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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UML dated 23 June 2005

Latest change indicated by CHG tags

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SECTION 03413A

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01/06

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SECTION 03413A

PRECAST ARCHITECTURAL CONCRETE

01/06

NOTE: This guide specification covers the requirements for precast architectural concrete units.

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

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

Use of electronic communication is encouraged.

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

PART 1 GENERAL

1.1 REFERENCES

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

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

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

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

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991; R 2002) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998; R 2004) Selecting Proportions for Structural Lightweight Concrete
ACI 318/318R	(2005) Building Code Requirements for Structural Concrete and Commentary
ACI 318M/318RM	(2002) Metric Building Code Requirements for Structural Concrete and Commentary
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2004) Structural Welding Code - Steel
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ASTM INTERNATIONAL (ASTM)

ASTM A 416/A 416M	(2002) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM C 1017/C 1017M	(2003) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1260	(2005) Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 1567	(2004) Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C 494/C 494M	(2005) Chemical Admixtures for Concrete

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1999) Quality Control for Plants and Production of Structural Precast Concrete Products
PCI MNL-117	(1996) Quality Control for Plants and Production of Architectural Precast Concrete Products

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

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

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Erection[; G][; G, [_____]]

Detail drawings showing details in accordance with ACI SP-66 and ACI 318M/318RM ACI 318/318R, including installation details. Detail drawings shall indicate separate identification marks for each different precast unit, location of units in the work, elevations, fabrication details, welding details, reinforcement, connections, dimensions, interface with adjacent members, blocking points for units stored at the precast concrete plant or at the jobsite, lifting points and special handling instructions in sufficient detail to cover manufacture, handling, and erection.

SD-03 Product Data

Calculations[; G][; G, [____]]

Design calculations, prior to the manufacture of any precast architectural concrete units for the project.

Mix Design[; G][; G, [____]]

A statement on the mix design formula, as specified.

Manufacturer's Qualifications

A statement giving the qualifications of the precast concrete manufacturer and of the installers, prior to commencing operations.

NOTE: SD-04: On small projects 300 by 300 mm (12 by 12 inch) samples will be sufficient. On large projects utilizing complex or many large panels, a full-size mock-up may be required and should be specified.

SD-04 Samples

Precast Concrete Units[; G][; G, [____]]

[Two 300 by 300 by 50 mm 12 by 12 by 2 inch samples of each type of precast unit finish required for the project. Samples shall show matrix color, surface color, surface texture, and panel back finish.] [A full-size mock-up, maintained at the precast concrete manufacturer's plant until approval by the Contracting Officer for removal or incorporating in the project. The mock-up shall be used to establish quality and acceptance of precast units to be used on the project, and shall consist of three or more units, showing the exterior finish (matrix color, surface color, surface texture), panel back finish, edge treatment, joint treatment, reinforcement, anchorage insert, lifting inserts, and other accessories. Mockup shall also include [doors and windows] [and] typical joints, including exterior corner joints and joints between units].

SD-06 Test Reports

Materials

Certified copies of test reports including all test data and all test results. Tests for compressive strength of concrete shall be performed by an approved independent commercial testing laboratory, except that compressive strength tests for initial prestress may be performed in the manufacturer's plant laboratory.

1.3 GENERAL REQUIREMENTS

Precast concrete units shall be designed and fabricated by an experienced and acceptable precast concrete manufacturer certified under the PCI Plant Certification Program. The manufacturer shall 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 shall submit a statement detailing the Manufacturer's Qualifications as specified in the Submittals paragraph. Precast work shall be coordinated with the work of other trades.

1.4 DESIGN

1.4.1 Standards and Loads

NOTE: Design loads will be shown on the drawings. Criteria for design loads are contained in ASCE 7 and EI 01S010. 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.

Precast unit design shall conform to ACI 318M/318RM ACI 318/318R and PCI MNL-122. Design loads for precast concrete shall be as indicated on the drawings. A differential temperature of [89] [_____] degrees C [160] [_____] degrees F, between interior and exterior faces of the units, shall be considered in the design. Stresses due to restrained volume change caused by shrinkage and temperature differential, handling, transportation and erection shall be accounted for in the design.

1.4.2 Connections

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

1.4.3 Concrete Strength

Precast concrete units shall have a 28-day compressive strength of 34 MPa 5000 psi.

1.4.4 Concrete Proportion

Selection of proportions for concrete shall be based on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. The concrete proportion shall be developed 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. Calcium chloride shall not be used in precast concrete and admixtures containing chloride ions, nitrates, or other substances that are corrosive shall not be used in prestressed concrete.

1.4.5 Calculations

Calculations for design of members and connections not shown shall be made by a professional engineer experienced in the design of precast architectural concrete. Calculation shall include the analysis of member

for lifting stresses and the sizing of the lifting inserts.

