

Specification for Masonry Structures (ACI 530.1-05/ASCE 6-05/TMS 602-05)

Reported by the Masonry Standards Joint Committee (MSJC)

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SYNOPSIS

This Specification for Masonry Structures (ACI 530.1-05/ASCE 6-05/TMS 602-05) is written as a master specification and is required by Building Code Requirements for Masonry Structures (ACI 530/ASCE 5/TMS 402) to control materials, labor, and construction. Thus, this Specification covers minimum construction requirements for masonry in structures. Included are quality assurance requirements for materials; the placing, bonding, and anchoring of masonry; and the placement of grout and of reinforcement. This Specification is meant to be referenced in the Project Manual. Individual project requirements may supplement the provisions of this Specification.

Keywords: AAC masonry, anchors; autoclaved aerated concrete (AAC) masonry, clay brick; clay tile; concrete block; concrete brick; construction; construction materials; curing; grout; grouting; inspection; joints; masonry; materials handling; mortars (material and placement); quality assurance and quality control; reinforcing steel; specifications; ties; tests; tolerances.

¹ Main Committee Members participate in Subcommittee and Main Committee activities, including correspondence and voting.

² Subcommittee Members participate in Committee activities, vote on Subcommittee Ballots, and can comment on Main Committee ballots.

³ Associate and Consulting Members participate in Committee activities.

+Deceased.

Adopted as a standard of the American Concrete Institute (October 27, 2004), the Structural Engineering Institute of the American Society of Civil Engineers December 15, 2004, and The Masonry Society (December 20, 2004) to supersede the 2002 edition in accordance with each organization's standardization procedures. The standard was originally adopted by the American Concrete Institute in November, 1988, the American Society of Civil Engineers in August, 1989, and The Masonry Society in July, 1992.

SI equivalents shown in this document are calculated conversions. Equations are based on U.S. Customary (inch-pound) Units; SI equivalents for equations are listed at the end of the Code.

PREFACE

P1. This Preface is included for explanatory purposes only; it does not form a part of Specification ACI 530.1-05/ASCE 6-05/TMS 602-05.

P2. Specification ACI 530.1-05/ASCE 6-05/TMS 602-05 is a reference standard which the Architect/Engineer may cite in the contract documents for any project, together with supplementary requirements for the specific project.

P3. Specification ACI 530.1-05/ASCE 6-05/TMS 602-05 is written in the three-part section format of the Construction Specifications Institute, as adapted by ACI. The language is generally imperative and terse.

P4. Specification ACI 530.1-05/ASCE 6-05/TMS 602-05 is intended to be used in its entirety by reference in the project specifications. Individual sections, articles, or paragraphs should not be copied into the project specifications since taking them out of context may change their meaning.

P5. These mandatory requirements should designate the specific qualities, procedures, materials, and performance criteria for which alternatives are permitted or for which provisions were not made in this Specification. Exceptions to this Specification should be made in the project specifications, if required.

P6. A statement such as the following will serve to make Specification ACI 530.1-05/ASCE 6-05/TMS 602-05 an official part of the project specifications:

Masonry construction and materials shall conform to the requirements of "Specification for Masonry Structures (ACI 530.1-05/ASCE 6-05/TMS 602-05)," published by The Masonry Society, Boulder, Colorado; the American Concrete Institute, Farmington Hills, Michigan; and the American Society of Civil Engineers, Reston, Virginia, except as modified by the requirements of these contract documents.

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PART 1 — GENERAL

1.1 — Summary

1.1 A. This Specification covers requirements for materials and construction of masonry structures. SI values shown in parentheses are provided for information only and are not part of this Specification.

1.1 B. The Specification supplements the legally adopted building code and governs the construction of masonry elements designed in accordance with the Code, except where this Specification is in conflict with requirements in the legally adopted building code. In areas without a legally adopted building code, this Specification defines the minimum acceptable standards of construction practice.

1.1 C. This article covers the furnishing and construction of masonry including the following:

1. Furnishing and placing masonry units, grout, mortar, masonry lintels, sills, copings, through-wall flashing, and connectors.
2. Furnishing, erecting and maintaining of bracing, forming, scaffolding, rigging, and shoring.
3. Furnishing and installing other equipment for constructing masonry.
4. Cleaning masonry and removing surplus material and waste.
5. Installing lintels, nailing blocks, inserts, window and door frames, connectors, and construction items to be built into the masonry, and building in vent pipes, conduits and other items furnished and located by other trades.

1.2 — Definitions

A. AAC masonry — masonry made of autoclaved aerated concrete (AAC) units, manufactured without internal reinforcement, and bonded together using thin- or thick-bed mortar.

B. Acceptable, accepted — Acceptable to or accepted by the Architect/Engineer.

C. Architect/Engineer — The architect, engineer, architectural firm, engineering firm, or architectural and engineering firm, issuing Drawings and Specifications, or administering the Work under Contract Specifications and Project Drawings, or both.

D. Area, gross cross-sectional — The area delineated by the out-to-out dimensions of masonry in the plane under consideration.

E. Area, net cross-sectional — The area of masonry units, grout, and mortar crossed by the plane under consideration based on out-to-out dimensions.

F. Autoclaved aerated concrete — low-density cementitious product of calcium silicate hydrates.

G. Bonded prestressing tendon — Prestressing tendon that is encapsulated by prestressing grout in a

corrugated duct that is bonded to the surrounding masonry through grouting.

H. Cleanouts — Openings that are sized and spaced to allow removal of debris from the bottom of the grout space.

I. Collar joint — Vertical longitudinal space between wythes of masonry or between masonry and back up construction, which is permitted to be filled with mortar or grout.

J. Compressive strength of masonry — Maximum compressive force resisted per unit of net cross-sectional area of masonry, determined by testing masonry prisms; or a function of individual masonry units, mortar and grout in accordance with the provisions of this Specification.

K. Contract Documents — Documents establishing the required Work, and including in particular, the Project Drawings and Project Specifications.

L. Contractor — The person, firm, or corporation with whom the Owner enters into an agreement for construction of the Work.

M. Dimension, nominal — The specified dimension plus an allowance for the joints with which the units are to be laid. Nominal dimensions are usually stated in whole numbers. Thickness is given first, followed by height and then length.

N. Dimensions, specified — Dimensions specified for the manufacture or construction of a unit, joint, or element.

O. Glass unit masonry — Nonload-bearing masonry composed of glass units bonded by mortar.

P. Grout lift — An increment of grout height within a total grout pour. A grout pour consists of one or more grout lifts.

Q. Grout pour — The total height of masonry to be grouted prior to erection of additional masonry. A grout pour consists of one or more grout lifts.

R. Mean daily temperature — The average daily temperature of temperature extremes predicted by a local weather bureau for the next 24 hours.

S. Minimum daily temperature — The low temperature forecast by a local weather bureau to occur within the next 24 hours.

T. Minimum/maximum (not less than . . . not more than) — Minimum or maximum values given in this Specification are absolute. Do not construe that tolerances allow lowering a minimum or increasing a maximum.

U. Otherwise required — Specified differently in requirements supplemental to this Specification.

V. Owner — The public body or authority, corporation, association, partnership, or individual for whom the Work is provided.

