch) or

utility size (92 mm x 92 mm x 295 mm3-5/8 inch x 3-5/8 inch x 11-5/8 inch) brick, are required, change the specified dimensions. Consider the use of closure or utility size brick when it is architecturally acceptable. The cost per square foot of wall is generally less when using larger units. Use paragraph titled "Closure or Utility Brick" below.

Compressive strength of the brick units only needs to be specified when it is used structurally; a veneer wythe is nonstructural. Ccommonly available face brick are produced to much higher compressive strength than the minimum required by ASTM C216.

****

Provide solid clay or shale brick that conforms to [ASTM C216, Type [FBS] [FBA] [FBX]] [ASTM C62]. [Provide brick with minimum compressive strength of [_____] MPa psi.] Where brick cores, recesses, or deformation would be exposed to view, provide 100 percent solid units. Provide brick with texture and color tange to match the brick [on display at [_____]] [indicated].

Provide brick with specified sizes.

[a. Modular size, 92 mm 3-5/8 inches thick, 57 mm 2-1/4 inches high, and 194 mm 7-5/8 inches long.

][b. Closure size, 92 mm 3-5/8 inches thick, 92 mm 3-5/8 inches high, and 194 mm 7-5/8 inches long.

][c. Utility size, 92 mm 3-5/8 inches thick, 92 mm 3-5/8 inches high, and 295 mm 11-5/8 inches long.
]

2.2.2.3 Hollow Clay or Shale Brick

****

NOTE: For exposed exterior and interior masonry, Type HBX brick is manufactured to tighter tolerances and less chippage than Type HBS, but is also more expensive. Type HBS is for general use where greater variation is allowed. For architectural effects resulting from nonuniformity in size, use Type HBA. Use Type HBB where color and texture are not a consideration and a greater variation in size is permitted.

Commonly available hollow brick are produced to much higher compressive strength than the minimum required by ASTM C652.

****

Provide hollow clay or shale brick that conforms to ASTM C652, Type [HBS] [HBX] [HBA] [HBB].

a. Provide brick size of [_____] mm inches thick, [_____] mm inches high, and [_____] mm inches long.

b. Where vertical reinforcement is shown in hollow brick, provide hollow

brick designed to provide precise vertical alignment of the cells, with minimum cell dimension of 64 mm 2-1/2 inches.

c. Provide hollow brick with minimum compressive strength of [_____] MPa psi.

2.2.2.4 Refractory Brick

Provide brick units that comply with ASTM C27, low-duty type, [_____] mm inches thick, [_____] mm inches high, and [_____] mm inches long.

2.2.2.5 Glazed Brick and Glazed Structural Clay Facing Tile

****

NOTE: Indicate the designation of ceramic glazed brick and glazed structural clay facing tile on the project drawings, or use the schedule to indicate locations. Delete the schedule if it is not used.

ASTM C1405 applies to brick units fired with a glaze in a single process; ASTM C126 applies to brick units fired then fired again with a glaze. ASTM C126 also applies to hollow facing tiles. For both standards, specify Grade SS (select) for walls laid in stack bond; Grade S (standard) is supplied if nothing is specified. Type I indicates a single glazed face while Type II is double faced. Type I is the default.

Normally, prefaced ASTM C1634 concrete masonry units will be specified as a Contractor's option to ceramic glazed structural clay facing units. Structurally, the units will be considered as equal.

****

Provide [ceramic glazed brick] [glazed facing tile] indicated as [_____], conforming to ASTM C1405 [ASTM C126], Type I, Grade [SS] [S], glaze as indicated. In two-faced walls, Type II units may be used for the base course. Provide all shapes and sizes for a complete installation. Use bullnose units along sills and caps and at vertical external corners including door jambs, window jambs, and other such openings. Provide coved base units to meet finished floor surfaces where ceramic tile floor occurs.

a. Where backs of units will be exposed in unfinished rooms, provide smooth backs, free from glaze. Where backs of units will receive plaster, provide scored, combed, or otherwise roughened backs.

b. Provide unit surfaces, to receive mortar, reasonably free from glaze and suitable for receiving mortar.

c. Provide tile for fire rated walls with the percent of solid required for that rating.

****

NOTE: Appropriate information should be indicated. Include this schedule for information when it is not convenient to indicate on the project drawings. Select colors from manufacturer's standard colors.

****

d. Structural Clay Facing Tile Schedule

Location	Nominal Face Dimensions	Color of Field	Color of Base
[_____]	[_____]	[_____]	[_____]

2.2.2.6 Salvaged Brick

****

NOTE: Use of salvaged/recovered materials contributes to meeting the requirements of Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

Include bracketed wording if bricks will be in structures used for children or residences. Indicate on drawings locations where salvaged brick is acceptable.

****

Use [lead-free] salvaged bricks and other masonry units in place of new bricks or masonry units as indicated. [Wash bricks salvaged from foundries or industrial buildings with appropriate metal-dust removing cleaner.] When using salvaged brick, select salvaged exterior face bricks from exterior locations.

Provide salvaged bricks that meet standards of new bricks otherwise used in application, and cleaned of all mortar prior to use. Submit documentation certifying products are from salvaged/recovered sources. Indicate relative dollar value of salvaged content products to total dollar value of products included in project.

2.2.2.7 Flue Linings and Thimbles

Provide units that comply with ASTM C315, and are free from fractures. Provide sizes and shapes as indicated.

2.2.3 Concrete Units

2.2.3.1 Aggregates

****

NOTE: Where sufficient evidence based on previous construction experience indicates concrete masonry units manufactured from aggregate from a specific source may be subject to excessive popouts and/or staining, contract specifications may be written to exclude such aggregate. Delete this article when the concrete units will not be exposed to view.

****

Test lightweight aggregates, and blends of lightweight and heavier aggregates in proportions used in producing the units, for stain-producing iron compounds in accordance with ASTM C641,visual classification method. Do not incorporate aggregates for which the iron stain deposited on the filter paper exceeds the "light stain" classification.

Use industrial waste by-products (air-cooled slag, cinders, or bottom ash), ground waste glass and concrete, granulated slag, and expanded slag in aggregates.

2.2.3.2 Concrete Masonry Units (CMU)

****
NOTE: Concrete units may be produced in three weight classifications. It is important that the weight classification desired be designated.

Low alkali cement maybe specified for use in CMU if efflorescence caused by the use of available cement is a problem. However, these cements are difficult to obtain in some regions where sulfates are not an issue. Also, alkali-silica reactivity (ASR) is not as big an issue in concrete masonry units as it is in cast-in-place concrete. If efflorescence is not a problem, or if the CMU will not be exposed to weather, delete the first sentence.

Specify lightweight aggregate where required for fire-resistive or "U" value purposes. Coordinate with structural and mechanical designers. Otherwise, unit density is at the option of the contractor, including single wythe, grouted walls.

For single-wythe, concrete masonry unit exterior walls, specify water-repellant admixture for both the masonry units and the mortar.

See addition information regarding use of recycled content materials in Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.
****

[2.2.3.2.1 Cement

Use only cement that has a low alkali content and is of one brand.

]2.2.3.2.2 Recycled Content

[Provide units with a minimum of [5] [10] [_____] percent post-consumer recycled content, or a minimum of [20] [40] [_____] percent post-industrial recycled content, based on mass, cost, or volume.][Units may contain post-consumer or post-industrial recycled content.]

2.2.3.2.3 Size

Provide units with specified dimension of [_____] mm inches wide, [_____] mm inches high, and [_____] mm inches long.

2.2.3.2.4 Surfaces

[For units that are to be plastered or stuccoed, provide surfaces that are sufficiently rough to provide bond.] [[Elsewhere, provide][Provide] units with exposed surfaces that are smooth and of uniform texture.]

2.2.3.2.5 Weather Exposure

Provide concrete masonry units with water-repellant admixture added during manufacture where units will be exposed to weather.

2.2.3.2.6 Unit Types

****
NOTE: The weight of concrete masonry units is not important except as it effects porosity, the heavier the block the less porous it will be. Direct design and production of masonry units towards reducing shrinkage, porosity, and absorption. However, heavier units will effect masons' production rates as they prefer the lightest possible units to lay. Proper vibration and autoclave curing of CMU in the manufacturing process will provide better quality units. Admixture to densify units is recommended. Specify loading-bearing type masonry units in exterior walls or interior walls subject to moist environments. Only specify Non-Load-bearing Units for interior partitions.
****

a. Hollow Load-Bearing Units: ASTM C90, lightweight [or medium weight] [or normal weight]. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Hollow Non-Load-Bearing Units: ASTM C129, lightweight [or medium weight] [or normal weight]. Load-bearing units may be provided in lieu of non-load-bearing units.

c. Solid Load-Bearing Units: ASTM C90, lightweight [or medium weight] [or normal weight] units. Provide solid units as indicated.

2.2.3.2.7 Jamb Units

Provide jamb units of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved.

Provide sash jamb units with a 19 by 19 mm 3/4 by 3/4 inch groove near the center at end of each unit.

2.2.3.3 Architectural Units

****
NOTE: Where architectural units are used, local sources should be checked to determine available shapes, sizes, patterns, and colors. Desired unit pattern should be clearly indicated. Delete integral coloring if units will be painted or if natural color is satisfactory. Concrete masonry veneer wythes should be 100 percent solid units to minimize trapping water which could lead to damage from freezing, mildew, and efflorescence.
****

Provide architectural units with patterned face shell: [fluted] [vertical

scored] [split ribbed] [_____].

Provide units that are integrally colored during manufacture, with color [_____].

2.2.3.4 Patterned, Decorative Screen Units

****
NOTE: Manufacturer's catalogs will be consulted for patterned units that are locally available. Optional designs of patterned units will be shown as necessary for competitive bidding.

Concrete masonry units conforming to applicable requirements of ASTM C129 are suitable for interior nonload-bearing screens, and may be specified where required.
****

Provide patterned, decorative screen units that conform to [ASTM C90] [ASTM C129]. Provide units that have uniform through-the-wall pattern, color, and texture.

2.2.3.5 Fire-Rated Concrete Masonry Units

****
NOTE: The thickness of fire-rated walls as well as the required fire rating will be indicated on the drawings. Such walls will be shown as continuous from floor to deck above. Sections and details of these walls will clearly indicate the extent of such walls. Solid grouted hollow concrete units and concrete brick masonry 150 mm 6 inches or greater in thickness will be considered a 4-hour fire-rated wall regardless of aggregate type.
****

For indicated fire-rated construction, provide concrete masonry units of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated by linear interpolation based on the percent by dry-rodded volume of each aggregate used in manufacturing the units.

TABLE I
FIRE-RATED CONCRETE MASONRY UNITS

Aggregate Type	Minimum Equivalent Thickness for Fire-Resistance Rating, mm inch						
	1/2 hour	3/4 hour	1 hour	1-1/2 hour	2 hours	3 hours	4 hours
Calcareous or siliceous gravel (other than limestone)	50.82.0	70.02.4	71.12.8	91.43.6	106.74.2	134.65.3	157.5 6.2

TABLE I FIRE-RATED CONCRETE MASONRY UNITS							
Aggregate Type	Minimum Equivalent Thickness for Fire-Resistance Rating, mm inch						
Limestone, cinders, or air-cooled slag	48.31.9	58.42.3	68.62.7	86.43.4	101.64.0	1275.0	149.9 5.9
Expanded clay, expanded shale, or expanded slate	45.71.8	55.92.2	66.02.6	83.83.3	91.43.6	111.84.4	129.5 5.1
Expanded slag or pumice	38.11.5	48.31.9	53.32.1	68.62.7	81.33.2	101.64.0	119.4 4.7

Determine equivalent thickness in accordance with ACI 216.1. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; include the thickness of plaster or brick or other material in the assembly in determining the equivalent thickness. Submit calculation results.

2.2.3.6 Prefaced Concrete Masonry Units

****

NOTE: Bullnose units will be specified only in cases where sharp corners are considered objectionable, such as in heavy traffic areas. If bullnose units are specified, the locations of use will be detailed on the drawings and/or listed in this paragraph.

