Preparing Activity: USACE Superseding
UFGS-03 51 00 (October 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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USACE / NAVFAC / AFCEC / NASA **UFGS-03 52 16 (April 2008)**

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SECTION 03 52 16

LIGHTWEIGHT INSULATING CONCRETE
04/08

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NOTE: This guide specification covers the requirements for low density cast-in-place concrete roof decking.

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).
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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 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 IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE FUN IP	(2021) Fundamentals Handbook, I-P Edition
ASHRAE FUN SI	(2021) Fundamentals Handbook, SI Edition

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1064/A1064M	(2022) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C150/C150M	(2022) Standard Specification for Portland Cement
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C332	(2017) Standard Specification for Lightweight Aggregates for Insulating Concrete
ASTM C495/C495M	(2012; R 2019) Standard Test Method for Compressive Strength of Lightweight Insulating Concrete
ASTM C578	(2022) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C595/C595M	(2021) Standard Specification for Blended

	Hydraulic Cements
ASTM C796/C796M	(2012) Standard Test Method for Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam
ASTM C869/C869M	(2011; R 2016) Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete

1.2 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification 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

Low Density Roof Systems; G[, [_____]]

SD-06 Test Reports

Design Mix

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

Provide the services of a firm experienced in the installation of cast-in-place low density roof systems. Supervise the mixing, transporting, placing, finishing, and testing of the low density concrete. Submit drawings indicating shop and erection details for form systems proposed to be used. Show on the drawings cuts, vent holes, cut-outs for other trades, connections, and welds. Indicate welds in accordance with AWS A2.4.

2.1.1 Concrete

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NOTE: Oven-dry unit weight of low density concrete should not exceed 800 kg/cubic meter 50 pcf; nor should the compressive strength exceed 3100 kPa 450 psi. Insulation value decreases with high unit weights. Unit weight of 400 kg/cubic meter 25 pcf with a minimum compressive strength of 862 kPa 125 psi will normally be specified. Manufacture of this type of concrete is specialized and manufacturer's data should be relied on to establish mixture proportions. See ACI 523.1R for additional information.
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Establish the strength qualities of the low density concrete proposed for use from manufacturer's submitted data prior to the beginning of construction operations. Perform the preparation of the design mix and subsequent testing through an approved testing laboratory capable of performing such services or, if approved, by the manufacturer of the low density concrete. Prepare trial design batches with the same materials proposed for use in the work. Make and test Test Cylinders in accordance with ASTM C495/C495M for perlite and vermiculite concrete and ASTM C796/C796M for cellular concrete. Proportion low density concrete for a minimum oven-dry unit weight of [400] [_____] kg/cubic meter [25] [_____] pcf and the minimum average compressive strengths at 28 days of [862] [_____] kPa [125] [_____] psi. Submit certified copies of the design mix report for low density concrete indicating mixture proportions, average compressive strength in MPa psi, and wet unit weight at point of placement for the type proposed for the project. Make allowances for any unit weight changes resulting from handling and placing methods.

2.1.2 Required U-Value

The actual average installed thickness of concrete, forms, and insulation, if used, must be sufficient to provide a coefficient of heat transmission, or U-value, based on winter conditions, through the affected construction, not in excess of [_____] W per square meter, per degree K Btu per hour, per square foot, per degree F temperature difference, when determined in accordance with recognized methods set forth in the ASHRAE FUN SI ASHRAE FUN IP. Determine the U-value from inside air to outside air.

2.1.3 Steel Forms

Design steel forms in conformance to AISI SG03-3. Design units for attachment to the structural supports by welding or by a special system of clips as recommended by the manufacturer. Deflection of the steel forms under the design live load indicated exceeding 1/240 of the clear span is unacceptable.

2.2 MATERIALS

2.2.1 Admixtures

Provide air-entraining admixtures conforming to ASTM C260/C260M. Do not use admixtures containing chloride ions.

2.2.2 Aggregate

Provide light weight aggregate free of asbestos and conforming to ASTM C332, Group I.

2.2.3 Foaming Agent

Provide foaming agents, for making cellular concrete, conforming to ASTM C869/C869M.

2.2.4 Cementitious Material

Provide portland cement conforming to ASTM C150/C150M, Type I, III; or ASTM C595/C595M, Type IS.

2.2.5 Wire Reinforcement

Provide reinforcement consisting of either wire mesh or welded wire fabric. Mesh must be 50 mm 2 inch hexagonal, woven from 19 gauge 19 gauge steel wire and reinforced with 16 gauge 16 gauge longitudinal steel wire spaced on 75 mm 3 inch maximum centers. Wires forming common sides of mesh spaces that are adjacent to longitudinal wires must be woven around longitudinal wires. Wire must be galvanized conforming to ASTM A1064/A1064M. Welded wire fabric must conform to ASTM A1064/A1064M, galvanized, 12 gauge 12 gauge longitudinal wires spaced on 100 mm 4 inch maximum centers with 14 gauge 14 gauge transverse wires spaced on 200 mm 8 inch maximum centers.

