UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION 03 45 00

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05/16, CHG 1: 02/21

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USACE / NAVFAC / AFCEC / NASA	**UFGS-03 45 00 (May 2016)** **Change 1 - 02/21**
Preparing Activity: NAVFAC	**Superseding** **UFGS-03 45 00 (November 2011)**

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SECTION 03 45 00

PRECAST ARCHITECTURAL CONCRETE
05/16, CHG 1: 02/21

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NOTE: This guide specification covers the requirements for architectural precast concrete products, that through their finish, shape, color, or texture contribute to a structure's architectural expression. These products may be custom designed or feature standard shapes. They may be manufactured with conventional mild-steel reinforcement, or they may be pretensioned or posttensioned. These products typically have more stringent requirements for dimensional tolerances, finish variations, and color consistency. Architectural precast concrete products includes wall panels, mullions, bollards, urns, railings, sills, copings, benches, planters, pavers, and other types of miscellaneous shapes.

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).

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NOTE: The panels specified are intended for attachment of the building framing system at each floor elevation and at the roof elevation. The panels may be provided with built-in anchorage devices for the attachment of thermal insulation

blankets to the interior face of the wall panels and for the attachment of metal flashing after the wall panels have been installed.

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Note: Drawings should include a complete design indicating the character of the work to be performed and the following:

1. Location and details of wall panels and precast units, showing all dimensions, and size and type of reinforcement.

2. Details of joints between wall panel and precast units, showing sealant or gasket shape, dimensions, and location.

3. Details showing both the location and type of anchorage devices of the precast units to the building framing system and the connection of other materials (reglets, insulation nailers, etc.) to the precast units. Indicate gravity loads, live loads, dynamic loads, and stresses inherent in the structure for the manufacturer to provide embedded precast units anchorage.

4. Locations where flashing reglets are required.

5. Locations of inserts (wedge type, slotted type, etc.) cast into the precast concrete units.

6. Location of each type of surface finish, with details of transitions between different types of surface finishes.

7. Indicate integral color(s) of precast units.

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PART 1 GENERAL

1.1 REFERENCES

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

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

References not used in the text will automatically

be deleted from this section of the project specification when you choose to reconcile references in the publish print process.
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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 251	(2006; R 2011) Standard Specification for Plain and Laminated Elastomeric Bridge Bearings

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 214R	(2011) Evaluation of Strength Test Results of Concrete
ACI 301	(2016) Specifications for Structural Concrete
ACI 301M	(2016) Metric Specifications for Structural Concrete
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI 318M	(2014; ERTA 2015) Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108/A118/A136.1	(2019) American National Standard Specifications for theInstallation of Ceramic Tile
ANSI A118.7	(2010) American National Standard Specifications for High Performance Cement Grouts for Tile Installation

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 90.1 - SI	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.21.1	(2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA U1	(2020) Use Category System: User Specification for Treated Wood

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M	(2020) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

ASTM A416/A416M	(2018) Standard Specification for Low-Relaxation, Seven-Wire for Prestressed Concrete
ASTM A449	(2014) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A666	(2015) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM B370	(2012; R 2019) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C31/C31M	(2019a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2020) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2020) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

ASTM C67/C67M	(2020) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C78/C78M	(2018) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94/C94M	(2020) Standard Specification for Ready-Mixed Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C144	(2018) Standard Specification for Aggregate for Masonry Mortar
ASTM C150/C150M	(2020) Standard Specification for Portland Cement
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C185	(2020) Standard Test Method for Air Content of Hydraulic Cement Mortar
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C311/C311M	(2018) Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C578	(2019) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	(2020) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C650	(2004; R 2014) Standard Test Method for Resistance of Ceramic Tile to Chemical Substances
ASTM C666/C666M	(2015) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C979/C979M	(2016) Standard Specification for Pigments

	for Integrally Colored Concrete
ASTM C989/C989M	(2018a) 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 C1218/C1218M	(2020c) Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1240	(2020) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1602/C1602M	(2018) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D746	(2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D5759	(2012; R 2020) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-117	(2013) Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products, 3rd Edition
PCI MNL-122	(2007) Architectural Precast Concrete, 3rd Edition

1.2 SUBMITTALS

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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-01 Preconstruction Submittals

Pre-Installation Meeting

SD-02 Shop Drawings

Precast Drawings; G[, [_____]]

SD-03 Product Data

Cast-In Embedded Items And Connectors; G[, [_____]]

Connection Devices; G[, [_____]]

Admixtures

Gasket

Thin Brick Veneer

Bearing Pads

SD-04 Samples

Concrete Wall Panel Surface Finish; G[, [_____]]

Mock-up

Brick Color Chips

Form Liner

[Full Size Sample Wall Panel

] SD-05 Design Data

Design Calculations; G[, [_____]]

Contractor-Furnished Mix Design; G[, [_____]]

Concrete Mix Design for Repair of Surface Defects; G[, [_____]]

Thermal Calculations; G[, [_____]]

SD-06 Test Reports

Strength Tests; G[, [_____]]

Slump

Air Content

Test for Concrete Materials

Water

Testing Precast Units for Strength

SD-07 Certificates

Manufacturer's Qualifications; G[, [_____]]

Fabricator Quality Certifications

Erector Certification

[Erector's Post Audit Declaration

] SD-08 Manufacturer's Instructions

Installation; G[, [_____]]

Cleaning; G[, [_____]]

Thin Brick

SD-11 Closeout Submittals

Concrete Batch Ticket Information; G[, [_____]]

Recycled Content for Fly Ash and Pozzolan; S

Recycled Content for Ground Iron Blast-Furnace Slag; S

Recycled Content for Silica Fume; S

1.3 MODIFICATION OF REFERENCES

In the referenced ACI and PCI publications, consider the advisory provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.4 GENERAL REQUIREMENTS

Precast concrete units must be designed and fabricated by an experienced and certified precast concrete manufacturer. The manufacturer needs to have been regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings for at least 3 years. The Contractor must submit a statement detailing the Manufacturer's Qualifications. Coordinate precast work with the work of other trades.

1.5 DESIGN

1.5.1 Standards and Loads

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NOTE: Design loads will be shown on the drawings. Criteria for design loads are contained in ASCE 7-16 and UFC 3-301-07. The differential temperature of 89 degrees C 160 degrees F is based on extreme values of 40 degrees C 40 degrees F below zero to 49 degrees C 120 degrees F above zero; it should be used for computing volume changes due to temperature variations. Other values, greater or smaller, should be used instead whenever justified by climatic conditions at the jobsite. For in-house design delete all references to design by others.

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Precast unit design must conform to ASCE 7-16, ACI 318M ACI 318 and PCI MNL-122. Indicate design loads for precast concrete on the drawings. A differential temperature of [89] [_____] degrees C [192] [_____] degrees F, between interior and exterior faces of the units, must be considered in the design. Stresses due to restrained volume change caused by shrinkage and temperature differential, handling, transportation and erection must be accounted for in the design.