W. Partition wall — An interior wall without structural function.

X. Post-tensioning — Method of prestressing in which prestressing tendons are tensioned after the masonry has been placed.

Y. Prestressed masonry — Masonry in which internal stresses have been introduced to counteract stresses in masonry resulting from applied loads.

Z. Pretensioning — Method of prestressing in which prestressing tendons are tensioned before the transfer of stress into the masonry.

AA. Prestressing grout — A cementitious mixture used to encapsulate bonded prestressing tendons.

AB. Prestressing tendon — Steel element such as wire, bar, or strand, or a bundle of such elements, used to impart prestress to masonry.

AC. Project Drawings — The Drawings that, along with the Project Specifications, complete the descriptive information for constructing the Work required or referred to in the Contract Documents.

AD. Project Specifications — The written documents that specify requirements for a project in accordance with the service parameters and other specific criteria established by the Owner or his agent.

AE. Quality assurance — The administrative and procedural requirements established by the Contract Documents to assure that constructed masonry is in compliance with the Contract Documents.

AF. Reinforcement — Nonprestressed steel reinforcement.

AG. Running bond — The placement of masonry units such that head joints in successive courses are horizontally offset at least one-quarter the unit length.

AH. Specified compressive strength of masonry, f'_m — Minimum compressive strength, expressed as force per unit of net cross-sectional area, required of the masonry used in construction by the project documents, and upon which the project design is based.

AI. Stack bond — For the purpose of this Specification, stack bond is other than running bond. Usually the placement of masonry units is such that head joints in successive courses are vertically aligned.

AJ. Stone masonry — Masonry composed of field, quarried, or cast stone units bonded by mortar.

1. **Stone masonry, ashlar** — Stone masonry composed of rectangular units having sawed, dressed, or squared bed surfaces and bonded by mortar.

2. **Stone masonry, rubble** — Stone masonry composed of irregular shaped units bonded by mortar.

AK. Submit, submitted — Submit, submitted to the Architect/Engineer for review.

AL. Tendon anchorage — In post-tensioning, a device used to anchor the prestressing tendon to the masonry or concrete member; in pretensioning, a device used to anchor the prestressing tendon during hardening of masonry mortar, grout, prestressing grout, or concrete.

AM. Tendon coupler — A device for connecting two tendon ends, thereby transferring the prestressing force from end to end.

AN. Tendon jacking force — Temporary force exerted by device that introduces tension into prestressing tendons.

AO. Unbonded prestressing tendon — Prestressing tendon that is not bonded to masonry.

AP. Veneer, adhered — Masonry veneer secured to and supported by the backing through adhesion.

AQ. Wall — A vertical element with a horizontal length to thickness ratio greater than 3, used to enclose space.

AR. Wall, loadbearing — A wall carrying vertical loads greater than 200 lb per lineal foot (2919 N/m) in addition to its own weight.

AS. Wall, masonry bonded hollow — A multiwythe wall built with masonry units arranged to provide an air space between the wythes and with the wythes bonded together with masonry units.

AT. When required — Specified in requirements supplemental to this Specification.

AU. Work — The furnishing and performance of equipment, services, labor, and materials required by the Contract Documents for the construction of masonry for the project or part of project under consideration.

AV. Wythe — Each continuous vertical section of a wall, one masonry unit in thickness.

1.3 — Reference standards

Standards referred to in this Specification are listed below with their serial designations, including year of adoption or revision, and are declared to be part of this Specification as if fully set forth in this document except as modified here.

American Concrete Institute

A. ACI 117-90 Standard Specifications for Tolerances for Concrete Construction and Materials

B. ACI 315-99 Details and Detailing of Concrete Reinforcement

American National Standards Institute

C. ANSI A 137.1-88 Standard Specification for Ceramic Tile

ASTM International

D. ASTM A 36/A 36M-01 Specification for Carbon Structural Steel

E. ASTM A 82-01 Specification for Steel Wire, Plain, for Concrete Reinforcement

F. ASTM A 123/A 123M-02 Specification for Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products

G. ASTM A 153/A 153M-02 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

H. ASTM A 185-01 Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

I. ASTM A 240/A 240M-02a Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

J. ASTM A 307-02 Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

K. ASTM A 416/A 416M-02 Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

L. ASTM A 421/A 421M-02 Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete

M. ASTM A 480/A 480M-02 Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

N. ASTM A 496-01 Specification for Steel Wire, Deformed, for Concrete Reinforcement

O. ASTM A 497-01 Specification for Steel Welded Reinforcement, Deformed, for Concrete

P. ASTM A510-02 General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

Q. ASTM A 580/A 580M-98 Specification for Stainless Steel Wire

R. ASTM A 615/A 615M-01b Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

S. ASTM A 641/A 641M-98 Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

T. ASTM A 653/A 653M-02a Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process

U. ASTM A 666-00 Specification for Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar

V. ASTM A 706/A 706M-01 Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement

W. ASTM A 722/A 722M-98 Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete

X. ASTM A 767/ A 767M-00b Specification for Zinc-Coated (Galvanized) Bars for Concrete Reinforcement

Y. ASTM A 775/A 775M-01 Specification for Epoxy-Coated Reinforcing Steel Bars

Z. ASTM A 884/A 884M-01 Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement

AA. ASTM A 899-91(2002) Specification for Steel Wire Epoxy-Coated

AB. ASTM A 951-00 Specification for Masonry Joint Reinforcement

AC. ASTM A 996/A 996M-01a Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

AD. ASTM A 1008/ A 1008M-02^{e1} Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability

AE. ASTM B 117-02 Practice for Operating Salt Spray (Fog) Testing Apparatus

AF. ASTM C 34-96 (2001) Specification for Structural Clay Load-Bearing Wall Tile

AG. ASTM C 55-01a Specification for Concrete Brick

AH. ASTM C 56-96 (2001) Specification for Structural Clay Non-Load-Bearing Tile

AI. ASTM C 62-01 Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)

AJ. ASTM C 67-02c Test Methods for Sampling and Testing Brick and Structural Clay Tile

AK. ASTM C 73-99a Specification for Calcium Silicate Face Brick (Sand-Lime Brick)

AL. ASTM C 90-02 Specification for Load-Bearing Concrete Masonry Units

AM. ASTM C 109/C109M-02 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)

AN. ASTM C 126-99 Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units

AO. ASTM C 129-01 Specification for Non-Load-Bearing Concrete Masonry Units

AP. ASTM C 140-02a Test Methods for Sampling and Testing Concrete Masonry Units

AQ. ASTM C 143/C 143-00 Test Method for Slump of Hydraulic Cement Concrete

AR. ASTM C 144-02 Specification for Aggregate for Masonry Mortar

AS. ASTM C150-02a Specification for Portland Cement

AT. ASTM C 212-00 Specification for Structural Clay Facing Tile

AU. ASTM C 216-02 Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)

AV. ASTM C 270-02 Specification for Mortar for Unit Masonry

AW. ASTM C 476-02 Specification for Grout for Masonry

AX. ASTM C 482-02 Test Method for Bond Strength of Ceramic Tile to Portland Cement

AY. ASTM C 503-99^{e1} Specification for Marble Dimension Stone (Exterior)

