
USACE / NAVFAC / AFCEA UFGS-03410N (March 2000)

Preparing Activity: NAVFAC Replacing without revision
NFGS of same number and date

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

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DIVISION 03 - CONCRETE

SECTION 03410N

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03/00

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PLANT-PRECAST STRUCTURAL CONCRETE 03/00

NOTE: This guide specification covers the requirements for precast non-prestressed concrete used for structural purposes (planks, columns, etc.) and for minor architectural purposes (copings, window sills, etc.) in building and waterfront facilities construction.

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.

NOTE: This guide specification does not cover precast concrete wall panels (Section 0345, PLANT-PRECAST ARCHITECTURAL CONCRETE), major precast non-prestressed architectural concrete, or precast concrete which is site manufactured and shall not be used for bridge or roadway construction. Precast concrete sound fences should be considered in lieu of block walls for use where sound barriers are used for noise abatement.

NOTE: The following information shall be shown on the project drawings:

1. Live and dead loads, and whether the topping is included in the dead load.

2. Details of fitting, bearing, and connections.
3. Location of expansion and control joints.
4. Style and area of steel fabric reinforcement in areas where required. Kind and size of reinforcing bars and spacing.
5. Strength and type of concrete.
6. Detail of placement of sealant or fillers in joints.
7. Fire rating.
8. Lightweight concrete unit weight.
9. Special requirements for concrete cover over reinforcing.
10. Areas where toppings are required, indicate areas where the full thickness of the topping is not present.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

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 304R	(2000) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 306.1	(1990) Standard Specification for Cold Weather Concreting
ACI 309R	(1996) Guide for Consolidation of Concrete
ACI 318M/318RM	(2002) Metric Building Code Requirements for Structural Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO HB-17 (2002) Standard Specifications for Highway
Bridges

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A135.4 (1995) Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4 (1998) Structural Welding Code -
Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings
on Iron and Steel Products

ASTM A 153/A 153M (2003) Zinc Coating (Hot-Dip) on Iron and
Steel Hardware

ASTM A 185 (2002) Steel Welded Wire Reinforcement,
Plain, for Concrete

ASTM A 27/A 27M (2003) Steel Castings, Carbon, for General
Application

ASTM A 307 (2002) Carbon Steel Bolts and Studs, 60
000 PSI Tensile Strength

ASTM A 325 (2002) Structural Bolts, Steel, Heat
Treated, 120/105 ksi Minimum Tensile
Strength

ASTM A 325M (2003) Structural Bolts, Steel, Heat
Treated, 830 Mpa Minimum Tensile Strength
(Metric)

ASTM A 36/A 36M (2003a) Carbon Structural Steel

ASTM A 47 (1999) Ferritic Malleable Iron Castings

ASTM A 47M (1990; R 1996) Ferritic Malleable Iron
Castings (Metric)

ASTM A 497 (2002) Steel Welded Wire Reinforcement,
Deformed, for Concrete

ASTM A 563 (2000) Carbon and Alloy Steel Nuts

ASTM A 563M (2001) Carbon and Alloy Steel Nuts (Metric)

ASTM A 615/A 615M (2003a) Deformed and Plain Billet-Steel
Bars for Concrete Reinforcement

ASTM A 616/A 616M (1996a) Rail-Steel Deformed and Plain Bars
for Concrete Reinforcement

ASTM A 617/A 617M	(1996a) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 706/A 706M	(2003) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM C 1107	(2002) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 150	(2002ae1) Portland Cement
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 33	(2003) Concrete Aggregates
ASTM C 330	(2003) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 59/C 59M5	(2000; Rev A) Blended Hydraulic Cements
ASTM C 59/C 59M5M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 618	(2003) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 94	(1994) Ready-Mixed Concrete
ASTM C 989	(1999) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM F 436	(2003) Hardened Steel Washers
ASTM F 436M	(2003) Hardened Steel Washers (Metric)
ASTM F 844	(2000) Washers, Steel, Plain (Flat), Unhardened for General Use

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1999) Quality Control for Plants and Production of Structural Precast Concrete Products
PCI MNL-120	(1999) Design Handbook - Precast and Prestressed Concrete
PCI MNL-124	(1989) Design for Fire Resistance of Precast Prestressed Concrete