1.5.2 Connections

Connection of units to other members, or to other units must be of the type and configuration indicated. The design and sizing of connections for all design loads will be completed by the Contractor.

1.5.3 Concrete Proportion

Base the selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportion using the same type and brand of cement, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete and admixtures containing chloride ions, nitrates, or other substances that are corrosive will not be used in prestressed concrete.

1.5.4 Design Calculations

Calculations for design of members, connections and embedments not shown must be made by a registered professional engineer experienced in the design of precast architectural concrete. Calculation will include the analysis of member for lifting stresses and the sizing of the lifting inserts. Submit calculations for review and approval prior to fabrication, signed and sealed by the registered design professional who prepared the design.

1.5.5 Thermal Calculations

Submit thermal calculations prepared and sealed by a registered professional engineer for review complying with ASHRAE 90.1 - SI ASHRAE 90.1 - IP, for the steady state thermal resistance for the precast concrete wall panels. Thermal calculations must demonstrate the thermal conductivity of all components, the spacing of all connectors, the percent area of the wall that is solid concrete, and the thermal resistance of all components.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver packaged materials, except for wall panels, to the project site in the original, unbroken packages or containers, each bearing a label clearly identifying manufacturer's name, brand name, weight or volume, and other pertinent information. Store packaged materials, and materials in containers, in a weathertight and dry place until ready for use.

Store products in manufacturer's unopened packaging in dry storage area, with ambient temperature between minus 1 degree C and 41 degrees C 30 degrees F and 120 degrees F, until installation.

1.7 STORAGE AND INSPECTION AT MANUFACTURER'S PLANT

Protect precast units temporarily stored at the manufacturer's plant from damage in accordance with PCI MNL-117 and PCI MNL-122. Immediately prior to shipment to the jobsite, all precast concrete units must be inspected for quality to insure all precast units conform to the requirements specified. Inspection for quality will include, but will not be limited to, the following elements: color, texture, dimensional tolerances, chipping, cracking, staining, warping and honeycombing. Replace or repair all defective precast concrete units as approved.

1.8 PLANT INSPECTION

[At the option of the Contracting Officer, precast units may be inspected.] [Precast units must be inspected by the QC representative

prior to being transported to the job site.] The Contractor is to give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.8.1 Fabricator Quality Certifications

Plants must be certified by the PCI Plant Certification Program for Group A, Category A1, or Architectural Precast Association (APA) certification or National Precast Concrete Association (NPCA). When plants are not currently enrolled in one of the three certification programs listed above then they must provide a product quality control system in accordance with PCI MNL-117 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory.

1.9 ERECTOR CERTIFICATION

Erector with erecting organization and all erecting crews certified and designated by PCI's Certificate of Compliance to erect Category [A (Architectural Systems) for non-load][S2 (Complex Structural Systems) for load]-bearing members.

[

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NOTE: Use the following paragraph when a PCI Certified erector is not available in the project location.

****

1.10 ERECTOR QUALIFICATIONS

A precast erector that is not certified by PCI who retains a PCI-Certified Field Auditor, at the erector's expense, to conduct a field audit of a project in the same category as this project prior to start of precast concrete erection and must submit the Erector's Post Audit Declaration to be considered qualified.

]

1.11 CONCRETE SAMPLING AND TESTING

1.11.1 Test for Concrete Materials

Sample and test concrete materials proposed for use in the work in accordance with PCI MNL-117.

Submit reports for each material sampled and tested prior to the start of work. Reports must contain the project name and number, date, name of Contractor, name of precast unit manufacturer, name of concrete testing service, source of concrete aggregates, generic name of aggregate, and values specified.

1.11.2 Quality Control Testing DuringFabrication

Sample and test concrete for quality control during fabrication as follows:

REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Sampling fresh concrete	ASTM C172/C172M except modified for slump per ASTM C94/C94M	As required for each test
Slump test	ASTM C143/C143M	One for each concrete load at point of discharge and one for each set of compressive strength tests
Air Content by pressure method	ASTM C231/C231M	One for each set of compressive strength tests
Compressive test specimens	ASTM C31/C31M	One set of six specimens for each Compressive Strength test, one set per day or for every 15 cubic meters 20 cubic yards of concrete placed, whichever is greater.

Compression test specimens may be either standard 150 by 300 millimeter 6 by 12 inch cylinders or 100 millimeter 4-inch cubes. Cubes may be molded individually or cut from slabs. Preparation and testing of cube specimens must be as nearly consistent with the test methods specified as possible, with the exception that the concrete will be placed in a single layer.

Curing of compression test specimens must be the same as the curing method used for the precast concrete wall panels until panels are stripped of forms and then standard moist cure will continue.

REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Concrete temperature		Each time a set of compression test specimens is made

Compressive strength tests	ASTM C39/C39M	One set of facing strength tests mix and one set of backing mix for every ten panels or fraction thereof cast in any one day; two specimens in each set tested at 7 calendar days; three specimens in each set tested at 28 calendar days, and one specimen in each set retained in reserve for testing if required

Evaluate compression test results at 28 days in accordance with ACI 214R using a coefficient of variation of 20 percent. Evaluate the strength of concrete by averaging the test results (two specimens) of standard cylinders tested at 28 days. Not more than 20 percent of the individual tests can have an average compressive strength less than the specified ultimate compressive strength. Submit test reports on the same day that tests are made.

Reports for Compressive Strength tests need to contain the project name and number, date of concrete placement, name of Contractor, name of precast concrete wall panel manufacturer, name of concrete testing service, panel identification letter and number, use of concrete mixture (facing or backing), design compressive strength at 28 calendar days, concrete-mix proportions and materials, and compressive breaking strength and type of break.

If 100 millimeter 4-inch cubes are used for compressive strength specimens, average strength of the cubes at any test age must be multiplied by the factor of 0.8 to arrive at an estimate of the corresponding 150 by 300 millimeter 6 by 12 inch cylinder strength. Report both of these values .

1.12 QUALITY ASSURANCE

1.12.1 Precast Drawings

Submit precast drawings with the following information:

a. Precast dimensions, cross-section, and edge details; location, size, and type of reinforcement, including reinforcement necessary for safe handling and erection of precast units and other embedded items. Comply with ACI SP-66.

b. Layout, dimensions, and identification of each precast unit, corresponding to installation sequence.

c. Setting drawings, instructions, and directions for installation of concrete inserts.

d. Location and details of anchorage devices and lifting devices embedded in panels, and connection details to building framing system.

[e. Location of embedded brick work including joint locations, joint widths, brick coursing, brick coursing alignment across panel joints and reveal and false-joint locations and dimensions.

