
USACE / NAVFAC / AFCEC UFGS-07 32 13 (April 2006)

Preparing Activity: NAVFAC

Replacing without change
UFGS-07320 (June 2005)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2025

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ROOF TILES
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NOTE: This guide specification covers the requirements for clay and concrete roofing tiles and underlayments.

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).

NOTE: "The NRCA Steep Roofing Manual," National Roofing Contractors Association, 6250 River Road, Rosemont, IL 60018, may be consulted by the designer for a more detailed description of the tile roofing installation.

NOTE: On the drawings, show:

1. Pitch of substrate/tile roofing.
2. Roof edge, rake, ridge, valley, and intersections with vertical surfaces.

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.

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 WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1 (2003) All Timber Products - Preservative Treatment by Pressure Processes

ASTM INTERNATIONAL (ASTM)

ASTM C67/C67M (2024) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile

ASTM C270 (2025) Standard Specification for Mortar for Unit Masonry

ASTM C1167 (2022) Standard Specification for Clay Roof Tiles

ASTM C1177/C1177M (2024) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing

ASTM D226/D226M (2017) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

ASTM D412 (2016; R 2021) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D4586/D4586M (2007; R 2018) Standard Specification for Asphalt Roof Cement, Asbestos-Free

ASTM E84 (2024) Standard Test Method for Surface
Burning Characteristics of Building
Materials

ASTM E108 (2025) Standard Test Methods for Fire
Tests of Roof Coverings

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0437 (2017) The NRCA Roofing Manual:
Steep-slope Roof Systems

KOREAN INDUSTRIAL STANDARDS (KS)

KS F 3510 (2019; R 2024) Standard Specification for
Clay Roof Tiles

KS F 4029 (2018; R 2023) Standard Specification for
Pressed Cement Roof Tiles

KS F 4901 (2022) Asphalt Felts (Fiber Base,
Saturated Bitumen Felts)

KS L 5219 (2024) Masonry Cement

KS M 2201 (2021) Straight Asphalt

KS M ISO 7619-1 (2016; R 2021) Rubber, Vulcanized or
Thermoplastic - Determination of
Indentation Hardness - Part 1: Durometer
Method (Shore Hardness)

1.2 SUBMITTALS

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
and Air Force 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 and Air Force projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are 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

Clay Tile Roofing System

SD-03 Product Data

- [Clay Tile
-][Concrete Tile
-][Korean Roofing Tile
-][Korean Clay Roofing Tiles
-] Underlayment Membrane
- Flexible Hip and Ridge Flashing
- Glass Mesh Mortar Units
- Fiberglass-Faced Gypsum Roof Board

Submit data including tile properties , styles, and configurations.

SD-04 Samples

- [Manufacturer's color charts for Clay Tile; G
-][Manufacturer's color charts for Concrete Tile; G
-][Clay Tile; G
-][Concrete Tile; G
-] Submit an appropriate number of tiles for each type to illustrate the full range of colors and surface finish.

SD-06 Test Reports

Self-Adhering Membrane Underlayment

Glass Mesh Mortar Units

Fiberglass-Faced Gypsum Roof Board

Preservative-Treated lumber

SD-07 Certificates

Qualifications of roofing personnel

SD-08 Manufacturer's Instructions

Installation

1.3 DELIVERY AND STORAGE

Deliver materials in the manufacturer's unopened bundles and containers bearing the manufacturer's brand name. Keep materials dry, completely covered, and protected from the weather. Store according to manufacturer's written instructions.

1.4 WARRANTIES

1.4.1 Contractor's Warranty

The Contractor shall warrant for 5 years that the tile roofing system, as installed, is free from defects in workmanship. When repairs due to defective workmanship are required during the Contractor's warranty period, the Contractor shall make such repairs within 72 hours of notification. When repairs are not performed within the specified time, emergency repairs performed by others will not void the warranty.

1.5 COORDINATION

Coordinate with the installation of flashing and gutters provided under Section 07 60 00 FLASHING AND SHEET METAL to ensure proper sequencing. Do not install roofing materials until vent stacks and other penetrations through roof deck have been installed.

