
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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SECTION 03435

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06/04

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SECTION 03435

PRECAST CONCRETE DECK
06/04

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers flat-shaped or channel-shaped roof slabs placed over purlins or joists spaced not more than 8 feet 2.5 meter 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 8 feet 2.5 meter are specified in Section 03413, "Structural Precast, Pretensioned Concrete Plant-Cast."

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 05120, "Structural Steel."

An open-web steel joist roof framing system is specified in Section 05210, "Steel Joists."

Wood fiber cant strips are specified in Section 07510, "Built-Up Bituminous Roofing."

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.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

The publications listed below form a part of this section to the extent referenced:

ACI INTERNATIONAL (ACI)

ACI COMP 21 (1993) Elevated Slabs

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182 (1991; R 2000) Burlap Cloth Made from Jute or Kenaf

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1 (1975; R 1998) Plain Washers

ANSI B18.22M (1981; R 2000) Metric Plain Washers

ASME INTERNATIONAL (ASME)

ASME B18.2.2 (1987; R 1999) Square and Hex Nuts

ASME B18.2.4M (1979; Rev 1989) Metric Hex Nuts

ASME B18.6.3 (1998) Machine Screws and Machine Screw Nuts

ASME B18.6.7M (2000) Metric Machine Screws

ASTM INTERNATIONAL (ASTM)

ASTM C 150 (2002ae1) Standard Specification for Portland Cement

ASTM C 171 (2003) Standard Specification for Sheet Materials for Curing Concrete

ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 387	(2000e1) Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete
ASTM C 514	(2001) Standard Specification for Nails for the Application of Gypsum Board
ASTM C 595	(2003) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2003) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 989	(2004) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 312	(2000) Standard Specification for Asphalt Used in Roofing

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-W-571	(Rev J) Wood Preservation: Treating Practices
FS UU-B-790	(1992) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330, "Submittal Procedures," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings and Installation Drawings shall be submitted 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

Manufacturer's catalog data shall be submitted 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 shall be in accordance with the paragraph entitled, "Precast Concrete Roof Slabs," of this section.

SD-06 Test Reports

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

Nail Driving and Nail Pulling Tests
Strength Tests

SD-07 Certificates

Certificates of compliance shall be submitted 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

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

1.3 DRAWINGS

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

Installation Drawings for Precast Concrete Roof Slabs and Cast-in-Place Curb Units shall 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 shall 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.

Installation Instructions shall 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 shall be in accordance with ACI COMP 21.

Roof slabs shall be flat or plank-shape and shall conform to ACI COMP 21, Type I or Type II, with the following modifications:

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

Slabs shall 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 5 feet 1.5 meter, delete the first of the following paragraphs. When spacing of the structural framing members exceeds 5 feet 1.5 meter, delete the second of the following paragraphs.

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

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

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

Precast Concrete Roof Slabs shall be channel-shaped and shall conform to ACI COMP 21, Type I or Type II, with the following modifications:

Channel slabs shall be reinforced with steel-wire mesh in the web section and one No. 4 12.7 millimeter steel reinforcing bar in each flange.

Slabs shall have nailing edges.

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

Roof slabs not suitable for nailing shall have wood inserts. Wood shall be pressure treated 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 FS TT-W-571. Inserts shall be at least 1 by 3 inches 25 by 75 millimeter in section, shall be placed in rows on 24 inches 600 millimeter on center, and shall be parallel with the roof slope. Inserts shall 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 shall be of same material and reinforced for same strength requirements as precast concrete roof slabs. Precast curb units shall be designed to fit securely in the anchorage provided by structural framing members.

2.3 CLIPS AND NAILS

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

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

2.4 THREADED FASTENERS

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

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

Nuts shall be hexagon, galvanized, carbon steel conforming to ASME B18.2.2 ASME B18.2.4M, Type II, Style 10.

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

2.5 CEMENT GROUT JOINT SEALING MATERIALS

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

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

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

2.6 BITUMINOUS JOINT SEALING MATERIALS

Bituminous cement shall be steep asphalt for use in constructing built-up roof coverings conforming to ASTM D 312, Type IV.

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

Width shall be 6 inches 150 millimeter.

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

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

2.7 PACKAGED CONCRETE MATERIALS

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

<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
<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

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 shall 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 shall be potable.

2.9 CONCRETE CURING MATERIALS

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

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

PART 3 EXECUTION

3.1 GENERAL

Precast roof slabs and accessories shall be installed in accordance with the approved drawings and as specified.

3.2 PLACING ROOF SLABS

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

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

NOTE: Delete following paragraph when the spacing of the structural framing members exceeds 5 feet 1.5 meter, 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; such end joints in adjacent rows shall be staggered.

Roof slabs in each row shall be aligned end to end, and adjacent rows shall be parallel. Alignment shall not depend on adjacent walls or structural framing members being accurately square.

3.3 FASTENING ROOF SLABS

Roof slabs shall be fastened to each structural framework member by means of clips and nails. Where possible, clips shall alternate in position so that each clip is facing in the opposite direction of the next clip. Clips shall be secured to roof slabs with one nail per clip and shall be fitted 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, roof slabs shall be fastened to supporting members by threaded fasteners in addition to the clips specified. Threaded Fasteners shall be not less than 1/2 inch 13 millimeter in diameter. Fastener heads shall be countersunk. Fasteners shall be attached to the top flange or chord of supporting members by means of offset clips or other approved method. Threaded fasteners shall be spaced not less than one fastener per 30 square feet 3 square meter 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.

Roof slab cutting and fitting shall be performed as required for passage of other work projecting through or adjacent to the roof decking. Cuts shall 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, the top portion of joints shall be sealed as specified.

Joints at ridges and hips and tongue-and-groove joints shall be filled with cement grout. Cement grout shall consist of portland cement, sand, and water mixed to the consistency of thick cream. Grout shall be placed so as to be even with the top surface of roof slabs. Excess grout shall be removed and grout surface shall be given a smooth finish.

Other joints shall be sealed with specified bituminous joint sealing materials. Joint sealing tape shall be centered over the joint and

embedded in hot bituminous cement applied at the rate of 15 to 20 pounds per 100 square feet 6 to 8 kilogram per 10 square meter of joint sealing tape. End laps shall be not less than 4 inches 100 millimeter. Excess bitumen shall be removed and the joint sealing tape surface shall 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.

Precast curb units shall be installed in accordance with approved drawings.

3.7 FILL FOR SLOPING SURFACES

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

Concrete shall be mixed either manually or by mechanical mixer, using the quantity of water indicated on packaged concrete materials. Water used in manual mixing shall be accurately measured. Mechanical mixer shall be equipped with a device to measure and control the amount of water used. Mixer drums, mixing boxes, tools, and other mixing equipment shall be kept clean and free from hardened lumps of concrete.

Concrete mixture shall be handled 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 shall 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 shall be maintained free of hardened concrete, debris, water, snow, ice, and other deleterious materials.

Concrete mixture shall be placed and screeded in a continuous operation until placing a section is completed. Finished surface shall be free of humps or hollows; sloped to drains; uniform, smooth, even plane; and of granular texture.

Immediately following the concrete finishing operation, concrete shall 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, concrete shall be protected 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 shall not be performed when the ambient temperature is 40 degrees F 5 degrees C or below.

3.9 CLEANING AND PROTECTION

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

Finished roof decking shall be protected from damage by weather and construction operations until the start of installation of roofing.

-- End of Section --