]1.12.2 Concrete Wall Panel Surface Finish Sample

Submit a concrete wall panel sample 300 mm by 300 mm 12 inches by 12 inches by approximately 40 mm 1 1/2 inches in thickness, to illustrate quality, color, and texture of both exposed-to-view surface finish and finish of panel surfaces that will be concealed by other construction.[Obtain approval prior to submission of sample panels.]

After approval of the surface, Contractor must provide one full size sample Wall Panel. Approved sample may be used in construction when properly identified.

1.12.3 Required Records

ASTM C94/C94M. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.12.4 Mock-Up

Provide mock-up to establish that proposed materials and construction techniques provide acceptable visual effect. Materials used for mock-up should be those proposed for actual construction. Include all anchors, connections, flashing and joint fillers. Apply specified products to determine acceptability of appearance and optimum coverage rate required for application

Provide mock-up sections of building and structures which typify the most difficult areas to build.

1. Finish areas designated by Contracting Officer.
2. Apply water repellent in accordance with manufacturer's instructions.
3. After materials have cured, water test surface to determine that sufficient water repellent has been applied.
4. Do not proceed with remaining work until workmanship, color, and detail are approved by Contracting Officer.

5. Modify mock-up area as required to produce acceptable work.

Job Mock Up Panel: Minimum 1.2 meters by 1.2 meters 4 feet by 4 feet

1. Incorporate edge, reveal[, and brick coursing detail] as shown on drawings.
[2. Utilize full range of brick sizes, variance of brick size, general color of brick and variance in color and texture of brick.
][3. Show clean, pressure washed brick and concrete surface.
][4. Utilize full range of color of concrete mortar joints.
] 5. Maintain Mock Up for comparison with finished work.

After approval by Contracting Officer, transport mock-up to job-site and erect where directed by [Contracting Officer][_____].

1.12.5 Pre-Installation Meeting

Hold a meeting at the job site with representative of the manufacturer[and the applicator prior to application of water repellents] and all other trades that may be effected by work of this section. Notify the Contracting Officer at least 3 days in advance of the time of the meeting.

1.13 TOLERANCES

Dimensions of the finished panel, at the time of erection in the structure, must conform to the tolerances for precast, non-prestressed elements in PCI MNL-117, unless otherwise specified by the Architect.

PART 2 PRODUCTS

2.1 CONCRETE

2.1.1 Contractor-Furnished Mix Design

****
NOTE: If gap-graded or one size architectural aggregates are used in a high coarse aggregate mix, delete the air percentage requirements and use the second bracketed sentence.
****

ACI 211.1 and ACI 301M ACI 301. The Contractor must submit the mix design report giving the maximum nominal coarse aggregate size, the proportions of all ingredients and the type and amount of any admixtures that will be used in the manufacture of each strength and type of concrete, a minimum of sixty days prior to commencing operations. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. Plot a curve for each concrete mixture, showing the relationships between water-cementitious material ratios and compressive strengths. Maximum permissible water-cementitious material ratio must be that value not exceeding the maximum water-cementitious material ratio specified, indicated by the curve to produce a design minimum laboratory compressive strength at 28 calendar days not less than that specified. The mix design report is to contain the project name and number, date, name of Contractor, name of precast concrete wall panel manufacturer, name of concrete testing service, use of concrete mixture (facing or backing), source of concrete aggregates for each mixture. Submit certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, and aggregates. The statement must be accompanied by test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. Make no substitutions without additional tests to verify that the concrete properties are satisfactory. Concrete must have a 28-day compressive strength of 28 MPa [4000] [_____] psi.[Air content of plastic concrete must be between 4 and 6 percent air by volume.][Provide a dosage of air entraining agent which will produce 19 plus or minus 3 percent air in a 1 to 4 by weight standard sand mortar in accordance ASTM C185.]

If, the compressive strength falls below that specified, adjust the mix proportions and water content and make necessary changes in the temperature, moisture, and curing procedures to secure the specified strength. Notify the Contracting Officer of all changes.

[2.1.2 Exposed-to-View Facing Mixture

Provide aggregates for exposed-to-view facing mixture; white, gray, or buff portland cement or a blend of two or more portland cements; [air-entraining admixture;] and water. Provide exact proportions of

facing mixture to produce concrete having the specified properties and capable of obtaining the approved surface color and finish.

]2.1.3 Backing Mixture

Provide the approved mix design.

2.2 MATERIALS

2.2.1 Material Sustainability Criteria

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING:

a. Recycled content for fly ash and pozzolan
b. Recycled content for Ground Iron Blast-Furnace Slag
c. Recycled content for Silica Fume

2.2.2 Fine Aggregates

****
NOTE: Choose appropriate gradation based upon use of concrete. Where concrete is for back-up and separate facing aggregate is used, a gradation or maximum aggregate size may be specified.
****

ASTM C33/C33M. The optional method of reducing the No. 50 and No. 100 sieve aggregates does not apply. The restriction to use only fine aggregates that do not contain any materials that are deleteriously reactive with alkalis in cement does apply.

2.2.3 Coarse Aggregate

****
NOTE: Choose appropriate gradation based upon use of concrete. Where concrete is for back-up and separate facing aggregate is used, a gradation or maximum aggregate size may be specified. Class 5S is for exposed architectural concrete.
****

ASTM C33/C33M, Size No. [57] [67], Class 5S. The restriction to use only coarse aggregates that do not contain any materials that are deleteriously reactive with alkalis in cement does apply. Aggregate must not contain slag or crushed concrete.

2.2.4 Exposed Aggregate

****
NOTE: Choose appropriate gradation based upon use of concrete. Where concrete is for back-up and separate facing aggregate is used, a gradation or maximum aggregate size may be specified.
****

In addition to the above, facing mixture aggregate, and aggregate for homogeneous panels with exposed aggregate finish, will be [gravel]

[crushed gravel] [crushed stone] of size and color to produce exposed surfaces to match the color and texture of the sample on file with the Contracting Officer.

****

NOTE: Aggregates for exposed-to-view facing mixture may be natural mineral particles, natural building stone particles, or combinations thereof, or synthetic materials such as glass or plastic; natural aggregates may be crushed or gravel. Delete the following paragraph when crushed natural aggregate is not required by the project. Specify the mineral or rock generic name, color, particle shape, size range of particles, and other information relative to the appearance of the exposed-to-view finish surface as applicable to the project.

****

Crush coarse aggregate by a means that will produce material of cubical shape with a minimum of elongated, thin, or partially fractured particles. Material or crushing methods that produce particles classified by petrographic examination as being weak, highly fractured or somewhat friable, or both, in excess of 16 percent of the particles in any whole sample will be rejected. Material for coarse aggregate must be free of substances that change color on oxidation. Obtain material used for the work from the same basic source and stratum. Quarry material to produce a uniformly colored aggregate that does not change color upon weathering. During quarrying operations, the uniformity of rock face color must be verified by periodically comparing the rock face color to the approved coarse aggregate sample.