1.2 PRECAST MEMBERS

The work includes the provision of precast non-prestressed concrete herein referred to as precast members [except that precast concrete wall panels shall be provided as specified in Section 03450 PLANT-PRECAST ARCHITECTURAL CONCRETE]. Precast members shall be the product of a manufacturer specializing in the production of precast concrete members. In the ACI publications, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

1.3 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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

Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings of precast members; G

SD-03 Product Data

Anchorage and lifting inserts and devices

Bearing pads

SD-04 Samples

**NOTE: Sample panels should only be required when a
finish Grade A or better is specified.**

Surface finish

Submit two 300 by 300 by 50 mm 12 by 12 by 2 inch thick sample panels representative of the color and finish for each type of precast member requiring a finish Grade [A] [_____] surface finish.

SD-05 Design Data

Precast concrete members design calculations; G

Concrete mix design

SD-06 Test Reports

Contractor-furnished mix design

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement.

SD-07 Certificates

Fabrication

Submit quality control procedures established in accordance with PCI MNL-116 by the precast manufacturer.

SD-11 Closeout Submittals

Concrete batch ticket information

1.4 QUALITY CONTROL

**NOTE: Edit when precast members are to be fire
rated. On most large jobs, not all members will
have the same fire rating, so fire ratings for each
specific member should be indicated for clarity.**

NOTE: When concrete toppings are indicated, they are normally allowed to be used in establishing the design strength of the precast member. However, areas where the topping is not the full thickness, and areas without topping located inside of larger areas with topping need to be indicated so that the topping is not used in the untopped areas to establish the design strength of the precast members.

1.4.1 Precast Concrete Member Design

ACI 318M/318RM and the PCI MNL-120. Design precast members (including connections) for the design load conditions and spans indicated, and for additional loads imposed by openings and supports of the work of other trades. Design precast members for handling without cracking in accordance with the PCI MNL-120. [Precast members [where indicated] shall have a fire rating [of [____]-hours] [as indicated] in accordance with UL Fire Resist Dir, or as designed in accordance with PCI MNL-124.] [Concrete toppings shall [not] be used in establishing the design strength of the precast members.]

1.4.2 PCI Quality Certifications

NOTE: For normal routine projects, use the first paragraph. For complex or large precast/prestressed projects, use the second paragraph. Note that use of the second paragraph may limit competition. Verify the availability of certified PCI precasters in the bidding area.

PCI MNL-116. At the precast manufacturer's option, in lieu of core samples, ACI 318M/318RM, full scale load tests may be performed. Perform on randomly selected members, as directed by the Contracting Officer.

1.4.2.1 Product Quality Control

PCI MNL-116 for PCI enrolled plants. Where panels are manufactured by specialists in plants not currently enrolled in the PCI "Quality Control Program," provide a product quality control system in accordance with PCI MNL-116 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory. Submit test results to the Contracting Officer.

or

1.4.2.2 Product Quality Control

NOTE: Category C1: Mild steel reinforced precast concrete element. Category C2: Prestress hollow core and repetitive products. Category C3: Prestressed Straight Strand Structural Members. Category C4: Prestressed Draped Strand Structural Members.

Plants shall be certified by the PCI Plant Certification Program for Category [C1] [C2] [C3] [C4] work.

1.5 DELIVERY AND STORAGE

Lift and support precast members at the lifting and supporting points indicated on the shop drawings. Store precast members off the ground. Separate stacked precast members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

1.6 FACTORY INSPECTION

At the option of the Contracting Officer, [precast units may be inspected by the Contracting Officer] [precast units shall be inspected by the QC Representative] prior to being transported to the job site. The Contractor shall 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.

1.7 QUALITY ASSURANCE

1.7.1 Drawing Information

Submit drawings indicating complete information for the fabrication, handling, and erection of the precast member. Drawings shall not be reproductions of contract drawings. Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

- a. Marking of members for erection
- b. Connections for work of other trades
- c. Connections between members, and connections between members and other construction
- d. Location and size of openings
- e. Headers for openings
- f. Joints between members, and joints between members and other construction
- g. Reinforcing details
- h. Material properties of steel and concrete used
- i. Lifting and erection inserts
- j. Dimensions and surface finishes of each member
- k. Erection sequence and handling requirements
- l. All loads used in design (such as live, dead, handling, and

erection)

m. Bracing/shoring required

n. Areas to receive toppings, topping thickness.