AZ. ASTM C 568-99 Specification for Limestone Dimension Stone

BA. ASTM C 615-99 Specification for Granite Dimension Stone

BB. ASTM C 616-99 Specification for Quartz-Based Dimension Stone

BC. ASTM C 629-99 Specification for Slate Dimension Stone

BD. ASTM C 652-01a Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)

BE. ASTM C 744-99 Specification for Prefaced Concrete and Calcium Silicate Masonry Units

BF. ASTM C 901-01 Specification for Prefabricated Masonry Panels

BG. ASTM C 920-02 Specification for Elastomeric Joint Sealants

BH. ASTM C 1006-84 (2001) Test Method for Splitting Tensile Strength of Masonry Units

BI. ASTM C 1019-02 Test Method for Sampling and Testing Grout

BJ. ASTM C 1072-00a Standard Test Method for Measurement of Masonry Flexural Bond Strength

BK. ASTM C 1088-02 Specification for Thin Veneer Brick Units Made from Clay or Shale

BL. ASTM C 1314-02a Test Method for Compressive Strength of Masonry Prisms

BM. ASTM C 1386-98 Specification for Precast Autoclaved Aerated Concrete (PAAC) Wall Construction Units

BN. ASTM D 92-02b Test Method for Flash and Fire Points by Cleveland Open Cup Tester

BO. ASTM D 95-99^{e1} Test Method for Water in Petroleum Product and Bituminous Material by Distillation

BP. ASTM D 512-89 (1999) Test Method for Chloride Ion in Water

BQ. ASTM D 566-02 Test Method for Dropping Point of Lubricating Grease

BR. ASTM D 610-01 Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces

BS. ASTM D 638-02a Test Method for Tensile Properties of Plastics

BT. ASTM D 994-98 Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

BU. ASTM D 1056-00 Specification for Flexible Cellular Materials — Sponge or Expanded Rubber

BV. ASTM D 1187-97 (2002)^{e1} Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal

BW. ASTM D 1227-95 (2000) Specification for Emulsified Asphalt Used as a Protective Coating for Roofing

BX. ASTM D 2000-01 Classification System for Rubber Products in Automotive Applications

BY. ASTM D 2265-00 Test Method for Dropping Point of Lubricating Grease Over Wide Temperature Range

BZ. ASTM D 2287-96 (2001) Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

CA. ASTM D 4289-97 Test Method for Elastomer Compatibility of Lubricating Greases and Fluids

CB. ASTM E 72-02 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction

CC. ASTM E 328-86 (1996)^{e1} Test Methods for Stress Relaxation Tests for Materials and Structures

CD. ASTM E 518 E518-03 Standard Test Methods for Flexural Bond Strength of Masonry

CE. ASTM E519-02 Standard Test Method for Diagonal Tension (Shear) in Masonry Assemblages

CF. ASTM F 959-02 Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

American Welding Society

CG. AWS D 1.4-98 Structural Welding Code — Reinforcing Steel

Federal Test Method Standard

CH. FTMS 791B (1974) Oil Separation from Lubricating Grease (Static Technique). Federal Test Method Standard from the U.S. Army General Material and Parts Center, Petroleum Field Office (East), New Cumberland Army Depot, New Cumberland, PA 17070

1.4 — System description

1.4 A. Compressive strength requirements — Compressive strength of masonry in each masonry wythe and grouted collar joint shall equal or exceed the applicable f'_m or f'_{AAC} . For partially grouted masonry, the compressive strength of both the grouted and ungrouted masonry shall equal or exceed the applicable f'_m . At the transfer of prestress, the compressive strength of the masonry shall equal f'_{mi} , which shall be less than or equal to f'_m .

1.4 B. Compressive strength determination

1. Alternatives for determination of compressive strength — Determine the compressive strength for each wythe by the unit strength method or by the prism test method as specified here.

2. Unit strength method

a. Clay masonry — Determine the compressive strength of masonry based on the strength of the units and the type of mortar specified using Table 1. The following Articles must be met:

- 1) Units conform to ASTM C 62, ASTM C 216, or ASTM C 652 and are sampled and tested in accordance with ASTM C 67.
- 2) Thickness of bed joints does not exceed $\frac{5}{8}$ in. (15.9 mm).

- 3) For grouted masonry, the grout meets one of the following requirements:
- Grout conforms to ASTM C 476.
 - Grout compressive strength equals or exceeds f'_m but compressive strength is not less than 2000 psi (13.79 MPa). Determine compressive strength of grout in accordance with ASTM C 1019.
- b. *Concrete masonry* — Determine the compressive strength of masonry based on the strength of the unit and type of mortar specified using Table 2. The following Articles must be met:
- Units conform to ASTM C 55 or ASTM C 90 and are sampled and tested in accordance with ASTM C 140.
 - Thickness of bed joints does not exceed $\frac{5}{8}$ in. (15.9 mm).
 - For grouted masonry, the grout meets one of the following requirements:
 - Grout conforms to ASTM C 476.
 - Grout compressive strength equals or exceeds f'_m but compressive strength is not less than 2000 psi (13.79 MPa). Determine compressive strength of grout in accordance with ASTM C 1019.
- c. *AAC masonry* — Determine the compressive strength of masonry based on the strength of the AAC masonry unit only. The following Articles must be met:
- Units conform to ASTM C 1386.
 - Thickness of bed joints does not exceed $\frac{1}{8}$ in. (3.2 mm).
 - For grouted masonry, the grout meets one of the following requirements:
 - Grout conforms to ASTM C 476.
 - Grout compressive strength equals or exceeds f'_{AAC} but compressive strength is not less than 2000 psi (13.79 MPa). Determine compressive strength of grout in accordance with ASTM C 1019.
3. *Prism test method* — Determine the compressive strength of masonry by the prism test method in accordance with ASTM C 1314.
- 1.4 C. *Adhered veneer requirements* — Determine the adhesion of adhered veneer unit to backing in accordance with ASTM C 482.

Table 1 — Compressive strength of masonry based on the compressive strength of clay masonry units and type of mortar used in construction

Net area compressive strength of clay masonry units, psi (MPa)		Net area compressive strength of masonry, psi (MPa)
Type M or S mortar	Type N mortar	
1700 (11.72)	2100 (14.48)	1000 (6.90)
3350 (23.10)	4150 (28.61)	1500 (10.34)
4950 (34.13)	6200 (42.75)	2000 (13.79)
6600 (45.51)	8250 (56.88)	2500 (17.24)
8250 (56.88)	10,300 (71.02)	3000 (20.69)
9900 (68.26)	—	3500 (24.13)
13,200 (91.01)	—	4000 (27.58)

Table 2 — Compressive strength of masonry based on the compressive strength of concrete masonry units and type of mortar used in construction

Net area compressive strength of concrete masonry units, psi (MPa)		Net area compressive strength of masonry, psi ¹ (MPa)
Type M or S mortar	Type N mortar	
1250 (8.62)	1300 (8.96)	1000 (6.90)
1900 (13.10)	2150 (14.82)	1500 (10.34)
2800 (19.31)	3050 (21.03)	2000 (13.79)
3750 (25.86)	4050 (27.92)	2500 (17.24)
4800 (33.10)	5250 (36.20)	3000 (20.69)

¹ For units of less than 4 in. (102 mm) height, 85 percent of the values listed.