****

Prefaced concrete masonry units [may] [may not] be provided in lieu of ceramic glazed structural clay facing tile units. Where prefaced concrete masonry units are provided, concrete masonry unit backing may be omitted when the nominal thickness of the prefaced concrete masonry units is the same as the total indicated nominal thickness of the facing tile plus the backing.

a. Provide prefaced concrete masonry units conforming to ASTM C744 using masonry units conforming to ASTM C90, with the facing turned over the edges and ends of the unit at least 9.5 mm 3/8 inch in the direction of the thickness of the unit to form a lip at least 1.6 mm 1/16 inch thick. Limit variation in color and texture to that in the approved sample.

b. Provide all shapes and sized for a complete installation. Use bullnose units along sills and caps and at vertical external corners including door jambs, window jambs, and other such openings with a bullnose radius of 25 mm 1 inch. Cove base units to meet finished floor surfaces where ceramic tile floor occurs.

2.2.3.7 Concrete Brick

****

NOTE: ASTM C1634 concrete brick are used for high strength and resistance to moisture penetration.

Split face brick (solid concrete facing units), where required by design, should be added to this paragraph. A particular color and texture may be specified when locally available and competitively priced. Sizes may be specified for brick or split face brick where required by the design.

ASTM C55 concrete brick are used for lesser strength and moisture resistance, and where appearance is of low importance.

ASTM C73 sand-lime brick may be used on the interior or exterior. Where limited to interior use, Grade MSW may be specified as an option to Grade SW.

****

2.2.3.7.1 Common Concrete Brick

Provide common concrete brick conforming to ASTM C55. Common concrete brick may be used where necessary for filling out in concrete masonry unit construction.

2.2.3.7.2 Concrete Brick for Facing

Provide concrete brick for exposed applications that conforms to ASTM C1634. Submit samples as specified.

2.2.3.7.3 Sand-Lime Brick

Provide calcium-silicate (sand-lime) that conforms to ASTM C73, Grade SW, approximately 92 mm thick, 57 mm high, 194 mm long 3-5/8 inches thick, 2-1/4 inches high, and 8 inches long or modular, with smooth surfaces and natural color.

2.2.4 Precast Concrete Units

****

NOTE: Architectural Cast Stone is a refined architectural concrete building unit manufactured to simulate natural cut stone and may be specified in lieu of precast concrete. It exceeds minimum requirements for compressive strength and weathering qualities essential for common installations and may be a suitable replacement for natural cut limestone, brownstone, sandstone, bluestone, granite, slate, keystone, travertine, and other natural building stones. When specified for use in climates that experience freeze-thaw, its durability can be demonstrated by field performance of similar products in similar exposures for many years, or it can be tested by a modified version of ASTM C666, Procedure A, per Cast Stone Institute literature. Cast stone masonry products may be used as architectural feature, trim, and ornament, facing or other non-structural use in buildings and other structures.

****

2.2.4.1 General

a. Provide precast concrete trim, lintels, copings, splashblocks and sills that are factory-made units in a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, provide precast concrete with minimum [28] [20] MPa [4,000] [3000] psi compressive strength, conforming to Section 03 30 00 CAST-IN-PLACE CONCRETE using 13 mm 1/2 inch to No. 4 nominal-size coarse aggregate, and with reinforcement required for handling of the units. Maintain minimum clearance of 19 mm 3/4 inch between reinforcement and faces of units.

b. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 827 kPa 120 psi for at least 5 hours, either damp-cure for 24 hours or steam-cure and then age under cover for 28 days or longer. In precast concrete members weighing over 35 kg 80 pounds provide built-in loops of galvanized wire or other approved provisions for lifting and anchoring.

c. Fabricate units with beds and joints at right angles to the face, with sharp true arises and with drip grooves on the underside where units overhang walls. Form exposed-to-view surfaces free of surface voids, spalls, cracks, and chipped or broken edges and with uniform appearance and color. Unless otherwise specified, provide units with a smooth dense finish.

d. Prior to installation, wet and inspect each unit for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

e. Submit specified factory certificates.[

f. Provide architectural cast stone masonry trim, copings, heads, and sills that are manufactured in a plant by a producer regularly engaged in producing cast stone. Provide cast stone units that comply with ASTM C1364. Submit test reports and three exemplars of the same cast stone product installed in similar projects in similar climatic conditions.]

2.2.4.2 Precast Concrete Lintels

****

NOTE: Insert strength of concrete; precast lintels usually range from 17 to 25 MPa 2500 to 3500 psi. Alternatively, reinforced masonry lintels may be designed in conformance with TMS MSJC.

****

Provide precast concrete lintels, unless otherwise shown, of a thickness equal to the wall and reinforced with minimum two No. 4 bars for the full length. Provide top and bottom bars for lintels over 914 mm 36 inches in length. Provide at least 200 mm 8 inches bearing at each end. Label the top of lintels and clearly mark each lintel to show location in the structure. Design reinforced lintels in conformance with ACI 318M ACI 318 for flexural and shear strength, using concrete with a minimum 28 day compressive strength of [_____] MPa psi. Limit lintel deflection due to dead plus live load to L/600 or 7.6 mm 0.3 inches.

2.2.4.3 Precast Concrete Sills and Copings

****
NOTE: Lug sills, which are longer than the window opening, eliminate the vulnerable head joint that occurs at the end of slip sills, which are the same length as the window opening.
****

Cast sills and copings washes. For windows having mullions, cast sills in sections with head joints at mullions and a 6 mm 1/4 inch allowance for mortar joints. Roughen the ends of sills, except a 19 mm 3/4 inch wide margin at exposed surfaces, for bond. Provide rounded nosings on treads of door sills. [Reinforce sills with not less than two No. 15 No. 4 bars.]

2.2.5 DIMENSION STONE UNITS

****
NOTE: The stone specified herein is for structures requiring a limited quantity of cut stone. Where previous experience indicates difficulty in obtaining precast concrete trim of the specified quality, stone may be specified as a Contractor's option.
****

Provide dimension stone for trim, sills, lintels, and copings cut to the design shown and conforming to:

Limestone	ASTM C586	Standard buff color with a smooth machine finish free from tool marks
Sandstone	ASTM C616/C616M	Standard grade, buff, gray, or buff brown, with a smooth finish free from clay pits and tool marks
Granite	ASTM C616/C615M	Commercial grade of medium or moderately coarse grain, with a light or medium gray or light pink color

Provide a smooth machine finish on washes, 4-cut finish on treads, and 6-cut or equivalent machine finish on other exposed surfaces. Except when supported by a steel member, provide lintels 100 mm 4 inches or more in thickness from face to back edge and of the depth required to support the masonry over the opening. Fabricate stone with beds and joints at right angles to the face, and with sharp, true arises. Provide copings and sills with washes, and where overhanging the walls, with drips cut on the underside. Submit samples as specified.

2.3 EQUIPMENT

****
NOTE: The requirement for spare vibrator may be deleted on small projects.
****

2.3.1 Vibrators

Maintain at least one spare vibrator on site at all times.

2.3.2 Grout Pumps

Pumping through aluminum tubes is not permitted.

2.4 MATERIALS

2.4.1 Mortar Materials

****

NOTE: Refer to ASTM C270 for specifying mortar, which allows mortar to be specified by proportions (ASTM C270 Table 1) or properties (ASTM C270 Table 2) but not both. Acceptable cementitious materials are listed in the standard, though not all are appropriate for all applications. For instance, some cements are used for high early strength or for sulfate resistance. See Table Hydraulic Cements for Masonry Mortar below for comparable designations between different cement specifications. Also, ASTM C270 Appendix X1 contains guidance on selection and use of mortar for unit masonry by location (exterior, interior, above grade, below grade) and building segment type (wall, partition, foundation, etc.).

Mortar that complies with ASTM C1714 for Unit Masonry, meets the requirements of ASTM C270. These mortars are preblended dry in a factory and delivered to the job-site in packages (bags or silos or trucks).

A good rule of thumb is to specify the weakest mortar that will perform adequately, not the strongest. In accordance with TMS MSJC, mortar in masonry elements that are part of the seismic force-resisting system in Seismic Design Category D or higher must be Type S or Type M, and must use portland cement/lime or mortar cement as their cementitious material (masonry cement is not permitted). Therefore, these masonry members must be indicated on the Drawings. Type O mortar should not be used in new construction.

Laboratory testing of mortar is only required for acceptance of mortar mixes under the property specifications of ASTM C270. Field testing of mortars, conducted under ASTM C780, is used to verify consistency of materials and procedures, not mortar strength. While field testing of mortar strength is not recommended, it can provide information about degree of quality control exercised during mortar production at the construction site if compared to preconstruction test values. However, compressive test results for mortar are evaluated after 28 days, so

mortar-aggregate ratio testing per ASTM C780, which can take as little as four hours, may be more useful for evaluating mortar consistency. Observation of mortar mixing, to verify proper proportioning, is the best evaluator of mortar consistency and quality.

For white mortar, specify white cement. For colored mortar, white cement or gray cement may be specified, depending on the desired color. Color is achieved by adding pigments at the time of mixing or by selecting preblended colored cementitious materials or preblended colored mortar materials. Excessive use of pigments to achieve mortar color may reduce both compressive and tensile strengths of masonry. Conformance to maximum percentages indicated will limit loss of strength to acceptable amounts. Due to their fine particle size, coloring pigments increase water demand.

Where efflorescence is a concern, techniques for minimizing its occurrence are described in ASTM C1400. Techniques include: minimizing water penetration into the wall, such as by use of overhangs; facilitating drainage of water in the wall; avoiding contact between dissimilar masonry units; and minimizing potential efflorescence compounds in the wall materials.

****

2.4.1.1 Cementitious Materials

****

NOTE: See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING and include additive options unless designer determines that justification for non-use exists. Supplementary cementitious materials are often included as ingredients in mortar that conforms to ASTM C595 blended cements or ASTM C1157 hydraulic cements. See "Hydraulic Cements for Masonry Mortar" table below for different ASTM C150, C595, and C1157 cements that are allowed in masonry mortar by ASTM C270. For example, high-early strength cement may be used when constructing in cold weather. Contractors select cementitious materials based on performance, availability, and familiarity, and the Contracting Officer should be aware that more than one cement designation can satisfy the same need, such as high early strength.

Hydraulic Cements for Masonry Mortar			
	Cement Specification+		
	ASTM C150 portland cements	ASTM C595 blended hydraulic cements*	ASTM C595 blended hydraulic cements*
General Purpose	I	IL IS(<70) IP IT(S<70)	GU
Moderate heat of hydration	II(MH)	IL(MH) IS(<70)(MH) IP(MH) IT(S<70)(MH)	MH
High early strength	III	-	HE
Low heat of hydration	IV	IL(LH) IS(<70)(LH) IP(LH) IT(S<70)(LH)	LH
Moderate sulfate resistance	II, II(MH)	IS(<70)(MS) IP(MS) IT(S<70)(MS)**	MS
High sulfate resistance	V	IS(<70)(HS) IP(HS) IT(S<70)(HS)**	HS
*Type IT(S<70) cements are ternary blended cements with less than 70 percent by mass slag cement content. For this table, this includes ternary blended cements with pozzolans and limestone (no slag cement) as the non-portland ingredients.			
**Type IT cements with between 5 and 15 percent (by mass) limestone content are not permitted to be used in sulfate exposure applications, pending results of research.			
+Air-entrained counterparts for cements listed are also allowed in masonry mortar per the proportioning requirements of ASTM C270.			

****

Provide cementitious materials that conform to those permitted by ASTM C270.

2.4.1.2 Hydrated Lime and Alternates

****

NOTE: Higher lime content increases workability and water retentivity. Allowable lime materials include ASTM C207 hydrated lime and ASTM C5 quicklime.

****

Provide lime that conforms to one of the materials permitted by ASTM C207 for use in combination with portland cement, hydraulic cement, and blended hydraulic cement. Do not use lime in combination with masonry cement or

mortar cement.

