**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated July 2023**
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DIVISION 03 - CONCRETE

SECTION 03 44 00

REINFORCED AUTOCLAVE AERATED CONCRETE PANELS

**02/13**

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**USACE / NAVFAC / AFCEC / NASA** **UFGS-03 44 00 (February 2013)**

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**Preparing Activity: USACE** **New**

**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated July 2023**

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SECTION 03 44 00

REINFORCED AUTOCLAVE AERATED CONCRETE PANELS
**02/13**

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**NOTE: This guide specification covers the requirements for fabrication and erection of reinforced precast autoclave aerated concrete (PAAC) panels, used as structural floor units, and roof units and wall units for buildings.**

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

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

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

**********

PART 1 GENERAL

**********

**NOTE: Precast autoclave aerated concrete (PAAC) floor, roof, and wall units for clear spans up to 5.94 meters 19 feet 6 inches**

**Drawings must include a complete design indicating the character of the work to be performed and giving the following:**

**Assumed loads, including floor live load, roof live load, wind load, concentrated loads such as partitions, and equipment mounted on or suspended from precast concrete construction, concrete floor**

topping weight, and other design data as may be required for the proper preparation of shop drawings.

Layout of the framing system indicating the relative location of the structural PAAC sections, floor elevations, column centers and offsets, openings, and sufficient dimensions to adequately convey the quantity and nature of the required structural PAAC framing system.and/or elements.

Details of all structural PAAC Sections indicating cross-sections and dimensions.

Location of structural PAAC Sections having an architectural finish on exposed-to-view surfaces when required.

;Details of reinforcement indicating smooth welded wire reinforcing schedule for PAAC panels as required

Details of connections indicating end bearing minimums and anchorage devices in the structural PAAC sections.

Location and details of concrete floor topping, when required.

Details of openings including the size of steel framing members as required.

Details of precast concrete filler blocks, as required.

Details of hangers for suspended ceilings, ducts, piping, lighting fixtures, conduit, or other construction, as required.

When both fire-resistance-rated construction and nonrated construction are required, the location of fire-resistance-rated construction.

Cast-in-place normal-weight concrete, including concrete floor topping, is specified in Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE.

Precast conventionally reinforced concrete wall panels, solid-section type, are specified in Section 03 45 00 PRECAST ARCHITECTURAL CONCRETE.

Precast-concrete roof slabs placed over purlins or joists spaced not more than 2.4 m 8 feet on center are specified in Section 03 41 16.08 PRECAST CONCRETE SLABS (MAX. SPAN 8 FEET 0.C).

Sealing joints in exposed-to-view surfaces of PAAC slabs, such as at ceilings and walls, is specified in Section 07 92 00 JOINT SEALANTS.

Painting exposed-to-view surfaces of PAAC units such

**as ceilings, is specified in Section 09 90 00 PAINTS AND COATINGS.**

**Fire-resistance-rated construction using PAAC sections is described in Underwriters Laboratories, Inc., "Fire Resistance Ratings (BXUV)" included in UL Fire Resistance Directory and the "Fire-Resistance Ratings" contained in AIA CO-1. Fire-resistance-rated construction limits the types of structural PAAC sections; the requirements for end restraint; the PAAC materials and proportions of concrete mix for floor top fill; the requirements for grouting and sealing joints; and the type of roof insulation and roof covering.**

**********

## 1.1 REFERENCES

**********

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

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

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

**********

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO M 200 | (1973; R 2012) Standard Specification for Epoxy Protective Coatings |

AMERICAN CONCRETE INSTITUTE (ACI)

| | |
|---|---|
| ACI 318 | (2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14) |
| ACI 523.4R | (2009) Guide for Design and Construction with Autoclaved Aerated Concrete Panels |

| | |
|---|---|
| ACI 530/530.1 | (2013) Building Code Requirements and Specification for Masonry Structures and Related Commentaries |
| ACI/MCP-2 | (2015) Manual of Concrete Practice Part 2 |
| ACI/MCP-3 | (2015) Manual of Concrete Practice Part 3 |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2020; Errata 1 2021) Structural Welding Code - Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36/A36M | (2019) Standard Specification for Carbon Structural Steel |
| ASTM A283/A283M | (2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates |
| ASTM A615/A615M | (2022) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A675/A675M | (2014) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties |
| ASTM A1064/A1064M | (2022) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| ASTM C33/C33M | (2018) Standard Specification for Concrete Aggregates |
| ASTM C42/C42M | (2020) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete |
| ASTM C94/C94M | (2022a) Standard Specification for Ready-Mixed Concrete |
| ASTM C150/C150M | (2022) Standard Specification for Portland Cement |
| ASTM C260/C260M | (2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete |
| ASTM C404 | (2018) Standard Specification for Aggregates for Masonry Grout |
| ASTM C595/C595M | (2021) Standard Specification for Blended Hydraulic Cements |
| ASTM C989/C989M | (2022) Standard Specification for Slag Cement for Use in Concrete and Mortars |

| | |
|---|---|
| ASTM C1107/C1107M | (2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) |
| ASTM C1452 | (2000; R 2006) Standard Specification for Reinforced Autoclaved Aerated Concrete Elements |
| ASTM C1660 | (2010) Standard Specification for Thin-bed Mortar for Autoclaved Aerated Concrete (AAC) Masonry |
| ASTM C1693 | (2011) Standard Specification for Autoclaved Aerated Concrete (AAC) |
| ASTM C1694 | (2009) Standard Specification for Reinforced Autoclaved Aerated Concrete (AAC) Elements |
| ASTM D312/D312M | (2016a) Standard Specification for Asphalt Used in Roofing |
| ASTM D2103 | (2015) Standard Specification for Polyethylene Film and Sheeting |
| ASTM D4397 | (2016) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications |
| ASTM E165/E165M | (2018) Standard Practice for Liquid Penetrant Examination for General Industry |
| ASTM E709 | (2021) Standard Guide for Magnetic Particle Testing |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FS MMM-A-001993 | (1978; Rev A) Adhesive, Epoxy, Flexible, Filled (For Binding, Sealing, and Grouting) |
| FS UU-B-790 | (Rev A; Notice 2) Building Paper Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL Fire Resistance | (2014) Fire Resistance Directory |