1.6 EXTRA STOCK

Provide an extra two percent of each type and color of tile used in clean marked containers. In the extra stock provided, include hip, ridge, and other special shapes in the same proportion as used on the project.

1.7 QUALITY ASSURANCE

1.7.1 Qualifications of Roofing Personnel

Submit documentation showing qualifications of personnel proposed to perform the roofing work and a listing identifying prior installations completed by the Contractor.

1.7.2 Clay Tile Roofing System Drawings

Submit drawings showing clay tile roofing installation and details for appearance, flashing and fastening of tiles.

PART 2 PRODUCTS

2.1 MATERIALS

**NOTE: Roofing systems specified in this section
have a life expectancy in excess of 50 years.
Flashing materials should be selected with similar
life expectancy.**

[2.1.1 Clay Tile

ASTM C1167, Grade 1, Machine formed natural clay tiles, [One Piece "S" Mission] [Two Piece Spanish Mission consisting of a cover and pan tile] [Flat Bar Tile with interlocking edges], kiln-fired to vitrification and free from surface imperfections. Provide specially shaped, color-matched units as indicated or required, including hip and ridge covers, rake covers and [birdstops]. Provide with fastening holes preformed at factory prior to firing.

] [2.1.2 Concrete Tile

**NOTE: Use only concrete roof tiles with integral
color in areas where freeze/thaw cycles exceed 30
per year.**

ASTM C67/C67M, **ASTM E108**, Extruded, interlocking concrete roofing tile units, shapes as indicated, with [integral color] [color slurry coat on exposed surfaces]. Include specially shaped, color-matched units as indicated or required for ridges, rakes and hips. Provide with cast-in anchor lugs, transverse weather checks and fastening holes.

] [2.1.3 Existing Korean Tile

Intact and serviceable existing Korean tiles shall be salvaged and reused whenever possible. New tiles being incorporated into existing tile roofs shall match existing as closely as possible. Korean tiles from the same manufacturer as the original shall be used if possible.

] [2.1.4 Korean Roofing Tile

Korean roofing tile shall conform to **KS F 4029**. Tile shall be unglazed, color as indicated.

2.1.4.1 Composition

Cement tiles shall be composed by weight of 1 part portland cement to 2 parts aggregate, mixed with the minimum amount of water necessary to produce a workable mass, molded and pressed with a uniform pressure of not less than **50 kgf/cm²**. Coloring pigments shall not be harmful to metals which may come in contact with the cement tiles in the completed construction.

2.1.4.2 Curing

Before shipment, cement tiles shall be cured under room conditions of at least 5 degrees C and 70 percent relative humidity for not less than 10 days and then cured by wet cotton mats or burlap for not less than 10 days, or until such time that the required crushing strength has been obtained.

]2.1.5 Korean Clay Roofing Tiles and Accessories

Clay roofing tiles shall be standard commercial type and size, conforming to KS F 3510. Tiles showing cracks, chips or defacements will be rejected.

2.1.5.1 Composition

Korean clay tiles shall be composed of firm, fine-grained earth particles under 3 mm in size, mixed with the minimum amount of water necessary to produce a workable mass, molded and pressed with a uniform pressure of not less than 280 kgf. Coloring pigments shall not be harmful to metals which may come in contact with the clay tiles in the completed construction.

]2.2 UNDERLAYMENT MEMBRANE

NOTE: If a felt membrane is desired solely or in combination with the elastomeric self-adhering membrane, please select either the asphalt glass felt or asphalt-saturated felt component.

Provide underlayment membrane on surfaces that will be covered with tile. Membrane shall consist of asphalt-saturated felt or high strength composite self-adhering membrane.

2.2.1 Asphalt-Saturated Felt

Provide Type II, No. 30 asphalt felt in accordance with ASTM D226/D226M or KS F 4901.

2.2.2 Flexible Hip and Ridge Flashing

SBS modified rubberized asphalt adhesive on a lineal, low density polyethylene membrane with a 1.52 mm total thickness.

2.2.3 Self-Adhering Membrane Underlayment

ASTM D412 or KS M ISO 7619-1, high strength polyethylene-sheet-backed, rubberized asphalt membrane, 1.02 mm thickness.

2.2.4 Primer for Self-Adhering Membrane Underlayment

VOC compliant primer as recommended by membrane manufacturer for application on concrete substrates.

