
USACE / NAVFAC / AFCESA / NASA UFGS-03 41 16 (November 2008)

Preparing Activity: NASA Superseding
UFGS-03 50 00.00 40 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2009

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SECTION 03 41 16

PRECAST CONCRETE SLABS (MAX. SPAN 8'- 0" O.C.) 11/08

NOTE: This specification covers the requirements for flat-shaped or channel-shaped roof slabs placed over purlins or joists spaced not more than 2.5 meter 8 feet on center that receive insulation board and built-up roofing.

Drawings must include the following:

Complete design indicating the character of the work to be performed and giving the roof framing, type, and sizes of purlins or joists, thrust angles at walls, bearing angles at ridges for sloping roofs, end bearing plates, dimensions of roof slab units, details of precast cant units, details of cast-in-place concrete cants and other sloping surfaces, details of openings, and sufficient dimensions to convey adequately the quantity and nature of the required roof decking.

Assumed loads and other design data as may be required for the proper preparation of shop drawings.

Precast concrete slabs for clear spans exceeding 2.5 meter 8 feet are specified in Section 03 41 33 PRECAST STRUCTURAL PRETENSIONED CONCRETE.

A structural steel roof framing system, including steel purlins and framing for openings larger than 1/2 width of roof slabs in any dimension, is specified in Section 05 12 00 STRUCTURAL STEEL.

An open-web steel joist roof framing system is specified in Section 05 21 19 OPEN WEB STEEL JOIST FRAMING.

Fire resistance-rated roof and ceiling constructions using precast concrete roof decking are described in Underwriters Laboratories, Inc., "Fire Resistance Ratings (BXUV)" contained in UL FRD and the "Fire Resistance Ratings" contained in AIA CO-1. Fire resistance rated construction limits the type and

spacing of the roof framing system; type of roof slab units and method of fastening the roof slabs to the supporting frame; ceiling construction; and roof construction..

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

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

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).

PART 1 GENERAL

1.1 REFERENCES

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

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

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

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

ACI INTERNATIONAL (ACI)

ACI C-21

(1992) Elevated Slabs

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 182 (2005) Standard Specification for Burlap
Cloth Made from Jute or Kenaf and Cotton
Mats

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1 (1965; R 2003) Plain Washers

ANSI B18.22M (1981; R 2005) Metric Plain Washers

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA BOOK (2007) Book of Standards

ASME INTERNATIONAL (ASME)

ASME B18.2.2 (1987; R 2005) Standard for Square and Hex
Nuts

ASME B18.2.4.1M (2002; R 2007) Metric Hex Nuts, Style 1

ASME B18.6.3 (2003; R 2008) Machine Screws and Machine
Screw Nuts

ASME B18.6.7M (1999; R 2005) Metric Machine Screws

ASTM INTERNATIONAL (ASTM)

ASTM C 150 (2007) Standard Specification for Portland
Cement

ASTM C 171 (2007) Standard Specification for Sheet
Materials for Curing Concrete

ASTM C 33/C 33M (2008) Standard Specification for Concrete
Aggregates

ASTM C 387/C 387M (2009) Standard Specification for
Packaged, Dry, Combined Materials for
Mortar and Concrete

ASTM C 514 (2004) Standard Specification for Nails
for the Application of Gypsum Board

ASTM C 595 (2008a) Standard Specification for Blended
Hydraulic Cements

ASTM C 618 (2008a) Standard Specification for Coal
Fly Ash and Raw or Calcined Natural
Pozzolan for Use in Concrete

ASTM C 989 (2009) Standard Specification for Ground
Granulated Blast-Furnace Slag for Use in
Concrete and Mortars

ASTM D 312 (2000; R 2006) Standard Specification for

Asphalt Used in Roofing

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS UU-B-790

(Rev A) Building Paper, Vegetable Fiber:
(Kraft, Waterproofed, Water Repellent and
Fire Resistant)

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. Submittals should be kept to the minimum required for adequate quality control.

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

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

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

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

SD-02 Shop Drawings

Submit [Fabrication Drawings](#) and [Installation Drawings](#) for the following items in accordance with paragraph entitled, "Drawings," of this section.