****

NOTE: Revise the following paragraph when fine white-quartz aggregate is not required by the project.

****

Fine aggregate will be white quartz natural sand or stone screenings, or manufactured sand produced from white quartz. Aggregate must be free of substances that change color on oxidation. Color must conform to the approved sample.

2.2.5 Cementitious Materials

****

NOTE: Acceptable types of cement are as follows:

ASTM C150/C150M Portland	**ASTM C595/C595M Blended**	**Use**
Type I	**Type IP or IS**	**For general use in construction.**

ASTM C150/C150M Portland	ASTM C595/C595M Blended	Use
Type II	Type IP (MS) or Type IS (MS)	For general use in construction where concrete is exposed to moderate sulfate action or where moderate heat of hydration is required. ASTM C595/C595M (blended hydraulic cements): add the suffix MS or MH where either moderate sulfate resistance or moderate heat of hydration, respectively, is required. Type IP is portland-pozzolan blended cement and Type IS is portland-blast furniture slag cement.
	Type IP (MS) or Type IS (MS)	For general use in construction where Concrete is exposed to moderate heat of hydration.
Type III	None	For use when high early strength is required. Confer with the agency's Subject Matter Expert in Concrete Materials before specifying Type III cement.
Type V	None	For use when high sulfate resistance is required.

For concrete subjected to salt water, near salt water or exposed to alkali/sulfate soils refer to specification Section 03 31 30 MARINE CONCRETE for additional criteria.
****

****
NOTE: For NAVFAC LANT: Typically allow Type II, IP(MS), or IS(MS). May use Type I if Type II not locally available and no sulfate problems expected (i.e. not near seawater or sulfate soils). Type III is for high early strength. Type V is for high sulfate resistance.
****

****
NOTE: Coal fly ash, slag, cenospheres, and silica fumes are EPA designated products to be ingredients in concrete and cement. See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING and include additive options unless designer determines that justification for non-use exists.
****

For exposed concrete, use one manufacturer and one source for each type of cement, ground slag, fly ash, and pozzolan.

2.2.5.1 Fly Ash

****

NOTE: Fly ash, pozzolan, and slag cement may produce uneven discoloration of the concrete during the early stages of construction, depending upon the type of curing provided. Fly ash or pozzolan meeting the specified test results, which are more stringent than ASTM C618, should provide acceptable end results. It is suggested that fly ash be used as a replacement for 35 percent of the cement. Class C fly ash is not permitted.

****

ASTM C618, Class F, except that the maximum allowable loss on ignition must not exceed [3][6] percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 8 percent and a total equivalent alkali content less than 1.5 percent.

Add with cement. Fly ash content must be a minimum of [15] [20] [30] [35] [40] [_____] percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759.

2.2.5.2 Raw or Calcined Natural Pozzolan

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and must have an ignition loss not exceeding 3 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

2.2.5.3 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) must conform to ASTM C618, Class F or N, and the following additional requirements:

a. The strength activity index at 28 days of age must be at least 95 percent of the control specimens.

b. The average particle size must not exceed 6 microns.

c. The sum of SiO_2 + Al_2O_3 + Fe_2O_3 must be greater than 77 percent.

2.2.5.4 Ground Granulated Blast-Furnace Slag

ASTM C989/C989M, Grade [100] [120]. Slag content must be a minimum of [25][50][70] percent by weight of cementitious material.

[2.2.5.5 Silica Fume

****

NOTE: Silica fume must only be used for OCONUS projects where Class F fly ash and GGBF slag are not available, and when approved by the Contracting

Officer. Guidance for use of silica fume should be sought from the agency's Subject Matter Expert in Concrete Materials.

****

****

NOTE: The initial cost of the concrete must increase, and supervision at the batch plant, finishing, and curing is necessary. A HRWR must be used with silica fume, the slump can be increased 50 to 125 mm 2 to 5 inches without redusing strength. Finishing may be more difficult. Proper curing is essential because there is a tendency for plastic shrinkage cracking.

****

Silica fume must conform to ASTM C1240, including the optional limits on reactivity with cement alkalis. Silica fume may be furnished as a dry, densified material or as slurry. Proper mixing is essential to accomplish proper distribution of the silica fume and avoid agglomerated silica fume which can react with the alkali in the cement resulting in premature and extensive concrete damage. Supervision at the batch plant, finishing, and curing is essential. Provide at the Contractor's expense the services of a manufacturer's technical representative, experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume. This representative must be present on the project prior to and during at least the first 4 days of concrete production and placement using silica fume. A High Range Water Reducer (HRWR) must be used with silica fume.

]2.2.5.6 Portland Cement

****

NOTE: If high early strength concrete is required, specify Type III after consulting the agency's Subject Matter Expert in Concrete Materials.

When concrete is exposed to sea water use specification Section 03 31 30 MARINE CONCRETE.

When high-volume fly ash mixtures, mixtures where fly ash replacement of portland cement is greater than 50 percent by weight, are specified they may be blended with Type II or Type III cement for higher early strength. Consult the agency's Subject Matter Expert in Concrete Materials prior to using Type III cement.

Low alkali cement or Type II cement with high SCM content may be required if the proposed aggregates are found to be expansive.

****

Provide cement that conforms to ASTM C150/C150M, Type [I][II][III], [low alkali] [including false set requirements] with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali content of 0.80 percent Na2Oe (sodium oxide) equivalent. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

[For portland cement manufactured in a kiln fueled by hazardous waste, maintain a record of source for each batch.][Supplier must certify that no hazardous waste is used in the fuel mix or raw materials.][Supplier must certify that the hazardous waste is neutralized by the manufacturing process and that no additional pollutants are discharged.]

2.2.6 Admixtures

ASTM C260/C260M for air-entraining admixtures. Other admixtures: ASTM C494/C494M.[Certify that admixtures are free of chlorides.] [Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral oxide or colored water reducing admixtures, temperature stable, and non-fading. [Certify that coloring admixtures are free of chlorides.]]

2.2.7 Water

Water must comply with the requirements of ASTM C1602/C1602M. Minimize the amount of water in the mix. Improve workability by adjusting the grading rather than by adding water. Water must be [potable][from rainwater collection][from graywater][from recycled water]; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete. Submit test report showing water complies with ASTM C1602/C1602M.

2.2.8 Reinforcement

****

NOTE: Specify ASTM A775/A775M for epoxy-coated reinforcing bars or ASTM A767/A767M and ASTM A780/A780M for zinc-coated (galvanized) bars. Define where coated bars are to be used, if not for entire project. Include ASTM publications in paragraph REFERENCES:

A 767: Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

A 775: Epoxy-Coated Reinforcing Bars

A 780: Repair of Damaged Hot-Dip Galvanized Coatings

****

All exposed steel must be phosphate treated, primed, and coated to prevent rust.

