UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2020
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PRECAST STRUCTURAL PRETENSIONED CONCRETE

11/16

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SECTION 03 41 33

PRECAST STRUCTURAL PRETENSIONED CONCRETE
11/16

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NOTE: This guide specification covers the requirements for fabrication and erection of precast structural concrete framing elements, floor units, and roof units for buildings including, as required by the project, the following:

Precast conventionally reinforced concrete floor and roof units for clear spans up to 10.5 meter 35 feet.

Precast conventionally reinforced concrete columns, joists, beams, and other structural framing elements.

Precast prestressed concrete single- and double-tee slabs, hollow-cored flat slabs, tee- or keystone-joists, columns, and other structural elements.

Precast concrete cellular floor units with cells suitable for use as electrical raceways.

Include in drawings a complete design indicating the character of the work to be performed and giving the following:

Assumed loads, including floor live load, roof live load, wind load, concentrated loads such as partitions, and equipment mounted on or suspended from precast concrete construction, concrete floor topping weight, and other design data as may be required for meeting building codes and the proper preparation of shop drawings.

Layout of the framing system indicating the relative location of the various precast structural concrete sections, floor elevations, column centers and offsets, openings, and sufficient dimensions to adequately convey the quantity and nature of the required precast structural concrete framing system.

Details of all precast structural concrete sections indicating cross-sections and dimensions.

Location of precast structural concrete sections having an architectural finish on exposed-to-view surfaces when required.

Details of reinforcement indicating reinforcing-bar schedules; location and size of welded-wire fabric; and tenons for prestressed concrete indicating the final stressing force in kips, as required.

Details of connections indicating end bearing minimums and anchorage devices and other items embedded in the precast structural concrete sections.

Location and details of concrete floor topping, when required.

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

Details of precast concrete filler blocks, as required.

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

Precast concrete floor-unit cells that will be used for electrical raceways, when required.

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

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

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

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

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

Painting exposed-to-view surfaces of precast concrete units such as ceilings and walls, is specified in Section 09 90 00 PAINTS AND COATINGS.

When cells of precast concrete cellular floor units will be used for electrical raceways, the inspection of cells to be used for electrical raceways, cutting

the floor units for inserts, and electrical raceway fittings are specified in Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.

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

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

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

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

****

PART 1 GENERAL

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 200	(1973; R 2012) Standard Specification for Epoxy Protective Coatings

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
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
ACI/MCP-2	(2015) Manual of Concrete Practice Part 2
ACI/MCP-3	(2015) Manual of Concrete Practice Part 3
ACI/MCP-4	(2015) Manual of Concrete Practice Part 4

AMERICAN HARDBOARD ASSOCIATION (AHA)

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BTH-1	(2014) Design of Below-the-Hook Lifting Devices

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel
AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel

ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A322	(2013) Standard Specification Steel Bars, Alloy, Standard Grades
ASTM A370	(2018) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A416/A416M	(2018) Standard Specification for Low-Relaxation, Seven-Wire for Prestressed Concrete
ASTM A421/A421M	(2015) Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A675/A675M	(2014) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A767/A767M	(2016) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C29/C29M	(2017a) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C31/C31M	(2019) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2018) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C40	(2011) Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C42/C42M	(2018a) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C70	(2013) Standard Test Method for Surface Moisture in Fine Aggregate

ASTM C78/C78M	(2018) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C88	(2018) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C94/C94M	(2018) Standard Specification for Ready-Mixed Concrete
ASTM C109/C109M	(2016a) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C114	(2015) Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C115/C115M	(2010; E 2013) Standard Test Method for Fineness of Portland Cement by the Turbidimeter
ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C123	(2014) Standard Test Method for Lightweight Particles in Aggregate
ASTM C126	(2018) Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
ASTM C127	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C131/C131M	(2014) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	(2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138/C138M	(2017a) Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C142/C142M	(2017) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C143/C143M	(2015) Standard Test Method for Slump of

	Hydraulic-Cement Concrete
ASTM C150/C150M	(2018) Standard Specification for Portland Cement
ASTM C151/C151M	(2018) Standard Test Method for Autoclave Expansion of Hydraulic Cement
ASTM C157/C157M	(2017) Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C183/C183M	(2015) Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
ASTM C185	(2015) Standard Test Method for Air Content of Hydraulic Cement Mortar
ASTM C191	(2013) Standard Test Method for Time of Setting Hydraulic Cement by Vicat Needle
ASTM C192/C192M	(2018) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C204	(2017) Standard Test Methods for Fineness of Hydraulic Cement by Air Permeability Apparatus
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C232/C232M	(2014) Standard Test Methods for Bleeding of Concrete
ASTM C233/C233M	(2018) Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C266	(2015) Standard Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles
ASTM C330	(2014) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C403/C403M	(2008) Standard Test Method for Time of Setting of Concrete Mixtures by

	Penetration Resistance
ASTM C404	(2018) Standard Specification for Aggregates for Masonry Grout
ASTM C451	(2013) Standard Test Method for Early Stiffening of Hydraulic Cement (Paste Method)
ASTM C535	(2016) Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C566	(2013) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C595/C595M	(2018) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C881/C881M	(2015) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1107/C1107M	(2017) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D312/D312M	(2016a) Standard Specification for Asphalt Used in Roofing
ASTM D395	(2016; E 2017) Standard Test Methods for Rubber Property - Compression Set
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D471	(2016a) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D573	(2004; R 2010) Standard Test Method for Rubber - Deterioration in an Air Oven
ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D2103	(2015) Standard Specification for

	Polyethylene Film and Sheeting
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D3744/D3744M	(2011a) Standard Test Method for Aggregate Durability Index
ASTM D4397	(2016) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E165/E165M	(2018) Standard Practice for Liquid Penetrant Examination for General Industry
ASTM E648	(2017a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM E709	(2015) Standard Guide for Magnetic Particle Examination

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2009; 28th Ed; Errata) Manual of Standard Practice

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1999) Manual for Quality Control for Plants and Production of Structural Precast Concrete Products, 4th Edition
PCI MNL-120	(2010) PCI Design Handbook - Precast and Prestressed Concrete, 6th Edition

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS UU-B-790	(Rev A; Notice 2) Building Paper Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

UNDERWRITERS LABORATORIES (UL)

UL Electrical Construction	(2012) Electrical Construction Equipment Directory
UL Fire Resistance	(2014) Fire Resistance Directory

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated 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 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.