## 1.2 ADMINISTRATIVE REQUIREMENTS

### 1.2.1 Pre-Installation Conference

Prior to installation of reinforced PAAC panels, schedule and hold a pre-installation conference to review scope of the work. Attendees will include a representative from each subcontractor involved with reinforced PAAC panels and adjacent construction material installation. Notify Contracting Officer at least seven days prior to the meeting.

1.2.2 Sequencing and Scheduling of PAAC element Installation

1.2.2.1 Panel Loadign

Loading AAC wall panels is prohibited prior to the following:

| | |
|---|---|
| Uniform floor or roof loads | 12 hours, minimum |
| Concentrated loads | Three days, minimum |

1.2.2.2 Construction Activities Coordination

a. Work required under this Section includes chase and routing coordination with construction activities specified in other Specification Sections.

b. As panel installation is completed, coordinate with work required in other Specification Sections for chases or routing areas required in AAC panels for electrical, plumbing, and other items.

c. Request relevant construction activities to mark actual routing or chase locations; include required depth.

d. Filling in chases and routed areas specified in other Specification Sections.

1.3 SUBMITTALS

**********

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

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

**The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification**

**and as described in Section 01 33 00 SUBMITTAL PROCEDURES.**

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

**********

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

SD-02 Shop Drawings

Fabrication Drawings; G[, [_____]]

Installation Drawings; G[, [_____]]

Reinforcement; G[, [_____]]

SD-04 Samples

PAAC Framing Mock-up; G[, [_____]]

SD-05 Design Data

Design Mix; G[, [_____]]

SD-06 Test Reports

Fabrication

Compressive Strength

Moisture Content

Dry Bulk Density

Drying Shrinkage

Modulus of Elasticity

SD-07 Certificates

PAAC Manufacturer

Installer

Qualifications for Welding Work

SD-08 Manufacturer's Instructions

Welding Sequence and Procedure

Epoxy-Resin Grout

## 1.4 PERFORMANCE REQUIREMENTS

### 1.4.1 Design Methods

For PAAC elements, design in accordance with ACI 523.4R. Also design PAAC wall elements in accordance with ACI 530/530.1, Chapter 11 entitled "Strength Design of Autoclaved Aerated Concrete Masonry". Determine Weld-Point Shear Strength in the reinforcement of PAAC panels in accordance with ASTM C1694, Section 8, and conform to the requirements in ASTM C1694, Table 2.

### 1.4.2 Allowable Design Loads and Deflections

**********

**NOTE: Allowable design loads must be indicated and include dead loads, live loads, stationary loads, concentrated moving loads, deflection of roof slab sections, etc.**

**Recommended design loads are specified in article ix of the National Building Code, recommended by the American Insurance Association AIA CO-1 and ANSI A58.1.**

**********

Allowable design loads and deflections are as indicated.

### 1.4.3 UL Fire-Resistance Listing and Label

**********

**NOTE: Delete paragraph heading and the following paragraph when UL-listed fire-resistant structural PAAC sections are not required. The UL lists several manufacturers of PAAC panels. Location and fire-resistance classification of fire-resistant-rated structural sections must be indicated.**

**********

Sections indicated requiring a fire-resistance classification must be listed in UL Fire Resistance, part entitled, "Precast Concrete Units (CFTV)," and bear the UL label and marking.

## 1.5 DRAWINGS

Show type and location of all reinforcement, size and spacing of welds within Fabrication Drawings. Indicate loads used for the design of reinforced AAC panels.

Indicate type and location of all anchorage devices, size and spacing of all welded connections, grouting and joint sealant details, and dimensions and locations of all openings in structural concrete sections within Installation Drawings. Indicate dimensions of panels, arrangement of joints, reinforcement, and erection details. Include location of openings fabricated in panels. Identify reinforced AAC panels with mark used on shop drawings. Locate identifying marks on surfaces not visible in installed configuration. Indicate AAC Strength Class - AC4, AC4.4 or AC6.

## 1.6 QUALITY CONTROL

### 1.6.1 Qualifications for PAAC Manufacturer

Provide structural PAAC sections manufactured by an organization experienced in the manufacture of reinforced PAAC sections. Submit a written description of the manufacturer giving the qualifications of personnel, location of plant, concrete batching facilities, manufacturing equipment and facilities, list of projects similar to specified work, and that the PAAC material and panels are manufactured in accordance with ASTM C1693, and ASTM C1694. (these ASTM specs supersede ASTM C1452).

### 1.6.2 Qualifications For Installer

Install members by an organization experienced in the installation of precast PAAC members, if applicable. Submit a written description of installers giving the qualifications of personnel, handling and erection equipment, list of projects similar to specified work, and other information as may be required.