[Precast Concrete Roof Slabs](#)
[Cast-in-Place Curb Units](#)

SD-03 Product Data

Submit manufacturer's catalog data for the following, including all accessories including nails, threaded fasteners, and joint sealing compounds for the following items:

Precast Concrete Roof Slabs

Precast Curb Units

Packaged Concrete Materials

Absorption Cover

Moisture-Retaining Cover

SD-05 Design Data

Design analysis and calculations must be in accordance with the paragraph entitled, "Precast Concrete Roof Slabs," of this section.

SD-06 Test Reports

Test Reports for the following must be in accordance with paragraph entitled, "Precast Concrete Roof Slabs," of this section.

Nail Driving and Nail Pulling Tests
Strength Tests

SD-07 Certificates

Submit certificates of compliance for the following items showing conformance with referenced standards contained in this section.

Precast Concrete Roof Slabs

Precast Curb Units

Clips and Nails

Threaded Fasteners

Cement Grout Joint Sealing Materials

Bituminous Joint Sealing Materials

SD-08 Manufacturer's Instructions

Submit Installation Instructions in accordance with paragraph entitled, "Precast Concrete Roof Slabs," of this section.

1.3 DRAWINGS

Fabrication Drawings for precast concrete deck units must show dimensions, and size and number of openings to be cut.

Installation Drawings for Precast Concrete Roof Slabs and Cast-in-Place Curb Units must include details and layouts indicating structural framing,

location and length of concrete slabs corresponding with the sequence and procedure to be followed in placing and fastening roof slabs, and location and type of fasteners. Drawings must also show details of curb units indicating location of cants, crickets, drainage saddles, and other sloping surfaces.

PART 2 PRODUCTS

2.1 MATERIALS

NOTE: Precast-concrete roof-slab dimensions must be indicated.

2.1.1 Precast Concrete Roof Slabs

NOTE: Delete the following paragraphs when channel roof slabs are required.

Provide [Installation Instructions](#) that indicate the manufacturer's recommended installation methods and sequence.

[Test Reports](#) for precast concrete roof slabs regarding [Nail Driving and Nail Pulling Tests](#) and [Strength Tests](#) must be in accordance with [ACI C-21](#).

Roof slabs must be flat or plank-shape and conform to [ACI C-21](#), Type I or Type II, with the following modifications:

Flat slabs must have wire mesh reinforcing in both top and bottom of the slab.

Slabs must have nailing edges.

NOTE: Delete one of the following two paragraphs as applicable to the project. When spacing of the structural framing members is less than 1.5 meter 5 feet, delete the first of the following paragraphs. When spacing of the structural framing members exceeds 1.5 meter 5 feet, delete the second of the following paragraphs.

Flat slabs must have tongue-and-groove edges on sides and square edges on ends, except that edges for exposed roof sides must be square.

Flat slabs must have tongue-and-groove edges on sides and ends, except that edges for exposed roof sides and ends must be square.

NOTE: Delete the following paragraphs when flat or plank roof slabs are required.

Precast Concrete Roof Slabs must be channel-shaped and conform to [ACI C-21](#), Type I or Type II, with the following modifications:

Reinforce channel slabs with steel-wire mesh in the web section and one 12.7 millimeter No. 4 steel reinforcing bar in each flange.

Slabs must have nailing edges.

NOTE: The following paragraph applies to both flat and channel roof slabs.

Roof slabs not suitable for nailing must have wood inserts. Pressure treat wood using a water-borne preservative and attain the minimum net retention of the solid preservative for lumber to be used in protected locations, in accordance with **AWPA BOOK**. Inserts must be at least 25 by 75 millimeter 1 by 3 inches in section, placed in rows on 600 millimeter 24 inches on center, and parallel with the roof slope. Inserts must be set flush with surfaces of slabs and rigidly secured in place with anchors designed and spaced to provide the holding strength required for subsequent nailing of roofing.

2.2 PRECAST CURB UNITS

NOTE: Delete paragraph heading and the following paragraph when precast curb units, such as curbs for vents, skylights, and other units not in the same plane as the roof decking, are not required.

Curb units must be of same material and reinforced for same strength requirements as precast concrete roof slabs. Design precast curb units to fit securely in the anchorage provided by structural framing members.