Use the "S" Classification only in SD-11 Closeout Submittals. An "S" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

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

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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.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G[, [____]]

Installation Drawings; G[, [____]]

SD-05 Design Data

Normal-Weight Concrete; G[, [____]]

Lightweight Structural Concrete; G[, [____]]

SD-06 Test Reports

Air Content of Mortar; G[, [____]]

Normal-Weight Concrete Air Content; G[, [____]]

Lightweight Structural Concrete Air Content; G[, [_____]]

Air Entrainment for Normal-Weight Concrete; G[, [_____]]

Air Entrainment for Lightweight Structural Concrete; G[, [_____]]

Lightweight Structural Concrete Compressive Strength; G[, [_____]]

Normal-Weight Concrete Compressive Strength; G[, [_____]]

Slump for Normal-Weight Concrete; G[, [_____]]

Slump for Lightweight Structural Concrete; G[, [_____]]

Moisture Content; G[, [_____]]

Design Mix; G[, [_____]]

Unit Weight; G[, [_____]]

Anchorages

Nondestructive Testing; G[, [_____]]

SD-07 Certificates

Qualifications for Welding Work; G[, [_____]]

Installers

Manufacturer

Normal-Weight Concrete Aggregate; G[, [_____]]

Lightweight Structural Concrete Aggregate; G[, [_____]]

Pretensioning

Detensioning

Welding Procedures

SD-08 Manufacturer's Instructions

Installation Instructions

Welding Sequence and Procedure

Epoxy-Resin Grout

Epoxy-Resin Adhesive

1.3 QUALITY CONTROL

1.3.1 Qualifications for Precast-Concrete Manufacturer

Provide precast structural concrete sections manufactured by an organization experienced in the manufacture of precast concrete.

Submit a written description of the manufacturer giving the qualifications of personnel, location of plant, concrete batching facilities, manufacturing equipment and facilities, list of projects similar to specified work[and [_____]].

Produce sections/units under plant-controlled conditions conforming to PCI MNL-116 by a firm certified under the PCI Plant Certification Program and specializing in providing precast/prestressed products and related services.

1.3.2 Qualifications for Installer

Install members by using an organization experienced in the installation of precast structural-concrete sections.

Submit a written description of installers giving the qualifications of personnel, handling and erection equipment, list of projects similar to specified work[and [_____]].

1.3.3 Qualifications for Welding Work

Submit certificates of Compliance for the following items:

a. Qualifications of personnel

b. A list of projects similar to specified work

c. Performance requirements

[Section 05 05 23.16 STRUCTURAL WELDING applies to work specified in this section.

] Ensure all welding procedures are in accordance with AWS D1.1/D1.1M, and welders are qualified by tests in accordance with AWS D1.1/D1.1M.

[Ensure welders make only those types of weldments for which each is specifically qualified.

] Provide installation instructions for the welding sequence and procedure which indicates the manufacturer's recommended sequence and method of installation.

1.3.4 Concrete Sampling and Testing

Submit test reports. Include within each report the following items:

a. Project name and number, date, name of Contractor

b. Name of precast-concrete manufacturer, name of concrete testing service,

c. Type of concrete

d. Structural-member identification letter and number

e. Design compressive strength at 28 calendar days

f. Concrete-mix proportions and materials

g. Compressive breaking strength and type of break

h. A record of gage pressures or dynamometer readings,

i. Compression strength of concrete at time of detensioning, and type of reinforcement

Submit design mix reports for approval at least 15 calendar days prior to start of work.

1.3.4.1 Tests for Concrete Materials

****
NOTE: Delete the following materials and tests that are not required.
****

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

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Concrete aggregates for normal-weight concrete	Sampling	ASTM D75/D75M	One for each material source and grading size
	Sieve analysis	ASTM C136/C136M	
	Calculating fineness modulus	ASTM C126	
	Amount of material passing No. 200 sieve	ASTM C117	
	Amount of friction particles	ASTM C142/C142M	
	Amount of organic impurities	ASTM C40	
	Amount of coal and lignite	ASTM C123	
	Magnesium sulfate soundness test	ASTM C88	
	Aggregate durability	ASTM D3744/D3744M	
	Compact unit weight of slag (course aggregate)	ASTM C29/C29M	
	Resistance to abrasion test of small size coarse aggregate	ASTM C131/C131M or ASTM C535	

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Lightweight aggregates	Sampling	ASTM D75/D75M	One for each material source and grading size
	Sieve analysis	ASTM C136/C136M ASTM C330	
	Compact unit Unit weight (loose)	ASTM C29/C29M and	
Lightweight structural concrete using the proposed lightweight aggregates	Specimen preparation	ASTM C192/C192M and ASTM C330	As required for each type of test to determine conformance
	Compressive strength	ASTM C39/C39M	
	Unit weight	ASTM C330	
	Shrinkage	ASTM C157/C157M and ASTM C330	
Hydraulic cement	Sampling	ASTM C183/C183M	One for each material source, type, and color
	Chemical analysis	ASTM C114	
	Finess	ASTM C115/C115M or ASTM C204	
	Autoclave expansion	ASTM C151/C151M	
	Time of setting	ASTM C191 or ASTM C266	
	Air content of mortar	ASTM C185	
	Compressive Strength	ASTM C109/C109M	
	Heat of hydration	ASTM C185	
	False set	ASTM C451	

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Air entrained concrete using air entraining admixture made of the proposed concrete materials	Materials for tests	ASTM C233/C233M	One set of tests for each type of portland cement proposed for use and for each type of concrete
	Number of specimens	ASTM C233/C233M, Table 1	
	Bleeding	ASTM C232/C232M	
	Time of setting	ASTM C403/C403M and ASTM C233/C233M	
	Compressive Test Specimen	ASTM C192/C192M and ASTM C233/C233M	
	Compressive Strength test at 3, 7, and 28 calendar days	ASTM C39/C39M and ASTM C233/C233M	

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Concrete aggregates for normal-weight concrete	Sampling	ASTM D75/D75M	One for each material source and grading size
	Sieve analysis	ASTM C136/C136M	
	Calculating fineness modulus	ASTM C126	
	Amount of material passing No. 200 sieve	ASTM C117	
	Amount of friction particles	ASTM C142/C142M	
	Amount of organic impurities	ASTM C40	
	Amount of coal and lignite	ASTM C123	
	Magnesium sulfate soundness test	ASTM C88	
	Aggregate durability	ASTM D3744/D3744M	

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
	Compact unit weight of slag (course aggregate)	ASTM C29/C29M	
	Resistance to abrasion test of small size coarse aggregate	ASTM C131/C131M or ASTM C535	
Lightweight aggregates	Sampling	ASTM D75/D75M	One for each material source and grading size
	Sieve analysis	ASTM C136/C136M ASTM C330	
	Compact unit Unit weight (loose)	ASTM C29/C29M and	
lightweight structural concrete using the proposed lightweight aggregates	Specimen preparation	ASTM C192/C192M and ASTM C330	As required for each type of test to determine conformance
	Compressive strength	ASTM C39/C39M	
	Unit weight	ASTM C330	
	Shrinkage	ASTM C157/C157M and ASTM C330	
Hydraulic cement	Sampling	ASTM C183/C183M	One for each material source, type, and color
	Chemical analysis	ASTM C114	
	Fineness	ASTM C115/C115M or ASTM C204	
	Autoclave expansion	ASTM C151/C151M	
	Time of setting	ASTM C191 or ASTM C266	
	Air content of mortar	ASTM C185	
	Compressive Strength	ASTM C109/C109M	
	Heat of hydration	ASTM C185	
	False set	ASTM C451	

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Air entrained concrete using air entraining admixture made of the proposed concrete materials	Materials for tests	ASTM C233/C233M	One set of tests for each type of portland cement proposed for use and for each type of concrete
	Number of specimens	ASTM C233/C233M, Table 1	
	Bleeding	ASTM C232/C232M	
	Time of setting	ASTM C403/C403M and	
	Compressive Test	ASTM C192/C192M and	
	Compressive Strength test at 3, 7, and 28 calendar days	ASTM C39/C39M and ASTM C233/C233M	

1.3.4.2 Concrete Design Mixes

Submit design mix data.