### 1.6.3 Qualifications For Welding Work

[Section 05 05 23.16 STRUCTURAL WELDING applies to work specified in this section.][[Perform welding procedures in accordance with AWS D1.1/D1.1M.] [Provide welders that are qualified by tests in accordance with AWS D1.1/D1.1M.] [Welders are to make only those types of weldments for which each is specifically qualified.]]

Provide installation instructions for the Welding Sequence and Procedure which indicates the manufacturer's recommended sequence and method of installation.

### 1.6.4 Concrete Sampling and Testing

#### 1.6.4.1 Tests for Concrete Materials

**********

**NOTE: Manufacturers of precast Autoclaved Aerated Concrete(PAAC) typically have proprietary mixes/recipes to produce AAC material for meeting the various ASTM-designated strength classifications, and therefore have various inspection and testing requirements unique to their raw materials and proprietary recipe specifications. The following are a list of sample raw material testing requirements for PAAC. (Note: some requirements may be satisfied by a "certificate of analysis" from the raw material supplier based on testing performed prior to shipment of material to PAAC manufacturer).**

**********

Sample and test concrete materials proposed for use in the work as follows:

| MATERIAL | | |
|---|---|---|
| REQUIREMENT | TEST METHOD | NUMBER OF TESTS |
| QUICKLIME FOR AAC | | |
| Total Calcium Oxide | "certificate of analysis" from the supplier | certificate per truck delivered to the manufacturer |
| Total Magnesium Oxide Content | "certificate of analysis" from the supplier | certificate per truck delivered to the manufacturer |
| Percent retained on 90 µm No. 170 | "certificate of analysis" from the supplier | certificate per truck delivered to the manufacturer |
| Temperature rise during wet slaking process | "certificate of analysis" from the supplier | certificate per truck delivered to the manufacturer |
| CEMENT FOR AAC | | |
| Total CaO content | "certificate of analysis" from the supplier | certificate monthly from each supplier |
| Equivalent Alkali content | "certificate of analysis" from the supplier | certificate monthly from each supplier |
| Blaine Fineness | "certificate of analysis" from the supplier | certificate monthly from each supplier |
| Mill Report from supplier certifying it meets ASTM C150/C150M, Table 1, for Type I/II cement | "certificate of analysis" from the supplier | certificate monthly from each supplier |
| SAND FOR AAC | | |
| SiO2 content | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| Clay content | manufacturer proprietary requirement for AAC mix | test each delivery of sand received |
| Alkali (Na2O and K2O) content | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| Percent retained on 2.8 mm No. 7 | "certificate of analysis" from the supplier | test each delivery of sand received |
| Percent retained on 1 mm No. 18 | "certificate of analysis" from the supplier | test each delivery of sand received |
| GYPSUM OR ANHYDRITE FOR AAC | | |

| MATERIAL | | |
|---|---|---|
| REQUIREMENT | TEST METHOD | NUMBER OF TESTS |
| SO3 content | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| Blended Gypsum and Anhydrite | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| Percent retained on 90 µm No. 170 | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| SLAG FOR AAC | | |
| Sulfide Sulfur (S) content | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| Sulfur Trioxide (SO3) content | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| Slag Activity Index, percent, @ 7 days, | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| Slag Activity Index, percent, @ 28 days | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| Percent retained on 45 µm No. 325 sieve | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| Air content | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| Mill Report certifying it meets ASTM C989/C989M (for "Ground Granulated Blast Furnace Slag for Use in Concrete and Mortars" | "certificate of analysis" from the supplier | certificate every 90 days per each source |
| ALUMINUM POWDER FOR AAC | | |
| Meet PAAC manufacturer specifications | "certificate of analysis" from the supplier | certificate per each source per batch delivered to manufacturer |
| RECYCLE SLURRY FOR AAC | | |
| Density | manufacturer requirements for using recycle slurry in AAC in accordance with proprietary recipe requirements | test recycle slurry each mixing day, prior to using it in recipes that day |

| MATERIAL | | |
|---|---|---|
| REQUIREMENT | TEST METHOD | NUMBER OF TESTS |
| Moisture | manufacturer requirements for using recycle slurry in AAC in accordance with proprietary recipe requirements | test recycle slurry each mixing day, prior to using it in recipes that day |

1.6.4.2 Concrete Design Mixes

**********
**NOTE: Delete the types of concrete and tests not required.**
**********

Determine and test concrete design mix for autoclaved aerated concrete used as follows. Include within each test report the project name and number, date, name of Contractor, name of PAAC manufacturer, name of concrete testing service, strength class of PAAC mix, identification /mark numbers of structural-members cast with tested batch

| REQUIREMENT | TEST METHOD | NUMBER OF TESTS |
|---|---|---|
| Proprietary mix to meet specified strength class requirements for compressive strength and dry bulk density | manufacturer's proprietary recipe | various certifications and testing of raw material and mixed AAC material |
| Compressive strength (typically tested 1 to 7 days after casting) | ASTM C1693 | 3 cube specimens, per autoclave-cured batch, for each strength class of AAC material cured in that autoclave |
| Compressive strength (typically tested 1 to 3 days after casting; this is additional testing by manufacture to verify density sooner than 7 days) | ASTM C1693, except specimens are larger than the 4 inch cubes noted in ASTM C1693. | 3 specimens tested from each autoclave-cured batch, for each strength class of AAC material cured in that autoclave |
| Moisture content (typically tested 1 to 7 days after casting) | ASTM C1693 | 3 cube specimens, per autoclave-cured batch, for each strength class of AAC material cured in that autoclave |