2.4.1.3 Colored Mortar

****

NOTE: Indicate on the drawings locations of colored mortar. Maximum allowable pigment dosages are based on ASTM C270 Appendix X1 and TMS MSJC Article 2.6 A.2. When pigments that comply with ASTM C979 are used at maximum permitted dosage, 28-day strength of colored mortar is not less than 90 percent of the control mix and water-cementitious materials ratio is no more than 110 percent of the control mix.

****

Use mortar pigment that conforms to ASTM C979/C979M. Add pigment to mortar to produce a uniform color matching [_____]. Furnish pigments in accurately pre-measured and packaged units that can be added to a measured amount of cementitious materials or supply pigments via preblended cementitious materials or dry mortar mix.

a. In masonry cement or mortar cement, do not exceed [5][_____] percent of cement weight for mineral oxide pigment; do not exceed [1][_____] percent of cement weight for carbon black pigment.

b. In cement-lime mortar mix, do not exceed [10][_____] percent of cementitious materials' weight for mineral oxide pigment; do not exceed [2][_____] percent of cementitious materials' weight for carbon black pigment.

2.4.1.4 Admixtures for Masonry Mortar

****

NOTE: Admixtures can improve performance of mortar and are specified for beneficial purposes, but potential negative side effects include an increased risk of efflorescence, reduced strength of mortar, and corrosion of embedded steel items. Admixtures that comply with ASTM C1384 have limited negative side effects and meet the minimum requirements for improvement in performance of the desired attribute, such as rate of set, water-repellency, or bond.

Showers, kitchens, and single-wythe concrete masonry unit exterior walls should be built with concrete block containing integral water-repellent admixture. When water repellents are used in concrete masonry, the mortar should contain a compatible water-repellent admixture. A complementary material from the same manufacturer and of the same brand is designed to be compatible with the block admixture.

****

In cold weather, use a non-chloride based accelerating admixture that conforms to ASTM C1384, unless Type III portland cement is used in the mortar.

In showers and kitchens, use mortar that contains a water-repellent admixture that conforms to ASTM C1384. Provide a water-repellent

admixture, conforming to ASTM C1384 and of the same brand and manufacturer as the block's integral water-repellent, in the mortar used to place concrete masonry units that have an integral water-repellent admixture.

2.4.1.5 Aggregate and Water

Provide aggregate (sand) and water that conform to materials permitted by ASTM C270.

2.4.2 Grout and Ready-Mix Grout Materials

****

NOTE: Acceptable cements for masonry grout are listed in ASTM C476 and are summarized in Table "Hydraulic Cements for Masonry Grout Construction in ASTM C476" below. Check the local availability of specific cements as all cements are not available everywhere. Per ASTM C476, other acceptable cementitious materials for masonry grout are fly ash and slag and small quantities of lime. Note that masonry cement and mortar cement are not permitted to be used in grout. When high-early strength cement, such as Type III Portland cement, is used for cold weather construction, the protection period for grouted masonry may be reduced.

Hydraulic Cements for Masonry Grout Construction in ASTM C476				
Cement specification*	General Purpose	High early strength	Moderate sulfate resistance	High sulfate resistance
ASTM C150 portland cements	I	III	II	-
ASTM C595 blended hydraulic cements**	IS(<70) IP	-	IS(<70)(MS)	-
ASTM C1157 hydraulic cements	GU	HE	MS	HS
* Air-entrained counterparts for these cements listed are also allowed in masonry grout. However, use of air-entrainment is not recommended when the grout will be used to bond reinforcement to the masonry units.				
**				

****

2.4.2.1 Cementitious Materials for Grout

Provide cementitious materials that conform to those permitted by ASTM C476.

2.4.2.2 Admixtures for Grout

****

NOTE: Admixtures, including air entrainment, may

contribute to efflorescence and may adversely affect the strength of the mix or the protection of embedded steel items. Admixtures that comply with C494/C494M Type F or G water reducing admixtures and viscosity-modifying admixtures are permitted, but others, such as integral waterproofing compounds, accelerators, and others, require approval from purchaser.

When concrete masonry and clay brick units are highly absorbent, a grouting aid admixture may be desirable to reduce early water loss, promote bonding, and produce slight expansion to help ensure complete filling of cavities.

****

Water-reducing admixtures that conform to ASTM C494/C494M Type F or G and viscosity-modifying admixtures that conform to ASTM C494/C494M Type S are permitted for use in grout. Other admixtures require approval by the Contracting Officer.

In cold weather, a non-chloride based accelerating admixture may be used subject to approval by the Contracting Officer; use accelerating admixture that is non-corrosive and conforms to ASTM C494/C494M, Type C.

2.4.2.3 Aggregate and Water

Provide fine and coarse aggregates and water that conform to materials permitted by ASTM C476.

2.5 MORTAR AND GROUT MIXES

****

NOTE: Some preblended mortars may require special mixing procedures. If so, follow manufacturers published recommendations.

Indicate seismic force-resisting masonry elements on the Drawings.

****

2.5.1 Mortar Mix

a. Provide mortar Type [N] [S] [M] unless specified otherwise herein. [Do not use masonry cement in the mortar.] [Do not use air-entrainment in the mortar.]

b. Use ASTM C270 Type [S] [M] cement-lime mortar or mortar cement mortar for seismic-force-resisting elements indicated.[

c. Provide mortar that conforms to ASTM C270. Use Type [M] [S] [N] mortar [for foundation walls] [, basement walls,] [and in piers].][

d. Provide Type N or S mortar for non-load-bearing, non-shear-wall interior masonry.][

e. Provide approved commercial fire clay mortar or refractory cement (calcium-aluminate) mortar for fire brick and flue liners.]

[c][d][e][f]. For field-batched mortar, measure component materials by volume. Use measuring boxes for materials that do not come in packages, such as sand, for consistent batching. Mix cementitious materials and aggregates between 3 and 5 minutes in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Do not hand mix mortar unless approved by the Contracting Officer. Maintain workability of mortar by remixing or retempering. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours after initial mixing.

[d][e][f][g]. For preblended mortar, follow manufacturer's mixing instructions.

2.5.2 Grout and Ready Mix Grout Mix

****

NOTE: Grout strength must be at least as great as the specified compressive strength of masonry (f'm) but not less than 14 MPa 2000 psi at 28 days. Revise specification when grout compressive strength is required to be in excess of 14 MPa 2000 psi.

Choice of fine or coarse grout depends on width of grout space and pour height; tabulated limitation can be found in TMS MSJC. The Contractor usually has the option to select grout type, but under special circumstances, the Engineer-of-Record may want to define grout type.

****

Use grout that conforms to ASTM C476, [fine] [coarse]. Use conventional grout with a slump between 203 and [279] mm 8 and [11] inches. Use self-consolidating grout with slump flow of 610 to 762 mm 24 to 30 inches and a visual stability index (VSI) not greater than 1. Provide minimum grout strength of [14][_____] MPa [2000][_____] psi in 28 days, as tested in accordance with ASTM C1019. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that grout meets the specified requirements. Use ready-mixed grout that conforms to ASTM C476.

2.6 ACCESSORIES

2.6.1 Grout Barriers

Grout barriers for vertical cores that consist of fine mesh wire, fiberglass, or expanded metal.

2.6.2 Anchors, Ties, and Bar Positioners

****

NOTE: By definition, ties are connections between masonry wythes, anchors connect masonry to the structure and connect veneer to its backing, and fasteners are for attachment of non-masonry items to masonry. The anchors and ties specified in this paragraph are primarily used to laterally tie masonry veneer to backup elements. Anchors and ties not incorporated in the design should be deleted. If special anchors or ties are required by the

design, they will be specified to meet the necessary requirements. Standard anchors and ties can be used in cavities up to 114 mm 4.5 inches wide.

The required minimum zinc coating thicknesses for wire ties, anchors, and joint reinforcement are shown in the following table and are based on exposure:

Exposure	Finish	Wt. of Coating in Gram Per Sq. Meter Oz. Per Sq. Foot
Joint reinforcement, interior walls	ASTM A641/A641M	31 0.1
Wire ties or anchors	ASTM A53/A153M	458 1.50
Steel plates and bars	ASTM A153/A153M Class B or ASTM A123/A123M as applicable to size and form	
Joint reinforcement in exterior walls or interior walls exposed to moist environments (e.g. natatoria and food processing)	ASTM A153/A153M	458 1.50
Sheet metal ties or anchors in masonry exposed to weather	ASTM A153/A153M Class B	458 1.50
Sheet metal ties or anchors	ASTM A653/A653M (Class G60)	180 .60

****

2.6.2.1 General

a. Fabricate anchors and ties without drips or crimps. Size anchors and ties to provide a minimum of 16 mm 5/8 inch mortar cover from each face of masonry.

b. Fabricate steel wire anchors and ties shall from wire conforming to ASTM A1064/A1064M and hot-dip galvanize in accordance with ASTM A153/A153M.

c. Fabricate joint reinforcement in conformance with ASTM A951/A951M. Hot dip galvanize joint reinforcement in exterior walls and in interior walls exposed to moist environment in conformance with ASTM A153/A153M. Galvanize joint reinforcement in other interior walls in conformance with ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below.

d. Fabricate sheet metal anchors and ties in conformance with ASTM A1008/A1008M. Hot dip galvanize sheet metal anchors and ties in exterior walls and in interior walls exposed to moist environment in compliance with ASTM A153/A153M Class B. Galvanize sheet metal anchors and ties in other interior walls in compliance with ASTM A653/A653M, Coating Designation G60.

e. Submit two anchors, ties and bar positioners of each type used, as samples.

2.6.2.2 Wire Mesh Anchors

****

NOTE: Wire mesh anchors will only be used to connect interior non-bearing walls to other intersecting interior non-bearing masonry walls.

****

Provide wire mesh anchors of 6 mm 1/4 inch mesh galvanized hardware cloth, conforming to ASTM A185/A185M, with length not less than 305 mm 12 inches, at intersections of interior non-bearing masonry walls.

2.6.2.3 Wall Ties for Multi-Wythe Masonry Construction

****

NOTE: Wall ties will be specified to provide an option to the typically used continuous joint reinforcement to anchor the outer wythe to the inner wythe of multiple wythe masonry construction. Vertical spacing will normally be 400 mm 16 inches on center and horizontal spacing of the unit ties will normally be 600 mm 24 inches on center.

Rectangular ties may be used with either solid or hollow units. The maximum wall area per rectangular tie of wire size MW11 W1.7 is 0.25 m2 2-2/3 ft2; when the wire size is MW18 W2.8 the maximum wall area per tie is 0.42 m2 4.5 ft2. There are additional requirements for wall ties based on how the masonry is designed (veneer or engineered non-composite), spacing, and seismic design category of buildings with veneer.

Adjustable wall ties are normally used when constructing one wythe independent of the other. The preferred method of construction, however, is to bring the wythes up together. Delete the sentences pertaining to adjustable ties when they are not

permitted.
****

Provide rectangular-shaped wall ties, fabricated of hot-dipped galvanized [MW11W1.7][MW18W2.8] diameter steel wire. Provide rectangular wall ties no less than 100 mm 4 inches wide.

Provide adjustable type wall ties, if approved for use, that consist of two essentially U-shaped elements fabricated of minimum MW18 W2.8 diameter steel wire or pintle type ties that are inserted to eyes of horizontal joint reinforcement, hot-dip galvanized. Provide adjustable ties with double pintle legs and allows a maximum offset of 32 mm 1-1/4 inch between each element of the tie and maximum distance between connecting parts no more than 2 mm 1/16 inch. Form the pintle and eye elements shall be formed so that both can be in the same plane. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT.