****

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

****

Determine and test concrete Design Mix for concrete used as follows:

TYPE OF CONCRETE	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Normal-weight concrete	Specific gravity and absorption of fine aggregate	ASTM C128	As required for the concrete aggregates for each trial mix
	Specific gravity and absorption of coarse aggregate	ASTM C127	
	Moisture content of both fine and coarse aggregate	ASTM C70 and ASTM C566	
	Dry rodded unit weight of coarse aggregate	ASTM C29/C29M	

TYPE OF CONCRETE	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
	Trial mixes using at least three different water/cement ratios, minimum allowable slump; all with air entrainment for normal-weight concrete	ACI 211.1	As required to determine the concrete mix having the properties specified in paragraph QUALITY OF CONCRETE
	Making and curing concrete specimens in the laboratory	ASTM C192/C192M	Two sets of three specimens for each design mix
	Sampling fresh concrete in the laboratory	ASTM C192/C192M	One for each set of design mix specimens
	Slump for normal-weight concrete	ASTM C143/C143M	
	Normal-weight concrete air content	ASTM C231/C231M	
	Yield	ASTM C138/C138M	
	Compressive strength	ASTM C39/C39M	Three Specimens tested at 28 calendar days
Lightweight structural concrete	Dry loose unit weight of aggregates	ASTM C29/C29M and ASTM C330	As required for the lightweight aggregate for each trial mix
	Moisture content of aggregate	ASTM C566	
	Trial mixes using at least three different water/cement ratios, maximum allowable slump; both with and without air entrainment for lightweight structural concrete	ACI 211.1	As required to determine the concrete mix having the properties specified in paragraph QUALITY OF CONCRETE
	Making and curing concrete in the laboratory	ASTM C192/C192M	Two sets for each design mix
	Sampling fresh concrete in the laboratory	ASTM C192/C192M	One for each set of design mix specimens

TYPE OF CONCRETE	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
	Slump for lightweight structural concrete	ASTM C143/C143M	
	Light weight structural concrete air content	ASTM C173/C173M	
	Yield	ASTM C138/C138M	
	Compressive strength	ASTM C39/C39M	Three specimens tested at 7 calendar days and three specimens tested at 28 calendar days
	Air-dried unit weight	ASTM C330	Two specimens tested after curing 28 calendar days

****
NOTE: Delete the following paragraph when normal-weight concrete is not required.
****

From the results of the tests for normal-weight concrete, plot a curve showing the relationships between water/cement ratios and compressive strengths. When producing a design-minimum laboratory Compressive Strength at 28 calendar days, do not exceed the maximum water/cement ratio specified for normal-weight concrete properties shown by the curve.

****
NOTE: Delete the following paragraph when lightweight structural concrete is not required.
****

From the results of the tests for lightweight structural concrete, plot a curve showing the relationships between cement contents and compressive strengths. When producing a design-minimum laboratory compressive strength at 28 calendar days, do not provide less then the minimum cement content specified for lightweight structural properties shown by the curve.

1.3.4.3 Quality Control Testing During Fabrication

****
NOTE: Delete the following types of concrete not required by the project.
****

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

TYPE OF CONCRETE	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Normal-weight concrete	Sampling of 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
	Compression test Specimens	ASTM C31/C31M	One set of six standard cylinder specimens for each compressive strength test
			Ensure Curing of Compression Test Specimens are the same as the curing method used for the precast-concrete structural members.
	Concrete temperature		Each time a set of compression test specimens is made
	Compressive strength tests	ASTM C39/C39M	One set for every ten structural members, or fraction thereof, cast in any one day; two specimens tested at 7 calendar days, three specimens tested at 28 calendar days and one specimen retained in reserve for testing if required
Lightweight structural concrete	Sampling fresh concrete	ASTM C172/C172M except as modified for slump per ASTM C94/C94M	As required for each test.

TYPE OF CONCRETE	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
	Slump Test and unit weight of fresh concrete	ASTM C143/C143M ASTM C138/C138M	One for each concrete load at point of discharge and one for each set of compressive strength tests
	Air content by volumetric method	ASTM C173/C173M	One for each set of compressive strength tests
	Compressive test specimens	ASTM C31/C31M	One of six standard cylinder specimens for each compressive strength test
			Ensure the curing of Compressive Strength test specimens are the same as the curing method used for the precast-concrete structural members.
	Concrete temperature		Each time a set of compression test specimens is made
	Compressive strength tests	ASTM C39/C39M	One set for every ten structural members, or fraction thereof, cast in any one day; two specimens tested at 7 calendar days, three specimens tested at 28 calendar days and one specimen retained in reserve for testing if required
	Air dried Unit Weight at 28 calendar days	ASTM C330	One for each compressive strength test

Submit test results on the same day that tests are made.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Submit fabrication drawings. Show type and location of all reinforcement, size and spacing of welds within Fabrication Drawings.

Submit installation drawings indicating type and location of all anchorage devices, size and spacing of all welded connections, grouting and joint sealant details, and dimensions and locations of all openings in structural concrete sections.

2.1.1 Quality Of Concrete

2.1.1.1 Normal-Weight Concrete Properties

****
NOTE: Delete paragraph heading and the following paragraphs when normal-weight concrete will not be required.
****

PROPERTY	VALUE
Design normal-weight concrete compressive strength at 28 calendar days	Not less than 34.5 Megapascal
Maximum normal-weight concrete aggregate size	19 millimeter
Maximum water/cement ratio	16 liters per 42.5 kilogram sack of cement
Slump at point of concrete discharge	Not to exceed 75 millimeters
Total air content by volume at point of concrete discharge	Not less than 4 percent; not more than 8 percent

PROPERTY	VALUE
Design normal-weight concrete compressive strength at 28 calendar days	Not less than 5000 psi
Maximum normal-weight concrete aggregate size	3/4-inch
Maximum water/cement ratio	4.25 gallons per 94 pound sack of cement
Slump at point of concrete discharge	Not to exceed 3-inches
Total air content by volume at point of concrete discharge	Not less than 4 percent; not more than 8 percent

2.1.1.2 Lightweight Structural Concrete Properties

****
NOTE: Delete paragraph heading and the following paragraphs when light-weight structural concrete will not be required.
****

PROPERTY	VALUE
Design lightweight structural concrete compressive strength at 28 calendar days	Not less than 34.5 Megapascal
Maximum lightweight structural concrete aggregate size	19 millimeter
Maximum water/cement ratio	Seven 42.5 kilogram sacks of cement per 0.75 cubic meter
Slump at point of concrete discharge	Not to exceed 75 millimeters
Total air content by volume at point of concrete discharge	Not less than 4 percent; not more than 8 percent
Air-dry density at 28 calendar days	Not less than 1440 nor more than 1840 kilograms per cubic meter

PROPERTY	VALUE
Design lightweight structural concrete compressive strength at 28 calendar days	Not less than 5000 psi
Maximum lightweight structural concrete aggregate size	3/4-inch
Maximum water/cement ratio	Seven 94 pound sacks of cement per cubic yard
Slump at point of concrete discharge	Not to exceed 3-inches
Total air content by volume at point of concrete discharge	Not less than 4 percent; not more than 8 percent
Air-dry density at 28 calendar days	Not less than 90 nor more than 115 pounds per cubic foot

2.1.2 Performance Requirements

2.1.2.1 Design Methods

Design in accordance with ACI/MCP-3, ACI 318, ACI 318M and PCI MNL-120.