2.3 CLIPS AND NAILS

Clips must be zinc- or cadmium-plated steel strip not less than 0.76 millimeter 0.0299-inch thick (manufacturer's standard 0.76 millimeter) 22-gage, formed to fit the top flange of steel beam purlins or steel joists having steel angle top chords, and of design recommended by the precast concrete roof slab manufacturer.

Nails must be 32 millimeter 1-1/4-inches long, galvanized steel, roofing nails conforming to **ASTM C 514**, Type II, Style 20.

2.4 THREADED FASTENERS

Fasteners must consist of machine screws, nuts, and washers.

Machine screws must be slotted, flathead, galvanized, carbon steel conforming to **ASME B18.6.7M ASME B18.6.3**, Type I, Style 2s.

Nuts must be hexagon, galvanized, carbon steel conforming to **ASME B18.2.4.1M ASME B18.2.2**, Type II, Style 10.

Washers must be round-type, galvanized, carbon steel, general-purpose assembly washers conforming to **ANSI B18.22M ANSI B18.22.1**, Type A, Grade I, Class A.

2.5 CEMENT GROUT JOINT SEALING MATERIALS

[Blended hydraulic cement must conform to ASTM C 595, Type [____].]

[Portland cement must conform to ASTM C 150, Type I.]

Aggregate for cement grout must be clean, sharp, uniformly graded, natural or manufactured sand conforming to ASTM C 33/C 33M.

2.6 BITUMINOUS JOINT SEALING MATERIALS

Provide bituminous cement that is steep asphalt for use in constructing built-up roof coverings conforming to ASTM D 312, Type IV.

Compose joint-sealing tape of two layers of uncreped kraft paper united by steep asphalt with approximately 13 by 8 millimeter 1/2- by 1/3-inch glass-fiber reinforcement embedded in the asphalt laminate. Tape must meet requirements of FS UU-B-790, Type I, Grade C, Style 4, with the following modifications:

Width must be 150 millimeter 6 inches.

Dry tensile strength cannot be less than 35 pounds per inch width, both directions.

Dry tensile strength cannot be less than 6150 newton per meter width, both directions.

2.7 PACKAGED CONCRETE MATERIALS

Concrete materials must be packaged, dry, combined materials for concrete conforming to ASTM C 387/C 387M, lightweight concrete (using natural sand), and have the following properties:

<u>PROPERTY</u>	<u>VALUE</u>
Compressive strength at 28 calendar days	Not less than 20 Megapascal
Maximum aggregate size	9.5 millimeter
Slump	Not more than 75 millimeter
Total air content by volume	Not less than 6 nor more than 10 percent

<u>PROPERTY</u>	<u>VALUE</u>
Compressive strength at 28 calendar days	Not less than 3,000 psi
Maximum aggregate size	3/8 inch
Slump	Not more than 3 inches
Total air content by volume	Not less than 6 nor more than 10 percent

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

[Materials used as ingredients must include: [Blended hydraulic cement conforming to **ASTM C 595**] [Fly ash conforming to **ASTM C 618**, Class C or F] [Ground granulated blast furnace slag conforming to **ASTM C 989**, [Grade 120.]]]

2.8 WATER FOR MIXING CEMENT GROUT AND CONCRETE

Water must be potable.

2.9 CONCRETE CURING MATERIALS

Absorption Cover for curing concrete must be burlap cloth made from jute or kenaf, conforming to **AASHTO M 182**, Class 3.

Moisture-Retaining Cover for curing concrete must be white waterproof paper or white opaque polyethylene sheet conforming to **ASTM C 171**.

PART 3 EXECUTION

3.1 GENERAL

Install precast roof slabs and accessories in accordance with the approved drawings and as specified.

3.2 PLACING ROOF SLABS

Supporting walls, purlins or joists, and other supporting members must be in place before the placing of precast roof slabs is started. Do not place roof slabs during, or while there is a threat of, rain or snow.

Place each roof slab on structural framework to bear on at least two structural framing members. End bearing must be not less than **50 millimeter. 2 inches**. Ends of roof slabs having square edges must occur over a structural framing member. Where installation requires cutting roof slabs, cut ends must occur over supports at the wall or at openings. Cut roof slabs as specified.

NOTE: Delete following paragraph when the spacing

of the structural framing members exceeds 1.5 meter
5 feet, or when flat slabs having tongue-and-groove
edge on ends are not required.

