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USACE / NAVFAC / AFCESA / NASA | **UFGS-04 20 00.00 40 (June 2006)**

Preparing Activity: NASA | **Superseding**
UFGS-04 20 00.00 40 (April 2006)
NASA-04200S (December 2005)
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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 18 July 2006

Revised throughout - changes indicated by CHG tags
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SECTION 04 20 00.00 40

UNIT MASONRY
06/06

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NOTE: This guide specification covers the requirements for reinforced and nonreinforced masonry.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

This guide specification includes tailoring options for CMU, brick, PC items, stone, and insulation. Selection or deselection of a tailoring option will include or exclude that option in the section, but editing the resulting section to fit the project is still required.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
****

PART 1 GENERAL

****
NOTE: This guide specification covers reinforced and nonreinforced 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 to resist the design loading conditions. Design will conform to ACI/MCP 605, ASCE 5-92 BUILDING CODE REQUIREMENTS FOR MASONRY STRUCTURES, including Appendix A for seismic design.

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 nonreinforced masonry.

The following information will be shown 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 reinforcing.

8. Reinforcing 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 or UL assembly for fire rated walls.

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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 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.

ACI INTERNATIONAL (ACI)

ACI 318M/318RM	(2002) Building Code Requirements for Structural Concrete and Commentary
ACI SP-66	(2004) ACI Detailing Manual
ACI/MCP 605	(2005) Manual of Concrete Practice Part 6 (2005): 504R-90 to ITG3-04

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 615/A 615M	(2005a) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 641/A 641M	(2003) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 82	(2005) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM B 370	(2003) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C 1019	(2005) Standard Test Method for Sampling and Testing Grout
ASTM C 1072	(2000a) Measurement of Masonry Flexural Bond Strength
ASTM C 1142	(1995; R 2001) Extended Life Mortar for Unit Masonry
ASTM C 1289	(2005) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 129	(2003) Nonloadbearing Concrete Masonry Units

ASTM C 140	(2005) Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM C 207	(2005) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 216	(2005) Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 27	(1998; R 2002) Fireclay and High Alumina Refractory Brick
ASTM C 270	(2005a) Standard Specification for Mortar for Unit Masonry
ASTM C 315	(2002) Clay Flue Linings
ASTM C 476	(2002) Standard Specification for Grout for Masonry
ASTM C 494/C 494M	(2005) Standard Specification for Chemical Admixtures for Concrete
ASTM C 55	(2003) Concrete Brick
ASTM C 578	(2005) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 62	(2004a) Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 641	(1998e1) Staining Materials in Lightweight Concrete Aggregates
ASTM C 652	(2001a) Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
ASTM C 67	(2003a) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C 73	(1999a) Calcium Silicate Brick (Sand-Lime Brick
ASTM C 744	(2005) Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(2005) Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and

Reinforced Unit Masonry

ASTM C 90	(2005a) Standard Specification for Loadbearing Concrete Masonry Units
ASTM C 91	(2005) Standard Specification for Masonry Cement
ASTM C 94/C 94M	(2004a) Standard Specification for Ready-Mixed Concrete
ASTM D 2000	(2005) Standard Classification System for Rubber Products in Automotive Applications
ASTM D 2240	(2005) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2287	(1996; R 2001) Standard Specification for Non-rigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 119	(2000a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 514	(2003) Water Penetration and Leakage Through Masonry

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(2003) International Plumbing Code

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04	(1998) Seismic Design for Buildings

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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.

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" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation 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

Structural Masonry[; G][; G, [_____]]

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. Bar splice locations shall be shown. If the Contractor opts to furnish inch-pound CMU products, drawings showing elevation of walls exposed to view and indicating the location of all cut CMU products shall be submitted for approval. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. 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, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1 to 50. 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-03 Product Data

Clay or Shale Brick[; G][; G, [_____]]
Concrete Brick[; G][; G, [_____]]
Insulation[; G][; G, [_____]]
Flashing[; G][; G, [_____]]
Water-Repellant Admixture[; G][; G, [_____]]

Manufacturer's descriptive data.

Cold Weather Installation[; G][; G, [_____]]

Cold weather construction procedures.

SD-04 Samples

Concrete Masonry Units (CMU)[; G][; G, [_____]]
Concrete Brick[; G][; G, [_____]]
Stone Items[; G][; G, [_____]]
Clay or Shale Brick[; G][; G, [_____]]

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture. Submit sample of colored mortar with applicable masonry unit.

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

Two of each type used.

Expansion-Joint Materials[; G][; G, [_____]]

One piece of each type used.

Joint Reinforcement[; G][; G, [_____]]

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Insulation[; G][; G, [_____]]

One piece of board type insulation, not less than 400 by 600 mm 16 by 24 inches in size, containing the label indicating the rated permeance and R-values.

Portable Panel[; G][; G, [_____]]

One panel of clay or shale brick, 600 by 600 mm, 2 by 2 feet, containing approximately 24 brick facings to establish range of color and texture.

SD-05 Design Data

Pre-mixed Mortar[; G][; G, [_____]]
Unit Strength Method[; G][; G, [_____]]

Pre-mixed mortar composition. Calculations and certifications of masonry unit and mortar strength.

SD-06 Test Reports

Efflorescence Test[; G][; G, [_____]]
Field Testing of Mortar[; G][; G, [_____]]
Field Testing of Grout[; G][; G, [_____]]
Prism tests[; G][; G, [_____]]
Masonry Cement[; G][; G, [_____]]
Fire-rated CMU[; G][; G, [_____]]

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection[; G][; G, [_____]]

Copies of masonry inspector reports.

SD-07 Certificates

Clay or Shale Brick
Concrete Brick
Concrete Masonry Units (CMU)
Control Joint Keys
Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Joint Reinforcement
Reinforcing Steel Bars and Rods
Masonry Cement
Mortar Coloring
Insulation
Precast Concrete Items
Admixtures for Masonry Mortar
Admixtures for Grout

Certificates of compliance stating that the materials meet the specified requirements.

Insulation

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

SD-08 Manufacturer's Instructions

Masonry Cement

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

1.3 SAMPLE MASONRY PANELS

****
NOTE: Sample 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.
****

After material samples are approved and prior to starting masonry work, a portable panel of clay or shale brick and sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

1.3.1 Configuration

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

1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for 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 shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain [a masonry bonded corner] [a stacked bond corner] that includes a bond beam corner. Panels shall show [parging] [and] [installation of electrical boxes and conduit]. Panels that represent reinforced masonry shall contain a 600 by 600 mm 2 by 2 foot opening placed at least 600 mm 2 feet above the panel base and 600 mm 2 feet away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.3.3 Construction Method

Where anchored veneer walls are required, the Contractor shall 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. Temporary provisions shall be demonstrated 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, the Contractor shall 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. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid

chipping, breakage, and contact with soil or contaminating material.