| REQUIREMENT | TEST METHOD | NUMBER OF TESTS |
|---|---|---|
| Dry bulk density (typically tested 1 to 7 days after casting) | ASTM C1693 | 3 cube specimens, per autoclave-cured batch, for each strength class of AAC material cured in that autoclave |
| Dry bulk density (typically tested 1 to 3 days after casting; this is additional testing by manufacturer to verify density sooner than 7 days) | ASTM C1693, except specimens are larger than the 4 inch cubes noted in ASTM C1693. | 3 specimens tested from each autoclave-cured batch, for each strength class of AAC material cured in that autoclave |
| Drying shrinkage | ASTM C1693 | annual test for each strength class recipe made by the manufacturer |
| Modulus of elasticity | ASTM C1693 | annual test for each strength class recipe made by the manufacturer |

[1.6.5 PAAC Framing Mock-up

Build a mock-up demonstrating the following features:

a. Mortar joints.
b. Control joint complete with joint sealant.
c. Workmanship.
[ d. Reinforcement in joints.]
e. Flashing.
f. Exterior finishes.
g. Interior finishes.

Prepare mock-up at least 14 days prior to beginning PAAC unit work. Should mock-up be disapproved, prepare additional mock-ups until approved. Maintain mock-up throughout work as a standard of PAAC unit work. Do not destroy mock-up until directed.

]1.7 DELIVERY, STORAGE, AND HANDLING PAAC ELEMENTS

1.7.1 Packing and Shipping of PAAC Elements:

Transport and handle reinforced AAC panels with equipment designed to protect panels from strain, warping, cracking, chipping, or staining. Placing reinforced AAC panels in direct contact with earth is prohibited.

1.7.2 Storage and Protection of PAAC Elements:

Store to protect from strain, warping, cracking, chipping, or staining. Store in same position as transported. Store on firm, level, smooth surface. Place so identification marks are easily discernible.

## PART 2 PRODUCTS

### 2.1 CONCRETE MATERIALS

#### 2.1.1 Aggregates

Size aggregates in accordance with the AAC manufacturer specification, using ASTM C33/C33M for reference.

#### 2.1.2 Portland Cement

Provide portland cement conforming to ASTM C150/C150M, as set forth in Table 1 for Type I/II cement. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

#### 2.1.3 Ground Granulated Blast Furnace (GGBF) Slag

**********

**NOTE: Ground granulated blast furnace slag is one of the materials listed in the EPA's Comprehensive Procurement Guidelines(CPG)(http://www.epa.gov/cpg/). If the Architect/Engineer determines that use of certain materials meeting the CPG content standards and guidelines would result in inadequate competition, do not meet quality/performance specifications, are available at an unreasonable price or are not available within a reasonable time frame, the Architect/Engineer may submit written justification and supporting documentation for not procuring designated items containing recovered material. Written justification may be submitted on a Request for Waiver Form to the NASA Environmental Program Manager for approval. The Request for Waiver Form is located in the NASA Procedures and Guidelines (NPG 8830.1) (http://nodis3.gsfc.nasa.gov)**

**********

GGBF slag [is required as an admixture and] [used as an admixture] must conform to ASTM C989/C989M to the extent identified by the AAC manufacturer, in addition to conforming to other specifications required by the AAC manufacturer's proprietary mix design.

#### 2.1.4 Air Entraining Admixture

Provide admixture that is free of sodium chloride and nitrates and conforms to ASTM C260/C260M.

#### 2.1.5 Water

Use potable water.

### 2.2 REINFORCEMENT MATERIALS

**********

**NOTE: Delete the following reinforcement materials that are not required. Concrete reinforcement materials are required for both conventionally reinforced and structural PAAC sections.**

**********

2.2.1 Reinforcement Bars

Provide deformed bars conforming to ASTM A615/A615M, Grade 60, except that 9.5 millimeter diameter Number 3 bars may be Grade 40.

2.2.2 Cold-Drawn Steel Wire

Provide wire reinforcement conforming to ASTM A1064/A1064M and the requirements in ASTM C1694, Table 1. Weld-Point Shear Strength in the reinforcement must conform to the requirements in ASTM C1694, Table 2. Apply a corrosion protective coating of appropriate material for reinforcement for PAAC elements. Determine the effectiveness of the corrosion protection for the steel reinforcement as noted in ASTM C1694.

2.3 CONNECTION MATERIALS

2.3.1 Steel Plates

Provide plates conforming to ASTM A283/A283M, Grade C[, or to ASTM A36/A36M ].

2.3.2 Steel Shapes

Provide structural-steel shapes conforming to ASTM A36/A36M.

2.3.3 Steel Bars

Provide bar shapes, flats, and rounds conforming to ASTM A675/A675M, Grade 65[, or ASTM A36/A36M].

2.4 GROUTING MATERIALS

**********

**NOTE: Delete the following paragraphs that are not applicable to the project. When fire-resistance rated structural PAAC sections are required, the applicable fire agency's requirements for grouting materials must be consulted.**

**********

**********

**NOTE: Ground granulated blast furnace slag is one of the materials listed in the EPA's Comprehensive Procurement Guidelines (CPG)(http://www.epa.gov/cpg/ ). If the Architect/Engineer determines that use of certain materials meeting the CPG content standards and guidelines would result in inadequate competition, do not meet quality/ performance specifications, are available at an unreasonable price or are not available within a reasonable time frame, the Architect/Engineer may submit written justification and supporting documentation for not procuring designated items containing recovered material. Written justification may be submitted on a Request for Waiver Form to the NASA Environmental Program Manager for approval. The Request for Waiver Form is located in the NASA Procedures and Guidelines (NPG 8830.1) (http://nodis3.gsfc.nasa.gov**

).
**********

[2.4.1 Cement Grout

[Portland cement must conform to ASTM C150/C150M, Type I.][Blended hydraulic cement must conform to ASTM C595/C595M, Type [_____].] Aggregate for cement grout must conform to ASTM C404, Size No. 2.