2.2.8.1 Reinforcing Bars

ACI 301MACI 301 unless otherwise specified. ASTM A615/A615M, Grade [400] [60], [ASTM A706/A706M, Grade [400] [60], or ASTM A996/A996M, Grade [300] [40], or ASTM A996/A996M, Grade [400] [60].]

2.2.8.2 Welded Wire Reinforcement

ASTM A1064/A1064M.

2.2.8.3 Supports for Concrete Reinforcement

Include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening in place in accordance with PCI MNL-117.

2.2.9 Prestressing Strands

****
NOTE: This paragraph will be retained only when prestressed units are permitted or required.
****

Prestressing strands need to conform to ASTM A416/A416M Grade 1860 Grade 270.

2.2.10 Tie Wire

Tie wire must be soft monel or 18-8 stainless steel.

2.2.11 Plates, Angles, Anchors and Embedment

ASTM A36/A36M, ferrous metal plate connectors for attachment to the structural framing using manufacturer standard construction procedures. Headed studs will use 400 MPa 60,000 psi steel with construction conforming to AWS D1.1/D1.1M, Type B. Deformed bar anchors must conform to ASTM A1064/A1064M. Coat steel items, other than stainless, with a rust-inhibiting paint or provide hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

Furnish and install anchors, inserts, lifting devices, and other accessories which are to be embedded in the precast units in accordance with the approved detail drawings. Embedded items must be accurately positioned in their designed location, and have sufficient anchorage and embedment to satisfy design requirements.

2.2.12 Form Release Agent

Release agent must be manufacturer's standard non-staining type.

2.2.13 Grout

Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

2.3 CAST-IN EMBEDDED ITEMS AND CONNECTORS

2.3.1 Inserts

2.3.1.1 Threaded-Type Concrete Inserts

ASTM A47/A47M, Grade 22010 Grade 32510 or 35018, or may be medium strength cast steel conforming to ASTM A27/A27M, Grade 415-205 Grade U-60-30. Provide [galvanized] ferrous casting having enlarged base with two nailing lugs minimum length less than the thickness of panel less 20 mm 3/4 inch, and internally threaded to receive 20 mm 3/4 inch diameter machine bolt. Ferrous castings must be ferritic malleable iron.[Provide inserts hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.]

2.3.1.2 Wedge-Type Concrete Inserts

Provide galvanized, box-type ferrous castings with integral anchor loop at back of box to accept 20 mm 3/4 inch diameter bolts having special wedge-shaped head. Provide ferrous castings[ASTM A47/A47M, Grade 22010, Grade 32510 or 35018, ferritic malleable iron] [or] [ASTM A27/A27M, Grade 415-205, Grade U-60-30, medium-strength cast steel].[Provide inserts hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.]

2.3.1.3 Slotted-Type Concrete Inserts

Provide pressed steel plate, welded construction, box type with slot to receive 20 mm 3/4 inch diameter square head bolt, and provide lateral adjustment of bolt. Length of insert body, less anchorage lugs, must be 110 mm 4 1/2 inches minimum. Provide insert with knockout cover. Steel plate must be 3 mm 1/8 inch minimum thickness, ASTM A283/A283M, Grade C. [Provide inserts hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.]

2.3.1.4 Wood Nailer Inserts

****

NOTE: Location and size of wood nailer inserts must be indicated.

NOTE: AWPA use category UC3A is for wood that is exposed to all weather cycles but not exposed to prolonged wetting. AWPAA use category UC3B is for wood that is exposed to all weather cycles including prolonged wetting.

****

Inserts will be kiln-dried "standard" grade Douglas fir or "No. 2" grade southern pine, surfaced 4 sides, and sized as indicated. Treat with waterborne pressure-preservative in accordance with AWPA U1, use category [UC3A][UC3B]. All wood needs to be air or kiln dried after treatment. Verify specific treatments by the report of an approved independent inspection agency. The AWPA U1 Quality Mark ["UC3A"]["UC3B"] on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

2.3.1.5 Flashing Reglets

****

NOTE: Location of flashing reglets embedded in precast-concrete panels must be indicated.

****

Reglets must be sheet metal open-type with continuous groove not less than 30 millimeter deep by 5 millimeter wide 1-1/8 inches deep by 3/16-inch wide at opening and sloped upward, designed to anchor snap-lock counter flashing.

****

NOTE: Delete the following paragraphs if not applicable to the project.

When visible staining from the flashing reglets can occur, corrosion-resisting chromium-nickel steel

only must be specified.

When the precast units will be subjected to a sea coast atmosphere, galvanized carbon steel flashing reglets must not be specified.

****

Metal must be minimum 0.28 millimeter 0.011-inch thick conforming to ASTM A666, Type 302 or 304, No. 1 finish, soft temper.

[Metal must be copper strip weighing a minimum of 4.8 kilogram per square meter 16 ounces per square foot, and conforming to ASTM B370, cold-rolled temper.

][Metal is to be 0.55 millimeter 26-gage galvanized steel sheet conforming to ASTM A653/A653M, Z275 G90.

]2.3.2 Connection Devices

2.3.2.1 Clip Angles

ASTM A36/A36M steel, galvanized after fabrication in accordance with ASTM A153/A153M.

2.3.2.2 Ferrous Casting Clamps

ASTM A47/A47M, Grade 22010, Grade 32510 or Grade 35018 malleable iron or cast steel, or ASTM A27/A27M, Grade 415-205 Grade 60-30, cast steel casting, hot-dip galvanized in accordance with ASTM A153/A153M.

2.3.2.3 Threaded Fasteners

Provide galvanized machine bolts, washers and, when required, nuts.

a. Bolts: ASTM A449, 20 mm 3/4 inch diameter machine bolts with hexagon head.

b. Washers: ASME B18.21.1, medium or heavy lock-spring washers.

c. Nuts: ASTM A563M ASTM A563, Grade C, heavy, hexagon-type nuts.

d. Square Nuts: ASTM A563M ASTM A563, Grade A, plain, square-type nuts where required for slotted-type concrete inserts.

2.4 PRECAST ELEMENT FABRICATION

2.4.1 Formwork and Fabrication Tolerances

Provide forms and form-facing materials of wood, metal, plastic, or other approved material to produce concrete having the specified finish. Construct forms mortar-tight and of sufficient strength to withstand all pressures due to concrete placing operations and temperature changes. Brace and stiffen against deformation. Provide form liners where required to produce indicated finish. Provide dimensional tolerances per PCI MNL-117.

2.4.2 Reinforcement

ACI 301MACI 301. Place reinforcing bars and welded wire reinforcement.

Secure in position with tie wires, bar supports, and spacers.

2.4.3 Preparation for Placing Concrete

Remove hardened concrete, excess form parting compound, standing water, ice, snow, or other deleterious substances from form interiors and reinforcement before concrete placement. Secure reinforcement and embedded items.