1.4.1 Masonry Units

Cover and protect moisture-controlled concrete masonry units and cementitious materials from precipitation. Conform to all requirements of ASTM C 90. Prefabricated lintels shall be marked 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

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.5 STRUCTURAL MASONRY

1.5.1 Special Inspection

****
NOTE: This paragraph will be used for masonry construction only when f'm used in design is more than 10 MPa 1500 psi.
****

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

1.5.2 Unit Strength Method

****
NOTE: Use this method for clay masonry conforming to ASTM C 216, ASTM C 62, or ASTM C 652, and tested by ASTM C 67, with bed joints not exceeding 16 mm 5/8 inch and grouted, ASTM C 476, with strength at least equal to f'm, and also for concrete masonry

units conforming to ASTM C 90 or ASTM C 55, with bed joints and grout same as clay masonry. If masonry does not meet these requirements, use Prism Test Method.

****

Compute compressive strength of masonry system "Unit Strength Method," ACI/MCP 605. Submit calculations and certifications of unit and mortar strength.

1.5.3 Seismic Requirement

****

NOTE: For Army projects refer to TI 809-04; for Navy projects refer to minimum seismic reinforcing required in NAVFAC P-355, Chapter 13.

****

In addition to design requirements of ICC IPC, the Contractor shall provide additional seismic reinforcement [in accordance with TI 809-04] [as detailed on [the drawings] [sketches [_____] which are attached at the rear of this section]]. The total minimum reinforcing percentage for structural walls shall be 0.20 percent and non-structural walls shall be 0.15 percent. The maximum spacing of reinforcing bars shall be as follows:

Wall Type	Vertical	Horizontal
Structural	0.609 m	1.219 m
Non-structural	1.219 m	2.032 m
Wall Type	Vertical	Horizontal
Structural	24 inches	48 inches
Non-structural	48 inches	80 inches

Bond beams are required at the top of footings, at the bottom and top of openings at roof and floor levels, and at the top of parapet walls.

1.6 QUALITY ASSURANCE

1.6.1 Appearance

****

NOTE: A typical manufacturing batch of brick produces about 150,000 brick. Confirm with manufacturer if the job can be run in one batch to utilize the desirable bracketed option in the following paragraph.

****

[Bricks shall be manufactured at one time and from the same batch.] Blend all brick to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable.

1.6.2 Testing

Masonry strength shall be determined in accordance with ACI/MCP 605; submit test reports on three prisms as specified in ACI/MCP 605. The cost of testing shall be paid by the Contractor.

1.6.3 Spare Vibrator

****
NOTE: On small projects, requirement for spare vibrator may be deleted.
****

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

1.6.4 Bracing and Scaffolding

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval. The Contractor has the option to use either hard metric or substitute inch-pound (soft-metric) CMU products. If the Contractor decides to substitute inch-pound CMU products, the following additional requirements shall be met:

a. The metric dimensions indicated on the drawings shall not be altered to accommodate inch-pound CMU products either horizontally or vertically. The 100 mm building module shall be maintained, except for the CMU products themselves.

b. Mortar joint widths shall be maintained as specified.

c. Rebars shall not be cut, bent or eliminated to fit into the inch-pound CMU products module.

d. Brick and inch-pound CMU products shall not be reduced in size by more than one-third (1/3) in height and one-half (1/2) in length. Cut CMU products shall not be located at ends of walls, corners, and other openings.

e. Cut, exposed brick and CMU products shall be held to a minimum and located where they would have the least impact on the architectural aesthetic goals of the facility.

f. Other building components, built into the CMU products, such as window frames, door frames, louvers, grilles, fire dampers, etc., that are required to be metric, shall remain metric.

g. Additional metric guidance shall conform to Section 00 31 10 METRIC MEASUREMENTS.

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. Brick facings may be limited to Grade SW units where previous experience indicates that surfaces of Grade MW facings, 10 years of age in the project area, have deteriorated due to weathering.

Types FBS and HBS brick are for general use where normal size variation and color range is acceptable. Types FBX and HBX permit less variation. Types FBA and HBA permit large variations for special architectural effect.

Bricks of various modular sizes are available and, if for architectural reasons, other size bricks are included in the design, the nominal size selected shall be specified as necessary. If larger units, such as utility brick are required, change the specified dimensions. If nominal dimensions are used, they should be so noted.

****

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Brick shall conform to ASTM C 62; Grade SW shall be used for brick in contact with earth or grade and for [the first six exterior courses above grade] [all exterior work] and for all nonvertical surfaces. Grade SW or MW shall be used in other brickwork. Average dimensions of brick shall be 90 mm thick, 57 mm high, and 190 mm long (standard) 3-5/8 inches thick, 2-1/4 inches high, and 8 inches long (standard) or 4 inches thick, 2-2/3 inches high, and 8 inches long (nominal), subject to the tolerances specified in ASTM C 62. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.1 Solid Clay or Shale Brick

****

NOTE: ASTM C 216 may be deleted for projects located where brick conforming to ASTM C 62 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.

Specify facing brick only where aesthetic value is a prime consideration or to match existing construction. See ASTM C 216 for conditions under

which Grade MW may be allowed.

If larger units, such as utility brick, are required, change the specified dimensions. If nominal dimensions are used, they should be so noted. Consider the use of closure or utility brick when it is architecturally acceptable, though not solid, at least as a Contractor's option. The cost per square foot of wall is about 15 percent less for closure brick, 20 percent less for utility brick, than for standard brick. Use paragraph titled "Closure or Utility Brick" below.

****

Solid clay or shale brick shall conform to [ASTM C 62] [ASTM C 216, Type [FBS] [FBA] [FBX]]. Brick size shall be modular and the nominal size of the brick used shall be 92 mm 3-5/8 inches thick, 57 mm 2-1/4 inches high, and 200 mm 8 inches long (nominal) or 100 mm thick, 68 mm high and 200 mm long (nominal) 4 inches thick, 2-2/3 inches high and 8 inches long (nominal). Minimum compressive strength of the brick shall be [_____] MPa psi.

2.2.2 Hollow Clay or Shale Brick

****

NOTE: For exposed exterior and interior masonry, HBX has narrow color variation and high degree of mechanical perfection. Use HBS where greater variation is allowed. For architectural effects resulting from nonuniformity in size, color, and texture, use HBA. Use HBB where color and texture are not a consideration and a greater variation in size is permitted.

****

Hollow clay or shale brick shall conform to ASTM C 652, Type [HBS] [HBX] [HBA] [HBB]. Brick size shall be modular and the nominal size of the brick used shall be [_____] mm [_____] inches thick, [_____] mm [_____] inches high, and [_____] mm [_____] inches long. Where vertical reinforcement is shown in hollow brick, the minimum cell dimension shall be 64 mm (2-1/2 inches) 2-1/2 inches and the units shall be designed to provide precise vertical alignment of the cells. Minimum compressive strength of the brick shall be [_____] MPa [_____] psi.

2.2.3 Sand-Lime Brick

****

NOTE: Where all sand-lime brick is interior, Grade MW may be specified as an option to Grade SW.

****

ASTM C 73, Grade SW, approximately 92 mm thick, 57 mm high, 200 mm long (nominal) 3 5/8 inches thick, 2 1/4 inches high, and 8 inches long (nominal) or nominal modular, with smooth surfaces and natural color.

2.2.4 Refractory Brick

ASTM C 27, low-duty type, [_____] mm [_____] inches thick, [_____] mm [_____] inches high, and [_____] mm [_____] inches long.