][2.4.2 Shrink-Resistant Grout

Provide premixed and packaged ferrous aggregate shrinkage-resistant grouting compound conforming to ASTM C1107/C1107M, for expansive grouts.

][2.4.3 Epoxy-Resin Grout

[Provide two-component, mineral-filled, epoxy-polysulfide epoxy-resin grout conforming to FS MMM-A-001993, Type I.][Provide two-component, epoxy-polyamide cured type epoxy-resin adhesive conforming to AASHTO M 200.]

]2.5 BITUMINOUS JOINT SEALING MATERIALS

**********
**NOTE: Delete this paragraph when single- or double-tee roof slab structural sections are not required.**
**********

Use asphalt bituminous cement conforming to ASTM D312/D312M, Type IV. Use 150 millimeter 6 inches wide joint sealing tape; multilayered, asphalt treated, glass-fiber reinforced, conforming to [ASTM D2103] [ASTM D4397] [ FS UU-B-790, Type I, Grade C, Style 4,]. However, a dry tensile strength less than 6130 Newton per meter 35 pounds per inch width, both directions, is not acceptable.

2.6 FABRICATION

2.6.1 Fabrication Tolerances

Fabricate sections within the following tolerances as stated in ASTM C1694

| | |
|---|---|
| Length | Plus or minus 5 mm 0.2 inch |
| Width | Plus or minus 3 mm 1/8 inch |
| Thickness | Plus or minus 3 mm 1/8 inch |
| Tongue/Groove Alignment | Plus or minus 3 mm 1/8 inch |

2.6.2 Forms

**********
**NOTE: Structural-section dimensions, cross-sections, and other details as required by the project must be indicated.**
**********

Use forms and form-facing materials that are nonreactive with concrete. Conform to the shapes, lines, and dimensions indicated and adhere to the specified fabrication tolerances.

2.6.3 Reinforcement

**********

**NOTE: Reinforcement types, sizes, and arrangement as required for structural strength after the structural sections have been installed must be indicated.**

**Revise the following paragraphs when not applicable to the project. Concrete cover for reinforcement must be indicated.**

**********

Provide types, sizes, and arrangement as indicated. Submit details of reinforcement in accordance with ACI/MCP-3 and ACI 318, unless otherwise specified.

Use metal bar supports and spacers when placing and securing steel bars, welded-wire fabric, and other reinforcement. Provide concrete cover for reinforcement in accordance with ACI/MCP-3 and ACI 318.

2.6.4 Lifting Devices

Provide lifting devices designed for 100-percent impact, and of materials sufficiently ductile to ensure visible deformation before fracture.

2.6.5 Concrete Mixing and Conveying

Measure concrete materials, concrete batching plant, concrete mixers, and concrete mixing in accordance with ASTM C94/C94M. Handle concrete to prevent segregation and loss of concrete mix materials.

2.6.6 Preparations for Placing Concrete

Keep form interiors and reinforcement free of accumulations of hardened concrete, form-parting compound, standing water, ice, snow, or other deleterious substances. Secure in position, inspect and approve reinforcement and other embedded items.

2.6.7 Weather Limitations

Do not place concrete when temperature of the atmosphere is below 5 degrees C 40 degrees F nor during rain, sleet, and snow unless adequate protection is provided. Protection during inclement weather must prevent the entry of rain, sleet, or snow into the forms or into the fresh concrete.

2.6.8 Concrete Placing

Depost concrete so that no concrete is placed on concrete that has hardened sufficiently to cause formation of seams or planes of weakness. Consolidate concrete in a manner that will prevent segregation and will produce concrete free of honeycomb or rock pockets and with the required surface finish.

2.6.9 Identification Markings

Clearly mark each structural section in a permanent manner to indicate its location and orientation in the building

For reinforced PAAC elements, clearly mark each structural section in a permanent manner to indicate its location and orientation in the building. Locate identifying marks, consistent with those shown on the Shop Drawings and the Panel Schedule on surfaces of PAAC elements not visible in their installed configuration. Indent marks for identification and quality tracking on a surface of every reinforced PAAC element not visible in their installed configuration. These marks will be coded to determine, at a minimum, the following identification and quality control tracking information for the panel: 1. Panel identification. 2. Compressive strength and density classification. 3. Production date. 4. Position of the panel in the mold.

2.6.10 Finishing Unformed Surfaces

Trowel finish unformed surfaces unless otherwise specified. Provide smooth surface free of trowel marks, uniform in texture and appearance, and be plane to a tolerance not exceeding 3.2 millimeter in 3048 millimeter 1/8 inch in 10 feet when tested with a 3000 millimeter 10-foot straightedge. Provide top surfaces of sections that are to receive concrete topping after installation with a transversely scarified scratch finish and remove laitance.

2.6.11 Protection of Concrete After Placing

Protect in accordance with ACI/MCP-2, particularly with regards to hot or cold weather conditions.