1.5 — Submittals

1.5 A. Obtain written acceptance of submittals prior to the use of the materials or methods requiring acceptance.

1.5 B. Submit the following:

1. Mix designs and test results
 - a. One of the following for each mortar mix, excluding thin-bed mortar for AAC:
 - 1) Mix designs indicating type and proportions of ingredients in compliance with the proportion specification of ASTM C 270, or
 - 2) Mix designs and mortar tests performed in accordance with the property specification of ASTM C 270.
 - b. One of the following for each grout mix:
 - 1) Mix designs indicating type and proportions of the ingredients according to the proportion requirements of ASTM C 476, or
 - 2) Mix designs and grout strength test performed in accordance with ASTM C 476.
2. Material certificates — Material certificates for the following, certifying that each material is in compliance.
 - a. Reinforcement
 - b. Anchors, ties, fasteners, and metal accessories
 - c. Masonry units
 - d. Mortar, thin-bed mortar for AAC, and grout materials
3. Construction procedures
 - a. Cold weather construction procedures
 - b. Hot weather construction procedures

1.6 — Quality assurance

1.6 A. Testing Agency's services and duties

1. Sample and test in accordance with Table 3, 4, or 5, as specified for the project.
2. Unless otherwise required, report test results to the Architect/Engineer, Inspection Agency, and Contractor promptly after they are performed. Include in test reports a summary of conditions under which test specimens were stored prior to testing and state what portion of the construction is represented by each test.
3. When there is reason to believe that any material furnished or work performed by the Contractor fails to fulfill the requirements of the Contract Documents, report such deficiency to the Architect/Engineer, Inspection Agency, and Contractor.
4. The Testing Agency and its representatives are neither authorized to revoke, alter, relax, enlarge, or release any requirement of the Contract Documents, or to accept or approve, or reject or disapprove, any portion of the Work.
5. Unless otherwise required, these services will be paid for by the Owner.

1.6 B. Inspection Agency's services and duties

1. Inspect and evaluate in accordance with Table 3, 4, or 5, as specified for the project.
2. Unless otherwise required, report inspection results to the Architect/Engineer, and Contractor promptly after they are performed. Include in inspection reports a summary of conditions under which the inspections were made and state what portion of the construction is represented by each inspection.
3. Furnish inspection reports to the Architect/Engineer and Contractor.
4. When there is reason to believe that any material furnished or work performed by the Contractor fails to fulfill the requirements of the Contract Documents, report such deficiency to the Architect/Engineer and to the Contractor.
5. Submit a final signed report stating whether the Work requiring inspection was, to the best of the Inspection Agency's knowledge, in conformance. Submit the final report to the Architect/Engineer and Contractor.
6. The Inspection Agency is neither authorized to revoke, alter, relax, enlarge, or release any requirement of the Contract Documents, nor authorized to approve or accept, or reject or disapprove, any portion of the Work.
7. Unless otherwise required, these services will be paid for by the Owner.

1.6 C. Contractor's services and duties

1. Permit and facilitate access to the construction sites and the performance of activities for quality assurance by the Testing and Inspection Agencies.
2. The use of testing and inspection services does not relieve the Contractor of the responsibility to furnish materials and construction in full compliance.
3. To facilitate testing and inspection, comply with the following:
 - a. Furnish necessary labor to assist the designated testing agency in obtaining and handling samples at the Project.
 - b. Advise the designated Testing Agency and Inspection Agency sufficiently in advance of operations to allow for completion of quality assurance measures and for the assignment of personnel.
 - c. Provide masonry materials required for preconstruction and construction testing.
4. Provide and maintain adequate facilities for the sole use of the testing agency for safe storage and proper curing of test specimens on the Project Site.
5. In the submittals, include the results of testing performed to qualify the materials and to establish mix designs.

1.6 D. Sample panels

1. For masonry governed by Level B or C Quality Assurance (Table 4 or Table 5), construct sample panels of masonry walls.
 - a. Use materials and procedures accepted for the Work.
 - b. The minimum sample panel size is 4 ft (1.22 m) square.

2. The acceptable standard for the Work is established by the accepted panel.
3. Retain sample panels at the job site until Work has been accepted.

1.6 E. Grout demonstration panel — Prior to masonry construction, construct a grout demonstration panel if proposed grouting procedures, construction techniques, and grout space geometry do not conform to the requirements of Articles 3.5 C, 3.5 D, and 3.5 E.

Table 3 — Level A Quality Assurance

MINIMUM TESTS AND SUBMITTALS	MINIMUM INSPECTION
Certificates for materials used in masonry construction indicating compliance with the contract documents	Verify compliance with the approved submittals

Table 4 — Level B Quality Assurance

MINIMUM TESTS AND SUBMITTALS	MINIMUM INSPECTION
<p>Certificates for materials used in masonry construction indicating compliance with the Contract Documents</p> <p>Verification of f'_m or f'_{AAC} in accordance with Article 1.4 B prior to construction, except where specifically exempted by this Code</p>	<p>As masonry construction begins, verify that the following are in compliance:</p> <ul style="list-style-type: none"> • proportions of site-prepared mortar • construction of mortar joints • location of reinforcement, connectors, and prestressing tendons and anchorages • prestressing technique <p>Prior to grouting, verify that the following are in compliance:</p> <ul style="list-style-type: none"> • grout space • grade and size of reinforcement, and prestressing tendons and anchorages • placement of reinforcement, connectors, and prestressing tendons and anchorages • proportions of site-prepared grout and prestressing grout for bonded tendons • construction of mortar joints <p>Verify that the placement of grout and prestressing grout for bonded tendons is in compliance</p> <p>Observe preparation of grout specimens, mortar specimens, and/or prisms</p> <p>Verify compliance with the required inspection provisions of the contract documents and the approved submittals</p>

Table 5 — Level C Quality Assurance

MINIMUM TESTS AND SUBMITTALS	MINIMUM INSPECTION
<p>Certificates for materials used in masonry construction indicating compliance with the Contract Documents</p> <p>Verification of f'_m or f'_{AAC} in accordance with Article 1.4 B:</p> <ul style="list-style-type: none"> • prior to construction • every 5000 sq. ft (464.5 m²) during construction <p>Verification of proportions of materials in premixed or preblended mortar, grout, and prestressing grout as delivered to the site</p>	<p>From the beginning of masonry construction and continuously during construction of masonry:</p> <p>a) verify that the following are in compliance:</p> <ul style="list-style-type: none"> • proportions of site-mixed mortar, grout, and prestressing grout for bonded tendons • grade and size of reinforcement, and prestressing tendons and anchorages • placement of masonry units and construction of mortar joints • placement of reinforcement, connectors, and prestressing tendons and anchorages • grout space prior to grouting • placement of grout and prestressing grout for bonded tendons <p>b) Observe preparation of grout specimens, mortar specimens, and/or prisms</p> <p>c) Verify compliance with the required inspection provisions of the contract documents and the approved submittals</p>

1.7 — Delivery, storage, and handling

1.7 A. Do not use damaged masonry units, damaged components of structure, or damaged packaged material.

1.7 B. Protect cementitious materials for mortar and grout from precipitation and groundwater.

1.7 C. Do not use masonry materials that are contaminated.

1.7 D. Store different aggregates separately.

1.7 E. Protect reinforcement, ties, and metal accessories from permanent distortions and store them off the ground.

1.8 — Project conditions

1.8 A. Construction loads — Do not apply construction loads that exceed the safe superimposed load-carrying capacity of the masonry and shores, if used.