2.2.5 Closure or Utility Brick

ASTM C 216, Grade SW, Type FBS, [92 mm thick, 92 mm high, and 200 mm long (closure) 3 5/8 inches thick, 3 5/8 inches high, and 8 inches long (closure)] [or] [nominally 100 mm thick, 100 mm high, and 305 mm long (utility) 4 inches thick, 4 inches high, and 12 inches long (utility)]. [Closure] [or] [Utility] brick may be used at the option of the Contractor, provided that changes necessitated by the use of such brick shall be the responsibility of the Contractor. Color, texture, and range of brick shall match the brick [on display at [_____]] [indicated].

2.3 CONCRETE BRICK

****
NOTE: Grade N is used for high strength and resistance to moisture penetration. Grade S is used for lesser strength and moisture resistance. Combined Grade-Type designations such as N and S are commonly used. Grade N units are for general use and may be exposed to weather. 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.
****

Concrete brick shall conform to ASTM C 55, Grade [N] [S]. Concrete brick may be used where necessary for filling out in concrete masonry unit construction.

2.4 CONCRETE MASONRY UNITS (CMU)

****
NOTE: Three weight classifications are included in ASTM C 90. It is important that the weight classification desired be designated. If structural design requires an f'm greater than 10 MPa 1500 psi, or if the requirement in subpart d. of paragraph entitled "Prism Tests," is specified greater than 10 MPa 1500 psi that must be indicated here by adding an exception which states the f'm.

Low alkali cement should be specified for use in CMU if efflorescence caused by the use of available cement is a problem. If efflorescence is not a problem edit last sentence.

A lightweight high performance CMU has been developed by USACERL. This unit provides equivalent performance to a standard normal weight CMU, yet weighs only 8.5 kg 19 pounds. This CMU does not meet a strict interpretation of the ASTM C 90 requirements and may require a variance from local building officials. Contact USACERL for supporting technical information.

Specify lightweight aggregate where required for structural or "U" value purposes. Coordinate with structural and mechanical designers. Specify only normal weight aggregate for single-wythe, ungrouted, exterior walls. For PACNAVFACENGCOM projects that conforms to ASTM C 55, specify Brick. Otherwise, light or normal weight aggregate should be optional with 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. This is a regional requirement which shall be used, when applicable, for SOUTHNAVFACENGCOM projects; when appropriate, the requirements may be used for projects in other areas. Use only with ASTM C 744 masonry units.

****

Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions and air, water, or steam cured. [Surfaces of units which are to be plastered or stuccoed shall be sufficiently rough to provide bond]; [elsewhere,] [exposed surfaces of units shall be smooth and of uniform texture]. [Exterior concrete masonry units shall have water-repellant admixture added during manufacture.]

a. Hollow Load-Bearing Units: ASTM C 90, made with lightweight [or medium weight] [or normal weight] aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Hollow Non-Load-Bearing Units: ASTM C 129, made with lightweight [or medium weight] [or normal weight] aggregate. Load-bearing units may be provided in lieu of non-load-bearing units.

c. Solid Load-Bearing Units: ASTM C 90, lightweight [or medium weight] [or normal weight] units. Provide solid units [for masonry bearing under structural framing members] [as indicated].

2.4.1 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.

****

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.4.2 Kinds and Shapes

****
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.
****

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 25 mm 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.4.2.1 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 shown on the drawings. Delete integral coloring if units will be painted or if natural color is satisfactory. CMU veneer wythes should be solid units to minimize trapping water which could lead to damage from freezing, mildew, and efflorescence.
****

Units shall have patterned face shell. Face shell pattern shall be [fluted] [vertical scored] [split ribbed] [_____]. Units shall be integrally colored during manufacture. Color shall be [_____]. Patterned face shell shall be properly aligned in the completed wall.

2.4.2.2 Patterned, Decorative Screen Units

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

Concrete masonry units conforming to applicable requirements of ASTM C 129 are suitable for interior nonload-bearing screens, and may be specified where required.
****

Patterned, decorative screen units shall conform to the applicable requirements of [ASTM C 90] [ASTM C 129]. Units shall have uniform through-the-wall pattern, color, and texture.

2.4.3 Fire-Rated CMU

****

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 concrete 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.

****

Concrete masonry units used in fire-rated construction shown on the drawings shall be 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 on the aggregate requiring the greater minimum equivalent thickness to produce the required fire rating. Construction shall conform to ASTM E 119.

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

	Minimum equivalent thickness in mm (inches) for fire rating of:		
Aggregate Type	4 hours	3 hours	2 hours
Pumice	120	100	75
Expanded slag	130	110	85
Expanded clay, shale, or slate	145	120	95
Limestone, scoria, cinders or unexpanded slag	150	130	100
Calcareous gravel	160	135	105
Siliceous gravel	170	145	115

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

	Minimum equivalent thickness inches for fire rating of:		
Aggregate Type	4 hours	3 hours	2 hours
Pumice	4.7	4.0	3.0

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

	See note (a) below		
Expanded slag	5.0	4.2	3.3
Expanded clay, shale, or slate	5.7	4.8	3.7
Limestone, scoria, cinders or unexpanded slag	5.9	5.0	4.0
Calcareous gravel	6.2	5.3	4.2
Siliceous gravel	6.7	5.7	4.5

a Minimum equivalent thickness shall equal net volume as determined in conformance with ASTM C 140 divided by the product of the actual length and height of the face shell of the unit in millimeters inches. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; the thickness of plaster or brick or other material in the assembly will be included in determining the equivalent thickness.

2.5 PRECAST CONCRETE ITEMS

Trim, lintels, copings, splashblocks and door sills shall be factory-made units from a plant regularly engaged in producing precast concrete units. 93Unless otherwise indicated, concrete shall be [28] [20] MPa [4,000] [3000] psi minimum conforming to Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE using 13 mm (1/2 inch) 1/2 inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 20 mm 3/4 inch shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 827 kPa (120 psi) 120 psi for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 35 kg 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises and shall be cast with drip grooves on the underside where units overhang walls. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.5.1 Lintels

****

NOTE: Insert strength of concrete; precast lintels usually range from 17 to 25 MPa 2500 to 3500 psi.

****

Precast lintels, unless otherwise shown, shall be of a thickness equal to the wall and reinforced with two No. 4 bars for the full length. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure. In reinforced masonry, lintels shall conform to ACI 318M/318RM for flexural and shear strength and shall have at least 200 mm 8 inches bearing at each end. Concrete shall have a minimum 28 day compressive strength of [_____] MPa psi using 12 mm 1/2 inch to No. 4 nominal-size coarse aggregate. Reinforcement shall conform to ASTM A 615/A 615M Grade 400 MPa 60. Limit lintel deflection due to dead plus live load to L/600 or 7 mm 0.3 inches. Provide top and bottom bars for lintels over 900 mm 36 inches in length.

2.5.2 Sills and Copings

Sills and copings shall be cast with washes. Sills for windows having mullions shall be cast in sections with head joints at mullions and a 6 mm (1/4 inch) 1/4 inch allowance for mortar joints. The ends of sills, except a 20 mm 3/4 inch wide margin at exposed surfaces, shall be roughened for bond. Treads of door sills shall have rounded nosings. [Reinforce sills with not less than two No. 15 No. 4 bars.]