2.1.2.2 Allowable Design Loads and Deflections

****

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

Recommended design loads are found in ASCE 7-10.

****

Allowable design loads and deflections as indicated.

2.1.2.3 UL Fire-Resistance Listing and Label

****

NOTE: Delete paragraph heading and the following paragraph when UL-listed fire-resistant precast structural concrete sections are not required. The UL lists several manufacturers of prestressed precast-concrete, hollow-core flat slabs, and single-tee and double-tee slabs. Indicate location and fire-resistance classification of fire-resistant-rated structural sections.

****

Indicate sections requiring a fire-resistance classification as listed in UL Fire Resistance part, PRECAST CONCRETE UNITS (CFTV), and bear the UL label and marking.

2.1.2.4 Electrical Raceway UL Listing and Label

****

NOTE: Delete paragraph heading and the following paragraph when hollow-core floor-slab precast structural sections will not be used for electrical raceways, either under this contract or in the future. Indicate location of electrical raceway structural sections.

****

List the hollow-core floor slabs indicated as electrical raceways in UL Electrical Construction part, RACEWAYS (RGKT) CELLULAR CONCRETE FLOOR (RGYR), and bear the UL label and marking.

2.2 FABRICATION

2.2.1 Fabrication Tolerances

****

NOTE: Delete the following fabrication tolerances that are not required by the project.

****

Fabricate sections within the following tolerances:

Overall dimensions	Plus or minus 3 millimeter per 3048 millimeter but not greater than 19.1 millimeter overall
Cross-sectional dimensions of up to 150 millimeter	Plus or minus 3 millimeter
Over 150 to 460 millimeter	Plus or minus 4.8 millimeter
Over 460 to 915 millimeter	Plus or minus 6.4 millimeter
Over 915 millimeter	Plus or minus 9.5 millimeter
Deviation from straight line parallel to centerline of section up to 12.2 meters in length	Not over 9.5 millimeter
12.2 to 18.3 meter in length	Not over 12.7 millimeter

Overall dimensions	Plus or minus 3 millimeter per 3048 millimeter but not greater than 19.1 millimeter overall
Over 18.3 meter in length	Not over 19.1 millimeter
Deviation from camber indicated on the drawings	Plus or minus 3 millimeter per 3 meters
Ends out of square, up to 305 millimeter in width or depth	0.80 millimeter per 25.4 millimeter of width or depth
Over 300 millimeter in width or depth	0.80 plus 0.40 millimeter per 25.4 millimeter of width or depth
Position of block-outs	Plus or minus 12.7 millimeter
Position of voids in hollow cored flat slabs, for both vertical and horizontal dimensions	Plus or minus 12.7 millimeter
Concrete cover over reinforcement	Plus 6.4, minus 0 millimeter
Position of tendons for prestressed concrete	Plus or minus 3.2 millimeter
Position of deflection points for deflected strand tendons for prestressed concrete	Plus or minus 152 millimeter
Position of weld plates	Plus or minus 25.4 millimeter
Position of lateral anchorage points	Plus or minus 25.4 millimeter
Position of pickup devices	Plus or minus 152 millimeter

Overall dimensions	Plus or minus 1/8-inch per 10-feet but not greater than 3/4-inch overall
Cross-sectional dimensions of up to 6-inches	Plus or minus 1/8-inch
Over 6 to 18-inches	Plus or minus 3/16-inch
Over 18 to 36-inches	Plus or minus 1/4-inch
Over 36-inches	Plus or minus 3/8-inch
Deviation from straight line parallel to centerline of section up to 40-feet in length	Not over 3/8-inch
40 to 60-feet in length	Not over 1/2-inch
Over 60-feet in length	Not over 3/4-inch
Deviation from camber indicated on the drawings	Plus or minus 1/8-inch per 10-feet
Ends out of square, up to 12-inches in width or depth	0.80 millimeter per 1/32-inch of width or depth
Over 12-inches in width or depth	1/32-inch plus 1/64-inch per inch of width or depth

Overall dimensions	Plus or minus 1/8-inch per 10-feet but not greater than 3/4-inch overall
Position of block-outs	Plus or minus 1/2-inch
Position of voids in hollow cored flat slabs, for both vertical and horizontal dimensions	Plus or minus 1/2-inch
Concrete cover over reinforcement	Plus 1/4, minus 0 inch
Position of tendons for prestressed concrete	Plus or minus 1/8-inch
Position of deflection points for deflected strand tendons for prestressed concrete	Plus or minus 6-inches
Position of weld plates	Plus or minus 1-inch
Position of lateral anchorage points	Plus or minus 1-inch
Position of pickup devices	Plus or minus 6-inch

2.2.2 Forms

****
NOTE: Indicate structural-section dimensions, cross-sections, and other details as required by the project.
****

Use forms and form-facing materials that are nonreactive with concrete such as wood, metal, plastic, or other approved materials and are within the limits of the specified fabrication tolerances. Conform to the shapes, lines, and dimensions indicated.

2.2.3 Reinforcement

****
NOTE: Indicate reinforcement types, sizes, and arrangement as required for structural strength after the structural sections have been installed.
****

Provide types, sizes, and arrangement as indicated on the approved drawings. Detail reinforcement in accordance with ACI/MCP-3 and ACI 318.

Place and secure steel bars, welded-wire fabric, and other reinforcement by means of metal bar supports and spacers.

****
NOTE: Delete the following paragraph when prestressed structural-concrete sections are not required by the project.
****

Place tendons and anchorages in accordance with ACI/MCP-3 and ACI 318. Provide anchorages that are permanently protected with concrete; free of loose rust, grease, oil, paint, and other foreign matter. Ensure bearing surface is between anchorages and concrete; perpendicular to and concentric with the tendons and the line of action prestressing force.

****
NOTE: Revise or delete the following paragraph when not applicable to the project. Indicate concrete cover for reinforcement.
****

Provide concrete cover for reinforcement in accordance with ACI/MCP-3 and ACI 318.

2.2.4 Built-In Anchorage Devices

****
NOTE: Indicate anchorage devices that are to be embedded in the precast structural concrete sections. Anchorage devices include weld plates, bearing plates and steel shapes.
****

Position, anchor, and locate anchorage devices where they do not affect the position of the main reinforcement or placing concrete. Set bearing plates level, aligned properly, and anchor in the exact location indicated.

2.2.5 Lifting Devices

Provide lifting devices designed in accordance with ASME BTH-1, and of materials sufficiently ductile to ensure visible deformation before fracture.

2.2.6 Blockouts

****
NOTE: Blockouts are openings in slabs that would require the cutting of primary reinforcement if such openings were to be cut in the field. Ensure openings are cast in the unit during fabrication and indicated. The maximum size of field-cut openings may be from 150 to 300 millimeter 6 to 12 inches depending on the type of unit used such as the inside diameter of the voids in hollow cored flat slabs and the spacing of reinforcement.
****

Provide blockouts as indicated on drawings.