1.7.2 Design Calculations

Submit calculations reflecting design conforming to requirements of paragraph entitled "Precast Concrete Member Design." Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication.

1.7.3 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement, pozzolan, and admixtures; and applicable reference specifications.

1.7.4 Certificates: Record Requirement

ASTM C 94. Submit mandatory batch ticket information for each load of ready-mixed concrete.

PART 2 PRODUCTS

2.1 CONTRACTOR-FURNISHED MIX DESIGN

NOTE: Normal precast design is based on concrete having a compressive strength of 35 MPa 5000 psi at 28 days. Some precast manufacturers like to speed up production by using Type III (high early strength) concrete.

NOTE: Delete air entraining requirements when the project is located in a nonfreezing climate.

ACI 318M/318RM. The minimum compressive strength of concrete at [28] [_____] days shall be [35 MPa] [5000 psi] [_____] , unless otherwise indicated. [Add air-entraining admixtures at the mixer to produce between 4 and 6 percent air by volume.]

2.2 MATERIALS

2.2.1 Cement

NOTE: For normal precasting (not requiring sulfate resistance), use the first bracketed item. If sulfate resistance is required, use the second bracketed item.

[ASTM C 150, Type I, II, or III; or ASTM C 59/C 59M5M ASTM C 59/C 59M5 Type IP(MS) or IS(MS)] [ASTM C 150, Type II; or ASTM C 59/C 59M5M ASTM C 59/C 59M5 Type IP(MS) or IS(MS)] blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials: ASTM C 618pozzolan or fly ash, or ASTM C 989 ground iron blast furnace slag. The pozzolan/fly ash content shall not exceed 25 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Type N and F.

2.2.1.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 100 or 120.

2.2.2 Water

Water shall be fresh, clean, and potable.

2.2.3 Aggregates

2.2.3.1 Aggregates Selection

NOTE: Select gradation(s) based on job requirements and constraints. The maximum aggregate size shall not exceed three-quarters the minimum cover over reinforcing. Aggregate grading sizes with their general grading ranges are as follows: Size 57 (25 mmone inch to No. 4 sieve), Size 67 (20 mm3/ 4 inch to No. 4 sieve), and Size 7 (12 mm1/2 inch to No. 4 sieve).

ASTM C 33, Size [57] [67] [7] [____], except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement.

[2.2.3.2 Aggregates for Lightweight Concrete

ASTM C 330.

]2.2.4 Grout

2.2.4.1 Nonshrink Grout

ASTM C 1107.

2.2.4.2 Cementitious Grout

NOTE: Delete air entraining requirements when the project is located in a nonfreezing climate.

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. [Provide air entrainment for grout exposed to the weather.]

2.2.5 Admixtures

[2.2.5.1 Air-Entraining

NOTE: Delete air entraining requirements when the
project is located in a nonfreezing climate.

ASTM C 260.

]2.2.5.2 Accelerating

ASTM C 494, Type C or E.

2.2.5.3 Water Reducing

ASTM C 494, Type A, E, or F.

2.2.6 Reinforcement

2.2.6.1 Reinforcing Bars

NOTE: Specify ASTM A 706/A 706M reinforcing where
welding or bending of reinforcement bars is
important. In addition, ASTM A 775 epoxy coated
reinforcing may be specified where extra
reinforcement protection is required.

[ASTM A 706/A 706M, Grade 400 60;] ASTM A 615/A 615M, Grade [300] [400]
[40] [60]; ASTM A 617/A 617M, Grade [300] [400] [40] [60]; or ASTM A 616/A
616M, Grade [400] [50] [60].

2.2.6.2 Welded Wire Fabric

ASTM A 185 or ASTM A 497.

2.2.7 Metal Accessories

Provide ASTM A 123/A 123M or ASTM A 153/A 153M galvanized.

2.2.7.1 Inserts

ASTM A 47MASTM A 47, Grade 22010 32510 or 35018, or ASTM A 27/A 27M Grade
415-205 U-60-30.

2.2.7.2 Structural Steel

ASTM A 36/A 36M.

2.2.7.3 Bolts

ASTM A 307; ASTM A 325M ASTM A 325.