1.8 B. Masonry protection — Cover top of unfinished masonry work to protect it from the weather.

1.8 C. Cold weather construction — When ambient air temperature is below 40°F (4.4°C), implement cold weather procedures and comply with the following:

1. Do not lay glass unit masonry.

2. *Preparation* — Comply with the following requirements prior to conducting masonry work:

a. Do not lay masonry units having either a temperature below 20°F (-6.7°C) or containing frozen moisture, visible ice, or snow on their surface.

b. Remove visible ice and snow from the top surface of existing foundations and masonry to receive new construction. Heat these surfaces above freezing, using methods that do not result in damage.

3. *Construction* — These requirements apply to work in progress and are based on ambient air temperature. Do not heat water or aggregates used in mortar or grout above 140 F (60 C) Comply with the following requirements during construction during the following ambient air conditions:

a. 40°F to 32°F (4.4°C to 0°C): Heat sand or mixing water to produce mortar temperature between 40°F (4.4°C) and 120°F (48.9°C) at the time of mixing. Grout does not require heated materials, unless the temperature of the materials is below 32°F (0°C).

b. 32°F to 25°F (0°C to -3.9°C): Heat sand and mixing water to produce mortar temperature between 40°F (4.4°C) and 120°F (48.9°C) at the time of mixing. Maintain mortar temperature above freezing until used in masonry. Heat grout aggregates and mixing

water to produce grout temperature between 70°F (21.1°C) and 120°F (48.9°C) at the time of mixing. Maintain grout temperature above 70°F (21.1°C) at the time of grout placement. Heat AAC units to a minimum temperature of 40°F (4.4°C) before installing thin-bed mortar.

- c. 25°F to 20°F (-3.9°C to -6.7°C): Comply with Article 1.8 C.3.b and the following: Heat masonry surfaces under construction to 40°F (4.4°C) and use wind breaks or enclosures when the wind velocity exceeds 15 mph (24 km/h). Heat masonry to a minimum of 40°F (4.4°C) prior to grouting.
 - d. 20°F (-6.7°C) and below: Comply with Article 1.8 C.3.c and the following: Provide an enclosure and auxiliary heat to maintain air temperature above 32°F (0°C) within the enclosure.
4. *Protection* — These requirements apply after masonry is placed and are based on anticipated minimum daily temperature for grouted masonry and anticipated mean daily temperature for ungrouted masonry. Protect completed masonry in the following manner:
- a. Maintain the temperature of glass unit masonry above 40°F (4.4°C) for the first 48 hr after construction.
 - b. Maintain the temperature of AAC masonry above 32°F (0°C) for the first 4 hr after thin-bed mortar application.
 - c. 40°F to 25°F (4.4°C to -3.9°C): Protect newly constructed masonry by covering with a weather-resistive membrane for 24 hr after being completed.
 - d. 25°F to 20°F (-3.9°C to -6.7°C): Cover newly constructed masonry completely with weather-resistive insulating blankets, or equal protection, for 24 hr after completion of work. Extend time period to 48 hr for grouted masonry, unless the only cement in the grout is Type III portland cement.
 - e. 20°F (-6.7°C) and below: Maintain newly constructed masonry temperature above 32°F (0°C) for at least 24 hr after being completed by using heated enclosures, electric heating blankets, infrared lamps, or other acceptable methods. Extend time period to 48 hr for grouted masonry, unless the only cement in the grout is Type III portland cement.

1.8 D Hot weather construction — Implement approved hot weather procedures and comply with the following provisions:

1. *Preparation* — Prior to conducting masonry work:

- a. When the ambient air temperature exceeds 100°F (37.8°C), or exceeds 90°F (32.2°C) with a wind velocity greater than 8 mph (12.9 km/hr):
 - 1) Maintain sand piles in a damp, loose condition.
 - 2) Provide necessary conditions and equipment to produce mortar having a temperature below 120°F (48.9°C).
- b. When the ambient temperature exceeds 115°F (46.1°C), or exceeds 105°F (40.6°C) with a wind velocity greater than 8 mph (12.9 km/hr), implement the requirements of Article 1.8 D.1.a and shade materials and mixing equipment from direct sunlight.

2. *Construction* — While masonry work is in progress:

- a. When the ambient air temperature exceeds 100°F (37.8°C), or exceeds 90°F (32.2°C) with a wind velocity greater than 8 mph (12.9 km/hr):
 - 1) Maintain temperature of mortar and grout below 120°F (48.9°C).
 - 2) Flush mixer, mortar transport container, and mortar boards with cool water before they come into contact with mortar ingredients or mortar.
 - 3) Maintain mortar consistency by retempering with cool water.
 - 4) Use mortar within 2 hr of initial mixing.
 - 5) Spread thin-bed mortar no more than four feet ahead of AAC masonry units.
 - 6) Set AAC masonry units within one minute after spreading thin-bed mortar.
- b. When the ambient temperature exceeds 115°F (46.1°C), or exceeds 105°F (40.6°C) with a wind velocity greater than 8 mph (12.9 km/hr), implement the requirements of Article 1.8 D.2.a and use cool mixing water for mortar and grout. Ice is permitted in the mixing water prior to use. Do not permit ice in the mixing water when added to the other mortar or grout materials.

3. *Protection* — When the mean daily temperature exceeds 100°F (37.8°C) or exceeds 90°F (32.2°C) with a wind velocity greater than 8 mph (12.9 km/hr), fog spray newly constructed masonry until damp, at least three times a day until the masonry is three days old.

PART 2 — PRODUCTS

2.1 — Mortar materials

2.1 A. Provide mortar of the type and color specified, and conforming with ASTM C 270.

2.1 B. *Glass unit masonry*

1. Provide Type S or N mortar that conforms to Article 2.1 A.
2. Comply with the other requirements of Article 2.6.

2.1 C. *AAC Masonry*

1. Provide thin-bed mortar specifically manufactured for use with AAC masonry. Testing to verify mortar properties shall be conducted by the thin-bed mortar manufacturer and confirmed by an independent testing agency.
 - a. Provide thin-bed mortar with compressive strength that meets or exceeds the strength of the AAC masonry units. Conduct compressive strength tests in accordance with ASTM C 109.
 - b. Provide thin-bed mortar with shear strength that meets or exceeds the strength of the AAC masonry units. Conduct shear strength tests in accordance with ASTM E 519. Cure the gypsum capping for at least 6 hours prior to testing.
 - c. For each specified strength class, provide thin-bed mortar with flexural tensile strength that is not less than the smaller of: the maximum value specified in the governing building code; and the modulus of rupture of the masonry units. Conduct flexural strength tests in accordance with ASTM E 72, ASTM E518 Method A or ASTM C 1072.
 - 1) For conducting flexural strength tests in accordance with ASTM E 518, construct at least five test specimens as stack-bonded prisms at least 32 in. (810 mm) high. Use the type of mortar specified by the AAC unit manufacturer.
 - 2) For flexural strength tests in accordance with ASTM C 1072, construct test specimens as stack-bonded prisms comprised of at least 3 bed joints. Test a total of at least 5 joints. Use the type of mortar specified by the AAC unit manufacturer.
 - d. Perform splitting tensile strength tests in accordance with ASTM C 1006.
2. Mortar for leveling course shall be Type M or S. Conform to the requirements of Article 2.1 A.