2.2.7 Pretensioning

****
NOTE: Delete paragraph heading and the following paragraph when prestressed structural-concrete sections are not required by the project.
****

Pretensioning of tendons may be accomplished either by the single-strand or multiple-strand tensioning method. Determine the prestressing force by measuring the tendon elongation, either by checking the jack pressure on a recently calibrated gage or by use of a recently calibrated dynamometer. Correct any discrepancy that exceeds 5 percent. Base elongation requirements on the load-elongation curves for the type of tendon used.

The total loss of prestress due to unreplaced broken tendons is not to exceed 2 percent of the total prestress.

2.2.8 Concrete Mixing and Conveying

Measure concrete materials, concrete batching plant, concrete mixers, and concrete mixing in accordance with ASTM C94/C94M.

Handle concrete to prevent segregation and loss of concrete mix materials.

2.2.9 Preparations for Placing Concrete

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

2.2.10 Weather Limitations

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

2.2.11 Concrete Placing

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

2.2.12 Identification Markings

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

Ensure each structural section has the date of casting plainly indented in the unexposed face of the concrete.

2.2.13 Finishing Unformed Surfaces

Trowel finish unformed surfaces unless otherwise specified. Provide smooth surface free of trowel marks, uniform in texture and appearance, and be plane to a tolerance not exceeding 3.2 millimeter in 3048 millimeter 1/8-inch in 10-feet when tested with a 3000 millimeter 10-foot straightedge.

Provide top surfaces of sections that are to receive concrete topping after installation with a transversely scarified scratch finish and remove laitance.

2.2.14 Curing

Cure concrete by keeping the concrete damp for not less than 7 calendar days if made of Type I portland cement and for not less than 3 calendar days if made of Type III portland cement. For each decrease of 3 degrees below 21 degrees C 5 degrees below 70 degrees F in the average curing

temperature, increase the curing period by 4 calendar days for concrete made of Type I portland cement and by 2 calendar days for concrete made of Type III portland cement.

Curing by low-pressure steam, steam vapor, radiant heat and moisture, or other acceptable process may be employed provided that the compressive strength of the concrete is equal to that obtained by moist curing and the 28-day compressive strength of the concrete meets the requirements specified, as determined by test cylinders of the same concrete cured by the same curing process.

Do not remove sections from their casting beds until the curing period is completed or concrete has attained at least 75 percent of its design compressive strength.

2.2.15 Protection of Concrete After Placing

Meet protection requirements of ACI/MCP-2 for hot or cold weather, as applicable.

2.2.16 Detensioning

****
NOTE: Delete paragraph heading and the following paragraphs when prestressed structural-concrete sections are not required by the project.
****

Do not detension tendons until the concrete compressive strength, as indicated by test cylinders, is as follows:

TYPE OF REINFORCEMENT	COMPRESSIVE STRENGTH OF CONCRETE
Concentrically stressed sections	Not less than 20 Megapascal
Eccentrically stressed sections	Not less than 24.1 Megapascal
Beams or other sections in which camber must be minimized	Not less than 27.6 Megapascal

TYPE OF REINFORCEMENT	COMPRESSIVE STRENGTH OF CONCRETE
Concentrically stressed sections	Not less than 3,000 psi
Eccentrically stressed sections	Not less than 3,500 psi
Beams or other sections in which camber must be minimized	Not less than 4,000 psi

Remove test cylinders to be used to establish the compressive strength of the concrete from the casting bed at least 1 hour prior to the start of the detensioning operation. Allow test cylinders from heat-cured casting beds to cool for approximately 1/2 hour prior to capping, and allow caps of sulfur compound to cure for 1/2 hour prior to the compressive-strength test.

If concrete has been heat cured, ensure the detensioning operation is done following the curing period while the concrete is still warm and moist to

avoid cracking or undesirable stresses in the concrete.

Ensure prior to detensioning operations, forms, ties, inserts, holddowns, or other devices that would restrict the longitudinal movement of the sections along the casting bed are removed or loosened to provide free movement of the structural section. Alternately, perform detensioning so that longitudinal movement is precluded.

In detensioning operations, ensure prestressing forces are kept nearly symmetrical about the vertical axis of the section and applied in a manner that will minimize sudden or shock loading. Limit maximum eccentricity about the vertical axis to one strand. Detensioning of pretensioned tendons may be accomplished either by gradual release of the tensioning jacks or by heat-cutting the tendons in accordance with an approved pattern and sequence to prevent severe unbalancing of the loading.

2.2.17 Finishing Formed Surfaces

Upon removal of forms, repair and patch defective areas. Limit defective areas to holes left by tie rods and other temporary inserts and to honeycomb or rock pockets not deep enough to expose the reinforcement and not located in bearing areas. Cut out defective areas to sound concrete and clean. Ensure patches on lower side of sections, near the center or in areas of variable tensile strength, are bonded by a two-component epoxy-polysulfide or epoxy-polyamine bonding adhesive. Other areas will be dampened with water and patched with portland cement grout. Where the concrete surface will be exposed to view, match the patches, when dry, to the surrounding concrete.

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

****

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

****

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

2.3 MATERIALS

2.3.1 Concrete Materials

2.3.1.1 Normal-Weight Aggregates

****

NOTE: Delete paragraph heading and the following paragraphs when precast structural-concrete sections will be fabricated of lightweight structural concrete. Fabricate precast concrete elements exposed to the weather of normal-weight concrete. When an architectural finish, such as exposed aggregate, is required for exposed-to-view surfaces, refer to Section 03 45 00 PRECAST ARCHITECTURAL CONCRETE for concrete aggregate specifications.

****

Provide fine and coarse aggregates conforming to ASTM C33/C33M and the following:

a. Where a structural member is exposed to the weather, and for all concrete aggregates where surface appearance of the concrete is important, meet the requirements of ASTM C33/C33M for fine aggregate subject to abrasion, for coarse aggregate subject to severe exposure.

b. Maximum size of coarse aggregate is as specified.

2.3.1.2 Lightweight Aggregates

****

NOTE: Delete paragraph heading and the following paragraph when all precast structural-concrete sections will be fabricated of normal-weight concrete. Fire-resistance-rated structural sections may be fabricated of lightweight structural concrete, especially when the fire-resistance rating exceeds 2 hours.

****

Conform to ASTM C330.

2.3.1.3 Portland Cement

****

NOTE: If high early strength concrete is required, add Type III.

****

[Portland cement conforms to ASTM C150/C150M, Type [_____].

][Blended hydraulic cement conforms to ASTM C595/C595M, Type [_____].

] Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.3.1.4 Fly Ash

Use fly ash as an admixture, conforming to ASTM C618, Class [C or F], with 4 percent maximum loss on ignition and between 15 to 35 percent maximum cement replacement by weight.