1.4.6 Mix Design

The Contractor shall submit the mix design formula 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, prior to commencing operations. 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 shall be accompanied by test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made without additional tests to verify that the concrete properties are satisfactory.

1.5 STORAGE AND INSPECTION AT MANUFACTURER'S PLANT

Precast units temporarily stored at the manufacturer's plant shall be protected from damage in accordance with [PCI MNL-116] [and] [PCI MNL-117 and PCI MNL-122]. Immediately prior to shipment to the jobsite, all precast concrete units shall be inspected for quality to insure all precast units conform to the requirements specified. Inspection for quality shall include, but shall not necessarily be limited to, the following elements: color, texture, dimensional tolerances, chipping, cracking, staining, warping and honeycombing. All defective precast concrete units shall be replaced or repaired as approved.

1.6 HANDLING AND STORAGE

Precast units shall be delivered to the site in accordance with delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite all precast units shall be inspected for quality as specified above. If the precast units cannot be unloaded and placed directly into the work, they shall be stored onsite, off the ground and protected from weather, marring, or overload. Precast units shall be handled in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

Except as otherwise specified, material shall conform to Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE and Section 03200A CONCRETE REINFORCEMENT.

2.1.1 Aggregates

NOTE: If a specific type or size of aggregate is required for a desired unit finish, whether it be for a facing mix or the entire unit thickness, the additional requirements will be added in this paragraph.

This note may be disregarded for regions where Alkali-Silica Reactivity (ASR) is not a concern. Some aggregate sources may exhibit an ASR potential. ASR is a potentially deleterious reaction between alkalis present in concrete and some siliceous

aggregates, reference EM 1110-2-2000 paragraph 2-3b(6) and appendix D. Where ASR is known or suspected to pose a concern for concrete durability, it is recommended that aggregates proposed for use in concrete be evaluated to determine ASR potential and an effective mitigation. EM 1110-2-2000, provides recommendations for evaluating and mitigating ASR in concrete mixtures. Aggregate evaluations may not be practical for projects requiring small quantities of concrete (less than 250 cubic yards).

UFGS 02753, paragraph 2.2.1.2 Alkali-Silica Reactivity, provides a specification method for the Contractor to evaluate and mitigate ASR in concrete mixtures. The expansion limits specified in UFGS 02753 are requirements for pavements and exterior slab construction. For structural concrete applications the measured expansion shall be less than 0.10 percent. It may not be economical or practical to specify different test limit requirements for use on the same project. In which case the lower limit required by the application should be used.

The designer may use the specification method in UFGS 02753 by incorporating the relevant paragraphs into this specification, or may use the following requirements (retain either the 0.10 or the 0.08 percent expansion limits as appropriate) included in the set of brackets highlighted thus "[.]".

Fine and coarse aggregates proposed for use in concrete shall be [_____] "[tested and evaluated for alkali-aggregate reactivity in accordance with ASTM C 1260. The fine and coarse aggregates shall be evaluated separately and in combination, which matches the Contractor's proposed mix design proportioning. All results of the separate and combination testing shall have a measured expansion less than 0.10 (0.08) percent at 16 days after casting. Should the test data indicate an expansion of 0.10 (0.08) percent or greater, the aggregate(s) shall be rejected or additional testing using ASTM C 1260 and ASTM C 1567 shall be performed. The additional testing using ASTM C 1260 and ASTM C 1567 shall be performed using the low alkali portland cement in combination with ground granulated blast furnace (GGBF) slag, or Class F fly ash. GGBF slag shall be used in the range of 40 to 50 percent of the total cementitious material by mass. Class F fly ash shall be used in the range of 25 to 40 percent of the total cementitious material by mass.]"

2.1.2 Reinforcing Steel

Reinforcing steel shall be galvanized if clearance to an exterior face is 25 mm 1 inch or less.

2.1.3 Prestressing Strands

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

Prestressing strands shall conform to ASTM A 416/A 416M.

2.1.4 Tie Wire

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

2.1.5 Inserts

Inserts shall be manufacturer's standard, suited for the application.

2.1.6 Plates, Angles, Anchors and Embedments

Material shall be as specified in PCI MNL-117. Steel items, other than stainless, shall be coated with a rust-inhibiting paint or shall be hot-dip galvanized. Steel items, including items embedded in concrete, shall be either stainless steel or hot dip galvanized steel.

2.1.7 Form Release Agent

Release agent shall be manufacturer's standard nonstaining type.

2.1.8 Admixtures

Admixtures shall conform to ASTM C 494/C 494M. Plasticizing admixture, if used, shall conform to ASTM C 1017/C 1017M.