2.2 — Grout materials

Unless otherwise required, provide grout that conforms to the requirements of ASTM C 476. Do not use admixtures unless acceptable.

2.3 — Masonry unit materials

2.3 A. Provide concrete masonry units that conform to ASTM C 55, C 73, C 90, C 129, or C 744 as specified.

2.3 B. Provide clay or shale masonry units that conform to ASTM C 34, C 56, C 62, C 126, C 212, C 216, C 652, or C 1088, or to ANSI A 137.1, as specified.

2.3 C. Provide stone masonry units that conform to ASTM C 503, C 568, C 615, C 616, or C 629, as specified.

2.3 D. Provide hollow glass units that are partially evacuated and have a minimum average glass face thickness of $\frac{3}{16}$ in. (4.8 mm). Provide solid glass block units when required. Provide units in which the surfaces intended to be in contact with mortar are treated with polyvinyl butyral coating or latex-based paint. Do not use reclaimed units.

2.3 E. Provide AAC masonry units that conform to ASTM C 1386 for the strength class specified in the Contract Documents.

2.4 — Reinforcement, prestressing tendons, and metal accessories

2.4 A. *Reinforcing steel* — Provide deformed reinforcing bars that conform to one of the following as specified:

1. ASTM A 615/A 615M
2. ASTM A 706/A 706M
3. ASTM A 767/A 767M
4. ASTM A 775/A 775M
5. ASTM A 996/A 996M

2.4 B. *Prestressing tendons*

1. Provide prestressing tendons that conform to one of the following standards, except for those permitted in Articles 2.4 B.2 and 2.4 B.3:
 - a. Wire.....ASTM A 421
 - b. Low-relaxation wire.....ASTM A 421
 - c. Strand.....ASTM A 416/A 416M
 - d. Low-relaxation strand ... ASTM A 416/A 416 M
 - e. Bar.....ASTM A 722/A 722 M
2. Wire, strands, and bars not specifically listed in ASTM A 416/A 416 M, A 421, or A 722/A 722M are permitted, provided they conform to the minimum requirements in ASTM A 416 A/416 M, A 421, or A 722/A 722M and are approved by the Architect/Engineer.

3. Bars and wires of less than 150 ksi (1034 MPa) tensile strength and conforming to ASTM A 82, A 510/A 510M, A 615/A 615M, ASTM A 996/A 996M, or A 706/A 706M are permitted to be used as prestressed tendons, provided that :
 - a. The stress relaxation properties have been assessed by tests according to ASTM E 328 for the maximum permissible stress in the tendon.
 - b. Other non-stress-related requirements of Code Chapter 4 addressing prestressing tendons are met.

2.4 C. Joint reinforcement

1. Provide joint reinforcement that conforms to ASTM A 951. Maximum spacing of cross wires in ladder-type joint reinforcement and of points of connection of cross wires to longitudinal wires of truss-type joint reinforcement shall be 16 in. (400 mm).
2. *Deformed reinforcing wire* — Provide deformed reinforcing wire that conforms to ASTM A 496.
3. *Welded wire fabric* — Provide welded wire fabric that conforms to one of the following specifications:
 - a. PlainASTM A 185
 - b. Deformed.....ASTM A 497

2.4 D. Anchors, ties, and accessories — Provide anchors, ties, and accessories that conform to the following specifications, except as otherwise specified:

1. Plate and bent-bar anchors..... ASTM A 36/A 36M
2. Sheet-metal anchors and ties ASTM A 1008/A 1008 M
3. Wire mesh tiesASTM A 185
4. Wire ties and anchorsASTM A 82
5. Anchor bolts ASTM A 307, Grade A
6. Panel anchors (for glass unit masonry) — Provide 1 3/4-in. (44.5-mm) wide, 24-in. (610-mm) long, 20-gage steel strips, punched with three staggered rows of elongated holes, galvanized after fabrication.

2.4 E. Stainless steel —Stainless steel items shall be AISI Type 304 or Type 316, and shall conform to the following:

1. Joint reinforcementASTM A 580
2. Plate and bent-bar anchors..... ASTM A 480 and ASTM A 666
3. Sheet-metal anchors and ties ASTM A 480 and ASTM A 240
4. Wire ties and anchorsASTM A 580

2.4 F. Coatings for corrosion protection — Unless otherwise required, protect carbon steel joint reinforcement, ties, and anchors from corrosion by galvanizing or epoxy coating in conformance with the following minimums:

1. Galvanized coatings:

a. Mill galvanized coatings:

- 1) Joint reinforcement ASTM A 641(0.1 oz/ft²) (0.031 kg/m²)
- 2) Sheet-metal ties and sheet-metal anchors ASTM A 653 Coating Designation G60

b. Hot-dip galvanized coatings:

- 1) Joint reinforcement, wire ties, and wire anchors ASTM A 153 (1.50 oz/ft²) (458 g/m²)
- 2) Sheet-metal ties and sheet-metal anchors ASTM A 153 Class B
- 3) Steel plates and bars (as applicable to size and form indicated) ASTM A 123 or ASTM A 153, Class B

2. Epoxy coatings:

- a. Joint reinforcement ASTM A 884 Class A Type 1 —≥ 7 mils (175 μm)
- b. Wire ties and anchors.....ASTM A 899 Class C — 20 mils (508 μm)
- c. Sheet-metal ties and anchors 20 mils (508 μm) per surface or manufacturer's specification

2.4 G. Corrosion protection for tendons — Protect tendons from corrosion when they are in exterior walls exposed to earth or weather or walls exposed to a mean relative humidity exceeding 75 percent (corrosive environment). Select corrosion protection methods for bonded and unbonded tendons from one of the following:

1. Bonded tendons

— Encapsulate bonded tendons in corrosion resistant and watertight corrugated ducts complying with Article 2.4 G.1.a. Fill ducts with prestressing grout complying with Article 2.4 G.1.b.