****

NOTE: Ground granulated blast furnace slag is one of the materials listed in the EPA's Comprehensive Procurement Guidelines (CPG)

https://www.epa.gov/smm/comprehensive-procurement-guidelines-construction-pr

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

****

2.3.1.5 Ground Granulated Blast Furnace (GGBF) Slag

GGBF slag [is required] [used] as an admixture [and] conforming to ASTM C989/C989M, Grade [120] with between 25 to 50 percent maximum cement replacement by weight.

2.3.1.6 Air-Entraining Admixture

Use an admixture free of sodium chloride and nitrates, conforming to ASTM C260/C260M.

2.3.1.7 Water

Use potable water.

2.3.2 Reinforcement Materials

****

NOTE: Delete the following reinforcement materials that are not required. Concrete reinforcement materials are required for both conventionally reinforced and prestressed precast structural-concrete sections.

****

2.3.2.1 Reinforcement Bars

Provide deformed bars conforming to ASTM A615/A615M, Grade 60, except that 9.5 millimeter 0.375 inches diameter bars may be Grade 40.

****

NOTE: Delete the following paragraph when galvanized reinforcing bars for concrete reinforcement is not required. Galvanizing is recommended when the concrete cover over reinforcing bars is less than 38 millimeter 1-1/2 inches for structural sections exposed to the weather.

****

Galvanize bars for structural sections exposed to the weather in

accordance with ASTM A767/A767M.

2.3.2.2 Cold-Drawn Steel Wire

Provide wire conforming to ASTM A1064/A1064M.

2.3.2.3 Welded-Wire Fabric

Provide uncoated wire fabric conforming to ASTM A1064/A1064M. Provide galvanized wire fabric in structural sections exposed to the weather.

2.3.2.4 Supports for Concrete Reinforcement

Include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcement bars and wire in place.

Provide wire supports conforming to ACI/MCP-4, ASTM E648, ACI SP-66 and CRSI 10MSP.

Ensure legs of supports in contact with formwork for sections that will be exposed to weather are hot-dip galvanized after fabrication, plastic coated, or corrosion-resistant steel bar supports.

2.3.3 Prestressing Materials

****
NOTE: Delete paragraph heading and the following paragraphs when prestressed structural-concrete sections are not required.
****

2.3.3.1 Strand Tendons

****
NOTE: Strand tendons for prestressed concrete are primarily intended for use in pretensioned, bonded, prestressed concrete construction. Use galvanized tendons in project locations with Environmental Severity Classifications (ESC) of C4 or C5. See UFC 1-200-01 for determination of ESC for project locations.
****

Provide [uncoated][galvanized], 7-strand, stress-relieved, steel wire conforming to ASTM A416/A416M.

2.3.3.2 Wire Tendons

****
NOTE: Delete paragraph heading and the following paragraph when wire tendons for prestressed concrete will not be required. Prestressing steel wire is commonly used in prestressed linear concrete construction in which the steel wire ends are anchored by cold-end deformation (that is, button anchorage) or in which the steel wire ends are anchored by wedges.
****

Provide tendons conforming to ASTM A421/A421M, Type BA or Type WA, as required to suit the steel-wire anchorage method used.

2.3.3.3 Steel-Bar Tendons

****

NOTE: Delete paragraph heading and the following paragraphs when steel-bar tendons for prestressed concrete will not be required. Steel bars are principally used in post tensioning.

****

Provide uncoated round steel bars conforming to ASTM A322.

Tensile properties of the bars after processing, when tested in accordance with ASTM A370, as follows:

****

NOTE: Select one of the following values of tensile property and value as applicable to the project.

****

TENSILE PROPERTY	VALUE NO. 1	VALUE NO. 2
Ultimate tensile strength	1000 Megapascal min	1100 Megapascal min
Yield strength (0.2-percent offset)	900 Megapascal min	970 Megapascal min
Elongation at rupture in 20 diameters	4 percent min	4 percent min
Reduction on area at rupture	25 percent min	20 percent min

TENSILE PROPERTY	VALUE NO. 1	VALUE NO. 2
Ultimate tensile strength	145,000 psi min	160,000 psi min
Yield strength (0.2-percent offset)	130,000 psi min	140,000 psi min
Elongation at rupture in 20 diameters	4 percent min	4 percent min
Reduction on area at rupture	25 percent min	20 percent min

2.3.3.4 Tendon Anchorages for Pretensioning

Provide tendon anchorages capable of anchoring reinforcement without slippage after seating.

Proof test by the manufacturer, steel cases for prestressing steel strand to at least 90 percent of the ultimate tensile strength of the strand.

2.3.3.5 Tendon Anchorages for Post Tensioning

****

NOTE: Delete paragraph heading and the following paragraphs when tendon anchorages for post tensioning will not be required. Normally, pretensioning only is required for prestressed precast structural concrete sections for building construction. Post tensioning may be required for field connections.

****

Provide anchorages capable of developing 100 percent of the guaranteed ultimate tensile strength of the reinforcement for prestressed concrete without excessive deformation. Provide anchorage plates of sufficient size to keep bearing pressures within the stress allowed by ACI/MCP-3 and ACI 318 for the specified concrete strength at stressing.

Submit test data confirming the adequacy of anchorages.

2.3.4 Connection Materials

2.3.4.1 Steel Plates, Shapes, and Bars

Ensure plates conform to ASTM A283/A283M, Grade C, or to ASTM A36/A36M.

Ensure structural-steel shapes conform to ASTM A36/A36M.

Ensure bar shapes, flats, and rounds conform to ASTM A675/A675M, Grade 65, or ASTM A36/A36M.

Where connectors are recessed, allow a minimum 64 millimeters 2-1/2 inches of concrete cover for epoxy resin filler. Do not use welded or bolted metal connectors where exposed to the weather, unless such components are of stainless steel, galvanized steel or fusion-bonded epoxy coated steel.

2.3.4.2 Steel Anchor Bolts

****

NOTE: Delete paragraph heading and the following paragraph when anchor bolts will not be required. Anchor bolts are normally required for precast concrete column base connections.

****

Provide anchor bolts made of steel, with steel hexagon nuts and steel washers.

2.3.4.3 Electrodes for Welding

****

NOTE: Delete paragraph heading and the following paragraphs when welded connections are not required.

****

Provide electrodes for manual shielded metal-arc welding connections consisting of structural quality carbon-steel members conforming to the AWS Code and be covered mild-steel electrodes conforming to AWS A5.1/A5.1M, E60 series.

Provide electrodes for welding steel bars for concrete reinforcement conforming to AWS D1.4/D1.4M.

2.3.4.4 Flexible Bearing Pads

****

NOTE: Delete one of the following paragraphs as applicable to the project. Delete paragraph heading and the following paragraphs when flexible bearing pads are not required. Hardboard bearing pads are recommended for gravity connections having a bearing load not exceeding 1725 kilopascal 250 pounds per square inch (psi). Elastomeric nonlaminated bearing pads are recommended for gravity connections having a bearing load not exceeding 5500 kilopascal 800 psi. Where the bearing load exceeds 5500 kilopascal 800 psi or where there are small rotations, ensure laminated type bearing pads designed and constructed to meet the requirements for loading and movement is considered. Indicate the location and size of flexible bearing pads.

****

Provide tempered hardboard pads not less than 3 millimeter 1/8-inch in thickness, smooth-two-sides, conforming to AHA A135.4.