2.6.12 Finishing Formed Surfaces

Upon removal of forms, repair and patch defective areas. Limit defective areas to holes left by tie rods and other temporary inserts and to honeycomb or rock pockets not deep enough to expose the reinforcement and not located in bearing areas. Cut out defective areas to solid concrete and cleaned. Where the concrete surface will be exposed to view, the patches, when dry, must match the surrounding concrete.

2.6.12.1 Concealed Formed Surfaces

Formed surfaces of sections that will be concealed by other construction can have the standard smooth finish having the texture imparted by the forms. Repair and patch defective areas as specified and all fins and other projections removed.

2.6.12.2 PAAC Element Patching

Make patches on lower side of sections, near the center or in areas of variable tensile strength, or at bearing areas, with AAC panel repair mortar specified by the AAC manufacturer. Other areas can be patched with the same material, or with AAC "block patch" or Portland cement grout.

2.6.12.3 Finishing Exposed-To-View

**********

**NOTE: Delete the following paragraph and specify the required finish when an architectural finish is required. For an exposed-aggregate finish refer to Section 03 45 00 PRECAST ARCHITECTURAL CONCRETE. The location of precast structural concrete sections having an architectural finish must be indicated.**
**********

Provide grout finish on formed surfaces of sections that are to be exposed-to-view after installation. Final color of the grout, when dry, must be the same for all concrete surfaces. Spread over dampened concrete surface with clean burlap pads, carpet, or sponge rubber floats to fill pits, air bubbles, and surface holes. Remove excess grout by scraping and then rubbing the surface with clean burlap or carpet to remove visible grout film. In hot dry weather, kept grout damp by means of fog-spraying during the setting period.

## 2.7 QUALITY OF CONCRETE

### 2.7.1 Quality Control Testing During Fabrication

Sample and test concrete for quality control during fabrication as follows. Submit test results on the same day that tests are made.

| REQUIREMENT | TEST METHOD | NUMBER OF TESTS |
|---|---|---|
| Proprietary mix to meet specified AAC strength class requirements for AAC compressive strength and AAC dry bulk density as defined by ASTM C1693 | ASTM C1693 | See paragraph CONCRETE SAMPLING AND TESTING |
| PAAC manufacturer's Quality Control Manual | | See paragraph CONCRETE SAMPLING AND TESTING |
| PAAC manufacturer's certification of quarterly inspection of Quality Control process by a qualified third-party agency such as UL | on-site inspection by qualified third-party agency | quarterly, i.e. at least once every 90 days |

### 2.7.2 Autoclaved Aerated Concrete Properties

| PROPERTY | VALUE |
|---|---|
| Compressive strength | as specified for the Strength Classification in accordance with ASTM C1693 |
| Dry bulk density | within range shown for the specified Strength Classification in accordance with ASTM C1693 |
| Drying shrinkage | within range shown for the specified Strength Classification/Dry Bulk Density in accordance with ASTM C1693 |

## PART 3 EXECUTION

### 3.1 ANCHORAGE ITEMS EMBEDDED IN OTHER CONSTRUCTION

**********

**NOTE: Delete the paragraph heading and the following paragraph when structural PAAC sections will not be connected to cast-in-place concrete construction or masonry construction. Such anchorage items include anchor bolts, steel dowels, and steel bearing plates, steel studs, and steel straps.**

**********

Deliver items to the site before the start of other construction. Provide setting drawings, templates, instructions, and directions for the installation of anchorage items.

### 3.2 STRENGTH OF STRUCTURAL SECTIONS AT INSTALLATION

Do not install sections until PAAC concrete has attained the specified minimum laboratory strength at 1 to 7 calendar days.

### 3.3 INSTALLATION TOLERANCES

Install PAAC sections within the following tolerances:

| | |
|---|---|
| Deviation from plumb | Not over 10 mm in 4.8 m 1/4 inch in 10 feet, but not greater than 10 mm in 6.4 m 3/8 inch in 20 feet |
| Deviation from level | Not over 5 mm in 4.8 m 1/4 inch in 20 feet, but not greater than 10 mm in 9.6 m 1/2 inch in 40 feet |
| Deviation from linear building line from location indicated | Not over 6 mm 1/4 inch at base of wall |

### 3.4 PLACING FRAMING STRUCTURAL SECTIONS

**********

**NOTE: Delete paragraph heading and the following paragraphs when framing structural sections such as columns, beams, girders, and joists will not be required**

**********

Place supporting sections, including anchorage items attached to or embedded in other construction before placing sections is started.

#### 3.4.1 Placing PAAC Framing Sections

a. For mortared joints specified between PAAC elements, only use "thin-bed mortar" for AAC masonry manufactured in accordance with ASTM C1660.

b. For mortared joints used as leveling material for PAAC elements, use large grain mortar as specified by the PAAC manufacturer or mortar specified by the Engineer-of-Record.

c. Secure reinforced PAAC panels in place as indicated on approved shop drawings. Provide temporary bracing as required to resist construction loads, including wind, especially for wall panels.

d. Provide supplemental steel framing at openings in PAAC wall and/or floor and/or roof systems.

3.4.2 Cold Weather Precautions When Utilizing Thin Bed Mortar Joints

Do not install panels when temperature of AAC panel is below -6 degrees C 20 degrees F. Remove visible ice on AAC panel prior to installation. Heat mortar sand or mixing water to produce mortar temperatures between 4 degrees C and 50 degrees C 40 degrees F and 120 degrees F at time of mixing. Maintain mortar temperature above freezing until placed.