- a. Ducts — High-density polyethylene or polypropylene.
 - 1) Use ducts that are mortar-tight and non-reactive with masonry, tendons, and grout.
 - 2) Provide ducts with an inside diameter at least 1/4 in. (6.4 mm) larger than the tendon diameter.
 - 3) Maintain ducts free of water if members to be grouted are exposed to temperatures below freezing prior to grouting.
 - 4) Provide openings at both ends of ducts for grout injection.

b. Prestressing grout

1) Select proportions of materials for prestressing grout using either of the following methods as accepted by the Architect/Engineer:

- a) Results of tests on fresh and hardened prestressing grout — prior to beginning grouting operations, or

- b) Prior documented experience with similar materials and equipment and under comparable field conditions.
 - 2) Use portland cement conforming to ASTM C 150, Type I, II, or III, that corresponds to the type upon which selection of prestressing grout was based.
 - 3) Use the minimum water content necessary for proper pumping of prestressing grout; however, limit the water-cement ratio to a maximum of 0.45 by weight.
 - 4) Discard prestressing grout that has begun to set due to delayed use.
 - 5) Do not use admixtures, unless acceptable to the Architect/Engineer.
 - 6) Use water that is potable and free of materials known to be harmful to masonry materials and reinforcement.
 - 7) Use sand that conforms to ASTM C 144.
2. *Unbonded tendons* — Coat unbonded tendons with a material complying with Article 2.4 G.2b and covered with a sheathing complying with Article 2.4 G.2a. Acceptable materials include a corrosion-inhibiting coating material with a tendon covering (sheathing).
- a. Provide continuous tendon sheathing over the entire tendon length to prevent loss of coating materials during tendon installation and stressing procedures. Provide a sheathing of medium or high density polyethylene or polypropylene with the following properties:
 - 1) Sufficient strength to withstand damage during fabrication, transport, installation, and tensioning.
 - 2) Water-tightness over the entire sheathing length.
 - 3) Chemical stability without embrittlement or softening over the anticipated exposure temperature range and service life of the structure.
 - 4) Non-reactive with masonry and the tendon corrosion-inhibiting coating.
 - 5) In normal (non-corrosive) environments, a sheathing thickness of not less than 0.025 in. (0.6 mm). In corrosive environments, a sheathing thickness of not less than 0.040 in. (1.0 mm).
 - 6) An inside diameter at least 0.010 in. (0.3 mm) greater than the maximum diameter of the tendon.
 - 7) For applications in corrosive environments, connect the sheathing to intermediate and fixed anchorages in a watertight fashion, thus providing a complete encapsulation of the tendon.

- b. Provide a corrosion-inhibiting coating material with the following properties:

- 1) Lubrication between the tendon and the sheathing.
- 2) Resist flow from the sheathing within the anticipated temperature range of exposure.
- 3) A continuous non-brittle film at the lowest anticipated temperature of exposure.
- 4) Chemically stable and non-reactive with the tendon, sheathing material, and masonry.
- 5) An organic coating with appropriate polar-moisture displacing and corrosion-preventive additives.
- 6) A minimum weight not less than 2.5 lb of coating material per 100 ft (37.2 g of coating material per m) of 0.5-in. (12.7-mm) diameter tendon and 3.0 lb of coating material per 100 ft (44.6 g of coating material per m) of 0.6-in. (15.2-mm) diameter tendon. Use a sufficient amount of coating material to ensure filling of the annular space between tendon and sheathing.
- 7) Extend the coating over the entire tendon length.
- 8) Provide test results in accordance with Table 6 for the corrosion-inhibiting coating material.

- 3. Alternative methods of corrosion protection that provide a protection level equivalent to Articles 2.4 G.1 and 2.4 G.2 are permitted. Stainless steel prestressing tendons or tendons galvanized according to ASTM A 153, Class B, are acceptable alternative methods. If galvanized, further evidence must be provided that the coating will not produce hydrogen embrittlement of the steel.

2.4 H. *Prestressing anchorages, couplers, and end blocks*

- 1. Provide anchorages and couplers that develop at least 95 percent of the specified breaking strength of the tendons or prestressing steel when tested in an unbonded condition, without exceeding anticipated set.
- 2. Place couplers where accepted by Architect/Engineer. Enclose with housing that permits anticipated movements of the couplers during stressing.
- 3. Protect anchorages, couplers, and end fittings against corrosion.
- 4. Protect exposed anchorages, couplers, and end fittings to achieve the required mechanical protection and fire rating for the element as specified by local building codes.

Table 6 — Performance specification for corrosion-inhibiting coating

Test	Test Method	Acceptance Criteria
Dropping Point, °F (°C)	ASTM D 566 or ASTM D 2265	Minimum 300 (148.9)
Oil Separation @ 160° F (71.1°C) % by weight	FTMS 791B Method 321.2	Maximum 0.5
Water, % maximum	ASTM D 95	0.1
Flash Point, °F (°C) (Refers to oil component)	ASTM D 92	Minimum 300 (148.9)
Corrosion Test 5 % Salt Fog @ 100°F (37.8°C) 5 mils (0.13 mm), minimum hours (Q Panel type S)	ASTM B 117	For normal environments: Rust Grade 7 or better after 720 hr of exposure according to ASTM D 610. For corrosive environments : Rust Grade 7 or better after 1000 hr of exposure according to ASTM D 610. ¹
Water Soluble Ions ² a. Chlorides, ppm maximum b. Nitrates, ppm maximum c. Sulfides, ppm maximum	ASTM D 512	10 10 10
Soak Test 5% Salt Fog at 100°F (37.8°C) 5 mils (0.13 mm) coating, Q panels, type S. Immerse panels 50% in a 5% salt solution and expose to salt fog	ASTM B 117 (Modified)	No emulsification of the coating after 720 hr of exposure
Compatibility with Sheathing a. Hardness and volume change of polymer after exposure to grease, 40 days @ 150°F (65.6°C). b. Tensile strength change of polymer after exposure to grease, 40 days @ 150°F (65.6°C).	ASTM D 4289 ASTM D 638	Permissible change in hardness 15% Permissible change in volume 10% Permissible change in tensile strength 30%

¹ Extension of exposure time to 1000 hours for greases used in corrosive environments requires use of more or better corrosion-inhibiting additives.

² Procedure: The inside (bottom and sides) of a 33.8 oz (1L) Pyrex beaker, approximate O.D. 4.1 in. (105 mm), height 5.7 in. (145 mm), is thoroughly coated with 35.3 ± 3.5 oz (100 ± 10 g) corrosion-inhibiting coating material. The coated beaker is filled with approximately 30.4 oz (900 cc) of distilled water and heated in an oven at a controlled temperature of 100°F ± 2°F (37.8°C ± 1°C) for 4 hours. The water extraction is tested by the noted test procedures for the appropriate water soluble ions. Results are reported as ppm in the extracted water.

2.5 — Accessories

2.5 A. Unless otherwise required, provide contraction (shrinkage) joint material that conforms to one of the following standards:

1. ASTM D 2000, M2AA-805 Rubber shear keys with a minimum durometer hardness of 80.
2. ASTM D 2287, Type PVC 654-4 PVC shear keys with a minimum durometer hardness of 85.
3. ASTM C 920.

2.5 B. Unless otherwise required, provide expansion joint material that conforms to one of the following standards:

1. ASTM C 920.
2. ASTM D 994.
3. ASTM D 1056, Class 2A1.

2.5 C. Asphalt emulsion — Provide asphalt emulsion as follows:

1. Metal surfaces.....ASTM D 1187, Type II
2. Porous surfaces..ASTM D 1227, Type III, Class I

2.5 D. Masonry cleaner

1. Use potable water and detergents to clean masonry unless otherwise acceptable.
2. Unless otherwise required, do not use acid or caustic solutions.