2.5.3 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

2.5.4 Flue Linings and Thimbles

ASTM C 315, free from fractures. Sizes and shapes shall be as indicated.

2.6 STONE ITEMS

****

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.

****

Stone for trim, sills, lintels, and copings shall be limestone, sandstone, or granite, and shall be cut to the design shown. Sandstone shall be standard grade, buff, gray, or buff brown, with a smooth finish free from clay pits and tool marks. Granite shall be a good commercial grade building granite of medium or moderately coarse grain, and a light or medium gray or light pink color, with a smooth machine finish on washes, 4-cut finish on treads, and 6-cut or equivalent machine finish on other exposed surfaces. Limestone shall be standard buff limestone with a smooth machine finish free from tool marks. Lintels, except when supported by a steel member, shall be 100 mm 4 inches or more thick from face to back edge and of the depth required to support the masonry over the opening. Stone shall have beds and joints at right angles to the face, with sharp, true arises. Copings and sills shall be provided with washes, and where overhanging the walls, shall have drips cut on the underside.

2.7 MORTAR FOR STRUCTURAL MASONRY

****

NOTE: The defaults for mortar and grout materials in ASTM C 270 and ASTM C 476 are all right for general construction. Specify Type III portland cement for cold weather construction, Type II for moderate sulfate resistance. The blended cements make a gray mortar; specify portland cement mortar or masonry cement if white or colored mortar is necessary. Use only Type S for exterior walls and M below ground. Do not use Type O in areas of moderate or high seismic activity. Do not use Type N in areas of high seismic activity.

A, added to Type designation, i.e. IIA, means air-entrained. Use this for exterior mortar in severe climates, but do not use for grout.

ASTM C 270 TABLE 2 Property Specification Requirements
(For laboratory prepared mortar only)

Mortar	Type	Average Compressive Strength at 28 Days Min. MPa	Water Retention Min. Percent	Air Content Max. Percent	Aggregate Ratio (Measured in Damp, Loose Condition)
Cement-lime	M	17	75	12	Not less than 2 1/4 and not more than 3 1/2 time the sum of the separate volumes of cementitious materials
	S	12	75	12	
	N	5	75	14*	
	O	2	75	1	
Masonry cement	M	17	75	**	
	S	12	75	**	
	N	5	75	**	
	O	2	75	**	

* When structural reinforcement is incorporated in cement-lime mortar, the maximum air content shall be 12 percent.

** When structural reinforcement is incorporated in masonry cement mortar, the maximum air content shall be 18 percent.

Type N should be used only for non-load-bearing walls. Approximate the f'm of the unit masonry. Mortars should be slightly weaker than masonry units so that cracking will occur in joints where easy to repair.

ASTM C 270 TABLE 2 Property Specification Requirements
(For laboratory prepared mortar only)

Mortar	Type	Average Compressive Strength at 28 Days Min. psi	Water Retention Min. Percent	Air Content Max. Percent	Aggregate Ratio (Measured in in Damp, Loose Condition)
Cement-lime	M	2500	75	12	Not less than

ASTM C 270 TABLE 2 Property Specification Requirements (For laboratory prepared mortar only)

Mortar	Type	Average Compressive Strength at 28 Days Min. psi	Water Retention Min. Percent	Air Content Max. Percent	Aggregate Ratio (Measured in in Damp, Loose Condition)
	S	1800	75	12	2 1/4 and not more than 3 1/2 times the sum of the separate volumes of cementitious materials
	N	750	75	14*	
	O	350	75	14*	
Masonry cement	M	2500	75	**	
	S	1800	75	**	
	N	750	75	**	
	O	350	75	**	

* When structural reinforcement is incorporated in cement-lime mortar, the maximum air content shall be 12 percent.

** When structural reinforcement is incorporated in masonry cement mortar, the maximum air content shall be 18 percent.

Type N should be used only for non-load-bearing walls. Approximate the f'm of the unit masonry. Mortars should be slightly weaker than masonry units so that cracking will occur in joints where easy to repair.

****

ASTM C 270, Type [M] [N] [S]. Strength (f'm) as indicated. Test in accordance with ASTM C 780. [Use Type [I] [II] [III] portland cement.] [Use Type [IS] [IP] [I(PM)] blended hydraulic cement.] [Use Masonry cement.] Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar and 18 percent in masonry cement mortar.

2.8 MASONRY MORTAR

****

NOTE: See ASTM C 270 for guidance in selecting mortar types. Use Type M when masonry is in contact with earth and high degree of compressive strength is required.

Type S should be used for reinforced masonry and when high degree of compressive strength or high degree of lateral load resistance is required. Type S mortar provides worability, weather tightness, durability and corrosion protection, and will be used for most work. For cavity wall construction, a high degree of lateral load is defined as an 130 km/h (80 mph) wind.

Type N mortar generally provides improved workability and weather tightness; it has lower strength, durability and corrosion protection than

Type S. It should be used for all general interior and exterior above grade masonry construction including chimneys and parapets unless higher compressive strength or a high degree of lateral load resistance is required. For SOUTHNAVFACENGCOM projects, use only Type S mortar for exterior walls except use Type M mortar when masonry is in contact with earth.

The proportions allowed by ASTM C 270 for cement-lime mortars can result in properties that are essentially of another mortar type. Mortars proportioned for high strength can lead to debonding between the mortar joint and the brick resulting in reduced wall flexural capacity and increased water penetration leading to efflorescence problems. Therefore the proportions for cement-lime Types S and N mortars will be as shown below.

Mortar coloring may be specified as required by architectural design.

Low alkali cement should be specified for use in mortar if efflorescence caused by the use of available cement is a problem.

****

Type M mortar shall conform to ASTM C 270 and shall be used for foundation walls [, basement walls,] [and piers]. Mortar Type [S] [N] shall conform to the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate. Type N or S mortar shall be used for non-load-bearing, non-shear-wall interior masonry; [approved commercial fire clay mortar or refractory cement (calcium-aluminate) mortar for fire brick and flue liners;] and Type S for remaining masonry work; except where higher compressive strength is indicated on structural drawings. When masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.8.1 Admixtures for Masonry Mortar

****

NOTE: Admixtures may cause efflorescence and may adversely affect the strength of the mix or the protection of embedded steel items.

****

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C.

2.8.2 Colored Mortar

****
NOTE: Indicate on the drawings locations of colored mortar.
****

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color matching [_____]. Quantity of pigment to cementitious content of the masonry cement shall not exceed [5] [_____] by weight; carbon black shall not exceed [1] [_____] percent by weight. Quantity of pigment to cementitious content of cement-lime mix shall not exceed [10] [_____] percent by weight, carbon black no more than [2] [_____] percent by weight. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement. Compressive strength of colored mortar shall equal [_____].

2.8.3 Hydrated Lime and Alternates

****
NOTE: Lime alternates can increase spreadability.
****

Hydrated lime shall conform to ASTM C 207, Type [S] [SA]. Lime alternates which have a current ICBO, ICBO UBC, Evaluation Report number whose findings state it may be used as an alternate to lime for Type M, S, N, and O mortars will be deemed acceptable provided the user follows the manufacturer's proportions and mixing instructions as set forth in ICBO report.