3.4.2.1 Ambient Temperature Requirements

a. Between -4 degrees C and -7 degrees C 25 degrees F and 20 degrees F: Use heat sources on both sides of AAC panels under construction. Install wind breaks when wind velocity is in excess of 24 km/hr 15 mph.

b. Below - 7 degrees C 20 degrees F: Provide enclosure for AAC panels under construction. Use heat sources to maintain temperatures above 0 degrees C 32 degrees F within enclosures.

3.4.2.2 Daily Mean Temperature Requirements for Cold Weather

a. Between 4 degrees C and 0 degrees C 40 degrees F and 32 degrees F: Protect completed AAC panels from rain or snow by covering with weather resistive membrane for a minimum of 24 hours after construction.

b. Between 0 degrees C and - 4 degrees C 32 degrees F and 25 degrees F: Completely cover completed AAC panels with weather resistive membrane for a minimum of 24 hours after construction.

c. Between -4 degrees C and -7 degrees C 25 degrees F and 20 degrees F: Completely cover completed AAC panels with insulating blankets or equal protection for a minimum of 24 hours after construction.

d. Below -7 degrees C 20 degrees F: Maintain AAC panel construction environment above 0 degrees C 32 degrees F for 24 hours after completion by an enclosure(s) with supplementary heat, electric heating blankets, infrared heat lamps, or other acceptable methods outlined to Contracting Officer's Representative.

3.4.3 Hot Weather Precautions When Utilizing Thin Bed Mortar Joints

When erected in ambient air temperature of 37 degrees C 100 degrees F or ambient air temperature of 32 degrees C 90 degrees F with wind velocity in excess of 13 km/hr 8 mph, implement the following:

a. Spreading mortar beds more than 1200 mm 4 feet ahead of AAC panels is prohibited.

b. Installing AAC panel more than two minutes after spreading mortar is prohibited.

## 3.5 PLACING STRUCTURAL PAAC FLOOR OR ROOF SLAB SECTIONS

**********

**NOTE: Delete the paragraph heading and the following paragraphs when slab structural sections, such as PAAC floor or roof panels will not be required. PAAC floor or roof panels may be placed over structural-steel framing members, precast structural-concrete framing sections, cast-in-place structural-concrete framing sections, or bearing walls, or a combination thereof.**

**********

Place supporting sections, including bearing pads or plates before placing sections.

a. Place slab structural sections on supporting construction with ends bearing on the structural framing sections or bearing walls as indicated. End bearings less than 75 millimeter 3 inches are not acceptable.

b. Accurately align slabs end to end with sides and ends spaced as shown on shop drawings.

c. Provide grouting void at sides and ends of the slabs.

d. Secure reinforced PAAC panels in place as indicated on approved shop drawings. Provide temporary bracing as required to resist construction loads, including wind.

e. Provide supplemental steel framing at openings in PAAC wall and/or floor and/or roof systems.

## 3.6 GROUTING CONNECTIONS AND JOINTS

**********

**NOTE: Delete paragraph heading and the following paragraphs when precast structural-concrete framing sections or floor-slab structural sections or both will not be required. When fire-resistance-rated precast structural-concrete sections are required, consult the applicable fire agency's requirements for grouting joints.**

**********

After sections have been placed and connected, grout open spaces at connections and joints. Reinforce and grout cells at joints between PAAC wall panels, as specified and shown in structural drawings and shop drawings. Fill joints between reinforced PAAC floor or roof panels using reinforcing bars and grout, as specified in structural drawings and shop drawings.

### 3.6.1 Cement Grout

Provide cement grout consisting of 1 part cement, 2-1/2 parts of specified aggregate, and not more than 17 L 4-1/2 gallons of water per 42.6 kg 94-pound sack of cement.

### 3.6.2 Shrink-Resistant Grout

Mix shrink-resistant grout compound with water to provide a flowable mixture without segregation or bleeding. Provide forms or other approved methods to retain the grout in place. Pack spaces with grout until the voids are completely filled. Flush grout at slab structural sections with top surface of the slab and remove excess. Keep grout damp for not less than 24 hours.

### 3.6.3 Epoxy-Resin Grout

Epoxy-resin grout or adhesive may be used in lieu of shrink-resistant grout. Install epoxy-resin grout or adhesive in accordance with the manufacturer's printed instructions.

## 3.7 SEALING JOINTS IN ROOF SLABS

**********

**NOTE: Delete paragraph heading and the following paragraphs when roof slab structural-sections will not be required. Where fire-resistance-rated roof slab structural sections are required, the applicable fire agency's requirements for sealing joints must be consulted.**

**********

After PAAC roof slab sections have been placed and connected, seal open spaces at connections and the top portion of joints.

a. Fill keyways and joints at ridges, hips, and connections with cement grout. Level with the top surfaces of slabs, remove excess grout, and apply a smooth finish.

b. Fill keyways and joints between reinforced PAAC floor or roof panels using reinforcing bars and grout, as specified in structural drawings and shop drawings.

c. Seal other joints with bituminous joint-sealing material. Center joint-sealing tape over the joint and embedded in hot bituminous cement. Lap Ends not less than 100 mm 4 inches. Remove excess bitumen and provide a smooth tape surface.