Ends of roof slabs having tongue-and-groove edges on ends do not need to occur over a structural framing member; stagger such end joints in adjacent rows.

Align roof slabs in each row end to end, and adjacent rows parallel. Alignment does not depend on adjacent walls or structural framing members being accurately square.

3.3 FASTENING ROOF SLABS

Fasten roof slabs to each structural framework member by means of clips and nails. Where possible, alternate clips in position so that each clip is facing in the opposite direction of the next clip. Secure clips to roof slabs with one nail per clip and fit to the top flange or chord of structural framework member by slots in the clips formed for this purpose.

When the roof slope is greater than a 1 to 4 ratio, fasten roof slabs to supporting members by threaded fasteners in addition to the clips specified. Threaded Fasteners must be not less than 13 millimeter 1/2 inch in diameter. Fastener heads must be countersunk. Attach fasteners to the top flange or chord of supporting members by means of offset clips or other approved method. Threaded fasteners must not be less than one fastener per 3 square meter 30 square feet of roof area.

3.4 CUTTING AND FITTING

NOTE: Openings in precast roof slabs larger than
one-half the roof slab width in any dimension must
be framed with supporting members that are provided
as a part of the roof framing system.

Perform roof slab cutting and fitting as required for passage of other work projecting through or adjacent to the roof decking. Cuts must be straight and clean through roof slabs and at 90 degrees to severed surfaces without breaking, spalling, or appreciable crumbling at edges.

3.5 SEALING JOINTS

After roof slabs have been placed and fastened, seal the top portion of joints as specified.

Fill joints at ridges and hips and tongue-and-groove joints with cement grout. Cement grout must consist of portland cement, sand, and water mixed to the consistency of thick cream. Place grout so as to be even with the top surface of roof slabs. Remove excess grout and give grout surface a smooth finish.

Seal other joints with specified bituminous joint sealing materials. Center joint sealing tape over the joint and embedded in hot bituminous cement applied at the rate of 6 to 8 kilogram per 10 square meter 15 to 20 pounds per 100 square feet of joint sealing tape. End laps must not be less than 100 millimeter 4 inches. Remove excess bitumen and the joint

sealing tape surface must be smooth and free of wrinkles.

3.6 INSTALLATION OF PRECAST CURB UNITS

**NOTE: Delete paragraph heading and following
paragraph when precast curb units are not required.**

Install precast curb units in accordance with approved drawings.

3.7 FILL FOR SLOPING SURFACES

Fill for curb cants and other sloping surfaces must consist of the specified packaged concrete materials mixed with water.

Mix concrete either manually or by mechanical mixer, using the quantity of water indicated on packaged concrete materials. Accurately measure water used in manual mixing. Equip mechanical mixer with a device to measure and control the amount of water used. Mixer drums, mixing boxes, tools, and other mixing equipment must be kept clean and free from hardened lumps of concrete.

Handle concrete mixture from the point of mixing and transferred to concrete conveying equipment and to locations of final deposit as rapidly as possible by methods that will prevent segregation and loss of concrete mix materials. Mechanical equipment for conveying concrete mixtures must be of such size and design as to ensure a uniform, continuous flow of concrete mixture at the delivery end. Inner surfaces of concrete conveying equipment must be maintained free of hardened concrete, debris, water, snow, ice, and other deleterious materials.

Place and screed concrete mixture in a continuous operation until placing a section is completed. Finished surface must be free of humps or hollows; sloped to drains; uniform, smooth, even plane; and of granular texture.

Immediately following the concrete finishing operation, concrete must be kept continuously moist for at least 72 hours by covering the concrete surface with a specified absorptive cover for curing concrete kept continuously wet, by covering concrete surface with a specified moisture-retaining cover for curing concrete, or by a combination of both curing methods.

During the concrete curing period, protect concrete from damage caused by rain or running water, by excessively cold or hot temperatures, and from damaging mechanical disturbances.

3.8 COLD-WEATHER LIMITATIONS

Sealing joints and concrete mixing or placing must not be performed when the ambient temperature is 5 degrees C 40 degrees F or below.

3.9 CLEANING AND PROTECTION

Upon completion of roof decking work, sweep roof surfaces clean of debris and other foreign matter and left ready to receive roofing.

Protect finished roof decking from damage by weather and construction operations until the start of installation of roofing.

-- End of Section --