2.4.4 Concrete Mixing and Conveying

2.4.4.1 Batch Plant, Mixer, Mixing, and Measuring of Materials

ASTM C94/C94M.

2.4.4.2 Conveying

Prevent segregation and loss of materials.

2.4.5 Concrete Placing

ACI 304R. Deposit concrete in the forms continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the precast concrete units. Place concrete at a constant temperature of between 10 and 32 degrees C 50 and 90 degrees F throughout fabrication of each unit. Make temperature of forms or molds the same as or close to the concrete temperature. For hot or cold weather, use methods recommended by ACI 305R and ACI 306.1. Vibrate and consolidate concrete to prevent segregation and to produce a high-density concrete free of honeycomb and rock pockets. When specified, the exposed-to-view facing mixture is required to be a minimum thickness of 20 mm 3/4 inches. Place backing mixture before facing mixture attains initial set.

2.4.6 Identification Markings

Permanently mark each precast unit to indicate pick-up points, location, orientation in the building, and date of casting. Identification markings need to correlate with approved detail drawings. Do not locate in exposed-to-view finished surfaces.

2.4.7 Finishing

2.4.7.1 Unformed Concealed Surfaces (Standard Smooth Finish)

Provide a trowel finish. Level surface with a straightedge, and strike off. After surface water has disappeared, float and trowel surface. Provide smooth finished surface, free of trowel marks, and uniform in texture and appearance.

2.4.7.2 Smooth, Exposed-to-View Surfaces

Provide a standard smooth finish to all exposed-to-view surfaces of panels, unless otherwise indicated. Provide a concrete surface having the texture imparted by a steel form or other approved smooth surfaces form-facing material.

2.4.7.3 Exposed Aggregate Finish

Provide for exposed-to-view surfaces of panels, including chamfers, edges, recesses, and projections, unless otherwise indicated. Provide standard smooth finish with outer skin of mortar removed, before concrete has hardened, and exposing coarse aggregate. A chemical retarder may be used on exposed face to facilitate removal of mortar. Match finish of the approved surface finish sample. Expose aggregates as soon after concrete placing as practicable [by wire brushing, sand blasting, or bush hammering] [or] [by washing the concrete surface with a diluted solution of muriatic acid to thoroughly clean exposed aggregate. Rinse concrete surface with fresh, clean water to remove traces of acid.]

2.4.7.4 Other Surfaces

Surfaces of precast units not exposed to view or not otherwise indicated to be finished are to be finished in accordance with ACI 301M ACI 301 for a Surface Finish of 1.0.

2.4.8 Curing

Provide moist or steam curing or curing compound. Do not remove precast units from forms; prevent moisture loss and maintain 10 degrees C 50 degrees F minimum for at least 24 hours after finishing. Maintain precast units in a surface damp condition at 10 degrees C 50 degrees F minimum until concrete has attained 75 percent minimum of the design compressive strength.[Do not use steam curing with wood forms or in connection with chemically retarded exposed aggregate surfaces].

2.4.9 Repair of Surface Defects

Cut out defective areas to solid concrete, with edges of cuts perpendicular to the surface of the concrete, and clean thoroughly. Dampen area to be patched and brush-coat with nonshrink grout or bonding agent. Patch the surface in accordance with procedures previously submitted by the Contractor and approved by the Contracting Officer. Where exposed to view, the patches, when dry, needs to be indistinguishable from the surrounding surfaces.

2.4.9.1 Smooth, Concealed Surfaces

Acceptable defective area will be limited to holes left by rods and other temporary inserts, and to honeycomb or rock pockets of 6 mm 1/4 inch diameter maximum. Remove fins and other projections on the surfaces.

2.4.9.2 Exposed-to-View Surfaces

The combined area of acceptable defective areas must not exceed 0.2 percent of the exposed-to-view surface area and will be limited to holes of 6 mm 1/4 inch diameter maximum.

2.4.10 Stripping

Do not remove precast concrete units from forms until units develop sufficient strength to safely strip the formwork and to remove the precast concrete units from the forms to prevent damage to the units from overstress or chipping.

2.4.11 Built-In Anchorage Devices

****

NOTE: Anchorage devices to be embedded in the panels must be indicated. Anchorage devices include threaded concrete inserts for bolted connections; wood nailers to receive thermal insulation that will be applied to the panel; and flashing reglets to receive sheetmetal counter flashing.

****

Accurately position and securely anchor all anchorage devices. Openings in anchorage devices must be filled temporarily to prevent entry of concrete.

2.4.12 Lifting Devices

Lifting devices must be provided, and designed for a safety factor of 4, which includes 100 percent impact. Do not use brittle material.

2.4.13 Finishing for Formed Surfaces

Upon removal of forms, repair and patch defective areas. Where the finished surface will be exposed to view, the combined area of defective areas must not exceed 0.2 percent of the surface and will be limited to honeycomb or rock pockets not deep enough to expose the reinforcement. Where the finished surface will be concealed by other construction, defective areas are limited to holes left by the rods and other temporary inserts and honeycomb or rock pockets not deep enough to expose the reinforcement. Defective areas must be cut out to solid concrete, cleaned, and patched with grout. Where concrete surface will be exposed to view, the patches, when dry, must be indistinguishable from the surrounding surfaces.

****

NOTE: Delete the following paragraph, and specify the required finish or finishes when an exposed-aggregate finish is not required for exposed-to-view panel surfaces. Other finishes include textured form finishes, sculptured inserts, rubbed finishes, and combinations thereof; such finishes may require the specified exposed-to-view facing mixture.

It is recommended that a sample of the required exposed-to-view finish be on display where it may be seen by bidders during the bidding period.

****

[Exposed-aggregate finish must match the finish of the approved sample. Aggregates in exposed-to-view surfaces will be exposed as soon after concrete placing as practical by power sanders, wire brushes, or other acceptable methods. Give surfaces one or more washings with a dilute solution of muriatic acid, then washed with fresh, clean water to remove all traces of the acid.

][Create an abrasive-blast finish using an abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.

][Create an acid-etched finish using acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attach.

][Create a honed finish using a continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.

][Create a polished finish using a continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.

]2.5 JOINT MATERIALS

****
NOTE: Cross sections of gaskets with dimensions must be indicated.
****

Gasket must be elastomeric material, premolded to cross section indicated.

Material must be a vulcanized closed-cell expanded chloroprene conforming to ASTM D1056, Grade No. 2A2, with the following additional properties:

Brittleness temperature will be minus 5 degrees C 40 degrees F when tested in accordance with ASTM D746.

Flammability resistance needs to be self-extinguishing when tested in accordance with ASTM D635.