2.3 SUBSTRATE PANELS (FOR APPLICATION OVER STRUCTURAL METAL DECK)

NOTE: Choose one of the following substrate panels.

2.3.1 Glass Mesh Mortar Units

ASTM E84, exterior type panels consisting of portland cement, light weight aggregate, with vinyl-coated woven glass fiber mesh imbedded in both surfaces, 11 mm thickness by 900 mm width by 1200, 1500, 1800, or 2400 mm lengths.

2.3.2 Fiberglass-Faced Gypsum Roof Board

ASTM C1177/C1177M, non-structural, fiberglass faced, silicone treated core gypsum panels, 1200 by 2400 by 13 mm thickness.

2.4 FASTENERS

2.4.1 Nails For Applying Felt Underlayment

Hot dip galvanized steel, 2.9 mm thick, sharp pointed, conventional roofing nails with barbed shanks, minimum 9.5 mm diameter head, and of sufficient length to penetrate [19 mm into nailable concrete deck] [through plywood sheathing] [through substrate panels]. Verify that nails are compatible with flashing materials to prevent galvanic action.

2.4.2 Nails for Installation of Tile

Copper ring shank nails, 3.3 mm, with minimum 11 mm diameter head or 3.3 mm stainless steel ring shank nails with minimum 9.5 mm head and of sufficient length to penetrate 19 mm into [wood ridge and hip boards] [battens]. Verify that chemicals used in pressure treatment of ridge and hip boards are compatible with copper nails.

2.4.3 Twisted-Wire Tie System

NOTE: This paragraph is applicable for the
installation of clay tile on roofs with slopes in
excess of 12:12.

Continuously twisted 3.3 mm [copper][brass] [2.5 mm galvanized steel] wire with loops formed at 150 mm on center and with tie wires of 1.8 mm [copper] [brass] [1.5 mm galvanized steel] [9.4 mm diameter stainless steel] wire. Provide clips for anchorage of twisted-wire tie system to substrate as recommended by manufacturer.

2.4.4 Single-Line Wire Tie System

NOTE: This paragraph is applicable for the
installation of clay tile on roofs with slopes from
2:12 to 12:12.

[3.3 mm copper] [3.3 mm brass] [2.5 mm galvanized steel] [2.13 mm stainless steel] pre-formed wire ties with a hook on one end and a loop on the other end. Lengths as required for manufacturer's recommended exposure.

2.4.5 Wind Locks

**NOTE: This paragraph is applicable for the
installation of clay tiles for all slopes in high
wind areas as designated by local codes.**

[3.3 mm copper] [3.3 mm brass] [2.5 mm galvanized steel] [2.13 mm
diameter stainless steel] formed wire clips. Select material type as
recommended by manufacturer for specific locations.

2.4.6 Hurricane Clips

**NOTE: The following paragraph is applicable for the
installation of clay or concrete tiles for all
slopes in high wind areas as designated by local
codes.**

Tile edge clips fabricated from [1.2 mm brass] [1.05 mm galvanized
steel] [1.07 mm, type 302 stainless steel] strips, 13 mm wide. Provide
with two nail holes in horizontal leg for anchorage to deck [substrate].
Select material type as recommended by manufacturer for specific locations.

2.5 PRESERVATIVE-TREATED LUMBER

AWPA C1, provide treated ridge and hip boards, [eave starter strips and
battens].

[2.6 SHEET METAL BIRDSTOP FOR CONCRETE TILE

Formed 0.5 mm galvanized steel "L" section with 75 mm wide horizontal leg
and vertical leg cut to conform with bottom profile of tile. Provide
pre-finished to match tile color with drain holes punched in vertical leg
prior to application of finish.

]2.7 MORTAR

ASTM C270 or KS L 5219, Proportion specification for Type M mortar mix.

2.8 ASPHALT PLASTIC CEMENT

ASTM D4586/D4586M, Type I or KS M 2201.

PART 3 EXECUTION

3.1 EXAMINATION

Examine structural roof deck for compliance with requirements of selected
system. Verify that roof penetrations and openings are installed in their
proper location.