2.8.4 Cement

Portland cement shall conform to ASTM C 150, Type I, [IA,] II, [IIA,] or III, [IIIA]. Masonry cement shall conform to ASTM C 91, Type [N] [S] [M]. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

2.8.5 Pre-Mixed Mortar

Pre-mixed mortar shall conform to ASTM C 1142, Type [RN] [RS] [RM].

2.8.6 Sand and Water

Sand shall conform to ASTM C 144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

2.9 WATER-REPELLANT ADMIXTURE

****
NOTE: For single-wythe, concrete masonry unit exterior walls, specify water-repellant admixture for both the masonry units and the mortar. This is a regional requirement which shall be used, when applicable, for SOUTHNAVFACENGCOM projects; when appropriate, the requirements may be used for projects in other areas. Use only with ASTM C 744 masonry units.
****

Polymeric type formulated to reduce porosity and water transmission. Construct panels of masonry units conforming to ASTM C 744 and mortar which contain the water-repellant admixture. When tested in accordance with ASTM C 1072, such panels shall have flexural strength not less than that specified or indicated. When tested in accordance with ASTM E 514, panels shall exhibit no water visible on back of test panel and no leaks through the panel after 24 hours, and not more than 25 percent of wall area shall be damp after 72 hours.

2.10 GROUT AND READY-MIXED GROUT

****

NOTE: Low alkali cement should be specified for use in grout if efflorescence caused by the use of available cement is a problem.

For structural masonry, the following applies. The defaults for mortar and grout materials in ASTM C 270 and ASTM C 476 are all right for general construction. Specify Type III portland cement for cold weather construction, Type II for moderate sulfate resistance. The blended cements make a gray mortar; specify portland cement mortar or masonry cement if white or colored mortar is necessary. Use only Type S for exterior walls and M below ground. Do not use Type O in areas of moderate or high seismic activity. Do not use Type N in areas of high seismic activity.

Choice of fine or coarse grout depends on width of grout space and pour height; a table with this information is in ACI/MCP 605.

****

Grout shall conform to ASTM C 476, [fine] [coarse]. Cement used in grout shall have a low alkali content. Grout slump shall be between 200 and [250] [280] mm. 8 and [10] [11] inches. Minimum grout strength shall be 14 MPa 2000 psi in 28 days, as tested by ASTM C 1019. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C 94/C 94M.

2.10.1 Admixtures for Grout

****

NOTE: Admixtures, including air entrainment, may cause efflorescence and may adversely affect the strength of the mix or the protection of embedded steel items.

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

****

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer.

2.10.2 Grout Barriers

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

2.11 ANCHORS, TIES, AND BAR POSITIONERS

****

NOTE: By definition, ties are connections between masonry elements, anchors connect masonry to the structure, and fasteners are for attachments 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 will be deleted. If special anchors or ties are required by the design, they will be specified to meet the necessary requirements.

Wire ties, centering devices, and joint reinforcement are available with three weights of zinc coating and are recommended for the following types of exposure:

Exposure	Finish	Wt. of Coating in Gram Per Sq. Meter for 9 ga wire
Joint reinforcement, interior walls	ASTM A 641/A 641M Class 1	100
Wire ties or anchors in exterior, completely embedded in mortar or grout	ASTM A 641/A 641M Class 3	270
Wire ties or anchors in exterior walls not completely embedded in mortar or grout	ASTM A 153/A 153M Class B	540
Joint reinforcement in exterior walls or interior walls exposed to moist environments (e.g. natatoria and food processing)	ASTM A 641/A 641M Class B	540

Exposure	Finish	Wt. of Coating in Oz. Per Sq. Foot for 9 ga wire
Joint reinforcement, interior walls	ASTM A 641/A 641M Class 1	.35
Wire ties or anchors in exterior, completely embedded in mortar or grout	ASTM A 641/A 641M Class 3	.90
Wire ties or anchors in exterior walls not completely embedded in mortar or grout	ASTM A 153/A 153M Class B	1.80
Joint reinforcement in exterior walls or interior walls exposed to moist environments (e.g. natatoria and food processing)	ASTM A 641/A 641M Class B	1.80

	Finish	Wt. of Coating (sheets) Gram Per Sq. Meter
Sheet metal ties or anchors exposed to weather	ASTM A 153/A 153M Class B-2	458
Sheet metal ties or anchors completely embedded in mortar	ASTM A 653/A 653M Z180	180

	Finish	Wt. of Coating (sheets) Oz. Per Sq. Foot
Sheet metal ties or anchors exposed to weather	ASTM A 153/A 153M Class B-2	1.50
[Sheet metal ties or anchors completely embedded in mortar	ASTM A 653/A 653M Class G60]	.60

****

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Wire ties or anchors in exterior walls shall conform to ASTM A 641/A 641M. Joint reinforcement in interior walls, and in exterior or interior walls exposed to moist environment shall conform to ASTM A 641/A 641M; coordinate with paragraph JOINT REINFORCEMENT below. Anchors and ties shall be sized to provide a minimum of 16 mm 5/8 inch mortar cover from either face.

2.11.1 Wire Mesh Ties

****

NOTE: Wire mesh ties will only be used to tie 100 mm 4 inch thick concrete masonry unit partitions to other intersecting masonry partition walls.

****

Wire mesh for tying 100 mm 4 inch thick concrete masonry unit partitions to other intersecting masonry partitions shall be 13 mm 1/2 inch mesh of minimum 16 gauge 16 gauge steel wire. Minimum lengths shall be not less than 300 mm 12 inches.

2.11.2 Wall Ties

****

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 anchored veneer 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.

For SOUTHNAVFACENGCOM projects, add to text: "Provide anchors and ties for cavity walls with integral drip located in the cavity." Do not use corrugated metal ties in cavity walls; they are very thin and prone to corrosion. These ties are generally used in residential construction.

Z-shaped ties should only be specified when bonding walls constructed with solid units (not less than 75 percent of the gross cross-sectional area being solid). Rectangular ties may be used with either solid or hollow units.

Adjustable wall ties may be used in areas of low seismic activity when the design wind speed is less than 160 km/hr 100 mph; designer must follow the guidance provided in TI 809-04 Seismic Design for Buildings for any seismic design. 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.