## 3.8 OPENINGS IN SLAB STRUCTURAL SECTIONS

**********

**NOTE: In PAAC flat slabs, the maximum size of field-cut openings is governed by approval of the PAAC panel Manufacturer, based on spacing and reinforcing in the panel. Maximum size and relative location of such openings must be communicated to the PAAC panel manufacturer prior to initiation of the shop drawings. Regardless of reinforcing, the maximum size of an opening or notch within a single PAAC panel, in the direction of panel width, is typically limited to 25 percent of the panel width.**

**********

Cut and fit sections as required for other work projecting through, or

adjacent to, the members. Cut straight and at 90 degrees to the surfaces without breaking or spalling the edges.

**********

**NOTE: Openings larger than 300 mm 12 inches in the panel width direction must be framed with supporting members.**

**********

a. Reinforce openings in sections having a dimension more than 300 mm 12 inches in the panel width direction by means of hung steel angle saddle headers or additional framing. Headers must be shop prime-coat painted.

b. Provide headers at penetrations in floor and roof systems as detailed by the AAC Panel Manufacturer.

## 3.9 TOUCHUP PAINTING

**********

**NOTE: Delete this paragraph when precast structural members will not be supported by steel structural members.**

**********

Wire brush, clean, and touchup paint scarred surfaces on steel supporting members and weld plates after sections have been installed.

## 3.10 PROTECTION AND CLEANING

**********

**NOTE: Where architectural finishes such as exposed-aggregate finish are specified for exposed-to-view surfaces, such surfaces must be cleaned as specified in Section 03 45 00 PRECAST ARCHITECTURAL CONCRETE.**

**********

a. Patch spalls and chips in reinforced AAC panels in accordance with AAC panel manufacturer's recommendations.

b. Upon completion of installation, sweep clean and leave ready slab surfaces to receive concrete floor topping, roofing, or other covering.

c. Protect exposed-to-view surfaces against staining and other damage until completion of the work.

## 3.11 INSPECTION AND ACCEPTANCE PROVISIONS

### 3.11.1 Dimensional Tolerances

Members having any dimension outside the limits for fabrication tolerances specified will be rejected.

### 3.11.2 Surface-Finish Requirements

Sections will be rejected for any of the following surface-finish deficiencies:

**********
**NOTE: Delete the first of the following paragraphs when architectural finishes such as exposed-aggregate finish, are not required for exposed-to-view surfaces.**
**********

a. Exposed-to-view surfaces having architectural finishes that do not match the color, aggregate size and distribution, and texture of the approved sample for the exposed-to-view finish

b. Exposed-to-view formed surfaces that contain cracks, spalls, air bubbles, honeycomb, rock pockets, or stains or other discoloration that cannot be removed by cleaning

c. Concealed formed surfaces that contain cracks in excess of 0.25 millimeter 0.01 inch wide; cracks or any other surface deficiency that penetrates to the reinforcement regardless of the width of crack or size of other deficiency; honeycomb and rock pockets located in bearing surfaces; and spalls except minor breakage at corners

d. Unformed surfaces that contain cracks and other surface deficiencies as specified for concealed formed surfaces

3.11.3 Strength of Structural Members

Strength of structural PAAC sections will be considered potentially deficient if they fail to comply with the requirements that control the strength of the structural members, including the following conditions:

a. Failure to meet compressive strength tests

b. Reinforcement of PAAC section not conforming to the requirements specified

c. Concrete curing and protection of structural sections against extremes in temperature during curing not conforming to the requirements specified

d. Structural sections damaged during handling and erection

e. Reinforcement and Weld-Point Shear Strength of Precast Autoclaved Aerated Concrete (PAAC) panels not conforming to the requirements specified

3.11.4 Testing Structural Sections for Strength

When there is evidence that the strength of precast structural-concrete sections does not meet specification requirements, cores drilled in hardened concrete for compressive strength determination must be made in accordance with ASTM C42/C42M and as follows:

a. Take at least three representative cores from the precast structural concrete sections that are considered potentially deficient.

(1) Test cores saturated-surface-dry if the concrete they represent will be wet at all times during the use of the completed structure.

(2) Test cores air-dry if the concrete they represent will be dry at all times during the use of the completed structure.

b. Strength of cores will be considered satisfactory if their average is equal to or greater than the Minimum Compressive Strength (f'AAC)specified for the AAC Strength Class material intended for the PAAC sections, per the Shop Drawings and Panel Schedule

c. Fill core holes solidly with patching mortar and finished to match the adjacent concrete surfaces.

d. If the results of the core tests are unsatisfactory or if core tests are impractical to obtain, perform static load tests of a structural section. The test will be evaluated in accordance with ACI/MCP-3 and ACI 318, except that the superimposed test load must be as specified for the proof-test method of strength design.

Replace sections that are found inadequate by the core tests or by the results of static load tests with sections that meet the specified requirements.

3.11.5 Inspection of Welding

Perform inspection of weldingin accordance with AWS D1.1/D1.1M, Section entitled, "Inspection," and as follows:

**********

**NOTE: Delete the following paragraphs that are not applicable to the project. The location of welds requiring inspection and the type of inspection must be indicated. The liquid-penetration inspection of welds is the most economical and commonly used method.**

**********

a. Liquid-penetration inspection of welds must conform to ASTM E165/E165M.

b. Magnetic-particle inspection of welds must conform to ASTM E709.

3.11.6 Structural Sections-in-Place

Sections-in-place will be rejected for any one of the following deficiencies:

a. Sections not conforming to the requirements for installation tolerances specified

b. Sections that are damaged during construction operations

c. Sections having exposed-to-view surface finishes that develop surface finish deficiencies specified

-- End of Section --