3.2 PREPARATION

3.2.1 Cleaning

Clean structural deck surfaces to receive substrate panels or underlayment.

3.3 INSTALLATION

Comply with manufacturer's installation instructions and recommendations, but not less than recommended by **NRCA 0437**. Comply with local building code requirements for special fastening requirements such as wind locks and hurricane clips in high wind areas.

3.3.1 Substrate Panels

Install [glass mesh mortar units] [fiberglass-faced gypsum roof boards] over corrugated metal structural deck as recommended by panel manufacturer.

3.3.2 Felt Underlayment

NOTE: This paragraph is applicable for tile roof installations over concrete and wood roof decks with a slope of 4:12 or greater.

Apply one layer of felt underlayment horizontally over entire surface to receive roofing tile, lapping succeeding courses a minimum of **50 mm**, end laps a minimum of **150 mm**, and hips and valleys a minimum of **300 mm**. Fasten felt with sufficient number of roofing nails to hold underlayment in place until roofing tile installation. [Provide additional layer of felt underlayment when recommended by roof tile manufacturer].

3.3.3 Self-Adhering Membrane Underlayment

NOTE: This paragraph is applicable for tile roof installations over all substrates with slopes up to 4:12 or for any slope where high wind or freeze/thaw conditions exist.

Apply self-adhering membrane over [wood deck] [concrete deck] [substrate panels] in accordance with manufacturers recommendations. Provide manufacturer recommended primer for application on concrete surfaces.

3.3.4 Clay Roofing Tile Installation

Beginning at eaves, install roofing tiles as indicated and in accordance with recommendations of the tile manufacturer and fastening system manufacturer. Sawcut tiles at hips valleys and ridges. Cut tile at valleys to form a straight border. Taper valleys from a **50 mm** exposure on each side of valley at top and increase exposure **25 mm**, each side, per **2400 mm** of valley length. [Set ridge and hip tile in a full bed of mortar and strike mortar flush with face of cover tiles.] [Apply flexible hip and ridge flashing over ridge and hip boards and top edge of tile. Apply asphalt plastic cement at lap between tiles at hip and ridge.] Nail hip and ridge tiles to hip and ridge boards.

3.3.5 Batten Installation for Concrete Roofing Tile

Install **19 by 38 mm** treated wood battens with **13 mm** drain slots at **1200 mm** o.c. horizontally. At eave provide **38 by 38 mm** treated wood starter strip. [Provide sheet metal birdstops at eave for "S" Type mission tile.]

At metal structural decks, attach battens with self-tapping screws through substrate panels into metal deck.

3.3.6 Concrete Roofing Tile Installation

Beginning at eaves, install roofing tiles as indicated and in accordance with manufacturers recommendations. Hook mounting lugs over wood battens and nail through each tile into batten. Sawcut tiles at valleys to form a straight border. Taper valleys from a 50 mm exposure on each side of valley at the top and increase exposure by 25 mm, each side, per 2400 mm of valley length. [Set ridge and hip tile in a full bed of mortar and strike mortar flush with face of cover tile.] [Apply flexible hip and ridge flashing over ridge and hip boards and top edge of tile. Apply asphalt plastic cement between tiles at hip and ridge.] Nail hip and ridge tiles to hip and ridge boards.

3.3.7 CLEANING

Remove mortar and asphalt plastic cement spatter from exposed surfaces of tiles. Upon completion of work, remove excess materials and all refuse generated by the work of this section.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of English unit measurement, and not on metric measurement commonly agreed to by the manufacturers or other parties. The English and

metric units for the measurements shown are as follows:

<u>Products</u>	<u>English Units</u>	<u>Metric Units</u>
Nails - diameter	11 gage	2.9 mm
head diameter	3/8 inch	9.5 mm
Nails - diameter	10 gage	3.3 mm
head diameter	7/16 inch	11 mm
Wire	10 gage	3.3 mm
	12 gage	2.5 mm
	14 gage	1.8 mm
	0.037 inch	9.4 mm
	0.084 inch	2.13 mm
Edge Clips	18 gage	1.2 mm
	19 gage	1.05 mm
	0.042 inch	1.07 mm
	1/2 inch	13 mm
Birdstop	26 gage	0.5 mm

-- End of Section --