****

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 5 mm 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 100 mm 4 inches wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 5 mm 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 13 mm 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 2 mm 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

2.11.3 Dovetail Anchors

Dovetail anchors shall be of the flexible wire type, 5 mm 3/16 inch diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge 12 gauge or heavier steel dovetail section. These anchors shall be used for anchorage of veneer wythes or composite-wall facings extending over the face of concrete columns, beams, or walls. Cells within vertical planes of these anchors shall be filled solid with grout for full height of walls or partitions, or solid units may be used. Dovetail slots are specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.11.4 Adjustable Anchors

****
NOTE: Adjustable anchors will be used to anchor masonry to structural steel columns or beams. The fixed portion of the anchors (steel anchor rods) will be welded to the structural steel member. In instances where standard anchors are not available, such as when anchoring masonry to a steel beam that is offset from the masonry wall line, anchors will be detailed on the drawings.
****

Adjustable anchors shall be 5 mm 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 8 mm 5/16 inch diameter steel bars placed to provide 2 mm 1/16 inch play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.11.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.12 JOINT REINFORCEMENT

****
NOTE: Location of horizontal joint reinforcement should be shown on the drawings. Reinforcement will have one 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 mm	3.8 mm
Heavy Duty	4.8 mm	3.8 mm
Extra Heavy Duty	4.8 mm	4.8 mm

	Long. wires	Cross wires
Standard	9 gauge (0.1483 inch)	9 gauge
Heavy Duty	3/16 inch (0.1875 inch)	9 gauge
Extra Heavy Duty	3/16 inch	3/16 inch

Reinforcement made with 4.2 mm (8 gauge) wire is considered special and is not available from all manufacturers.

****

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of [9] [_____] gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 16 mm 5/8 inch cover from either face. The distance between crosswires shall not exceed 400 mm 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 3 m 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.13 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.14 CONTROL JOINT KEYS

****

NOTE: Control joint keys are generally not required vertically between the floor line or grade to other floor lines or roofs 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, 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.

****

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 16 mm 5/8 inchthick and 10 mm 3/8 inch thick flanges, with a tolerance of plus or minus 2 mm 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a

temperature of minus 34 degrees C minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.15 INSULATION

2.15.1 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 20 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 (11, in IP units) 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.

****

Rigid board-type insulation shall be extruded polystyrene, polyurethane, or polyisocyanurate. Polystyrene shall conform to ASTM C 578. Polyisocyanurate shall conform to ASTM C 1289, Type I, Class 1 or 2, faced with aluminum foil on both sides of the foam. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values.

2.15.1.1 Insulation Thickness and Air Space

The cavity space shall allow for a maximum insulation thickness of [50] [_____] mm, [2] [_____] inches, and a minimum air space of 20 mm 3/4 inch.

2.15.1.2 Aged R-Value

The insulation shall provide a minimum aged R-value of [2] [_____] [11] [_____] for the overall thickness. The aged R-value shall be determined at

24 degrees C 75 degrees F in accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

2.15.1.3 Recovered Material

****
NOTE: Detailed information concerning EPA requirements on recycled/recovered materials is available at the following URL's: http://www.epa.gov/cpg/products/ and then click on the appropriate item from the list (building.htm for building insulation, for example). http://www.epa.gov/cpg/products.htm (similar results). http://www.epa.gov/cpg/pdf/back.pdf which opens up EPA530-R-98-003 (dated July, 1998, titled BACKGROUND DOCUMENT FOR PROPOSED CPG III AND DRAFT RMAN III).

Using data from listed locations, fill in blank space for required percentage of recycled or recovered material. This is in accordance with the requirements of 40 CFR 247 and Section 01 62 35 RECYCLED / RECOVERED MATERIALS which should be included in all projects.
****

Contractor shall comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERD MATERIALS. The polyurethane or polyisocyanurate foam shall have a minimum recovered material content of [_____] percent by weight of the core material.

2.15.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.

2.16 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07 92 00.00 40 JOINT SEALANTS.

2.17 FLASHING

****
NOTE: Require flashing in exterior masonry walls, including single-wythe construction, at all obstructions such as bond beams, sills, lintels, and concrete tie beams. The wall design and detailing must conform to National Concrete Masonry

Association (NCMA) publications: TEK 13A, "Details for Building Dry Concrete Masonry Walls"; TEK 53, "Design of Concrete Masonry for Crack Control"; TEK 126, "Flashing Concrete Masonry"; BIA Technical Notes 7 for water penetration, resistance; and BIA Technical Notes 18A for crack control. Show locations and details on project drawings. This is a regional requirement which shall be used, when applicable, for SOUTHNAVFACENGCOM projects; when appropriate, the requirements may be used for projects in other areas.

Reinforced membrane flashing should only be an option for residential construction. Do not use polyester film flashing on any other type construction projects.

Copper may stain masonry and deteriorate in high chloride environments.

****

Flashing shall be as specified in Section 07 60 00.00 40 FLASHING AND SHEET METAL. Provide one of the following types [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.]

a. Coated-Copper Flashing: 0.2 kg 7 ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, elastic bituminous compound. Factory apply coating to a weight of not less than 1.8 kg per square meter 6 ounces per square foot (approximately 0.9 kg per square meter 3 ounces per square foot on each side).

b. Copper or Stainless Steel Flashing: Copper, ASTM B 370, minimum 450 g 16 ounce weight; stainless steel, ASTM A 167, Type 301, 302, 304, or 316, 4 mm 0.015 inch thick, No. 2D finish. Provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

[c. Reinforced Membrane Flashing: Polyester film core with a reinforcing fiberglass scrim bonded to one side. The membrane shall be impervious to moisture, flexible, and not affected by caustic alkalis. The material, after being exposed for not less than 1/2 hour to a temperature of 0 degrees C 32 degrees F, shall show 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.]

2.18 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum, plastic or wood blocking sized to form the proper size opening in head joints. Provide aluminum and plastic inserts with grill or screen-type openings designed to allow the passage of moisture from cavities and to prevent the entrance or insects. Ventilators shall be sized to match modular construction with a

standard 10 mm 3/8 inch mortar joint.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable onditions as set forth in ACI/MCP 605, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 37 degrees C 99 degrees F in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 32 degrees C 90 degrees F and the wind velocity is more than 13 km/h 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 1.2 m 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 4 degrees C 40 degrees F or temperature of masonry units is below 4 degrees C 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

Conform to ACI/MCP 605 for hot and cold weather masonry erection.

3.1.2.1 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 4 to 0 degrees C 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 4 and 49 degrees C 40 and 120 degrees F.

b. Air Temperature 0 to minus 4 degrees C 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 4 and 49 degrees C 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature minus 4 to minus 7 degrees C 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 4 and 49 degrees C 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 24 km/hour 15 mph.

d. Air Temperature minus 7 degrees C 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 4 and 49 degrees C 40 and 120 degrees F. Enclosure and

auxiliary heat shall be provided to maintain air temperature above 0 degrees C 32 degrees F. Temperature of units when laid shall not be less than minus 7 degrees C 20 degrees F.

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 4 to 0 degrees C 40 to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 0 to minus 4 degrees C 32 to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature minus 4 to minus 7 degrees C 25 to 20 degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature minus 7 degrees C 20 degrees F and Below. Masonry temperature shall be maintained above 0 degrees C 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.1.3 Stains

Potect 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.

3.1.4 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.

3.1.5 Surfaces

Surfaces on which masonry is to be placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 3 mm 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 LAYING MASONRY UNITS

****

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 alignment vertically. Where stacked bond is specified in reinforced hollow masonry, horizontal rebars shall be provided at 600 mm 2 foot intervals or horizontal joint reinforcement must be required in every other horizontal joint to provide mechanical bond between

adjacent units. Veneers should be anchored at 300 mm 12 inches on centers vertically when stacked bond is used and 400 mm 16 inches on centers vertically when running bond is used. 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.