2.6.2.4 Dovetail Anchors

Provide dovetail anchors of 5 mm 3/16 inch diameter steel wire, triangular shaped, and attached to a 12 gauge 12 gauge or heavier steel dovetail section. Use these anchors to connect the exterior masonry wythe as it passes over the face of concrete columns, beams, or walls. Fill cells immediately above and below these anchors unless solid units are used. Furnish dovetail slots, which are specified to be installed by others, in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.6.2.5 Adjustable Anchors

****
NOTE: Adjustable anchors will be used to anchor masonry to structural steel columns or beams. Such anchors will be either be detailed on the drawings, or the capacity requirements will be given in the specification and the contractor will be required to submit test data to verify compliance. Select the appropriate option.

Adjustable anchors may also be used to connect veneer to its backing. Adjustable anchors are required when the backing for the veneer is steel stud framing or concrete.
****

2.6.2.5.1 Anchorage to Structural Steel

Provide [hot-dip galvanized] [stainless steel] adjustable anchors for connecting masonry walls to the structural steel frame [as detailed on the drawings] [that have [_____] kg pounds capacity in both tension and compression for the span indicated when placed at [_____] mm inches on center; submit test data to verify compliance]. [Provide zinc-rich paint for touching up paint after welding galvanized anchors to structural steel.]

2.6.2.5.2 Anchorage of Veneer to Light Gauge Steel or Concrete Backing

Use one of the following types of adjustable anchors to connect veneer to light gauge steel or concrete backing:

a. sheet metal at least 22 mm 7/8 inch wide, 1.5 mm 0.06 inch thick, and with corrugations having a wavelength of 7.6 to 12.7 mm 0.3 to 0.5 inch and an amplitude of 1.5 to 2.5 mm 0.06 to 0.10 inch or bent, notched or punched to provide equivalent performance;

b. wire anchors of minimum size MW11 W1.7 with ends bent to form a minimum 50 mm 2 inches extension and without drips;

c. or wire pintle anchors used in conjunction with joint reinforcement.

Do not exceed 1.6 mm 1/16 inch clearance between connecting parts of the tie. Assemble adjustable anchors to prevent disengagement. Provide pintle anchors with one or more pintle legs of wire size MW18 W2.8 and an offset not exceeding 32 mm 1-1/4 inch.

2.6.2.6 Veneer Anchor Screws

****
NOTE: This paragraph should be edited to reflect the design option selected.
****

Provide screws for attachment of veneer anchors to cold-formed steel framing members of size [No. 12] [as indicated] [as required by design to provide the needed pullout load capacity but not less than No. 12]. Provide length of screws such that the screws penetrate the holding member by not less than 16 mm 5/8 inch.

2.6.2.7 Bar Positioners

Factory-fabricate bar positioners, used to prevent displacement of reinforcing bars during the course of construction, from 9 gauge steel wire or equivalent, and hot-dip galvanized. Bar positioners must be suitable for intended use and be corrosion resistant steel. Bar positioners not fully contained within the wythe must be hot-dip galvanized.

2.6.3 Joint Reinforcement

****
NOTE: Location of horizontal joint reinforcement should be shown on the drawings. Reinforcement will have one longitudinal wire in each mortar bed. Truss-type joint reinforcement will not be used. Adjustable joint reinforcement assemblies may be used in certain types of construction where it is feasible to construct one wythe independent of the other. If the type of design does not permit this type of construction, delete the sentences pertaining to adjustable joint reinforcement assemblies.

Various combinations of wire sizes are available and are usually designated as follows:

	Long. wires	Cross wires
Standard	**3.8 mm9 gauge (0.1483 inch)**	**3.8 mm9 gauge (0.1483 inch)**
Heavy Duty	**4.8 mm3/16 inch (0.1875 inch)**	**3.8 mm9 gauge (0.1483 inch)**
Extra Heavy Duty	**4.8 mm3/16 inch (0.1875 inch)**	**4.8 mm3/16 inch (0.1875 inch)**

****

Factory fabricate joint reinforcement in conformance with ASTM A951/A951M, welded construction. Provide ladder type joint reinforcement, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units and with all wires a minimum of [9][_____] gauge. Size joint reinforcement to provide a minimum of 16 mm 5/8 inch cover from each face. Space crosswires not more than 400 mm 16 inches. Provide joint reinforcement for straight runs in flat sections not less than 3 m 10 feet long. Provide joint reinforcement with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.6.4 Reinforcing Steel Bars

****

NOTE: ASTM A615/615M is typically used. Only use weldable bars if welding is unavoidable.

****

Reinforcing steel bars and rods shall conform to ASTM A615/A615M or ASTM A996/A996M, Grade 60.

2.6.5 Concrete Masonry Control Joint Keys

****

NOTE: Control joint keys are generally not required vertically when the concrete masonry spans vertically and no shear transfer is required across control joints. Delete paragraph when not required. Control joints will be detailed on the drawings. When control joint keys are not required by design, such as at reinforced bond beams, the control joint detail will show the head joint completely filled with mortar for the width of the wythe; but joints will be flush, raked, or raked and sealed as required.

****

Provide control joint keys of a factory fabricated solid section of

natural or synthetic rubber (or combination thereof) conforming to ASTM D2000 M2AA-805 with a minimum durometer hardness of 80 or polyvinyl chloride conforming to ASTM D2287 Type PVC 654-4 with a minimum durometer hardness of 85. Form the control joint key with a solid shear section not less than 16 mm 5/8 inch thick and 10 mm 3/8 inch thick flanges, with a tolerance of plus or minus 1.5 mm 1/16 inch, to fit neatly, but without forcing, in masonry unit jamb sash grooves.

2.6.6 Clay Masonry Expansion-Joint Materials

****
NOTE: Using interior low-VOC products contributes to meeting the requirements of Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.
****

Provide backer rod and sealant, adequate to accommodate joint compression and extension equal to 50 percent of the width of the joint. Provide the backer rod of compressible rod stock of closed cell polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Provide sealant in conformance with Section 07 92 00 JOINT SEALANTS[with a maximum volatile organic compound (VOC) content of 600 grams/liter].

Submit one piece of each type of material used.

2.6.7 Through Wall Flashing and Weeps

****
NOTE: Require flashing in exterior masonry walls, including single-wythe construction, at all obstructions such as bond beams, sills, lintels, shelf angles, and concrete tie beams. The wall design and detailing must conform to National Concrete Masonry Association (NCMA) publications: TEK 19-2B, "Design for Dry Single-Wythe Concrete Masonry Walls"; TEK 19-4A, "Flashing Strategies for Concrete Masonry Walls"; TEK 19-5A, "Flashing Details for Concrete Masonry Walls"; TEK 10-2C, "Control Joints for Concrete Masonry Walls"; and BIA Technical Notes 7 Water Penetration, Resistance. Show locations and details on project drawings. This is a regional requirement which shall be used, when applicable, for NAVFAC SE projects; when appropriate, the requirements may be used for projects in other areas.

Copper may stain masonry and deteriorate in high chloride environments. Deformed copper may be specified only when mortar must bond to the flashing, such as under copings without dowels.

Through wall flashing of single wythe walls is not appropriate for all applications. Omit this section when design requires seismic shear resistance of the masonry wall.
****

2.6.7.1 General

Provide coated copper, copper or stainless steel sheet, self-adhesive rubberized sheet, or reinforced membrane sheet flashing [except that flashing indicated to terminate in reglets shall be metal or coated-metal flashing] [and] [except that the material shall be one which is not adversely affected by dampproofing material.]

2.6.7.2 Coated-Copper Flashing

Provide 0.2 kg 7 ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, asphalt impregnated kraft paper or polyethylene sheets.

2.6.7.3 Copper or Stainless Steel Flashing

Provide copper sheet, complying with ASTM B370, minimum 450 kg 16 ounce weight; or stainless steel, ASTM A167, Type 304 or 316, 0.4 mm 0.015 inch thick, No. 2D finish. [Where indicated, provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions, where deformations consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.]

[2.6.7.4 Reinforced Membrane Flashing

Provide polyester film core with a reinforcing fiberglass scrim bonded to one side. Provide membrane that is impervious to moisture, flexible, is not affected by caustic alkalis, and after being exposed for not less than 1/2 hour to a temperature of 0 degrees C 32 degrees F, shows no cracking when, at that temperature, it is bent 180 degrees over a 2 mm 1/16 inch diameter mandrel and then bent at the same point over the same size mandrel in the opposite direction 360 degrees.

]2.6.7.5 Rubberized Flashing

Provide self-adhesive rubberized asphalt sheet flashing consisting of 0.8 mm 32-mil thick pliable and highly adhesive rubberized asphalt compound bonded completely and integrally to 0.2 8-mil thick, high density, cross-laminated polyethylene film to produce an overall thickness of 1 mm 40 mils. Provide rubberized, asphalt-based mastic and surface conditioner that are each approved by flashing manufacturer for use with flashing material.

2.6.7.6 Weep Ventilators

Provide weep ventilators that are prefabricated from stainless steel or plastic. Provide inserts with grill or louver-type openings designed to allow the passage of moisture from cavities and to prevent the entrance of insects, and with a rectangular closure strip to prevent mortar droppings from clogging the opening. Provide ventilators with compressible flanges to fit in a standard 10 mm 3/8 inch wide mortar joint and with height equal to the nominal height of the unit.

2.6.7.7 Single-Wythe Exterior Wall CMU Flashing System

In single-wythe exterior CMU walls, provide a system of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. For exterior CMU walls, provide a flashing/weep system in open cores that do not receive grout. Cell flashing pans are to have

integral weep spouts built into mortar bed joints that extend into the cell to prevent clogging with mortar.

2.6.7.8 Metal Drip Edge

Provide stainless steel drip edge, 0.4 mm 15-mil thick, hemmed edges, with down-turned drip at the outside edge and upturned dam at the inside edge for use with membrane flashings.

2.6.8 RIGID BOARD-TYPE INSULATION

****

NOTE: Insert the appropriate thickness and R-Value to be used for the insulation. The total R-value for the insulation and the total thickness of the insulation must be coordinated to fit the space provided within the wall cavity. The thickness of the insulation must allow for not less than 19 mm 3/4 inch air space between the insulation and the facing veneer. This will limit the insulation thickness to 50 mm 2 inches in a 70 mm 2-3/4 inch) cavity space. If greater insulation thickness is required the masonry wall must be designed to provide a larger cavity.

To assure adequate competition, an R-value should be chosen that allows several products to meet the specified thickness. The range of design R-values (in IP units) for foam insulations given by ASHRAE is 5 to 7 per inch. Verify range available from manufacturers. An aged R-value in SI units of 2 IP units of 11) can be readily achieved with 50 mm 2 inches of insulation.

Cellular plastic insulations (polystyrene, polyurethane and polyisocyanurate) are thermally efficient, however, certain precautions should be observed in their use due to high smoke development and toxicity of the smoke generated by the burning of these materials. Cellular plastic insulations should only be used in anchored veneer masonry walls where the insulation is completely isolated from the interior of the building by masonry, including all penetrations of the interior wythe.

****

Provide rigid board-type insulation as specified in Section 07 21 13 BOARD AND BLOCK INSULATION.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to start of work, verify the applicable conditions as set forth in TMS MSJC, inspection.

3.2 PREPARATION

3.2.1 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.2.2 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.2.3 Concrete Surfaces

Where masonry is to be placed, clean concrete of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 3 mm 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.4 Shelf Angles

Adjust shelf angles as required to keep the masonry level and at the proper elevation.

3.2.5 Bracing

****

NOTE: TMS MSJC, Article 3.3 E Commentary references "Standard Practice for Bracing Masonry Walls Under Construction" for guidance on wall bracing requirements. Design wind pressure for bracing design is lower than that required by building code for long term building performance.

****

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and submit bracing calculations, sealed by a registered professional engineer. Do not remove bracing in less than 10 days.