2.2.6 Steel Forms

Provide forms that are galvanized corrugated steel conforming to ASTM A653/A653M, Grade A or E, with coating Class G 90. Provide forms with side lap venting clips, formed in side lap vents, or vent slots in the corrugation. Vent area must be at least 700 square mm per square m 0.10 square inch per square foot of roof deck area.

2.2.7 Rigid Insulation

Provide insulation conforming to ASTM C578, Type as recommended by the manufacturer.

2.2.8 Expansion Joint Materials

Provide expansion joint material that is compressible up to at least 50 percent under 172 kPa 25 psi of pressure, weather resistant, and compatible with the roofing system used.

2.3 MIXING PROCEDURE

Mechanically mix concrete ingredients to produce low density concrete of uniform consistency and a wet unit weight at point of placement required to obtain the compressive strength specified. Mix and transport concrete in accordance with the low density concrete material manufacturer's recommendation.

PART 3 EXECUTION

3.1 FORMWORK

Attach forms to structural members by plug welding or special clips furnished by the manufacturer. Weld or use clips in conformance with recommendations of the manufacturer. Place sheets with edge-corrugation lips pointing upward and do not lap less than one full corrugation. Locate end laps over permanent supports. Make end laps a minimum of 50 mm 2 inches. Vent as recommended by the manufacturer. Prior to placing low density concrete, remove welding flux, spatter and slag from areas of coating that have been damaged by welding or other operations. Clean loose rust and other foreign matter by wire brushing, and coat with zinc-rich paint.

3.2 WIRE REINFORCEMENT

Unroll and place wire reinforcement so that the long dimension is perpendicular with the corrugation in the steel forms. Locate reinforcement approximately in the center of the lower one-third of the slab in which it is placed, and provide a 19 mm 3/4 inch minimum cover for reinforcement.

3.3 LOW DENSITY CONCRETE CONVEYING AND PLACEMENT

Convey low density concrete from the mixer to place of deposit by methods that will prevent segregation and loss of material. Use equipment for conveying concrete of such size and design to ensure uniform, continuous placement of concrete. Deposit and screed low density concrete in a continuous operation until the placing of a panel or section is completed. Do not use rodding, tamping, vibrating, or steel troweling. Use temporary runways during placement. The actual thickness of the roof system must be that required to obtain the U-value specified; however, the minimum thickness of the top-most layer of low-density concrete must not be less than 50 mm 2 inches. If used to obtain the required U-value, encapsulate rigid insulation in low density concrete as recommended by the manufacturer.

3.4 EXPANSION JOINTS

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NOTE: Expansion joints will be as required by normal building design and construction. Perlite systems require expansion joints at all intersections with vertical surfaces except where

designed as diaphragms in seismic design. Use 40 mm 1-1/2 inch joints when roof exceeds 30 m 100 feet in length.
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Locate expansion joints as indicated. In addition, where perlite aggregate is used, install [25] [40] mm [1] [1-1/2] inch expansion joints at junctions of roof and vertical surfaces. Extend joints the full depth of the roof system.

3.5 COLD WEATHER PLACEMENT

Provide reinforcement, forms, fillers, and other materials that will come in contact with the low density mixture that are free of frost, snow, or ice. Do not place low density concrete at temperatures below 4 degrees C 40 degrees F or when temperatures are predicted to fall below 4 degrees C 40 degrees F during placement, unless precautions recommended by the manufacturer are employed and such placement is approved.

3.6 CURING

Cure low density concrete in accordance with the manufacturer's recommendation. Commence curing operations at initial set of the concrete. After curing, allow surfaces to dry to permit subsequent application of roofing system, as determined by installation firm.

3.7 FIELD-CONTROL TESTS

Provide field-control tests performed by an approved commercial testing laboratory and consisting of wet-density at time of placement and compressive strength tests. If the specimens tested fail to meet the compressive-strength requirements, remove and replace the portion of roof decking represented by the specimens.

3.7.1 Wet-Density Tests

Make wet-density tests as required, but no less than twice during each day's pour. Take samples for wet-density tests at the point of placement. A variation in excess of 5 percent under the laboratory-established design of wet density, after discharge at point of placement, requires a modification of mix proportions or changes in mixing procedure, or both.

3.7.2 Compressive Strength Tests

Prepare and test cylinders in accordance with ASTM C495/C495M, or ASTM C796/C796M as applicable, except obtain samples at the point of placement. Take samples at least once a day and for each 60 cubic meters 75 cubic yards of low density concrete placed. Properly identify the area of roof decking represented by the sample. One sample will be sufficient to make at least four cylinders.

3.8 CLEANING AND PROTECTION

Upon completion of the roof deck, sweep the roof surfaces clean of debris leaving it ready to receive the roofing. Protect the finished deck from damage by weather and construction operations prior to installation of roofing.

-- End of Section --