Provide pads molded or cut from elastomeric material. Provide pad dimensions as indicated and within the following tolerances: thickness, plus or minus 1.5 millimeter 1/16-inch; width, minus 3 to plus 6.5 millimeter 1/8-to plus 1/4-inch; length, plus or minus 3 millimeter 1/8-inch. Material: vulcanized, chloroprene elastomeric compound conforming to the following tests:

PROPERTY	TEST METHOD	PERFORMANCE
Hardness Shore A durometer	ASTM D2240	70 plus or minus 5 points
Tensile strength	ASTM D412 Die C	Not less than 17.2 Megapascal
Ultimate elongation	ASTM D412 Die C	Not less than 300 percent
Resistance to oil aging: change in volume after 70-hour immersion in ASTM oil No. 3 at 100 degrees C	ASTM D471	Not more than plus 120 percent
Resistance to heat aging: change in original properties after 70 hours at 100 degrees C tensile strength ultimate elongation hardness	ASTM D573	Plus 15 percent, minus 40 percent, 0 to plus 15 points

PROPERTY	TEST METHOD	PERFORMANCE
Resistance to permanent set: compression set after 22 hours at 100 degrees C	ASTM D395 Method B	Not more than 35 percent
Resistance to ozone: condition after exposure of a sample kept under a surface tensile strain of 20 percent to an ozone concentration of 100 parts per million of air by volume in air for 100 hours at 40 degrees C	ASTM D1149	No cracks
		Not less than 91 kilogram per 25 linear millimeter

PROPERTY	TEST METHOD	PERFORMANCE
Hardness Shore A durometer	ASTM D2240	70 plus or minus 5 points
Tensile strength	ASTM D412 Die C	Not less than 2,500 psi
Ultimate elongation	ASTM D412 Die C	Not less than 300 percent
Resistance to oil aging: change in volume after 70-hour immersion in ASTM oil No. 3 at 212 degrees F	ASTM D471	Not more than plus 120 percent
Resistance to heat aging: change in original properties after 70 hours at 212 degrees F tensile strength ultimate elongation hardness	ASTM D573	Plus 15 percent, minus 40 percent, 0 to plus 15 points
Resistance to permanent set: compression set after 22 hours at 212 degrees F	ASTM D395 Method B	Not more than 35 percent

PROPERTY	TEST METHOD	PERFORMANCE
Resistance to ozone: condition after exposure of a sample kept under a surface tensile strain of 20 percent to an ozone concentration of 100 parts per million of air by volume in air for 100 hours at 104 degrees F	ASTM D1149	No cracks
		Not less than 200 pounds per linear inch

2.3.5 Grouting Materials

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

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

Provide Portland cement conforming to ASTM C150/C150M, Type I.

Provide Blended hydraulic cement conforming to ASTM C595/C595M, Type [_____].

Provide Aggregate for cement grout conforming to ASTM C404, Size No. 2.

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

Use potable water.

Provide two-component, mineral-filled, epoxy-polysulfide epoxy-resin grout conforming to ASTM C881/C881M, [Type I][Type II][____].

Provide two-component, epoxy-polyamide cured type epoxy-resin adhesive conforming to AASHTO M 200.

2.3.6 Bituminous Joint Sealing Materials

****
NOTE: Delete paragraph heading and the following paragraphs when single- or double-tee roof slab structural sections are not required.
****

Use asphalt bituminous cement conforming to ASTM D312/D312M, Type IV.

Provide joint sealing tape 15.24 cm 6-inches wide, multilayered, asphalt treated, glass-fiber reinforced, conforming to [ASTM D2103] [ASTM D4397] [FS UU-B-790, Type I, Grade C, Style 4,] with the following modification:

Dry tensile strength not be less than 6130 newton per meter 35 pounds per inchwidth, both directions.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Anchorage Items Embedded In Other Construction

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

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

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

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

3.2 INSTALLATION

Install precast sections in accordance with the drawings and as specified.

3.2.1 Welded Connections

****
NOTE: Welded connections are the most commonly used type of connection. Other types of connections that may be employed are gravity, structural-steel bolted, post-tensioned, cast-in-place reinforced-concrete, and doweled connections. Ensure connection details are indicated.
****

Ensure welding reinforcing steel, metal inserts, and connections in precast-concrete structural-member construction are in accordance with AWS D1.4/D1.4M.

Ensure welding structural steel connections are in accordance with AWS D1.1/D1.1M.

3.2.2 Installation of Flexible Bearing Pads

****
NOTE: Delete paragraph heading and the following paragraphs when flexible bearing pads are not required. Ensure bearing pads are indicated.
****

Install pads into cast-in-place concrete where indicated; set in correct position, and have a uniform bearing. Keep in the correct position while placing sections.

3.2.3 Strength of Structural Precast Sections at Installation

****
NOTE: Delete one of the following paragraphs as applicable to the project. Select the first paragraph except when the project schedule indicates installation of 28-day structural sections.
****

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

Do not install precast sections before 28 calendar days from the date of casting has elapsed 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 structural section to determine the strength of the concrete.

3.2.4 Installation Tolerances

Install precast sections within the following tolerances:

Deviation in location from indicated	Plus or minus 6.4 millimeter
Deviation from plumb for columns in any story or 6.1 meter maximum	Not over 6.4 millimeter

Deviation in location from indicated	Plus or minus 6.4 millimeter
In 12.2 meter or more	Not over 12.7 millimeter
Deviation from elevations indicated for girders, beams, joists, and slabs in any bay or 6.1 meter maximum	Not over 6.4 millimeter
In 12.2 meter or more	Not over 12.7 millimeter
Difference between adjacent structural sections in erected position	Plus or minus 1.6 millimeter per 3000 millimeter but not greater than 6.4 millimeter overall
Deviation in location from indicated	Plus or minus 1/4-inch
Deviation from plumb for columns in any story or 20-feet maximum	Not over 1/4-inch
In 40-feet or more	Not over 1/2-inch
Deviation from elevations indicated for girders, beams, joists, and slabs in any bay or 20-feet maximum	Not over 1/4-inch
In 40-feet or more	Not over 1/2-inch
Difference between adjacent structural sections in erected position	Plus or minus 1/16-inch per 10-feet but not greater than 1/4-inch overall

3.2.5 Placing Framing Structural Sections

****

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

****

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

****

NOTE: Delete the following paragraphs when precast concrete columns with attached steel bearing plates will not be required.

****

Installation of precast concrete columns with attached steel bearing plates is as follows:

a. Ensure concrete and steel plate bearing surfaces are cleaned of laitance, dirt, oil, grease, and other foreign materials. Roughen concrete surface.

b. Space between the top of the concrete bearing surface and the bottom of the steel plate is approximately 1/24 of the width of the bearing plate, but not less than 12.7 millimeter 1/2-inch for bearing plate

that is less than 300 millimeter 12-inches wide. Support and align bearing plate on steel wedges or shims.

c. After precast concrete columns have been positioned and braced and anchor bolts tightened, grout the space between the top of the bearing surface and the bottom of the steel bearing plate.

Do not remove wedges or shims but, when protruding, cut off flush with the edge of the steel bearing plate prior to grouting.

Install sections plumb, level, and in alignment within the limits of the installation tolerances specified.