2.2 PRECAST CONCRETE UNITS

**NOTE: If prestressing is required or permitted, PCI
MNL-116 will be referenced in addition to PCI
MNL-117.**

Precast concrete units shall be manufactured and cured in accordance with the applicable provisions of PCI MNL-116 and PCI MNL-117. Units shall be manufactured within the allowable tolerances given in [PCI MNL-116,] [PCI MNL-117 and PCI MNL-122].

2.2.1 Formwork

Forms shall be steel of adequate thickness, braced, stiffened, anchored and aligned to produce precast architectural concrete units within required dimensional tolerances. Forms shall be sufficiently rigid to provide dimensional stability during handling and concrete placement and consolidation. Fiberglass-reinforced plastic, plastic coated wood, elastomeric or other nonabsorptive material shall be used for making tight joints and rustication pieces.

2.2.2 Reinforcement

Fabrication and placement of reinforcement shall conform to the details shown on the approved detail drawings and [PCI MNL-116] [and] [PCI MNL-117].

2.2.3 Embedded Accessories

Anchors, inserts, lifting devices, and other accessories which are to be

embedded in the precast units shall be furnished and installed in accordance with the approved detail drawings. Embedded items shall be accurately positioned in their designed location, and shall have sufficient anchorage and embedment to satisfy design requirements.

2.2.4 Stripping

Precast concrete units shall not be removed 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.

2.2.5 Identification

Each precast concrete unit shall be marked to correspond to the identification marks for each different precast unit shown on the detail drawings.

2.2.6 Finishes

NOTE: The types of possible finishes for precast concrete faces are virtually limitless. The requirements for the project will be specified in this paragraph.

Some of the most common finishes are as follows:

a. As cast finishes:

(1) Smooth as cast-produced using smooth, nonporous forms.

(2) Textured as cast-produced using fluted, sculptured, board finish or textured form liners.

b. Mechanically textured finishes:

(1) Sandblasted concrete finishes:

(a) Brush - remove sheen from plastic, high density, or metal forms; no reveal.

(b) Light - provide a 0 to 2 mm (0 to 1/16 inch) reveal of coarse aggregate and uniform color.

(c) Medium - provide a 3 to 6 mm (1/8 to 1/4 inch) reveal of coarse aggregate.

(d) Heavy - provide a reveal of 13 mm (1/2 inch) to 1/3 of the diameter of the coarse aggregate.

(2) Bush hammered concrete finish - produced by pneumatic tools fitted with a bush hammer, comb, chisel, or multiple pointed attachment to remove approximately 5 mm (3/16 inch) of material

(3) Water jet finish - produced by applying even coat of retardant to face of form, removing form

after concrete hardens and providing a reveal 1/3 to 1/2 the diameter of coarse aggregate by washing away surface mortar with water.

(4) Manual brush finish - produced by applying even coat of retardant to face of form, removing form after concrete hardens and providing a reveal of 1/3 to 1/2 the diameter of coarse aggregate by brushing away surface mortar.

(5) Fractured fin of rib - produced by manual hammering of the rib at designated intervals and alternating directions.

c. Acid etch finish - produced by treating the surface of unit with brushes which have been immersed in acid solution. Surface sealers or coatings are generally not recommended. The designer should consult ACI 303 and PCI MNL-117 before specifying sealers or coatings.

2.2.6.1 Exposed Surfaces

Surfaces of precast units exposed to view or surfaces indicated to be finished shall be finished as follows: [____].

2.2.6.2 Other Surfaces

Surfaces of precast units not exposed to view or not otherwise indicated to be finished shall be finished in accordance with Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE.

PART 3 EXECUTION

3.1 ERECTION

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

3.2 JOINT SEALING

Joint sealing shall be as specified in Section 07920 JOINT SEALANTS.

3.3 CLEANING

Not sooner than 72 hours after joints are sealed, faces and other exposed

surfaces of precast concrete discolored during erection shall be cleaned to remove dirt and stains by dry scrubbing with a stiff fiber brush, wetting the surface and vigorous scrubbing of the finish with a stiff fiber brush followed by additional washing, or by chemical cleaning compounds such as detergents or other commercial cleaners. Commercial cleaners shall be used in accordance with the manufacturer's recommendations. Cleaning procedure shall be performed on a designated test area and shall be approved prior to proceeding with cleaning work. Discolorations which cannot be removed by these procedures, will be considered defective work. Cleaning work shall be done when temperature and humidity permit surfaces to dry rapidly. Adjacent surfaces shall not be damaged during cleaning operations.

3.4 PROTECTION OF WORK

Precast units shall be protected against damage from subsequent operations.

3.5 DEFECTIVE WORK

Precast concrete units damaged during erection shall be repaired as soon after occurrence as possible or replaced, as directed, using approved procedures. All repairs to precast concrete units shall match the adjacent surfaces in color and texture and shall be as approved. Unless otherwise approved, repair procedures shall conform to [PCI MNL-116] [and] [PCI MNL-117].

-- End of Section --