Resistance to ozone must be "no cracks" after exposure of a sample, at 20 percent elongation, to an ozone concentration of 100 parts per million of air by volume in air for 100 hours at 40 degrees C 104 degrees F when tested in accordance with ASTM D1149.

2.6 MISCELLANEOUS ARCHITECTURAL PRECAST CONCRETE SYSTEMS

2.6.1 Thin Brick Veneer

Not less than 13 mm 1/2 inch or more than 25 mm 1 inch thick, and as follows:

1. Dimensional Tolerances: Plus 0 mm 0 inch or minus 1.6 mm 1/16 inch for any dimension 203 mm 8 inches or less and plus 0 mm 0 inch or minus 2.4 mm 3/32 inch for any dimension more than 203 mm 8 inches.

2. Out-of-Square Tolerance: Plus or minus 1.6 mm 1/16 inch.

3. Warpage Tolerance: Plus 0 mm 0 inch or minus 1.6 mm 1/16 inch.

4. Variation of Shape from Specified Angle: Plus or minus one degree.

5. Modulus of Rupture: Not less than 1.7 MPa 250 psi when tested according to ASTM C67/C67M.

6. Tensile Bond Strength: Not less than 1.0 MPa 150 psi when tested before and after freeze-thaw test according to ASTM E488/E488M as modified: Adhere a steel plate with a welded rod on a single thin-brick face with epoxy for each test.

7. 24-Hour Cold-Water Absorption: Not more than 6 percent when tested according to ASTM C67/C67M.

8. Freeze-Thaw Resistance: No detectable disintegration or separation after 300 freezing-and-thawing cycles when tested according to ASTM C666/C666M, Method B.

9. Chemical Resistance: Tested according to ASTM C650 and rated "not affected."

10. Efflorescence: Tested according to ASTM C67/C67M and rated "not effloresced."

11. Surface Coating: Thin brick with colors or textures applied as coatings shallmust withstand 50 cycles of freezing and thawing; ASTM C67/C67M with no observable difference in applied finish when viewed from 3 m 10 feet.

12. Back Surface Texture: Scored, combed, wire roughened, ribbed, keybacked, or dovetailed.

13. Face Size: [57 mm2-1/4 inches high by 194 mm 7-5/8 inches long][57 mm 2-1/4 inches high by 295 mm 11-5/8 inches long][92 mm3-5/8 inches high by 194 mm 7-5/8 inches long][92 mm3-5/8 inches high by 295 mm 11-5/8 inches long][_____].

Submit the following for thin brick veneer:

a. Brick Color chips representing color and size of each brick type to be used.

b. Form Liner Samples representing all brick inlay form liners which will be used.

c. Bond breaker sample on brick chip representing bond breaker which will be used.

d. Printed product data and installation instructions for brick inlay form liner system, and brick.

****

NOTE: Use the following paragraph when filling thin-brick joints with mortar before placing precast concrete.

****

2.6.1.1 Sand-Cement Mortar

Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144. Mix at ratio of 1 part cement to 4 parts sand, by volume, with minimum water required for placement.

****

NOTE: Use the following paragraph when filling thin-brick joints with pointing grout after precast concrete panel production.

****

2.6.1.2 Pointing Grout

Packaged, polymer-modified, sanded grout complying with ANSI A118.7.

2.6.1.3 Thin Brick Facing

a. Place form liner templates accurately to provide grid for thin-brick facings. Provide solid backing and supports to maintain stability of liners while placing thin bricks and during concrete placement.

b. Securely place thin-brick units face down into form liner pockets and place concrete backing mixture.

****

NOTE: Delete the following two paragraphs if joint cavities are filled with concrete instead of using mortar or pointing grout.

****

c. Completely fill joint cavities between thin-brick units with sand-cement mortar, and place precast concrete backing mixture while sand-cement mortar is still fluid enough to ensure bond.

d. Mix and install pointing grout according to ANSI A108/A118/A136.1. Completely fill joint cavities between thin-brick units with pointing grout, and compress into place without spreading grout onto faces of thin-brick units. Remove excess grout immediately to prevent staining of thin brick.

2.7 BEARING PADS

Submit product data for all bearing pads being used.

2.7.1 Elastomeric

AASHTO M 251, for plain neoprene bearings.

2.7.2 Hardboard (Interior Only)

AHA A135.4, class as specified by the precast manufacturer.

2.7.3 Random-Oriented, Fiber-Reinforced Elastomeric Pads

Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D2240. Capable of supporting a compressive stress of 20.7 Mpa 3000 psi with no cracking, splitting or delaminating in the internal portion of the pad.

2.7.4 Cotton-Duck-Fabric-Reinforced Elastomeric Pads

Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer according to ASTM D2240. Conforming to Division II, Section 18.10.2 of AASHTO LRFD Bridge Design Specifications or Military Specification MIL-C-882E.

2.7.5 Frictionless Pads

Polytetrafluoroethylene (PTFE), glass-fiber reinforced, bonded to stainless or mild-steel plates, or random-oriented, fiber-reinforced elastomeric pads, of type required for in-service stress.

2.7.6 Sub Title

Multimonomer, nonleaching, plastic strip capable of supporting loads with no visible overall expansion.

2.8 INSULATED PANEL ACCESSORIES

2.8.1 Molded-Polystyrene (EPS) Board Insulation

ASTM C578, [Type XI, 12 kg/cu. m 0.70 lb/cu. ft][Type I, 15 kg/cu. m 0.90 lb/cu. ft][Type VIII, 18 kg/cu. m 1.15 lb/cu. ft][Type II, 22 kg/cu. m 1.35 lb/cu. ft][Type IX, 29 kg/cu. m 1.80 lb/cu. ft].

2.8.2 Extruded-Polystyrene (XPS) Board Insulation

ASTM C578, [Type X, 21 kg/cu. m 1.30 lb/cu. ft][Type IV, 25 kg/cu. m 1.55 lb/cu. ft][Type VI, 29 kg/cu. m 1.80 lb/cu. ft][Type VII, 35 kg/cu. m 2.20 lb/cu. ft][Type V, 48 kg/cu. m 3.00 lb/cu. ft].

2.8.3 Polyisocyanurate Board Insulation

ASTM C591, [Type I, 29 kg/cu. m 1.8 lb/cu. ft][Type II, 40 kg/cu. m 2.5 lb/cu. ft][Type III, 48 kg/cu. m 3.0 lb/cu. ft].

PART 3 EXECUTION

3.1 PREPARATION

Deliver anchorage devices to the site in time to be installed before the start of concrete placing or during steel erection. Contractor must provide setting drawings, instructions, and directions for the installation of anchorage devices.

3.2 EXAMINATION

Do not begin installation until supporting structures have been properly prepared.

Verify that all parts of the supporting structure are complete and ready to receive the precast units and that site conditions are conducive to proper installation.

If support structure is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before proceeding.

3.3 INSTALLATION

Install precast concrete units and accessories in accordance with approve detail drawings and descriptive data, and as specified below.