2.2.7.4 Nuts

ASTM A 563MASTM A 563.

2.2.7.5 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436M ASTM F 436 washers for ASTM A 325M ASTM A 325bolts.

2.2.8 Bearing Pads

2.2.8.1 Elastomeric

AASHTO HB-17, for plain neoprene bearings.

2.2.8.2 Hardboard (Interior Only)

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

2.3 FABRICATION

PCI MNL-116 unless specified otherwise.

2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 200 mm 3/4 inch, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2 Reinforcement Placement

ACI 318M/318RM for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between precast and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

2.3.3 Concrete

2.3.3.1 Concrete Mixing

ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.3.2 Concrete Placing

ACI 304R[, ACI 305R for hot weather concreting] [, ACI 306.1for cold weather concreting,] and ACI 309R, unless otherwise specified.

2.3.3.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 10 and 90 degrees C 50 and 190 degrees F. When accelerated curing is used, apply heat at controlled rate and uniformly

along the casting beds. Monitor temperatures at various points in a product line in different casts.

2.3.4 Surface Finish

Repairs located in a bearing area shall be approved by the Contracting Officer prior to repairs. Precast members containing hairline cracks which are visible and are less than 0.5 mm 0.02 inches in width, may be accepted, except that cracks larger than 0.1 mm 0.005 inches in width for surfaces exposed to the weather shall be repaired. Precast members which contain cracks greater than 0.5 mm 0.02 inches in width shall be approved by the Contracting Officer, prior to being repaired. Any precast member that is structurally impaired or contains honeycombed section deep enough to expose reinforcing shall be rejected.

2.3.4.1 Unformed Surfaces

Provide a [floated] [steel troweled] finish.

2.3.4.2 Formed Surfaces

NOTE: PCI MNL-116 different grades of formed surface finishes:

Commercial Grade: Concrete produced in forms that produce a rough finish. Fins are removed and large surface blemishes filled. Sharp edges that will be visible in the finished structure are ground down.

Standard Grade: Same finish as commercial grade, except the forms do not produce a texture on the concrete. Surface can be painted, but will have surface voids.

Finish Grade B: Same as standard grade, except all surface blemishes should be filled or finished to provide a smooth surface or uniform appearance if painted.

Finish Grade A: Same as Finish Grade B, except that the components of the completed structure, where exposed, shall be reasonably color matched. This finish is difficult to obtain.

PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.

- a. Unexposed Surfaces: Provide a [commercial] [standard] grade surface finish.
- b. Exposed Surfaces: Provide a [standard grade] [finish Grade B] [_____] surface finish. The combined area of acceptable defective areas shall not exceed 0.2 percent of the exposed to view surface area, and the patches shall be indistinguishable from the surrounding surfaces when dry.

PART 3 EXECUTION

3.1 SURFACE REPAIR

Prior to erection, and again after installation, precast members shall be checked for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, precast members that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" shall be repaired, or removed and replaced with new precast members.

3.2 ERECTION

Precast members shall be erected after the concrete has attained the specified compressive strength, unless otherwise approved by the precast manufacturer. Erect in accordance with the approved shop drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Brace precast members, unless design calculations submitted with the shop drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place precast members level, plumb, square, and true within tolerances. Align member ends.

3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the precast member and adjacent precast members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Do not use hardboard bearing pads in exterior locations. Place precast members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

3.4 ANCHORAGE

Provide anchorage for fastening work in place. Conceal fasteners where practicable. Make threaded connections up tight and nick threads to prevent loosening.

3.5 WELDING

AWS D1.4 for welding connections and reinforcing splices. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact. Grind smooth visible welds in the finished installation. Welding of epoxy-coated reinforcing is not allowed.

3.6 OPENINGS

Holes or cuts requiring reinforcing to be cut, which are not indicated on the approved shop drawing, shall only be made with the approval of the Contracting Officer and the precast manufacturer. Drill holes less than 300 mm 12 inches in diameter with a diamond tipped core drill.

3.7 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

3.8 GROUTING

Clean and fill [indicated] keyways between precast members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

3.9 SEALANTS

Provide as indicated and as specified in Section 07920 JOINT SEALANTS.

[3.10 CONCRETE TOPPING

Provide as indicated and as specified in Section 03300N CAST-IN-PLACE CONCRETE.

] -- End of Section --