2.5 E. Joint fillers — Use the size and shape of joint fillers specified.

2.6 — Mixing**2.6 A. Mortar**

1. Mix cementitious materials and aggregates between 3 and 5 min. in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Unless acceptable, do not hand mix mortar. Maintain workability of mortar by remixing or retempering. Discard mortar which has begun to stiffen or is not used within 2½ hr after initial mixing.
2. Limit the maximum percentage of mineral oxide or carbon black job-site pigments by weight of cement as follows:
 - a. Pigmented portland cement-lime mortar
 - 1) Mineral oxide pigment 10 percent
 - 2) Carbon black pigment 2 percent
 - b. Pigmented mortar cement mortar
 - 1) Mineral oxide pigment 5 percent
 - 2) Carbon black pigment 1 percent
 - c. Pigmented masonry cement mortar
 - 1) Mineral oxide pigment 5 percent
 - 2) Carbon black pigment 1 percent
3. Do not use admixtures containing more than 0.2 percent chloride ions.

4. *Glass unit masonry* — Reduce the amount of water to account for the lack of absorption. Do not retemper mortar after initial set. Discard unused mortar within 1½ hr after initial mixing.

2.6 B. Grout

1. Unless otherwise required, proportion and mix grout in accordance with the requirements of ASTM C 476.
2. Unless otherwise required, mix grout to a consistency that has a slump between 8 and 11 in. (203 and 279 mm).

2.6 C. Thin-bed mortar for AAC — Mix thin-bed mortar for AAC masonry as specified by the thin-bed mortar manufacturer.

2.7 — Fabrication**2.7 A. Reinforcement**

1. Fabricate bars used in masonry reinforcement in accordance with the fabricating tolerances of ACI 315.
2. Unless otherwise required, bend bars cold and do not heat bars.
3. The minimum inside diameter of bend for stirrups shall be five bar diameters.
4. Do not bend Grade 40 bars in excess of 180 degrees. The minimum inside diameter of bend is five bar diameters.
5. The minimum inside bend diameter for other bars is as follows:
 - a. No. 3 through No. 8 (M#10 through 25) 6 bar diameters
 - b. No. 9 through No. 11 (M#29 through 36) 8 bar diameters
6. Provide standard hooks that conform to the following:
 - a. A standard 180-degree hook: 180-degree bend plus a minimum extension of 4 bar diameters or 2½ in. (64 mm), whichever is greater.
 - b. A standard 135-degree hook: a 135-degree bend plus a minimum extension of 6 bar diameters or 4 in. (102 mm), whichever is greater.
 - c. A standard 90-degree hook: 90-degree bend plus a minimum extension of 12 bar diameters.
 - d. For stirrups: a 90- or 135-degree bend plus a minimum of 6 bar diameters or 2½ in. (64 mm), whichever is greater.
7. Fabricate joint reinforcement, anchors, and ties in accordance with this Specification and with the published specifications of the accepted manufacturer.

2.7 B. Prefabricated masonry

1. Unless otherwise required, provide prefabricated masonry that conforms to the provisions of ASTM C 901.
2. Unless otherwise required, provide prefabricated masonry lintels that have an appearance similar to the masonry units used in the wall surrounding each lintel.
3. Mark prefabricated masonry for proper location and orientation.

PART 3 — EXECUTION

3.1 — Inspection

3.1 A. Prior to the start of masonry construction, the Contractor shall verify:

1. That foundations are constructed with tolerances conforming to the requirements of ACI 117.
2. That reinforcing dowels are positioned in accordance with the Project Drawings.

3.1 B. If stated conditions are not met, notify the Architect/Engineer.

3.2 — Preparation

3.2 A. Clean reinforcement by removing mud, oil, or other materials that will adversely affect or reduce bond at the time mortar or grout is placed. Reinforcement with rust, mill scale, or a combination of both are acceptable without cleaning or brushing provided the dimensions and weights, including heights of deformations, of a cleaned sample are not less than required by the ASTM specification covering this reinforcement in this Specification.

3.2 B. Prior to placing masonry, remove laitance, loose aggregate, and anything else that would prevent mortar from bonding to the foundation.

3.2 C. *Wetting masonry units*

1. *Concrete masonry* — Unless otherwise required, do not wet concrete masonry or AAC masonry units before laying. Wet cutting is permitted.
2. *Clay or shale masonry* — Wet clay or shale masonry units having initial absorption rates in excess of 1 g per min. per in.² (0.0016 g per min. per mm²), when measured in accordance with ASTM C 67, so the initial rate of absorption will not exceed 1 g per min. per in.² (0.0016 g per min. per mm²) when the units are used. Lay wetted units when surface dry. Do not wet clay or shale masonry units having an initial absorption rate less than 0.2 g per min. per in.² (0.00031 g per min. per mm²).

3.2 D. Debris — Construct grout spaces free of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.

3.2 E. Reinforcement — Place reinforcement and ties in grout spaces prior to grouting.

3.2 F. Cleanouts — Provide cleanouts in the bottom course of masonry for each grout pour when the grout pour height exceeds 5 ft (1.52 m).

1. Construct cleanouts so that the space to be grouted can be cleaned and inspected. In solid grouted masonry, space cleanouts horizontally a maximum of 32 in. (813 mm) on center.

2. Construct cleanouts with an opening of sufficient size to permit removal of debris. The minimum opening dimension shall be 3 in. (76.2 mm).

3. After cleaning, close cleanouts with closures braced to resist grout pressure.

3.3 — Masonry erection

3.3 A. Bond pattern — Unless otherwise required, lay masonry in running bond.

3.3 B. *Placing mortar and units*

1. *Bed and head joints* — Unless otherwise required, construct $\frac{3}{8}$ -in. (9.5-mm) thick bed and head joints, except at foundation or with glass unit masonry. Construct bed joint of the starting course of foundation with a thickness not less than $\frac{1}{4}$ in. (6.4 mm) and not more than $\frac{3}{4}$ in. (19.1 mm). Provide glass unit masonry bed and head joint thicknesses in accordance with Article 3.3 B.5.c. Construct joints that also conform to the following:

- a. Fill holes not specified in exposed and below grade masonry with mortar.
 - b. Unless otherwise required, tool joint with a round jointer when the mortar is thumbprint hard.
 - c. Remove masonry protrusions extending $\frac{1}{2}$ in. (12.7 mm) or more into cells or cavities to be grouted.
2. *Collar joints* — Unless otherwise required, solidly fill collar joints less than $\frac{3}{4}$ in. (19.1 mm) wide with mortar as the job progresses.
3. *Hollow units* — Place hollow units so:
- a. Face shells of bed joints are fully mortared.
 - b. Webs are fully mortared in all courses of piers, columns and pilasters, in the starting course on foundations, and when necessary to confine grout or loose-fill insulation.
 - c. Head joints are mortared, a minimum distance from each face equal to the face shell thickness of the unit.
 - d. Vertical cells to be grouted are aligned and unobstructed openings for grout are provided in accordance with the Project Drawings.
4. *Solid units* — Unless otherwise required, solidly fill bed and head joints with mortar and:
- a. Do not fill head joints by slushing with mortar.
 - b. Construct head joints by shoving mortar tight against the adjoining unit.
 - c. Do not deeply furrow bed joints.