3.3 ERECTION

****

NOTE: Specify bond pattern for each type of masonry. Where more than one bond pattern is required, the drawings should indicate the location and extent of each bond pattern. Bond patterns for reinforced hollow masonry construction should be such that cores of units will be in vertical alignment. Perfect vertical alignment of cells may require special masonry units. Where stacked bond is specified in reinforced hollow masonry, horizontal reinforcing bars shall be provided at maximum 1220 mm 4 foot intervals or horizontal joint reinforcement must be required in every other

horizontal joint to provide mechanical bond between adjacent units. When veneer is specified to be laid in stack bond and the project is in Seismic Design Category E or higher, horizontal joint reinforcement consisting of a single wire size MW11 W1.7 is required at a maximum spacing of 460 mm 18 inches. The use of stacked bond is discouraged and should only be permitted for small wall areas to give an architectural feature, such as for a building entrance detail.

****

3.3.1 General

a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Lay masonry units in [running] [stacked] [the indicated] bond pattern. Lay facing courses level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances is plus or minus 13 mm 1/2 inch. Adjust each unit to its final position while mortar is still soft and has plastic consistency.

b. Remove and clean units that have been disturbed after the mortar has stiffened, and relay with fresh mortar. Keep air spaces, cavities, chases, expansion joints, and spaces to be grouted free from mortar and other debris. Select units to be used in exposed masonry surfaces from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work.

c. When necessary to temporarily discontinue the work, step (rack) back the masonry for joining when work resumes. Toothing may be used only when specifically approved by the Contracting Officer. Before resuming work, remove loose mortar and thoroughly clean the exposed joint. Cover the top of walls subjected to rain or snow with nonstaining waterproof covering or membrane when work is not in process. Extend the covering a minimum of 610 mm 2 feet down on each side of the wall and hold securely in place.

d. Ensure that units being laid and surfaces to receive units are free of water film and frost. Lay solid units in a nonfurrowed full bed of mortar. Bevel mortar for veneer wythes and slope down toward the cavity side. Shove units into place so that the vertical joints are tight. Completely fill vertical joints between solid units with mortar, except where indicated at control, expansion, and isolation joints. Place hollow units so that mortar extends to the depth of the face shell at heads and beds, unless otherwise indicated. Mortar will be permitted to protrude up to 13 mm 1/2 inch into the space or cells to be grouted. Provide means to prevent mortar from dropping into the space below or clean grout spaces prior to grouting.

e. In multi-wythe construction with collar joints no more than 20 mm 3/4 inch wide, bring up the inner wythe not more than 400 mm 16 inches ahead of the outer wythe. Fill collar joints with mortar during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by back-buttering each unit as it is laid.

3.3.1.1 Jointing

Tool mortar joints when the mortar is thumbprint hard. Tool horizontal

joints after tooling vertical joints. Brush mortar joints to remove loose and excess mortar.

3.3.1.1.1 Tooled Joints

****

NOTE: Tooling any joint densifies the mortar bonding. Joints in exterior masonry walls exposed to weather will be tooled with an approved mortar jointer, typically a concave jointer. Other joints that are suitable for weathertight construction and may be considered for architectural purposes are: Vee, Beaded, or Weathered types. Exposed to view or painted interior masonry walls will also be tooled, typically with a slightly concaved joint, but may also be tooled with other joint types as architecturally desired.

****

Tool mortar joints in exposed exterior and interior masonry surfaces [concave] [_____], using a jointer that is slightly larger than the joint width so that complete contact is made along the edges of the unit. Perform tooling so that the mortar is compressed and the joint surface is sealed. Use a jointer of sufficient length to obtain a straight and true mortar joint. No exterior joints are to be left un-tooled.

3.3.1.1.2 Flush Joints

****

NOTE: Label "wet areas" on the drawings.

****

Flush cut mortar joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas. Finish flush cut joints by cutting off the mortar flush with the face of the wall. Point joints in unparged masonry walls below grade tight. For architectural units, such as fluted units, completely fill both the head and bed joints and flush cut.

3.3.1.1.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm 3/8 inch.

3.3.1.1.4 Joint Widths

a. Construct brick masonry with mortar joint widths equal to the difference between the specified and nominal dimensions of the unit, within tolerances permitted by TMS MSJC.

b. Provide 10 mm 3/8 inch wide mortar joints in concrete masonry, except for prefaced concrete masonry units.

c. Provide 10 mm 3/8 inch wide mortar joints on unfaced side of prefaced concrete masonry units and not less than 5 mm 3/16 inch nor more than 6 mm 1/4 inch wide on prefaced side.

d. Maintain mortar joint widths within tolerances permitted by TMS MSJC

3.3.1.2 Cutting and Fitting

Use full units of the proper size wherever possible, in lieu of cut units. Locate cut units where they would have the least impact on the architectural aesthetic goals of the facility. Perform cutting and fitting, including that required to accommodate the work of others, by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Before being placed in the work, dry wet-cut units to the same surface-dry appearance as uncut units being laid in the wall. Provide cut edges that are clean, true and sharp.

a. Carefully make openings in the masonry so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Provide reinforced masonry lintels above openings over 300 mm 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

b. Do not reduce masonry units in size by more than one-third in height and one-half in length. Do not locate cut products at ends of walls, corners, and other openings.

3.3.1.3 Unfinished Work

Rack back unfinished work for joining with new work. Toothing may be resorted to only when specifically approved by the Contracting Officer. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

3.3.1.4 Clay Masonry Expansion Joints

****

NOTE: Expansion joints in clay or shale masonry will be located and detailed on the drawings. The wall design and detailing must conform to BIA Technical Notes 18A Accommodating Expansion of Brickwork.

****

Provide clay masonry expansion joints as indicated. Construct by [leaving a gap] [filling with a compressible foam pad]. Ensure that no mortar or other noncompressible materials are within the joint. Install backer rod and sealant in accordance with Section 07 92 00 JOINT SEALANTS.

3.3.1.5 Control Joints

****

NOTE: Control joints will be located and detailed on the drawings. The wall design and detailing for movement control must conform to National Concrete Masonry Association (NCMA) publications: TEK 10-01A, and 10-02C or 10-03 or 10-04, as applicable. When control joint keys are required, it is the Contractor's option to use either special control joint units or sash jamb units with control joint keys. If one is preferred over the other in the design, edit this paragraph accordingly and provide specific details on the drawings. Standard

industry practice is to discontinue horizontal reinforcement at control joints except at floor and roof diaphragms, where the reinforcement must be continuous. Where horizontal shear reinforcement is needed by design, however, the reinforcement must be continuous through the control joint. Select the appropriate option.

****

Provide control joints in concrete masonry as indicated. Construct by [raking out mortar within the head joint] [using special control-joint units] [using sash jamb units with control joint key] [using open end stretcher units placed with the closed end at the joint] in accordance with the details shown on the Drawings. Form a continuous vertical joint at control joint locations, including through bond beams, by utilizing half blocks in alternating courses on each side of the joint. Interrupt the control joint key in courses containing continuous bond beam reinforcement. [Do not interrupt the horizontal reinforcement and grout at the control joint.] [Interrupt the horizontal reinforcement and grout in bond beams at the control joint except in bond beams at the floor and roof diaphragms.]

Where mortar was placed in the joint, rake both faces of the control joints to a depth of 19 mm 3/4 inch. Install backer rod and sealant on both faces in accordance with Section 07 92 00 JOINT SEALANTS.

3.3.1.6 Decorative Architectural Units

Place decorative masonry units with the patterned face shell properly aligned in the completed wall.

3.3.2 Clay or Shale Brick Masonry

****

NOTE: Specify type of bond required, if other than running bond is desired.

****

3.3.2.1 Brick Placement

Blend all brick at the jobsite from several cubes to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable. Lay brick facing with the better face exposed. Lay brick in running bond with each course bonded at corners, unless otherwise indicated. Lay molded brick with the frog side down. Do not lay brick that is cored, recessed, or has other deformations in a manner that allows those deformations to be exposed to view; lay 100 percent solid units in these areas. Completely fill head and bed joints of solid units with mortar. Lay hollow units with mortar joints as specified for concrete masonry units. [Lay fire brick by dipping each brick in a soft mixture of fire clay and water and then rubbing the brick into place with joints as thin as practicable or provide refractory mortar with joints not more than 10 mm 3/8 inch thick.]

Place exterior face of salvaged bricks towards the exterior.

3.3.2.2 Wetting of Units

****

NOTE: If clay, shale brick, or hollow brick is specified, include wetting requirements for units having an initial rate of absorption (IRA) of more than 0.155 gm per minute per square cm 1 gm per minute per square inch of bed surface.

IRA is measured in the laboratory and reported in test results. However, the IRA can increase under hot weather conditions in the field. The wax pencil test can approximate the field IRA condition.

****

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 0.155 gm per minute per square cm 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C67/C67M. Ensure that each unit is nearly saturated when wetted but surface dry when laid.

Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

3.3.2.3 Brick Sills

****

NOTE: Brick sills are more susceptible to freeze-/thaw damage and should be carefully considered in freezing climates.

****

Lay brick on edge, slope not less than 19 mm 3/4 inch downward to the outside, and project not less than 13 mm 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.

3.3.2.4 Reinforced Brick Walls

****

NOTE: Multi-wythe walls with masonry headers are more susceptible to water penetration and efflorescence.

Show required length of reinforcing bar lap splices on the Drawings or by a schedule in the Specification. Required lap length of bars may be different depending on whether the masonry is designed by allowable stress or by strength.

****

Provide two wythes of brick separated by a [_____] mm inch wide continuous space filled with [grout] [bricks "floated" in grout] and reinforced as indicated. Bevel mortar beds away from grout space to prevent projection into grout space when bricks are shoved in place. Deeply furrowed bed joints will not be permitted. Lay exterior wythe of brick to the height of each grout pour in advance of interior wythe. Clean grout space and set reinforcing before laying interior wythe. Provide metal ties to

prevent spreading of the wythes and to maintain vertical alignment of walls. Place reinforcement and grout in accordance with paragraph BAR REINFORCEMENT INSTALLATION and paragraph PLACING GROUT in this Section.

3.3.2.5 Chimneys

****

NOTE: If a chimney wall is 200 mm 8 inches or less in thickness, the space between the flue liner and brickwork should be kept clean and clear to avoid cracking the brickwork.

****

Construct chimneys of brick with clay flue linings of the sizes indicated. Extend flue linings from 300 mm 12 inches below the smoke inlet to 100 mm 4 inches above the chimney cap. Place thimbles as indicated, flush with inside of or up to 25 mm one inch into the flue lining. Set linings in fire clay mortar or refractory mortar and fill and smooth the joints on the inside. Set each section of flue lining before surrounding brickwork reaches top of flue lining section below. Build brickwork around lining, and [fill the space] [leave a 25 mm one inch airspace] between lining and brickwork [with grout]. [Seal top of airspace before installing chimney cap.] Do not cut linings after they are installed in chimney. Unless indicated otherwise, provide a chimney cap of air-entrained concrete. Slope cap to a minimum edge thickness of 50 mm 2 inches and reinforce with two rings of No. 3 gage galvanized steel wire.

3.3.2.6 Partitions

****

NOTE: Walls and partitions that serve as fire walls or fire-rated walls will be shown. Sections and details of these walls will clearly indicate the extent of such walls. Non-structural masonry partition walls will not be tied in any way to structural or exterior masonry walls. Isolation joints will be used at these intersections. When 100 mm 4 inch masonry partitions are not used, delete reference to these units and their intersections.

****

a. Construct partitions continuous from floor to underside of floor or roof deck where shown. Fill openings in firewalls around joists and other structural members as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 100 mm 4 inches above the ceiling level. Construct an isolation joint in the intersection between partitions and structural or exterior walls.

b. Tie interior partitions having 100 mm 4 inch nominal thickness units to intersecting partitions of 100 mm 4 inch units, 125 mm 5 inches into partitions of 150 mm 6 inch units, and 175 7 inches into partitions of 200 mm 8 inch or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Tie interior partitions over 100 mm 4 inches thick together with joint reinforcement. Provide

joint reinforcement with prefabricated pieces at corners and intersections of partitions.

c. Double-Faced Bases or Partitions: Construct double-faced clay unit bases and partitions of two-unit construction. Bond units by overlapping from opposite faces of the wall, 50 mm for 150 mm 2 inches for 6 inch thick partitions and 100 mm for 200 mm 4 inches for 8 inch thick or greater. A single wythe prefaced concrete masonry base or partition may be made with double faced units.

3.3.3 Anchored Veneer Construction

****

NOTE: The air space behind the veneer should be a minimum of 25 mm 1 inch. The maximum distance between the inside face of veneer and outside face of backing (concrete surface, masonry surface, or wood or steel stud face) should be 114 mm 4.5 inches, unless specially designed anchors are used. Coordinate cavity dimensions with standard lintel and shelf angle dimensions.

Bond pattern should be running bond unless there are compelling architectural reasons to select another pattern.

Adjustable assemblies are normally used when constructing one wythe independent of the other. If the design does not permit this type of construction, delete the reference pertaining to adjustable joint reinforcement assemblies. The preferred method of construction, however, is to bring the wythes up together. Typically, continuous joint reinforcement is used to tie the two wythes together as well as providing for shrinkage cracking control. Continuous joint reinforcement, used as wall ties, will typically be spaced not over 400 mm 16 inches on center vertically. Spacing of joint reinforcement will be shown on the contract drawings.

Refer to "Maximum Spacing and Wall Area for Veneer Anchors" table for required wall area per anchor, and maximum vertical and horizontal spacing of veneer anchors based on anchor type, wind loads, and seismic loads per TMS MSJC.

Maximum Spacing and Wall Area for Veneer Anchors					
Masonry Design Approach	Unit Anchor Type and Size				
	Adjustable	Non-Adjustable	Non-Adjustable	Joint Reinforcement	Sheet Metal
	MW18W2.8 Wire	MW11W1.7 Wire	MW18W2.8 Wire	MW11W1.7 Wire	≥ 1.5mm0.06 inch
Anchored Veneer - prescriptive requirements where qz does not exceed 1.92 kPa 40 psf					
Maximum Area per Tie	0.25 $m^2$2.67 ft^2	0.25 $m^2$2.67 ft^2	0.33 $m^2$3.50 ft^2	0.25 $m^2$2.67 ft^2	0.33 $m^2$3.50 ft^2
Maximum Horizontal Spacing	813 mm32 inch	813 mm32 inch	813 mm32 inch	406 mm16 inch	813 mm32 inch
Maximum Vertical Spacing	635 mm25 inch	635 mm25 inch	635 mm25 inch	635 mm25 inch	635 mm25 inch
Anchored Veneer - prescriptive requirements where qz exceeds 1.92 kPa 40 psf but does not exceed 2.63 kPa 55 psf and the building's mean roof height does not exceed 18.3 m 60 feet					
Maximum Area per Tie	0.18 $m^2$1.87 ft^2	0.18 $m^2$1.87 ft^2	0.23 $m^2$2.45 ft^2	0.18 $m^2$1.87 ft^2	0.23 $m^2$2.45 ft^2
Maximum Horizontal Spacing	457 mm18 inch	457 mm18 inch	457 mm18 inch	457 mm18 inch	457 mm18 inch
Maximum Vertical Spacing	457 mm18 inch	457 mm18 inch	457 mm18 inch	457 mm18 inch	457 mm18 inch
Anchored Veneer - prescriptive requirements in SDC D, E, and F**					
Maximum Area per Tie	0.19 $m^2$2.00 ft^2	0.19 $m^2$2.00 ft^2	0.25 $m^2$2.63 ft^2	0.19 $m^2$2.00 ft^2	0.25 $m^2$2.63 ft^2
Maximum Horizontal Spacing	813 mm32 inch	813 mm32 inch	813 mm32 inch	406 mm16 inch	813 mm32 inch
Maximum Vertical Spacing	635 mm25 inch	635 mm25 inch	635 mm25 inch	635 mm25 inch	635 mm25 inch
**In Seismic Design Categories E and F, a continuous single wire joint reinforcement of wire size MW 11 W1.7 at a maximum vertical spacing of 457 mm 18 inch is required.					

For the additional anchors (ties) around openings, the maximum permitted spacing is reduced under high wind (over 1.92 kPa 40 psf) conditions and when the building's mean roof height does not exceed 18.3 m 60 feet; select the smaller spacing option when the veneer is subject to high winds.

****

a. Construct exterior masonry wythes to the thickness indicated on the drawings. Provide a minimum [_____] mm inch air space behind the masonry veneer. Provide means to ensure that the cavity space and flashings are kept clean of mortar droppings and other loose debris. Maintain chases and raked-out joints free from mortar and debris.

b. Place masonry [in running bond pattern.] [in stacked bond pattern.] [Place longitudinal reinforcement, consisting of at least one continuous hot-dip galvanized MW11 W 1.7 (9gauge) steel wire, in the veneer wythe when laid in stack bond.]

c. For veneer over stud framing, do not install veneer until the exterior sheathing, moisture barrier, veneer anchors and flashing have been installed on the backing. Take extreme care to avoid damage to the moisture barrier and flashing during construction of the masonry veneer. Repair or replace portions of the moisture barrier and flashing that are damaged prior to completion of the veneer. Provide a continuous cavity as indicated.

d. For veneer with a masonry backup wythe, lay up both the inner and the outer wythes together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, install through-wall flashings with the exterior wythe, securing the top edge of the flashing with a termination bar and sealant, or protect flashings that are installed with the interior wythe from damage until they are fully enclosed in the wall.

e. Provide anchors (ties) to connect the veneer to its backing in sufficient quantity to comply with the following requirements: maximum wall area per anchor {tie) of [_____], and maximum vertical spacing of [_____], and maximum horizontal spacing of [_____]. Provide additional anchors around openings larger than 406 mm 16 inch in either direction. Space anchors around perimeter of opening at a maximum of [0.91 m3 feet][610 mm24 inches] on center. Place anchors within 305 mm 12 inches of openings. Anchors with drips are not permitted.

f. With solid units, embed anchors in mortar joint and extend into the veneer a minimum of 38 mm 1-1/2 inch, with at least 16 mm 5/8 inch mortar cover to the outside face.

g. With hollow units, embed anchors in mortar or grout and extend into the veneer a minimum of 38 mm 1-1/2 inch, with at least 16 mm 5/8 inch mortar or grout cover to outside face.

3.3.4 Composite Walls

Tie masonry wythes together with joint reinforcement or with unit wall ties. Embed wall ties at least 38 mm 1-1/2 inch into mortar of solid units and at least 13 mm 1/2 inch into the mortar of the outer face shell of hollow units. Provide at least one tie every 0.25 square m 2.67 square feet for wire size MW11 W1.7 and at least one tie every 0.42 square m 4.50 square feet for wire size MW18 W2.8. Space ties at a maximum of 900 mm 36 inches horizontally and 610 mm 24 inches vertically. Do not cross expansion joints or control joints with ties. Fill collar joints between masonry facing and masonry backup solidly with grout.

3.3.5 Reinforced, Single Wythe Concrete Masonry Units Walls

****

NOTE: For single-wythe, concrete masonry unit exterior walls, specify water-repellant application for the constructed masonry walls or specify integral water repellent admixture for both the masonry units and the mortar. Units with an impervious coating, such as glazed-faced units, do not require a water-repellent. This is a regional requirement which shall be used, when applicable, for NAVFAC SE projects; when appropriate, the requirements may be used for projects in other areas.

Show required length of reinforcing bar lap splices on the Drawings or by a schedule in the Specification. Required lap length of bars may be different depending on whether the masonry is designed by allowable stress or by strength.

****

3.3.5.1 Concrete Masonry Unit Placement

a. Fully bed units used to form piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout in mortar under both face shells and webs. Provide mortar beds under both face shells for other units. Mortar head joints for a distance in from the face of the unit not less than the thickness of the face shell.

b. Solidly grout foundation walls below grade.

c. Stiffen double walls at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of each wall within the double wall. Adequately reinforce walls and partitions for support of wall-hung plumbing fixtures when chair carriers are not specified.

d. Submit drawings showing elevations of walls exposed to view and indicating the location of all cut CMU products.

3.3.5.2 Preparation for Reinforcement

Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be grouted. Remove mortar protrusions extending 13 mm 1/2 inch or more into cells before placing grout. Position reinforcing bars accurately as indicated before placing grout. Where vertical reinforcement occurs, fill cores solid with grout in accordance with paragraph PLACING GROUT in this Section.

3.3.6 Cavity Walls (Multi-Wythe Noncomposite Walls

****

NOTE: Include dampproofing or air barrier requirements in geographic areas where these are required or as an acceptable practices. Now that masonry wall cavities are usually at least half full of rigid board insulation, and the backup wythe is

usually completed before the brickwork is started, the wood strip method of keeping the cavities clean is neither practicable nor effective. A mortar divertingal placed at the bottom of the cavity will provide a path for water to drain through the weep holes. The specified method for concrete masonry unit and brick cavity wall is effective, but may be deleted if the specifier is reluctant to require it. Care must be taken (1) to prevent damage to mortar joints, especially adjacent to the washout holes, and (2) to prevent accumulation of water at the bottom of the wall. The cavities must be inspected to verify that they are clean and functional.

Refer to "Maximum Spacing and Wall Area for Ties" table for maximum wall area per tie, and maximum vertical and horizontal spacing of ties based on tie type per TMS MSJC.

Maximum Spacing and Wall Area for Veneer Anchors					
Masonry Design Approach	Unit Anchor Type and Size				
	Adjustable	Non-Adjustable	Non-Adjustable	Joint Reinforcement	Sheet Metal
	All Sizes	MW11W1.7 Wire	MW18W2.8 Wire	MW11W1.7 Wire	≥ 1.5mm0.06 inch
Allowable Stress Design, Strength Design and Prestressed Design					
Maximum Area per Tie	0.16 $m^2$1.77 ft^2	0.25 $m^2$2.67 ft^2	0.42 $m^2$4.50 ft^2	Same as non-adjustable unit ties of same wire size	Not permitted
Maximum Horizontal Spacing	406 mm16 inch	914 mm36 inch	914 mm36 inch	406 mm16 inch	
Maximum Vertical Spacing	406 mm16 inch	610 mm24 inch	610 mm24 inch	610 mm24 inch	

For NAVFAC SE projects, use second bracketed statement in the eighth sentence.
****

Provide a continuous cavity as indicated. Bevel mortar beds away from cavity to prevent projection into cavity when bricks are shoved in place. Keep cavities clear and clean of mortar droppings. [At the bottom of cavity walls, in the course immediately above the through-wall flashing, temporarily omit one brick every 1200 mm 4 feet. Clean mortar droppings and debris out of the cavity through the temporary openings at least once each day masonry is laid, and more often when required to keep the cavities clean. Fill in the openings with bricks and mortar after the wall is complete and the cavity has been inspected and found clean.]

[Dampproof cavity face of interior wythe in accordance with Section 07 11 13 BITUMINOUS DAMPPROOFING.]

Securely tie the two wythes together with horizontal joint reinforcement, or provide ties to connect the masonry wythes in sufficient quantity to comply with the following requirements: maximum wall area per tie of [_____], and maximum vertical spacing of [_____], and maximum horizontal spacing of [_____]. Provide additional ties around openings larger than 405 mm 16 inches in either direction. Space ties around perimeter of opening at a maximum of 910 mm 3 feet on center. Place ties within 305 mm 12 inchesof openings. Ties with drips are not permitted.

3.3.7 ANCHORAGE

****

NOTE: If spacing of anchors varies from that specified, edit these paragraphs accordingly.

For intersecting structural masonry walls, delete the types of anchorage that are not permitted for the project.

****

3.3.7.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 400 mm 16 inches on centers vertically and 600 mm 24 inches on center horizontally.

3.3.7.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 400 mm 16 inches on centers vertically, and if applicable, not over 600 mm 24 inches on centers horizontally.

3.3.7.3 Anchorage at Intersecting Walls

Provide wire mesh anchors at maximum 400 mm 16 inches spacing at intersections of interior non-bearing masonry walls.

****

NOTE: Details will be shown on the drawings which illustrate corners and intersections of structural bond beam reinforcement and factory-formed joint reinforcement. When joint reinforcement is not used, delete prefabricated corners or tee pieces.

****

Anchor structural masonry walls with [reinforced bond beams spaced no more than [_____] mm feet on center] [horizontal joint reinforcement spaced no more than [_____] mm feet on center] [overlapping masonry units] [strap anchors of minimum size 6 mm 1/4 inch x 38 mm 1-1/2 inch x 710 mm 28 inches including 50 mm 2 inch) 90 degree bends at each end to form U or Z shape at maximum spacing 1220 mm 48 inches, grouted into the wall], unless the drawings indicate a movement joint at the intersection.

3.3.8 Lintels

3.3.8.1 Masonry Lintels

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated. Extend lintel reinforcement beyond each side of masonry opening 40 bar diameters or 600 mm 24 inches, whichever is greater. Support reinforcing bars in place prior to grouting and locate 13 mm 1/2 inch above the bottom inside surface of the lintel unit.

3.3.8.2 Precast Concrete and Steel Lintels

Provide precast concrete and steel lintels as shown on the Drawings. Set lintels in a full bed of mortar with faces plumb and true. Provide steel and precast lintels with a minimum bearing length of 200 mm 8 inches unless otherwise indicated. In partially grouted masonry, provide fully grouted units under the full lintel bearing length, unless otherwise indicated.

3.3.9 Sills and Copings

****

NOTE: Coping and sills exceeding 1200 mm 4 feet should be mechanically anchored and detailed on the project drawings. Where such anchors penetrate through-wall flashing, sealing of the penetration should be required.

****

Set sills and copings in a full bed of mortar with faces plumb and true. Slope sills and copings to drain water. Mechanically anchor copings and sills longer than 1200 mm 4 feet as indicated.

3.4 INSTALLATION

3.4.1 Bar Reinforcement Installation

3.4.1.1 Preparation

Submit detail drawings showing bar splice locations. Identify bent bars on a bending diagram and reference and locate such bars on the drawings. Show wall dimensions, bar clearances, and wall openings. Utilize bending details that conform to the requirements of ACI SP-66. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, resubmit the approved shop drawings with the additional openings shown along with the proposed changes. Clearly highlight location of these additional openings. Provide wall elevation drawings with minimum scale of 1 to 50 1/4 inch per foot. Submit drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, and other coatings that might destroy or reduce its bond prior to placing grout. Do not use bars with kinks or bends not shown on the approved shop

drawings. Place reinforcement prior to grouting. Unless otherwise indicated, extend vertical wall reinforcement to within 50 mm 2 inches of tops of walls.

3.4.1.2 Positioning Bars

****

NOTE: Positioning of bars will be shown on the drawings.

****

a. Accurately place vertical bars within the cells at the positions indicated on the drawings. A minimum clearance of 13 mm 1/2 inch shall be maintained between the bars and masonry units. Provide minimum clearance between parallel bars of13 mm 1/2 inch between the bars and masonry units for coarse grout and a minimum clearance of 6 mm 1/4 inch between the bars and masonry units for fine grout. Provide minimum clearance between parallel bars of 25 mm 1 inch or one diameter of the reinforcement, whichever is greater. Vertical reinforcement may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement or by other means to prevent displacement beyond permitted tolerances. As masonry work progresses, secure vertical reinforcement to prevent displacement beyond allowable tolerances.

b. Wire column and pilaster lateral ties in position around the vertical reinforcing bars. Place lateral ties in contact with the vertical reinforcement and do not place in horizontal mortar bed joints.

c. Position horizontal reinforcing bars as indicated. Stagger splices in adjacent horizontal bars, unless otherwise indicated.

d. Form splices by lapping bars as indicated. Do not cut, bend or eliminate reinforcing bars. Foundation dowel bars may be field-bent when permitted by TMS MSJC.

3.4.1.3 Splices of Bar Reinforcement

****

NOTE: The designer must determine the required lap splice lengths and indicate on the project documents. Required lap splice length may vary depending upon whether the masonry is designed by allowable stress or strength.

****

Lap splice reinforcing bars as indicated. When used, provide welded or mechanical connections that develop at least 125 percent of the specified yield strength of the reinforcement.

3.4.2 Placing Grout

****

NOTE: Mechanical consolidation of self-consolidating grout should not be performed because it may cause segregation. When placing self-consolidating grout, the properties listed in ASTM C476 should be verified.

****

3.4.2.1 General

Fill cells containing reinforcing bars with grout. Solidly grout hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces. Solidly grout cells under lintel bearings on each side of openings for full height of openings. Solidly grout walls below grade, lintels, and bond beams. Units other than open end units may require grouting each course to preclude voids in the units.

Discard site-mixed grout that is not placed within 1-1/2 hours after water is first added to the batch or when the specified slump is not met without adding water after initial mixing. Discard ready-mixed grout that does not meet the specified slump without adding water other than water that was added at the time of initial discharge. Allow sufficient time between grout lifts to preclude displacement or cracking of face shells of masonry units. Provide a grout shear key between lifts when grouting is delayed and the lower lift loses plasticity. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, tear down the wall and rebuild.

3.4.2.2 Vertical Grout Barriers for Multi-Wythe Composite Walls

In multi-wythe composite walls, provide grout barriers in the collar join not more than 9 m 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.4.2.3 Horizontal Grout Barriers

Embed horizontal grout barriers in mortar below cells of hollow units receiving grout.

3.4.2.4 Grout Holes and Cleanouts

3.4.2.4.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 400 mm 16 inches on centers where grouting of hollow unit masonry is indicated. Fom such openings not less than 100 mm 4 inches in diameter or 75 by 100 mm 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.4.2.4.2 Cleanouts for Hollow Unit Masonry Construction

For hollow masonry units. provide cleanout holes at the bottom of every grout pour in cores containing vertical reinforcement when the height of the grout pour exceeds 1.6 m 5 feet 4 inches. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells. Provide cleanout holes at a maximum spacing of 800 mm 32 inches where all cells are to be filled with grout.

Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Provide cleanouts not less than 75 by 75 mm 3 by 3

inch by cutting openings in one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Do not cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.4.3 Cleanouts for Multi-Wythe Composite Masonry Construction

Provide cleanouts for construction of walls that incorporate a grout filled cavity between solid masonry wythes, provide cleanouts at the bottom of every pour by omitting every other masonry unit from one wythe. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Do not plug cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.5 Grout Placement

****

NOTE: The requirements listed are for normal grouting procedures. Other options, such as higher grout lifts, higher grout pours, or alternate methods of keeping the grout space clean, may be acceptable if proven through the process of constructing and examining a grout demonstration panel.

A grout pour is the total height of masonry to be grouted prior to erection of additional masonry. A grout lift is an increment of grout placement within a grout pour. A grout pour is filled by one or more lifts of grout. Maximum grout pour height is based on grout type (fine or coarse) and dimensions of grout space, per TMS MSJC Table 7. Fine grout has sand as the only aggregate while coarse grout uses both sand and pea gravel up to 10 mm 3/8 inch diameter. Coarse grout is preferred when grout will be placed in relatively large cross-sectional areas because shrinkage of the grout is reduced.

By following the TMS grout pour and lift recommendations and using grout of the proper consistency, grout placement occurs at a rate that does not cause displacement of masonry due to hydrostatic pressure of grout. Self-consolidating grout (SCG) attains its flow primarily from superplasticizing admixtures, not water, so it exerts a lower hydrostatic pressure than conventional grout during placement. Grout should be placed as rapidly as practical by methods that do not cause segregation and that minimize splatter on reinforcement and surrounding masonry. Conventional grout lifts should be consolidated (and reconsolidated) by mechanical vibration before the next lift is placed. SCG does not need to be consolidated.

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A grout pour is the total height of masonry to be grouted prior to erection of additional masonry. A grout lift is an increment of grout placement within a grout pour. A grout pour is filled by one or more lifts of grout.

a. Lay masonry to the top of a pour permitted by TMS MSJC Table 7, based on the size of the grout space and the type of grout. Prior to grouting, remove masonry protrusions that extend 13 mm 1/2 inch or more into cells or spaces to be grouted. Provide grout holes and cleanouts in accordance with paragraph GROUT HOLES AND CLEANOUTS above when the grout pour height exceeds 1.6 m 5 feet 4 inches. Hold reinforcement, bolts, and embedded connections rigidly in position before grouting is started. Do not prewet concrete masonry units.

b. Place grout using a hand bucket, concrete hopper, or grout pump to fill the grout space without segregation of aggregate. Operate grout pumps to produce a continuous stream of grout without air pockets, segregation, or contamination.

c. If the masonry has cured at least 4 hours, grout slump is maintained between 250 and 275 mm 10 to 11 inches, and no intermediate reinforced bond beams are placed between the top and bottom of the pour height, place conventional grout in lifts not exceeding 3.9 m 12 feet 8 inches. For the same curing and slump conditions but with intermediate bond beams, limit conventional grout lift to the bottom of the lowest bond beam that is more than 1.6 m 5 feet 4 inches above the bottom of the lift, but do not exceed 3.9 m 12 feet 8 inches. If masonry has not cured at least 4 hours or grout slump is not maintained between 250 and 275 mm 10 to 11 inches, place conventional grout in lifts not exceeding 1.6 m 5 feet 4 inches.

d. Consolidate conventional grout lift and reconsolidate after initial settlement before placing next lift. For grout pours that are 300 mm 12 inches or less in height, consolidate and reconsolidate grout by mechanical vibration or puddling. For grout pours that are greater than 300 mm 12 inches in height, consolidate and reconsolidate grout by mechanical vibration. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation. If previous lift is not permitted to set, dip vibrator into previous lift. Do not insert vibrators into lower lifts that are in a semi-solidified state. If lower lift sets prior to placement of subsequent lift, form a grout key by terminating grout a minimum of 38 mm 1-1/2 inch below a mortar joint. Vibrate each vertical cell containing reinforcement in partially grouted masonry. Do not form grout keys within beams.

e. If the masonry has cured 4 hours, place self-consolidating grout (SCG) in lifts not exceeding the pour height. If masonry has not cured for at least 4 hours, place SCG in lifts not exceeding 1.6 m 5 feet 4 inches. Do not mechanically consolidate self-consolidating grout. Place self-consolidating grout in accordance with manufacturer's recommendations.

f. Upon completion of each day's grouting, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.4.3 Joint Reinforcement Installation

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NOTE: Location of horizontal joint reinforcement should be shown on the drawings with the maximum vertical spacing normally being 400 mm 16 inches. A 150 mm 6 inch lap splice length is sufficient for joint reinforcement whose only purpose is shrinkage control. Joint reinforcement that is used structurally may need longer lap splices.

****

Install joint reinforcement at 400 mm 16 inches on center unless otherwise indicated. Lap joint reinforcement not less than [150][_____] mm [6][_____] inches. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement in mortar beds to provide not less than 16 mm 5/8 inch cover to either face of the unit.

3.4.4 Bond Beams

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NOTE: Bond beams that are continuous over openings will be reinforced to serve as lintels.

Bond beams at floor lines and roofs, where the beam acts as a tension tie for the diaphragm, are typically reinforced continuously through masonry movement joints, and the mortar is raked back and finished with backer rod and sealant. Intermediate bond beams are typically detailed with the reinforcement interrupted, but doweled, at control joints and again finished with raked back mortar, backer rod and sealant.

Interior control joints are raked to weaken the joint to focus cracks in the control joint and caulked so that 1) cracks don't show and 2) provide a second line of defense should moisture try to travel through the cracks in the control joint.

****

Reinforce and grout bond beams as indicated and as described in paragraphs above. Install grout barriers under bond beam units to retain the grout as required, unless wall is fully grouted or solid bottom units are used. For high lift grouting in partially grouted masonry, provide grout retaining material on the top of bond beams to prevent upward flow of grout. Ensure that reinforcement is continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated.

3.4.5 Flashing and Weeps

****

NOTE: Locate weeps and ventilators to ensure that in severe weather, wind driven water does not enter and drain into the interstitial space. Indicate acceptable locations on drawings.

Weep spacing of 610 mm 24 inches is appropriate for open head joint weeps and weep vents. When smaller weeps are used, the spacing should be reduced to 406 mm 16 inches.

Provide a flashing/weep system for open cores (non-grouted) of exterior single wythe CMU walls.

****

a. Install through-wall flashing at obstructions in the cavity and where indicated on Drawings. Ensure continuity of the flashing at laps and inside and outside corners by splicing in a manner approved by the flashing manufacturer. Ensure that the top edge of the flashing is sealed by [turning the flashing 13 mm 1/2 inch into the mortar bed joint of backup masonry] [attaching a termination bar and applying compatible sealant at the top edge of the termination bar] [lapping a minimum of 150 mm 6 inches under the weather resistive barrier] [securing the sheet metal flashing into a reglet cast into the concrete backup]. Terminate the horizontal leg of the flashing [by extending the sheet metal 13 mm 1/2 inch beyond the outside face of masonry and turning downward with a hemmed drip] [terminating the fabric flashing 13 mm 1/2 inch short of the outside face of masonry and adhering the flashing to a sheet metal drip edge] [extending the fabric flashing beyond the outside face of masonry and, when construction is complete, cutting the flashing flush with the face of masonry]. Provide sealant below the drip edge of through-wall flashing.

b. Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated. Provide weeps of [open head joints][weep ventilators]. Locate weeps not more than 600 mm 24 inches on centers in mortar joints of the exterior wythe directly on the horizontal leg of through-wall flashing over foundations, bond beams, and any other horizontal interruptions of the cavity. Place weep holes perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Other methods may be used for providing weeps when spacing is reduced to406 mm 16 inches on center and approved by the Contracting Officer. Maintain weeps free of mortar and other obstructions.

[c. Install single-wythe CMU flashing system in bed joints of CMU walls where CMU cells are open. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall on the exterior side. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

]3.5 APPLICATION

3.5.1 Insulation

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NOTE: Specify taping or sealing of board joints when the insulation must act as the air or vapor barrier.

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Insulate cavity walls (multi-wythe noncomposite masonry walls), where shown, by installing board-type insulation on the cavity side of the inner

wythe. Apply board type insulation directly to the masonry or thru-wall flashing with adhesive. Neatly fit insulation between obstructions without impaling insulation on ties or anchors. Apply insulation in parallel courses with vertical joints breaking midway over the course below and in moderate contact with adjoining units without forcing. Cut to fit neatly against adjoining surfaces. [Tape or seal the joints between the boards.]

3.5.2 Interface with Other Products

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NOTE: Label "wet locations" on the drawings.
****

3.5.2.1 Built-In Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout, unless otherwise indicated.

3.5.2.2 Door and Window Frame Joints

On the exposed interior and exterior sides of exterior frames, rake joints between frames and abutting masonry walls to a depth of 10 mm 3/8 inch.

3.5.2.3 Bearing Plates

****
NOTE: The bearing details must be shown on the drawings. The thermal effects must be considered for steel beams bearing on masonry to prevent cracking of masonry walls due to thermal expansion of steel framing members.
****

Set bearing plates for beams, joists, joist girders and similar structural members to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Provide bedding mortar and non-shrink grout s specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5.3 Tolerances

Lay masonry plumb, true to line, with courses level within the tolerances of TMS MSJC, Article 3.3 F.

3.6 FIELD QUALITY CONTROL

3.6.1 Tests

3.6.1.1 Field Testing of Mortar

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NOTE: Field testing of mortar should be limited or avoided. Better information can be obtained by observing mortar batching to confirm that proper

proportions and mixing procedures have been followed. When field testing is required, verification of proportions is preferred to mortar compressive strength testing. Results are available in a matter of hours rather than days or weeks. Proportions of fresh mortars can be determined by running the mortar aggregate ratio test of ASTM C780 Appendix A4. Mortar compressive strength, tested in accordance with ASTM C780 Appendix 6, is not required or expected to meet the property requirements of ASTM C270 Table 2 and has more meaningful comparisons to preconstruction test values to evaluate consistency. Therefore, when mortar is tested for compressive strength, testing must be performed prior to construction as well as during construction. Frequency of testing, if any, depends on the size and complexity of the project. Modify paragraph below to advise required frequency of testing and type(s) of testing required.
****

Perform mortar testing at the following frequency: [_____] times per [_____]. For each required mortar test, provide a minimum of three mortar samples. Perform initial mortar testing prior to construction for comparison purposes during construction.

Prepare and test mortar samples for mortar aggregate ratio in accordance with ASTM C780 Appendix A4. [Prepare and test mortar compressive strength specimens in accordance with ASTM C780 Appendix A6.]

3.6.1.2 Field Testing of Grout

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NOTE: Field testing of grout involves measuring temperature, slump of conventional grout, slump flow of SCG, visual stability index of SCG, and compressive strength. Field testing of grout is not required when masonry compressive strength is verified by the prism test method.

Frequency of testing depends on the size and complexity of the project. Minimum requirements for testing frequency are provided in TMS MSJC Tables 1.19.1, 1.19.2, and 1.19.3 depending upon how the masonry is designed (prescriptive or engineered) and the Risk Category of the project. Modify paragraph below to advise required frequency of testing.
****

a. Perform grout testing at the following frequency: [_____] times per [_____]. For each required grout property to be evaluated, provide a minimum of three specimens.

b. Sample and test conventional and self-conslidating grout for compressive strength and temperature in accordance with ASTM C1019.

c. Evaluate slump in conventional grout in accordance with ASTM C1019.

d. Evaluate slump flow and visual stability index of self-consolidating

grout in accordance with ASTM C1611/C1611M.

[3.6.1.3 Clay Brick Efflorescence Test

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NOTE: Delete this paragraph in areas where efflorescence has not been a problem. Efflorescence is generally the result of poor design and detailing and/or poor quality of construction. Properly covered and/or flashed walls with a good drainage and weep system are generally free of efflorescence. Efflorescence testing is generally not required.
****

Test clay brick that will be exposed to weathering for efflorescence in accordance with ASTM C67/C67M. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Units meeting the definition of "effloresced" are subject to rejection.

][3.6.1.4 Prism Tests

****
NOTE: Prism testing will only be required for structures requiring masonry compressive strengths higher than those indicated by the conservative values derived by the Unit Strength Method. When the compressive strength of masonry can be verified by the Unit Strength method, prism testing normally will not be required. Delete this paragraph when prism testing is not required. When prism test results are lower than the specified compressive strength, handling and testing of the prism specimens should be reviewed for compliance to the requirements contained in the ASTM standard.

Indicate the specified compressive strength of masonry in paragraph SYSTEM DESCRIPTION or on the Drawings.
****

Perform at least one prism test sample for each 465 square meters 5,000 square feet of wall but not less than three such tests for any building. Evaluate three prisms in each test. Fabricate, store, handle, and test prisms in accordance with ASTM C1314.

Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. If the compressive strength of any prism falls below the specified value by more than 3.5 MPa 500 psi, take steps to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, take three specimens for each prism test more than 3.5 MPa 500 psi below the specified value. Masonry in the area in question will be considered structurally adequate if the average compressive strength of three specimens is equal to or exceeds the specified value. Additional testing of specimens extracted from locations

represented by erratic core or prism strength test results will be permitted.

]3.6.1.5 Single-Wythe Masonry Wall Water Penetration Test

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NOTE: Include masonry wall water penetration testing only for single-wythe masonry wall constructions where wall water penetration will impair mission-critical operations, create an immediate safety hazard, or have a detrimental impact on interior finishes. Testing evaluates the assembled wall test panel and does not assure compliant wall construction in the field. As an option additional testing may be performed on the actual wall construction in accordance with ASTM C1601.

****

Prior to start of field construction of the single-wythe concrete masonry wall, perform masonry wall water penetration test on mock-up wall assemblies consisting of the identical design, materials, mix, and construction methods as the actual wall construction and in accordance with ASTM E514/E514M. Prepare a minimum of three specimens and cure for minimum 28 days prior to testing. Construct panels by the same methods, processes, and applications to be used on the project's construction site. Spray test for 6 hours on each specimen. If water is visible on back of test panels during the test and areas of dampness on the backside of the test panels do not exceed 25 percent of the wall area, the panels will be considered to have passed. Dampness is defined as any area of surface darkening or discoloration due to moisture penetration or accumulation below the observed surface.

Construct additional test panels for each failed test performed until three test panels pass the test. Factors that can affect test performance include materials, mixing, and quality of application and workmanship. Materials, mixing, and methods adjustments may be necessary in order to provide construction that passes the water penetration test. Document and record the test specimen construction materials and application and provide written test report in accordance with ASTM E514/E514M, supplemented by a detailed discussion of the specifics of test panel construction, application methods and processes used, quality of construction, and any variances or deviations that may have occurred between test panels during test panel construction. For failed test panels, identify in the supplemental report the variances, deficiencies or flaws that contributed to test panel failure and itemize the precautions to be taken in field construction of the masonry wall to prevent similar deficiencies and assure the wall construction replicates test panel conditions that pass the water penetration test. Submit the complete, certified test report, including supplemental report, to the Contracting Officer prior to start of single-wythe concrete masonry wall construction. Significant changes to materials, proportions, or construction techniques from those used in the passing water penetration test are grounds for performing new tests, at the discretion of the Contracting Officer.

3.6.2 Special Inspection

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NOTE: The designer must indicate on the drawings

all locations and all features for which special inspection and testing is required. This includes indicating the locations of all structural components and connections requiring inspection.
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Perform special inspections and testing in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

3.7 POINTING AND CLEANING

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NOTE: Cleaning of masonry using water pressure may be necessary, but the pressure used should be the minimum required to successfully clean the masonry surface. Saturating the masonry wall in the cleaning process should be avoided.
****

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs and splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, rake out defects in joints of masonry to be exposed or painted, fill with mortar, and tool to match existing joints. Immediately after grout work is completed, remove scum and stains that have percolated through the masonry work using a low pressure stream of water and a stiff bristled brush. Do not clean masonry surfaces, other than removing excess surface mortar, until mortar in joints has hardened. Leave masonry surfaces clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Do not use metal tools and metal brushes for cleaning.

3.7.1 Dry-Brushing Concrete Masonry

Dry brush exposed concrete masonry surfaces at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.7.2 Clay Brick Surfaces

Clean exposed clay brick masonry surfaces to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. Perform cleaning in accordance with the approved cleaning procedure demonstrated on the mockup.

After cleaning, examine the sample panel of similar material for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, change the method of cleaning to ensure that the masonry surfaces in the structure will not be adversely affected. Water-soak exposed masonry surfaces and then clean with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay brick manufacturer and manufacturer of the cleaning product. Apply the solution with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Use proprietary cleaning agents in conformance with the cleaning product manufacturer's printed recommendations. Remove efflorescence in conformance with the brick manufacturer's recommendations.

3.8 CLOSE-OUT TAKE-BACK PROGRAM

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NOTE: Take-back programs refer to programs in which the product manufacturer "takes-back" scrap material and/or packaging associated with its product.

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Collect information from manufacturer for take-back program options. Set aside [masonry units, full and partial] [scrap] [packaging] [_____] to be returned to manufacturer for recycling into new product. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

3.9 PROTECTION

****

NOTE: Covering masonry walls is required for protection from detrimental moisture intrusion, which can result in efflorescence, or as required by cold weather masonry construction provisions. In certain geographical areas, vertical reinforcement may be placed prior to installation of masonry units, which can significantly interfere with covering masonry walls.

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Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane to protect from moisture intrusion when work is not in progress. Continue covering the top of the unfinished walls until the wall is waterproofed with a complete roof or parapet system. Extend covering a minimum of 600 mm 2 feet down on each side of the wall and hold securely in place. Before starting or resuming work, clean top surface of masonry in place of loose mortar and foreign material.

-- End of Section --