3.2.6 Placing Slab Structural Sections

****
NOTE: Delete the paragraph heading and the following paragraphs when slab structural sections, such as single- and double-tee slabs and hollow-cored flat slabs will not be required. Slab structural-sections may be placed over structural-steel framing members, precast structural-concrete framing sections, cast-in-place structural-concrete framing sections, or bearing walls, or a combination thereof.
****

Ensure supporting sections, including bearing pads or plates, are in place before placing of precast sections is started. Slab structural sections are placed on supporting construction with ends bearing on the structural framing sections or bearing walls as indicated. End bearings cannot be less than75 millimeter 3-inches. Accurately align slabs end to end with sides and ends butted together. Provide grouting void at sides and ends of the slabs as indicated.

****
NOTE: Delete the following paragraph when electrical-raceway hollow-cored flat-slab structural sections will not be required.
****

Place electrical raceway hollow-cored flat-slab structural sections in straight alignment for the entire length of run of the hollow cores and with close alignment between hollow cores at the ends of abutting slab structural sections.

3.2.7 Grouting Connections and Joints

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

After precast sections have been placed and connected, grout open spaces

at connections and joints.

****
NOTE: Delete the following paragraph when shrink-resistant grout only is required.
****

Ensure cement grout is 1 part cement, 2-1/2 parts of specified aggregate for cement grout, and not more than 17 liter 4-1/2 gallons of water per 42.6 kilogram 94-pound sack of cement.

****
NOTE: Delete the following paragraph when cement grout only is required.
****

Mix shrink-resistant grout compound with potable water to provide a flowable mixture without segregation or bleeding.

Provide forms or other approved methods to retain the grout in place. Pack spaces with grout until the voids are completely filled. At slab structural section interfaces, finish the grout flush with top surface of the slab and remove excess. Keep grout damp for not less than 24 hours.

****
NOTE: Delete the following paragraphs when cement grout only is required or when epoxy-resin grout or adhesive instead of shrink-resistant grout is not required.
****

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

****
NOTE: Delete the following paragraph when electrical raceway hollow-cored flat-slab structural sections are not required.
****

Ensure open spaces at abutting ends of electrical raceway hollow-cored flat-slab structural sections are sealed with pressure-sensitive tape. Keep free from grout and other foreign materials hollow cores use for electrical raceways.

3.2.8 Sealing Joints in Roof Slabs

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

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

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

Seal other joints with bituminous joint-sealing material. Center joint-sealing tape over the joint and fill joint with hot bituminous cement. Lap ends not less than 100 millimeter 4-inches. Remove excess bitumen and provide a smooth tape surface.

3.2.9 Field Cut Openings in Slab Structural Sections

****

NOTE: The maximum size of field-cut openings is governed by the spacing of reinforcement and the inside diameter of the voids in hollow-cored flat slabs.

****

Cut and fit sections as required for other work projecting through, or adjacent to, the members. Ensure cuts are straight and at 90 degrees to the surfaces without breaking or spalling the edges. Do not cut reinforcing bars, strands, or wires. Do not allow cut size to exceed inside diameter of voids in hollow core flat slabs.

****

NOTE: Use the following paragraph when hollow-cored flat-slab structural sections are not required. Ensure openings larger than the width of a slab structural section are framed with supporting members.

****

Ensure openings in hollow-core flat-slab sections having any dimension more than the inside diameter of the hollow cores and not exceeding the width of the slab structural section are reinforced by means of hung steel angle saddle headers. Ensure headers are shop prime-coat painted and as indicated on the approved drawings.

3.2.10 Touchup Painting

****

NOTE: Delete paragraph heading and the following paragraph when precast structural-concrete sections will not be supported by steel structural members.

****

Ensure after sections have been installed, scarred surfaces on steel supporting members and weld plates are wire brushed, cleaned, and touchup painted.

3.2.11 Cleaning

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

3.3 FIELD QUALITY CONTROL

3.3.1 Evaluation of Compressive Strength Tests

Concrete quality control tests will be evaluated as specified.

****
NOTE: Delete the following paragraph when normal-weight concrete will not be required.
****

Do not use normal-weight concrete delivered to the point of placement having a slump or total air content outside the values specified.

****
NOTE: Delete the following paragraph when lightweight structural concrete will not be required.
****

Do not use lightweight structural concrete delivered to the point of placement having a unit weight of fresh concrete that varies more than 2 percent from the design mix wet unit weight or having a slump or total air content outside the values specified.

Compressive-strength tests will be considered satisfactory if the average of any group of 5 consecutive compressive-strength tests that may be selected is in each instance equal to or greater than the 28-day design compressive strength or if not more than one compressive-strength test in 10 has a value less than 90 percent of the 28-day design compressive-strength.

If the compressive-strength tests fail to meet the minimum requirements specified, the fabricated concrete sections represented by such tests will be considered deficient in strength and subject to the provisions specified in the supplemental testing paragraph below.

3.3.2 Dimensional Tolerances

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

3.3.3 Surface-Finish Requirements

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

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

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

b. Exposed-to-view formed surfaces that contain cracks, spalls, air bubbles, honeycomb, rock pockets, or stains or other discoloration

that cannot be removed by cleaning

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

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

3.3.4 Strength of Structural Members

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

a. Failure to meet compressive strength tests

b. Reinforcement and pretensioning and detensioning of tendons of prestressed concrete not conforming to the requirements specified

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

d. Structural sections damaged during handling and erection

3.3.5 Supplemental Testing of Deficient Structural Sections for Strength

When there is evidence through concrete cylinder testing that the strength of precast structural-concrete sections do not meet specification requirements, make supplemental compressive strength determinations through the use of cores drilled into the hardened concrete in accordance with ASTM C42/C42M and as follows:

a. Take at least three representative cores from the precast structural concrete sections that are considered potentially deficient. Do not cut reinforcing bars, strands, or wires.

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

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

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

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

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

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

3.3.6 Inspection of Welding

****
NOTE: Delete paragraph heading and the following paragraphs when inspection of welding will not be required.
****

Perform inspection of welding in accordance with[AWS D1.1/D1.1M, Section 6][AWS D1.4/D1.4M, Section 7], and as follows:

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

Ensure liquid-penetration inspection of welds conforms to ASTM E165/E165M.

Conduct Magnetic-particle inspection of welds in conformance with ASTM E709.

3.3.6.1 Weld Acceptance

****
NOTE: Drawings or the text of the contract specifications must specify the weld requirements: tensile strength, elongation, shear strength, size, length, type, and location. Complete penetration welds subject to primary tensile stress or cyclic loading must be identified in the contract drawings for purpose of selecting the correct NDT acceptance criteria.
****

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.4/D1.4M and the contract drawings. Perform nondestructive testing by visual inspection [and ultrasonic,] [magnetic particle,] [or] [dye penetrate] methods. The minimum extent of nondestructive testing is a random [_____] percent of welds or joints, as indicated on the drawings. Submit all records of nondestructive testing.

Nondestructive Testing

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop does not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface

conditioning shows that no unacceptable defect is present.

3.3.7 Structural Sections-in-Place

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

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

b. Sections that are damaged during construction operations

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

-- End of Section --