3.3.1 Building Framing System

Provide supporting members, including anchorage items attached to or embedded in building structural elements, prior to placement of precast units.

3.3.2 Concrete Strength at Time of Precast Unit Installation

****

NOTE: Delete one of the following paragraphs as applicable to the project. First paragraph will be selected except when the project schedule indicates installation of 28-day units.

****

Do not install precast units until concrete has attained the minimum laboratory compressive strength at 28 calendar days specified.

Do not install precast units before 28 calendar days from the date of casting unless approval has been obtained to make one compressive strength test, ASTM C39/C39M, and one flexural strength test using simple beam with third-point loading, ASTM C78/C78M, on field cured concrete test specimens, ASTM C31/C31M, for each individual precast unit to determine the strength of the concrete.

3.3.3 Erection

rect precast units in accordance with the detail drawings and without damage to other units or to adjacent members. Set units true to alignment and level, with joints properly spaced and aligned both vertically and horizontally. Erection tolerances must be in accordance with the requirements of PCI MNL-117 and PCI MNL-122. As units are being erected, shims and wedges will be placed as required to maintain correct alignment. After final attachment, grout precast units as shown. After erection, clean and touch-up welds and abraded surfaces of steel with a zinc-rich paint. Welds must be made by a certified welder in accordance with the manufacturer's erection drawings. Finish pickup points, boxouts, inserts, and similar items to match adjacent areas after erection. Erection of precast units must be supervised and performed by workmen skilled in this type of work. Welding and the qualifications of welders must be in accordance with AWS D1.1/D1.1M.

3.3.4 Erection Tolerances

Erect architectural precast concrete units level, plumb, square and in alignment without exceeding the noncumulative erection tolerances of PCI MNL-117, Appendix I.

3.3.5 Joints

Joint widths between precast units will be as specified unless otherwise indicated.

3.3.5.1 Joint Sealing

Joint sealing will be as specified in Section 07 92 00 JOINT SEALANTS.

3.3.6 Protection

Protect exposed-to-view facing from staining and other damage from subsequent operations. Do not allow laitance to penetrate, stain, or harden on exposed surfaces.

3.4 DEFECTIVE WORK

Repair precast concrete units damaged during erection as soon after occurrence as possible or replaced, as directed, using approved procedures. All repairs to precast concrete units must match the adjacent surfaces in color and texture, as approved. Unless otherwise approved, repair procedures will conform to PCI MNL-117.

3.5 JOINTS AND GASKETS

Joints between precast units must be the width indicated and within limits of installation tolerances.

Install gaskets in joints as indicated, continuous throughout the joint length, and compressed at least 25 percent by volume.

3.6 INSPECTION AND ACCEPTANCE PROVISIONS

3.6.1 Dimensional Tolerances

Precast units having dimensions outside the limits for fabrication tolerances will be rejected.

3.6.2 Surface Finish Requirements

Precast units will be rejected for the following surface finish deficiencies:

Exposed-to-view surfaces that do not match the color, aggregate size and distribution, and texture of the approved sample

Exposed-to-view surfaces that contain defects that affect the appearance of the finish, such as cracks, spalls, honeycomb, rock pockets, or stains and discoloration of aggregate or matrix that cannot be removed by cleaning

Concealed surfaces that contain cracks in excess of 0.2 millimeter 0.01 inch wide, cracks that penetrate to the reinforcement regardless of width, honeycomb, rock pockets, and spalls except minor breakage at corners and edges

3.6.3 Strength of Precast Units

Strength of precast concrete units will be considered potentially deficient if the units fail to comply with the requirements that control the strength of the units, including the following conditions:

Failure to meet compressive strength tests

Reinforcement not conforming to the requirements specified

Concrete curing and protection of precast units against extremes of temperature during curing not conforming to the requirements specified

Precast units damaged during handling and erection

3.6.4 Testing Precast Units for Strength

When there is evidence that the strength of precast concrete units does

not meet specification requirements, cores drilled from hardened concrete for compressive strength determination must be made in accordance with ASTM C42/C42M and as follows:

Take at least three representative cores from the precast-concrete units that are considered potentially deficient.

Test cores with the saturated surface dry.

Strength of cores will be considered satisfactory if their average is equal to or greater than 90 percent of the 28-day design compressive strength of 150 by 300 millimeter 6 by 12 inch cylinders.

Submit test reports on the same day that tests are made. Reports must contain the project name and number, date, name of contractor, name of precast concrete wall units manufacturer, name of concrete-testing service, identification letter and number of units represented by core tests, nominal maximum size of aggregate, design compressive strength of concrete at 28 calendar days, compressive breaking strength and type of break, length of core test specimen before capping, compressive strength after correcting for length diameter ratio, direction of application of the load on the core test specimen with respect to the horizontal plane of the concrete as placed, and the moisture condition of the core test specimen at time of testing.

If the results of the core tests are unsatisfactory or if core tests are impractical to obtain, a static load tests of a precast unit will be evaluated in accordance with ACI 318M ACI 318.

Replace precast units used for core tests or static load tests with units that meet the requirements of this section.

3.7 SAMPLING AND TESTING

3.7.1 Rejection

Precast units in place may be rejected for any one of the following product defects or installation deficiencies remaining after repairs and cleaning have been accomplished. "Visible" means visible to a person with normal eyesight when viewed from a distance of 6 m 20 feet in broad daylight.

a. Nonconformance to specified tolerances.

b. Air voids (bugholes or blowholes) larger than 10 mm 3/8 inch diameter.

c. Visible casting lines.

d. Visible from joints.

e. Visible irregularities.

f. Visible stains on precast unit surfaces.

g. Visible differences between precast unit and approved sample.

h. Visible non-uniformity of textures or color.

i. Visible areas of backup concrete bleeding through the facing concrete.

j. Visible foreign material embedded in the face.

k. Visible repairs.

l. Visible reinforcement shadow lines.

m. Visible cracks.

n. Precast units that are damaged during construction operations.

3.7.2 Field Quality Control

Perform field inspection of precast unit connections. Notify the Contracting Officer in writing of defective welds, bolts, nuts and washers within 7 working days of the date of inspection. All defective connections or welds are to be removed and re-welded or repaired as required by the Contracting Officer.

3.7.2.1 Welded Connection Visual Inspection

AWS D1.1/D1.1M, furnish the services of AWS-certified welding inspector for erection inspections. Welding inspector must visually inspect all welds and identify all defective welds.

3.8 CLEANING

Clean exposed-to-view surfaces of precast units thoroughly with detergent and water; use a brush to remove foreign matter. Remove stains that remain after washing in accordance with recommendations of the precast manufacturer. Surfaces must be clean and uniform in color. Include precast concrete wall panel manufacturer's written recommendations for installation and cleaning.

-- End of Section --