****

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in [running] [stacked] [the indicated] bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 13 mm 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 13 mm 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 400 mm 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 200 mm 8 inches.

3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.2 Reinforced Concrete Masonry Units Walls

****

NOTE: For single-wythe, concrete masonry unit exterior walls, specify water-repellant admixture for both the masonry units and the mortar. This is a regional requirement which shall be used, when applicable, for SOUTHNAVFACENGCOM projects; when appropriate, the requirements may be used for projects in other areas. Use only with ASTM C 744 masonry units.

****

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 50 by 75 mm 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 12 mm 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be 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. Double walls shall be stiffened 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 the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Clay or Shale Brick Units

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

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view. [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.]

3.2.4.1 Wetting of Units

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

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 gm per minute per square inch) 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated 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.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.4.4 Brick-Faced Walls

****
NOTE: Use the first bracketed option for masonry cavity wall construction. Use the second bracketed option for cold-formed steel framing and brick veneer.
****

For brick-faced walls [bond the two wythes in every sixth brick course with continuous horizontal joint reinforcement.] [bond brick in the pattern as indicated on the drawings.] Provide additional bonding ties spaced not more than one meter 3 feet apart around the perimeter of and within 300 mm 12 inches of all openings.

a. Collar Joints: Fill collar joints solid with mortar as each course of brick is laid. Do not disturb units in place.

b. Brick Sills: Lay brick on edge, slope, and project not less than 10 mm 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.

3.2.4.5 Cavity Walls

****
NOTE: Include weep holes and dampproofing requirements in geographic areas where these are acceptable practices. Specify dampproofing for projects utilizing concrete masonry unit interior wythe cavity walls. Now that masonry wall cavities are usually at least half full of rigid board insulation, and the backup wythe is usually complete before the brickwork is started, the wood strip method of keeping the cavities clean is neither practicable nor effective. 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.

For SOUTHNAVFACENGCOM projects, use second bracketed statement in the eighth sentence.

****

Provide a continuous cavity as indicated. Securely tie the two wythes together with horizontal joint reinforcement. 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. With a hose and clean water, wash all mortar droppings and debris out of the cavity through the temporary openings at least twice 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.] Provide weep holes of open head joints spaced 600 mm 24 inches o.c. [wherever the cavity is interrupted] [at base of wall and vertical obstructions (e.g. lintels)]. [Cavity face of interior wythe shall be dampproofed in accordance with Section 07 11 13 BITUMINOUS DAMPPROOFING.]

3.2.4.6 Reinforced Brick Walls

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. Position reinforcing as indicated. Wire vertical reinforcing securely in position as the brickwork progresses. Use puddling rod or vibrator to consolidate the grout. The minimum clear distance between parallel bars shall be the nominal diameter of the bars; the minimum clear distance between masonry and reinforcing shall be 6 mm 1/4 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together. Stagger splices in adjacent horizontal bars.

3.2.4.7 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.

3.2.4.8 Brick Veneer

****
NOTE: Use this paragraph when cold-formed steel framing and brick veneer construction is required.
****

Provide a continuous cavity as indicated. Install brick veneer after sheathing, masonry anchors, and flashing have been installed to the cold-formed steel framing system. Care shall be provided to avoid damaging the moisture barrier. Damaged moisture barrier and flashing shall be repaired or replaced before brick veneer is installed. Means shall be provided to keep cavities clean and clear of mortar droppings.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	3 mm
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm
Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 6 m	6 mm
In 12 m or more	13 mm
Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 6 m	6 mm
In 12 m or more	13 mm
Variation from level for bed joints and top surfaces of bearing walls	

TOLERANCES

In 3 m	6 mm
In 12 m or more	13 mm

Variations from horizontal lines

In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm

Variations in cross sectional dimensions of columns and in thickness of walls

Minus	6 mm
Plus	13 mm

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises

In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from the plumb for external corners, expansion joints, and other conspicuous lines

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from level for bed joints and top surfaces of bearing walls

In 10 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from horizontal lines

TOLERANCES	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations in cross sectional dimensions of columns and in thickness of walls

Minus	1/4 inch
Plus	1/2 inch

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully 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. Reinforced masonry lintels shall be provided above openings over 300 mm 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

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

3.2.7.2 Tooled Joints

****
NOTE: Joints in exterior masonry walls exposed to weather will be tooled with an approved mortar joint, typically a slightly concave joint. 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.
****

Joints in exposed exterior and interior masonry surfaces shall be tooled

[slightly concave] [_____]. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 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.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 10 mm 3/8 inch joints, except for prefaced concrete masonry units.

3.2.8.2 Prefaced Concrete Masonry Units

Prefaced concrete masonry units shall have a joint width of 10 mm 3/8 inch wide on unfaced side and not less than 5 mm 3/16 inch nor more than 6 mm 1/4 inch wide on prefaced side.

3.2.8.3 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

****

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.

****

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.12 Partitions

****

NOTE: Walls and partitions which 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.

****

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled 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. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 100 mm 4 inch nominal thick units shall be tied 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. Interior partitions having masonry walls over 100 mm 4 inches thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

3.3 ANCHORED VENEER CONSTRUCTION

****

NOTE: Adjustable joint reinforcement assemblies may be used at locations of low seismic activity where the design wind speed is less than 160 km/hr 100 mph; designer must follow the guidance provided in TI 809-04 Seismic Design for Buildings for any seismic design. 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.
****

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 100 mm 4 inches of coarse aggregate or 250 mm 10 inches of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

****
NOTE: Include weep holes and dampproofing requirements in geographic areas where these are acceptable practices. Specify dampproofing in Division 7 of the project specification for projects utilizing concrete masonry unit interior wythe cavity walls. Now that masonry wall cavities are usually at least half full of rigid board insulation, and the backup wythe is usually complete before the brickwork is started, the wood strip method of keeping the cavities clean is neither practicable nor effective. 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.

For SOUTHNAVFACENGCOM projects, delete the second sentence and substitute with the following: "Weep holes shall be full open head joints 600 mm 20 inches o.c. for brick faced walls and minimum 50 mm 2 inch open head joints 900 mm 32 inches o.c. for concrete masonry unit construction."
****

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior. Weep holes shall be [open head joints].[clear round holes not less than 6 mm 1/4 inch in diameter] at 600 mm 24 inches o.c. Weep holes shall be provided not more than 600 mm 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. [Weep holes shall be formed by placing short lengths of well-greased No. 10, 8 mm 5/16 inch nominal diameter, braided cotton sash cord in the mortar and withdrawing the cords after the wall has been completed.] [Weep holes shall be constructed using weep hole ventilators.] Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. Facing shall be anchored to concrete backing with wire dovetail anchors set in slots built in the face of the concrete as specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 400 mm 16 inches on center vertically and 600 mm 24 inches on center horizontally. Unit ties shall be spaced not over 600 mm 24 inches on centers horizontally, in courses not over 400 mm 16 inches apart vertically, staggered in alternate courses. Ties shall be laid not closer than 16 mm 5/8 inch to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

3.6 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within [2-1/2] [_____] hours after mixing shall be discarded.

3.7 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 50 mm 2 inches of tops of walls.

3.7.1 Positioning Bars

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

Vertical bars shall be accurately placed 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. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing 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. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.7.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the

specified yield strength of the reinforcement.

3.8 JOINT REINFORCEMENT INSTALLATION

****
NOTE: Location of horizontal joint reinforcement should be shown on the drawings with the maximum vertical spacing normally being 400 mm 16 inches.
****

Joint reinforcement shall be installed at 400 mm 16 inches on center or as indicated. Reinforcement shall be lapped not less than 150 mm 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 16 mm 5/8 inch cover to either face of the unit.

3.9 PLACING GROUT

Cells containing reinforcing bars shall be filled with 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 shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.9.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 10 m 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.9.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.9.3 Grout Holes and Cleanouts

3.9.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 400 mm 16 inches on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be 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, grouting holes shall be plugged and finished to match surrounding surfaces.

3.9.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 1.5 m 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 800 mm 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 75 by 100 mm 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.3.3 Cleanouts for Solid Unit Masonry Construction

Cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes shall be provided at the bottom of every pour by omitting every other masonry unit from one wythe. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanout holes shall not be plugged until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.4 Grouting Equipment

3.9.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.9.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.9.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used

on pours up to and including 1.5 m 5 feet in height. High-lift grout methods shall be used on pours exceeding 1.5 m 5 feet in height.

3.9.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 13 mm 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 300 mm 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 300 mm 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.9.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 6 mm 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 1.2 m 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 300 to 450 mm 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (m) (4)	Grout Type	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2) Grouting Procedure	Multiwythe Masonry (3)	Hollow-unit Masonry
0.3	Fine	Low Lift	20	40 x 50

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (m) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
1.5	Fine	Low Lift	50	50 x 75
2.4	Fine	High Lift	50	50 x 75
3.6	Fine	High Lift	65	65 x 75
7.3	Fine	High Lift	75	75 x 75
0.3	Coarse	Low Lift	40	40 x 75
1.5	Coarse	Low Lift	50	65 x 75
2.4	Coarse	High Lift	50	75 x 75
3.6	Coarse	High Lift	65	75 x 75
7.3	Coarse	High Lift	75	75 x 100

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

(1) The actual grout space or cell dimension must be larger than the sum of the following items:
a) The required minimum dimensions of total clear areas given in the table above;
b) The width of any mortar projections within the space;
c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 20 mm 3/4 inch or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.10 BOND BEAMS

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

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 13 mm 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.11 CONTROL JOINTS

****
NOTE: Control joints will be located and detailed on the drawings. When control joint keys are required it is a 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. When control joint keys are not required, fill head joints with mortar as detailed.
****

Control joints shall be provided as indicated and shall be constructed by using [mortar to fill the head joint] [special control-joint units] [sash jamb units with control joint key] [open end stretcher units] in accordance with the details shown on the drawings. Sash jamb units shall have a 19 by 19 mm 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 20 mm; 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07 92 00.00 40 JOINT SEALANTS. Exposed interior control joints shall be raked to a depth of 6 mm 1/4 inch. Concealed control joints shall be flush cut.

3.12 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

****
NOTE: Brick expansion joints and concrete masonry veneer joints will be located and detailed on the drawings.
****

Brick expansion joints and concrete masonry veneer joints shall be provided

and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

3.13 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 3 m 10 feet and installed with a 6 mm 1/4 inch gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 1.2 m, 4 feet, unless limited by wall configuration.

3.14 LINTELS

3.14.1 Masonry Lintels

Masonry lintels shall be constructed 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 on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 600 mm, 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 13 mm 1/2 inch above the bottom inside surface of the lintel unit.

3.14.2 Precast Concrete and Steel Lintels

Precast concrete and steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 200 mm 8 inches unless otherwise indicated on the drawings.

3.15 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.16 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

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

3.16.1 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.

3.16.2 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.

3.17 PARGING

****

NOTE: If parging is not required, or if other types of dampproofing are in the project, this paragraph will be deleted.

****

The outside face of below-grade exterior concrete-masonry unit walls enclosing usable rooms and spaces, except crawl spaces, shall be parged with type S mortar. Parging shall not be less than 13 mm 1/2 inch thick troweled to a smooth dense surface so as to provide a continuous unbroken shield from top of footings to a line 150 mm 6 inches below adjacent finish grade, unless otherwise indicated. Parging shall be coved at junction of wall and footing. Parging shall be damp-cured for 48 hours or more before backfilling. Parging shall be protected from freezing temperatures until hardened.

3.18 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Board type insulation shall be applied directly to the masonry or thru-wall flashing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.19 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.20 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.20.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.20.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for

discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 30 mL 1/2 cup trisodium phosphate and 30 mL 1/2 cup laundry detergent to 1 L one gallon of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.21 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.
****

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.22 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 600 mm 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.23 TEST REPORTS

3.23.1 Field Testing of Mortar

****
NOTE: Delete this paragraph for structures having 185 square meters 2,000 square feet or less of wall area, including openings. See TM 5-809-3 and ASTM C 780 for evaluating mortar test results.
****

At least three specimens of mortar shall be taken each day. A layer of mortar 13 to 16 mm 1/2 to 5/8 inch thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.23.2 Field Testing of Grout

****
NOTE: Delete this paragraph for structures having 185 square meters 2,000 square feet or less of wall area, including openings.
****

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 13.8 MPa 2000 psi at 28 days.

3.23.3 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.
****

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

3.23.4 Prism Tests

****
NOTE: Prism testing will only be required for structures requiring masonry compressive strengths higher than the assumed value of 9.3 MPa (1350 psi). Prism testing normally will not be required. Delete this paragraph when prism testing is not required.
****

At least one prism test sample shall be made for each 465 square meters 5,000 square feet of wall but not less than three such samples shall be made for any building. Three prisms shall be used in each sample. Prisms shall be tested in accordance with ACI/MCP 605. 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. Compressive strength shall not be less than [_____] MPa [_____] psi at 28 days. If the compressive strength of any prism falls below the specified value by more than 3.5 MPa, 500 psi, steps shall be taken 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, three specimens shall be taken for each prism test more than 3.5 MPa 500 psi below the specified value. Masonry in the area in question shall be considered structurally adequate if the average compressive strength of three specimens is equal to at least 85 percent of the specified value, and if the compressive strength of no single specimen is less than 75 percent of the specified value. Additional testing of

specimens extracted from locations represented by erratic core or prism strength test results shall be permitted.

3.24 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

****
NOTE: Include this paragraph only when special inspection and testing for seismic-resisting systems is required by paragraph 3.2 of FEMA 302, NEHRP RECOMMENDED PROVISIONS FOR SEISMIC REGULATIONS FOR NEW BUILDINGS AND OTHER STRUCTURES.

This paragraph will be applicable to both new buildings designed according to TI 809-04, SEISMIC DESIGN FOR BUILDINGS, and to existing building seismic rehabilitation designs done according to TI 809-05, SEISMIC EVALUATION AND REHABILITATION FOR BUILDINGS.

The designer must indicate on the drawings all locations and all features for which special inspection and testing is required in accordance with Chapter 3 of FEMA 302. This includes indicating the locations of all structural components and connections requiring inspection.

Add any additional requirements as necessary.
****

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --