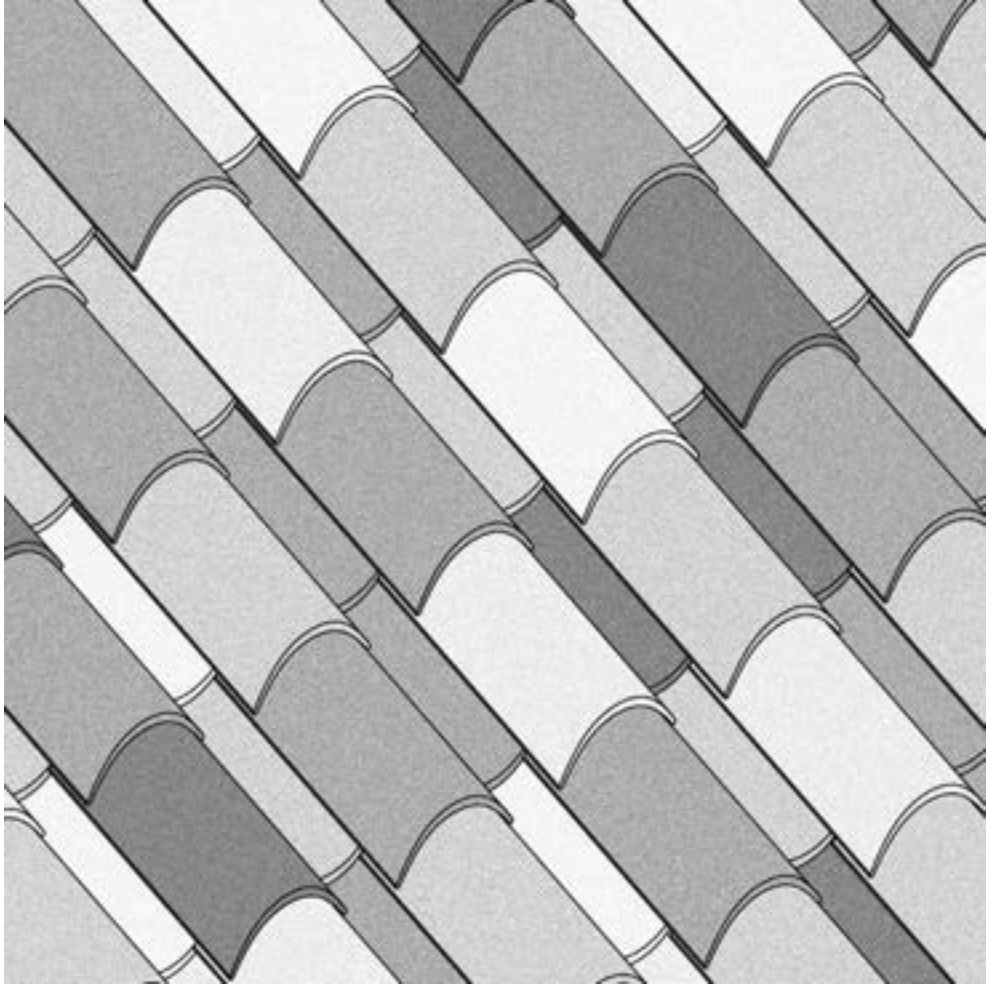


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**LUDOWICI<sup>®</sup>**



# **Barrel Tile Installation Manual**

[www.Ludowici.com](http://www.Ludowici.com)

## CLAY TILE ROOFING

has been in existence for over a millennium. In the last few decades, clay tile roof installation techniques have been refined to protect your project while retaining the aesthetic, “of the earth”, characteristics that make up the roof’s appeal. The purpose of this manual is to provide technical information and installation instructions for Ludowici clay tile. It is intended to serve as a guide for proper techniques for typical installations. Ludowici clay tile is a versatile roofing material and can be applied on complex, original designed roofs. Installers are encouraged to contact Ludowici representatives for any question not covered in this manual. Some techniques may vary from region to region and other sound installation techniques may also be acceptable.

A Ludowici roof installed today will last over 100 years, be sure that all other roof components and installation techniques are as durable.

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## Field Tile Physical Characteristics

Chart 4.1 Spanish and Scandia™ Field Tile Characteristics



**Spanish 13 1/4"**



**Spanish 18 3/8"**



**Scandia™**

	<b>Spanish 13 1/4"</b>	<b>Spanish 18 3/8"</b>	<b>Scandia™</b>
Weight/Square	900 lbs.	900 lbs.	900 lbs.
Pieces/Square	171	114	185
Overall Size	9 3/4" x 13 1/4"	9 3/4" x 18 3/8"	9 3/4" x 13 1/4"
Exposure	8 1/4" x 10 1/4"	8 1/4" x 15 3/8"	7 9/16" x 10 1/4"
Minimum Slope	4:12	4:12	4:12

Chart 4.2 Straight Barrel Mission Field Tile Characteristics



**14 1/4"**  
**Straight Barrel Mission**



**16"**  
**Straight Barrel Mission**



**18 3/8"**  
**Straight Barrel Mission**

	<b>14 1/4"</b> <b>Straight Barrel Mission</b>	<b>16"</b> <b>Straight Barrel Mission</b>	<b>18 3/8"</b> <b>Straight Barrel Mission</b>
Weight/Square	1,250 lbs.	1,190 lbs.	1,165 lbs.
Pieces/Square	225	192	163
Overall Size	8" x 14 1/4"	8" x 16"	8" x 18 3/8"
Exposure	P = 3 1/2" x 11 1/4" C = 8" x 11 1/4"	P = 3 1/2" x 13" C = 8" x 13"	P = 3 1/2" x 15 3/8" C = 8" x 15 3/8"
Center to Center	11 1/2"	11 1/2"	11 1/2"
Minimum Slope	5:12	5:12	5:12

## Field Tile Physical Characteristics

Chart 5.1 Tapered Barrel Mission Field Tile Characteristics



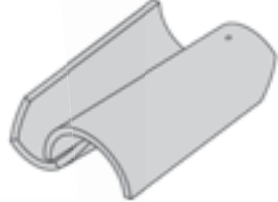


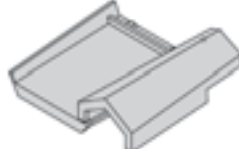

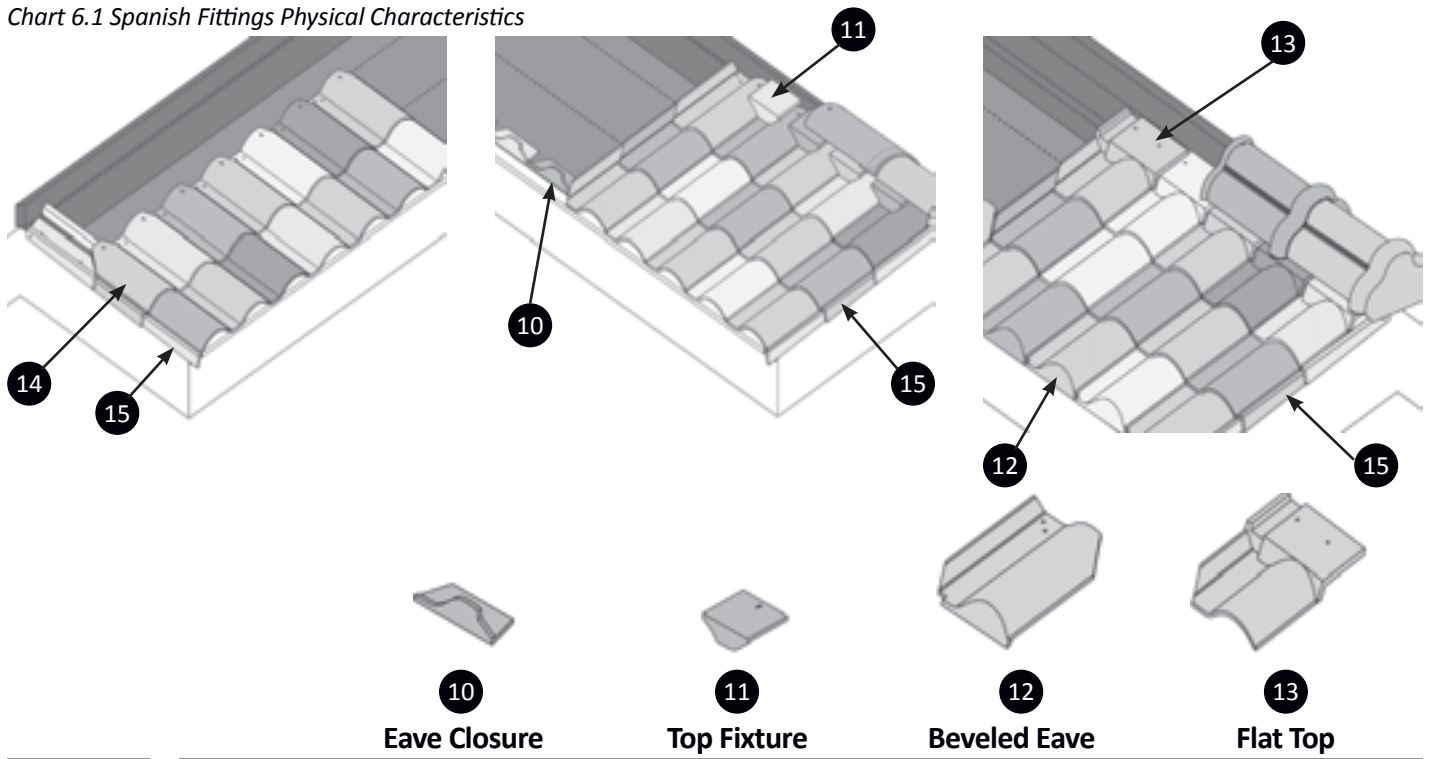
				
	<b>14 <sup>1/4</sup>" Tapered Barrel Mission</b>	<b>16" Tapered Barrel Mission</b>	<b>Cubana 18 <sup>3/8</sup>" Tapered Barrel Mission</b>	<b>18 <sup>3/8</sup>" Palm Beach Mission</b>
Weight/Square	1,345 lbs.	1,230 lbs.	1,200 lbs.	1,165 lbs.
Pieces/Square	270	212	163	163
Overall Size	P = 7" x 14 <sup>1/4</sup> " C = 7" x 14 <sup>1/4</sup> "	P = 8" x 16" C = 7" x 16"	P = 7" x 18 <sup>3/8</sup> " C = 7" x 18 <sup>3/8</sup> "	8" x 18 <sup>3/8</sup> "
Exposure	P = 3-1/2" x 11 <sup>1/4</sup> " C = 7" x 11 <sup>1/4</sup> "	P = 3 <sup>1/2</sup> " x 13" C = 7" x 13"	P = 4" x 15 <sup>3/8</sup> " C = 7" x 15 <sup>3/8</sup> "	P = 3 <sup>1/2</sup> " x 15 <sup>3/8</sup> " C = 8" x 15 <sup>3/8</sup> "
Center to Center	10 <sup>1/2</sup> "	10 <sup>1/2</sup> "	11"	11-1/2"
Minimum Slope	5:12	5:12	5:12	5:12

Chart 5.2 Special Profile Mission Field Tile Characteristics

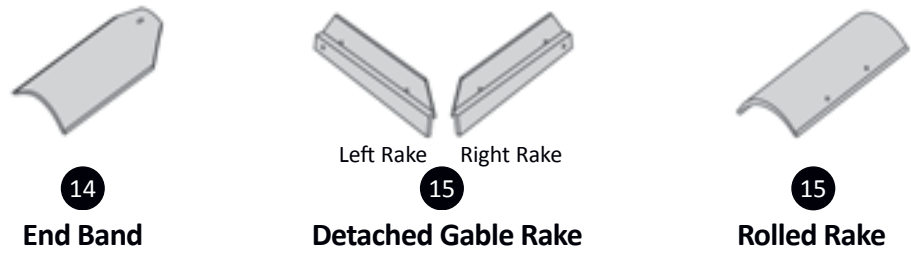
			
	<b>Italia™</b>	<b>Greek</b>	<b>Roman</b>
Weight/Square	900 lbs.	1,510 lbs.	1,415 lbs.
Pieces/Square	125	240	240
Overall Size	P = 9 <sup>3/4</sup> " x 18 <sup>3/8</sup> " C = 8" x 18 <sup>3/8</sup> "	P = 11 <sup>1/2</sup> " x 12 <sup>5/8</sup> " C = 6 <sup>3/8</sup> " x 13"	P = 11 <sup>1/2</sup> " x 12 <sup>5/8</sup> " C = 6" x 13"
Exposure	P = 7" x 15 <sup>3/8</sup> " C = 8" x 15 <sup>3/8</sup> "	P = 5 <sup>5/8</sup> " x 10" C = 6 <sup>3/8</sup> " x 10"	P = 6" x 10" C = 6" x 10"
Center to Center	15"	12"	12"
Minimum Slope	5:12	5:12	5:12

# Spanish Tile Fittings Physical Characteristics

Chart 6.1 Spanish Fittings Physical Characteristics



	<b>Eave Closure</b>	<b>Top Fixture</b>	<b>Beveled Eave</b>	<b>Flat Top</b>
<b>Spanish 13-1/4"</b>	Overall Size	-	9 3/4" x 13 1/4"	9 3/4" x 13 1/4"
	Exposure	8 1/4"	8 1/4" x 10 1/4"	8 1/4"
	Weight/Pc.	1.2 lbs.	6 lbs.	6 lbs.
<b>Spanish 18-3/8"</b>	Overall Size	-	9 3/4" x 18 3/8"	9 1/4" x 18 3/8"
	Exposure	8 1/4"	8 1/4" x 15 3/8"	8 1/4" x 15 3/8"
	Weight/Pc.	1.2 lbs.	8 lbs.	8 lbs.



	<b>End Band</b>	<b>Detached Gable Rake</b>	<b>Rolled Rake</b>
<b>Spanish 13-1/4"</b>	Overall Size	13 1/4"	13 1/4"
	Exposure	10 1/4"	10 1/4"
	Weight/Pc.	4.5 lbs.	2.1 lbs.
<b>Spanish 18-3/8"</b>	Overall Size	18 3/8"	NA
	Exposure	15 3/8"	NA
	Weight/Pc.	4.6 lbs.	NA

# Scandia™ Tile Fittings Physical Characteristics

Chart 7.1 Scandia™ Fittings Physical Characteristics

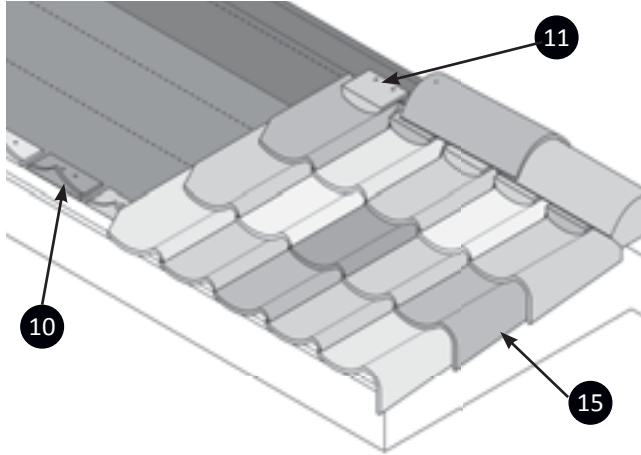
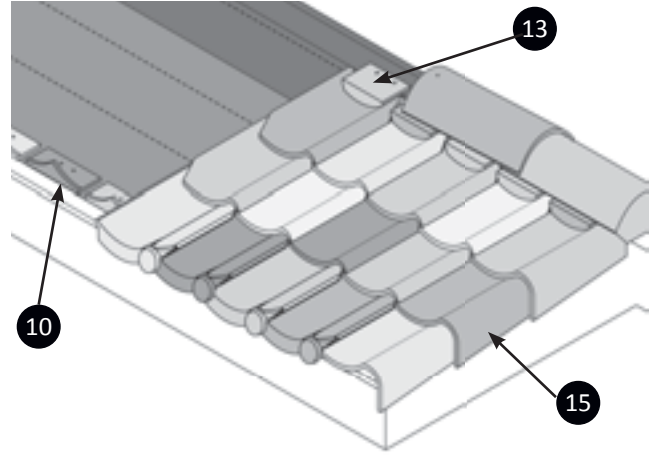


Chart 7.2 Scandia™ Fittings Physical Characteristics



10

Eave Closure



11

Top Fixture



Left Rake



Right Rake

15

Attached Gable Rake



13

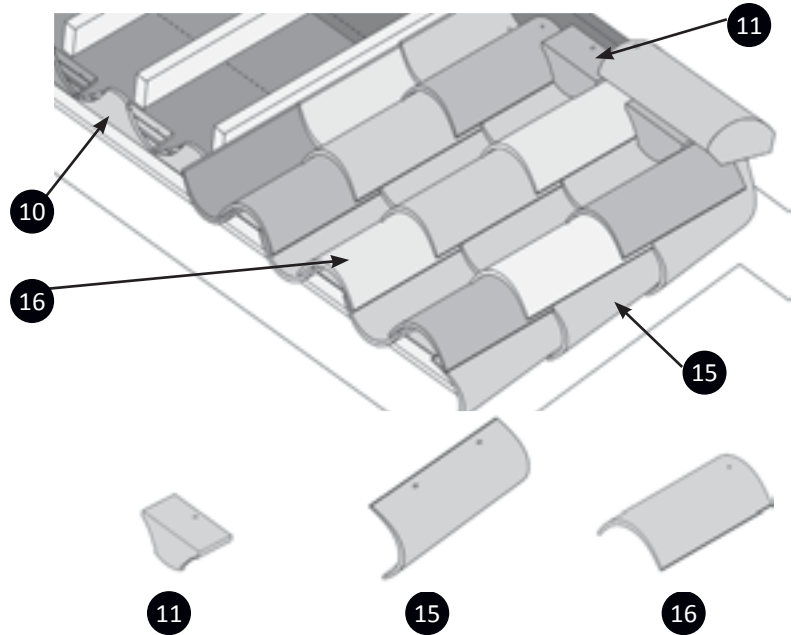
Decorative Eave

<b>Scandia™</b>	Overall Size	-	-	-	9 3/4" x 13 1/4"
	Exposure	7 9/16"	7 9/16"	10 1/4"	7 9/16" x 10 1/4"
	Weight/Pc.	1.2 lbs.	1.2 lbs.	7 lbs.	7 lbs.

# Mission Tile Fittings

## Physical Characteristics

Chart 8.1 Mission Tile Fittings  
Physical Characteristics



	10	11	15	16
	Eave Closure	Top Fixture	Rolled Rake	Short Course Cover
<b>Straight Barrel Mission 14-1/4"</b>	Overall Size	11"	7-1/4"	8" x 11 1/4"
	Exposure	11 1/2"	11 1/2"	11 1/4"
	Weight/Pc.	1.7 lbs.	1.7 lbs.	6 lbs.
<b>Straight Barrel Mission 16"</b>	Overall Size	11"	7 1/4"	8" x 16"
	Exposure	11 1/2"	11-1/2"	13"
	Weight/Pc.	1.7 lbs.	1.7 lbs.	6.2 lbs.
<b>Straight Barrel Mission 18-3/8"</b>	Overall Size	11"	7 1/4"	8" x 18 3/8"
	Exposure	11 1/2"	11 1/2"	15 3/8"
	Weight/Pc.	1.7 lbs.	1.7 lbs.	7.1 lbs.
<b>Tapered Barrel Mission 14-1/4"</b>	Overall Size	-	-	8" x 14 1/4"
	Exposure	10 1/2"	10 1/2"	11 1/4"
	Weight/Pc.	3.1 lbs.	2.2 lbs.	5.8 lbs.
<b>Tapered Barrel Mission 16"</b>	Overall Size	-	-	8" x 16"
	Exposure	10 1/2"	10 1/2"	13"
	Weight/Pc.	3.1 lbs.	2.1 lbs.	6.2 lbs.
<b>Cubana Mission 18-3/8"</b>	Overall Size	-	-	18 3/8"
	Exposure	11"	11"	15 3/8"
	Weight/Pc.	1.7 lbs.	1.7 lbs.	7.1 lbs.
<b>Palm Beach Mission 18-3/8"</b>	Overall Size	11"	7 1/4"	8" x 18 3/8"
	Exposure	11 1/2"	11 1/2"	15 3/8"
	Weight/Pc.	1.7 lbs.	1.7 lbs.	7.1 lbs.



## Mission Profile Tile Fittings Physical Characteristics

Chart 9.1 Italia™ Fittings  
Physical Characteristics

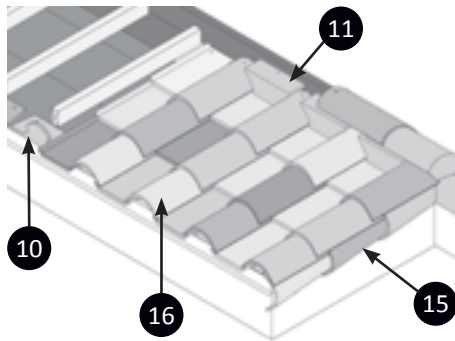


Chart 9.2 Greek Fittings  
Physical Characteristics

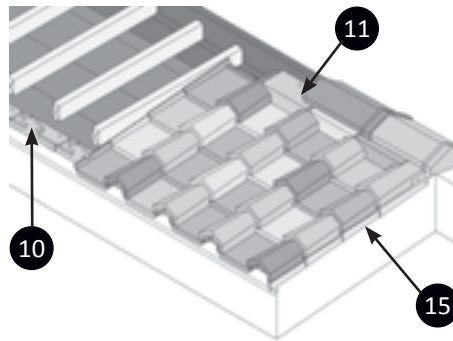
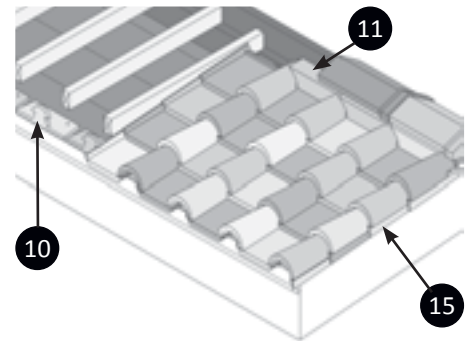


Chart 9.3 Roman Fittings  
Physical Characteristics



10

Eave Closure



11

Top Fixture



15

Rolled Rake



16

Short Course Cap

<b>Italia™</b>	Overall Size	-	-	8" x 18 <sup>3</sup> / <sub>8</sub> "	8" x 15 <sup>3</sup> / <sub>8</sub> "
	Exposure	12"	12"	18 <sup>3</sup> / <sub>8</sub> "	12 <sup>3</sup> / <sub>8</sub> "
	Weight/Pc.	2.5 lbs.	2.5 lbs.	7.1 lbs.	6.0 lbs.



10

Eave Closure



11

Top Fixture



15

Detached Rake

<b>Greek</b>	Overall Size	-	-	12 <sup>5</sup> / <sub>8</sub> "	
	Exposure	12"	12"	10"	
	Weight/Pc.	2.5 lbs.	2.5 lbs.	2.1 lbs.	



10

Eave Closure



11

Top Fixture



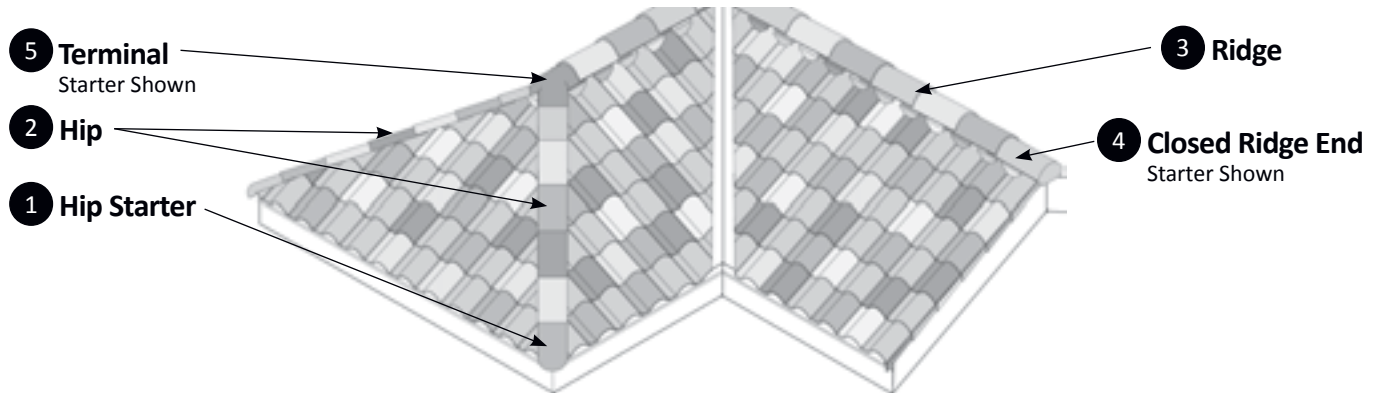
15

Detached Rake

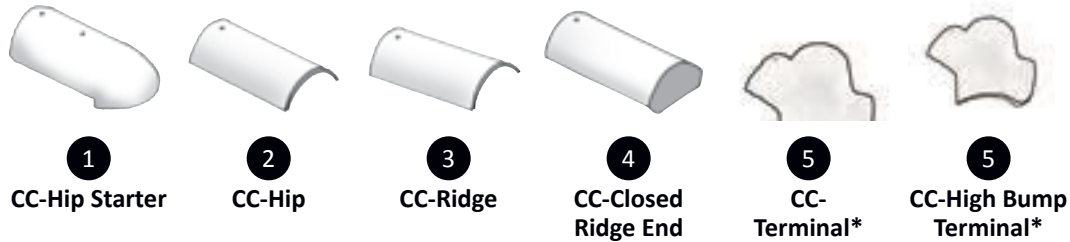
<b>Roman</b>	Overall Size	-	-	12 <sup>5</sup> / <sub>8</sub> "	
	Exposure	12"	12"	10"	
	Weight/Pc.	2.5 lbs.	2.5 lbs.	2.1 lbs.	

## Hip and Ridge Physical Characteristics

Chart 10.1 Hip and Ridge Physical Characteristics

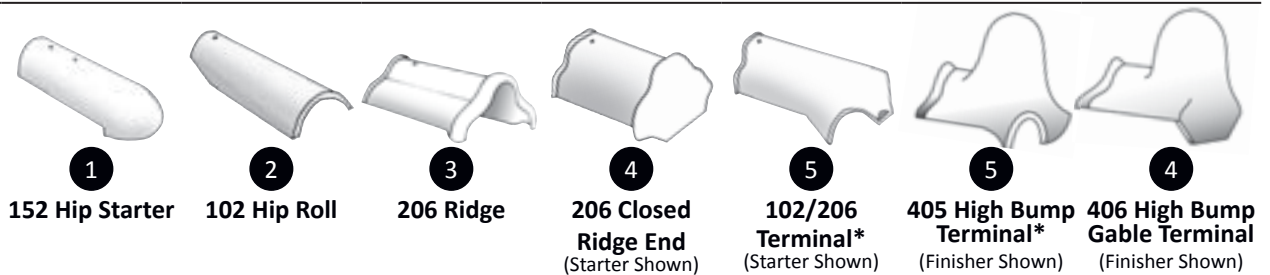


### Circular Cover Hip and Ridge Trim Group



Overall Size	15 1/2"	16"	16"	14 1/4"	-	-
Exposure	12"	13"	13"	12"	-	-
Weight/Pc.	9 lbs.	5.8 lbs.	5.8 lbs.	9.8 lbs.	15 lbs.	25 lbs.

### 102/206 Hip and Ridge Trim Group



Overall Size	14"	14"	13 1/4"	13 1/4"	-	-	-
Exposure	12"	12"	12"	12"	-	-	-
Weight/Pc.	6.3 lbs.	6.2 lbs.	11.5 lbs.	18 lbs.	17 lbs.	35 lbs.	30 lbs.

\* Ludowici makes ridge/hip terminals to fit any roof geometry. Contact your Ludowici representative for assistance.

Chart 11.1 Hip and Ridge Physical Characteristics

**V-Hip and Ridge Trim Group**



Overall Size	15 1/2"	14 1/4"	14 1/4"	14 1/4"	-
Exposure	12"	12"	12"	12"	-
Weight/Pc.	8 lbs.	8.8 lbs.	8.8 lbs.	8 lbs.	15 lbs.

**V-Ridge Angles**

Description	Degree	Roof Pitch
Regular	116°	3:12 to 10:12
Intermediate	90°	11:12 to 20:12
Steep	75°	20:12 +

**V-Hip Angles**

Degree	Roof Pitch
116°	3:12 to 18:12

**118/211 Hip and Ridge Trim Group**



Overall Size	14"	14"	13 1/4"	13 1/4"	-
Exposure	12"	12"	12"	12"	-
Weight/Pc.	5 lbs.	4.8 lbs.	9.7 lbs.	14 lbs.	20 lbs.

**211 Ridge Angles**

Description	Angle	Roof Pitch
Regular	116°	3:12 to 10:12
Intermediate	90°	11:12 to 20:12
Steep	75°	20:12 +

\* Ludowici makes ridge/hip terminals to fit any roof geometry. Contact your Ludowici representative for assistance.

# Before Getting Started

## Roof Slope

Ludowici Roof Tile's recommended minimum slope requirements for Spanish and Scandia™ tile are 4:12 and for Mission tile 5:12. **No clay tile roofs are to be installed below a roof slope of 3:12.**

*There is no maximum slope requirement for tile roofs. However, on extremely steep (above 19:12) or vertical applications, wind current may cause the tiles to rattle. To avoid this, set the butt of each tile with a bead of sealant where it will not be seen.*

## Weight

Proper roof framing is required to carry the weight of a tile roof. The weight of one square (100 sq. ft.) of Barrel tile will range from 800 pounds to over 1,250 pounds. The weight of the roof tile is determined by the type and size of the tile and the exposure of each course of tile. Reducing the exposure of the tile will increase the roof load.

The weight of the underlayment, fastening system, roof accessories and trim tile also needs to be considered when determining the total weight. Check dead load allowances of the applicable local building codes.

It is recommended that the structural design of the roof be evaluated by a registered engineer to determine that it can support the load; most building codes require an engineering review. Getting a written letter of approval is suggested and may be required by local building codes.

If the installation is in a region of seismic activity or heavy wind load, local building codes must be consulted for additional requirements.

## Roof Deck

A design standard for roofing decks is to have a **maximum deflection of L/240 between supports**. A deck will be exposed to live and dead loads. A live load is one that will only be exerting pressure on the roof deck for a short time. Example; Snow or wind loads. A dead load is one that will exert a constant pressure to the roof deck; e.g., underlayments, tile and battens.

**Fastener Pullout Resistance:** Minimum average fastener pullout resistance for clay roofing tile is 180 lbs. with no single value less than 170 lbs. Greater pullout values may be required depending upon the predicted aerodynamic moment expected for the tile shape, building shape and the proximity to the coastline. An engineer should be consulted to assure local building code compliance.

**For Board Plank Deck:** Use well-seasoned plank board (1" full thickness, maximum 6" nominal width) that is not prone to warping, cupping or twisting.

**For Plywood Deck:** APA rated plywood is required for a minimum of 3/4" thick wood decking and must be rated for structural use as roof sheathing. The expansion crack between panels shall be at least 1/16" but no greater than 1/8". H-clips are to be used when rafters are spaced greater than 16" on center to hold the side joints of the plywood together between supports. Unsupported end joints must be blocked.

**Nailable Concrete Decks:** Nailable concrete decks over time may lose their plastic nature, which allows direct nailing. For old decking material, a pullout test should be performed to determine the usefulness of the deck and the appropriate fastener. An engineer should be consulted to assure local building code compliance.

**Non-Nailable Concrete Decks:** For concrete decks that will not accept direct nailing, nailer boards are required. Attachment strips that allow the tile to be fastened to them should be pressure treated wood. These may be a board and batten system or pressure treated wood strips. Other means of attaching tile to a concrete deck include wire-tie systems, foam

adhesive and expanding nail-in anchors.

**NOTE: Ludowici does not recommend applying tile over spaced board sheathing or open battens.**

## Underlayment

Most problems with water-shedding roof installations occur from water that migrates through the joints of the tiles through capillary action, wind driven rain and runoff or ice damming. Because of this possibility, the underlayment is critical to the success of the roof. It is the architect or building owner’s responsibility to select an underlayment product that is suitable to specific location, climate, roof pitch and attic ventilation. When selecting an underlayment remember that Ludowici roof tiles are expected to last over 75 years so the underlayment should be of a comparable lifespan and quality.

Ludowici recommends the following for minimum underlayment:

- All decks shall be covered with two layers of No. 30# asphalt-impregnated roofing felt or one layer of No. 43# coated base sheet or one layer of Ice and Water Shield.

**NOTE: When using non-breathing Ice and Water Shield underlayments to cover the entire roof, the attic space MUST be properly ventilated to prevent moisture buildup.**

- All hips, valleys, rakes and ridges shall be covered with a waterproof underlayment; example: Ice and Water Shield or two layers of No. 43# coated base sheet.
- For proper ice dam protection a layer of Ice and Water Shield underlayment should be installed from the eave to a point 24” beyond the inside of the exterior wall. See page 18 for more information on ice dam protection.

**NOTE: Roofing felt should meet or exceed ASTM standards D226/D2626. Self adhered polymer modified bituminous sheet should meet or exceed ASTM D1970.**

Chart 13.1 Underlayment Characteristics

Type	Pros	Cons
Asphalt Roofing Felt	<ul style="list-style-type: none"> <li>• Long track record</li> <li>• Well suited for most applications</li> <li>• Readily available</li> <li>• Breathable</li> <li>• Less expensive than Synthetics or Self Adhered</li> </ul>	<ul style="list-style-type: none"> <li>• Doesn’t seal around the nail holes</li> <li>• Not as effective on lower pitches</li> <li>• Can tear</li> <li>• Not suitable for long duration exposure directly to the elements</li> </ul>
Ice & Water Shield (Self Adhered Polymer-Modified Bituminous Sheet)	<ul style="list-style-type: none"> <li>• Rubberized material seals around nail holes</li> <li>• Self adhering materials creates a more monolithic water barrier</li> <li>• Ideal for low slope applications</li> </ul>	<ul style="list-style-type: none"> <li>• More expensive</li> <li>• <b>Non breathing requires good attic ventilation</b></li> <li>• Can be damaged by UV if exposed for 180+ days</li> </ul>
Synthetic Underlayments	<ul style="list-style-type: none"> <li>• Purported life span and durability</li> <li>• Some Synthetics are breathable</li> </ul>	<ul style="list-style-type: none"> <li>• Unproven. Most products have been on the market less than 20 years.</li> <li>• Two to three times cost of felt</li> </ul>

## Fastening Methods

Attachment requirements and fastener length are referenced in Chart 15.2

**Nails or Screws:** Nails are the most commonly used fastener for attaching clay tiles. Nails for tiles and cleats must be copper or stainless steel, 11 gauge minimum, .285"-.312" head minimum and proper length to give good penetration. Screws must be stainless steel or brass, #8 or #9, with a minimum .285"-.312" diameter head.

**NOTE: The use of Galvanized, Ceramic coated or any other fastener not mentioned above is not acceptable to Ludowici. All components of the roof should have an expected lifespan of 75+ years.**

**NOTE: When installing field tiles, care should be taken to fasten each tile with nails or screws in every provided fastening hole. Spanish tile can be special ordered with an optional third hole for wind lock installation.**

- For a plywood deck, use ring shank copper nails of the specified length to assure good penetration through under side of deck (see Chart 15.2).
- For board plank deck, use smooth shank copper nails of the specified length. Fasteners should penetrate deck board 3/4". Do not penetrate underside of deck.
- For gypsum plank or nailable concrete deck, use stainless steel or silicon bronze screw shank nails of length to penetrate half to three-quarters the thickness of the deck. Never penetrate underside of deck.
- When insulation is applied over the deck, observe the following:
  - Minimum slope 4:12 for Spanish tile and 5:12 for Mission tile - The tile can be nailed through underlayment and insulation into the deck with a sufficient length fastener.
  - On 6:12 or greater, a tile-tie system should be used.
- For metal decks, use sheet metal screws and the proper mastic.

- For fibrous cement decks, use a tile-tie system.

**NOTE: When using stainless steel screws, tile replacement will require the use of a hack saw to remove the screws. A slate ripper may be used with copper or brass fasteners.**

**Wire:** On non-nailable surfaces or some insulated decks or where fastening through the metal flashing needs to be avoided or if underlayment cannot be penetrated, such as special low slope applications, wire and strapping systems are sometimes used. Wire must be 13 gauge stainless steel or 10 gauge solid copper, with or without insulation. Wire-tieing is also usually specified in areas prone to earthquakes. Consult Newportfastener.com for specific design and installation assistance.

**Clips:** Wind clips are often specified and/or required in high wind and seismic areas. They aid in holding the tiles in place and reduce stress at the preliminary fastening point. Refer to local building codes in such areas.

**NOTE: In high wind regions, install each tile with #8 or #9 stainless steel or brass flathead Phillips or square drive screws and/or use Hurricane clips or wind lock nose hook. Hurricane clips, wind lock nose clips and sealants may be required by the local building codes.**

**Bedding Tile:** Where freeze-thaw cycles are not an issue, tile may be laid in a full or partial bed of mortar. This method is best used in combination with other means of attachment.

**Foam Adhesive:** This method of application is approved for use in Sun Belt non freeze-thaw areas and is being tested for use in other areas. Refer to local building codes. Do not use single part foam systems with Ludowici tile. Only two part systems such as Polyset® from Polyfoam are acceptable. Visit Polyfoam.cc for design and installation assistance.

**IMPORTANT:**  
**Before application of Ludowici tiles in Alpine conditions, plans must be submitted to the Ludowici Technical Department for approval. Ludowici will not assume liability or responsibility for damage caused by the application of clay tiles in Alpine conditions.**

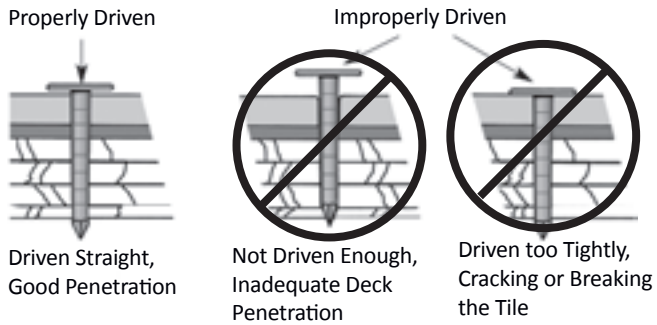


Figure 15.1 Proper Nailing Techniques for Plywood Decks

Chart 15.2 Attachment Requirements

Spanish 13-1/4" Spanish 18-3/8"	<b>Substrate</b>	<b>Field Tile</b>	<b>Hip</b>	<b>Ridge</b>	<b>Quik-Tach™ Bracket</b>	<b>Hurricane Clip</b>
	Boards	1 1/2"	2"	2 1/2"	Type B (13 1/4")	2 5/16"
	3/4" Plywood	1 3/4"	2"	2 1/2"	Type D (18 3/8")	2 5/16"
Scandia™	<b>Substrate</b>	<b>Field Tile</b>	<b>Hip</b>	<b>Ridge</b>	<b>Quik-Tach™ Bracket</b>	<b>Hurricane Clip</b>
	Boards	1 3/4"	2"	2 1/2"	Type B	2 3/8"
	3/4" Plywood	2"	2"	2 1/2"		2 3/8"
Straight Barrel Mission 14-1/4", 16", 18-3/8" & Palm Beach Mission	<b>Substrate</b>	<b>Field Tile</b>	<b>Hip</b>	<b>Ridge</b>	<b>Quik-Tach™ Bracket</b>	<b>Wind Lock</b>
	Boards	1 1/2"	2"	2 1/2"	Type B (14 1/4")	1 1/4"
	3/4" Plywood	1 3/4"	2"	2 1/2"	Type D	1 1/4"
Tapered Barrel Mission 14-1/4", 16" & Cubana	<b>Substrate</b>	<b>Field Tile</b>	<b>Hip</b>	<b>Ridge</b>	<b>Quik-Tach™ Bracket</b>	<b>Wind Lock</b>
	Boards	1 1/2"	2"	2 1/2"	Type B (14 1/4")	1 1/4"
	3/4" Plywood	1 3/4"	2"	2 1/2"	Type D	1 1/4"

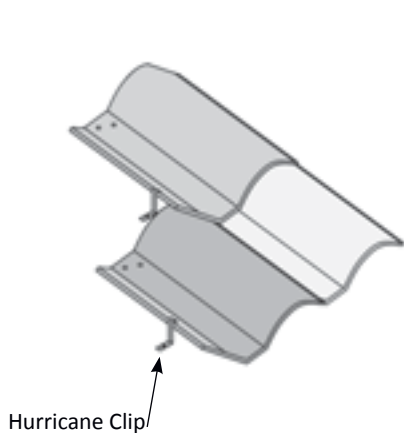


Figure 15.3 Hurricane Clip for Spanish

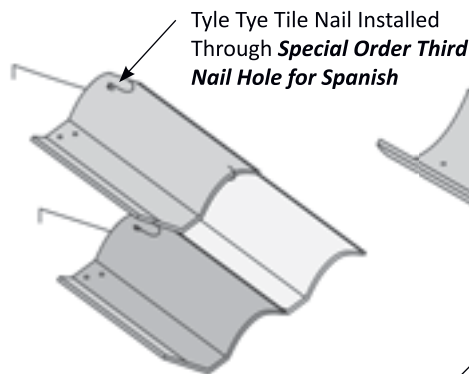


Figure 15.4 Tyle Tye Tile Nail for Spanish

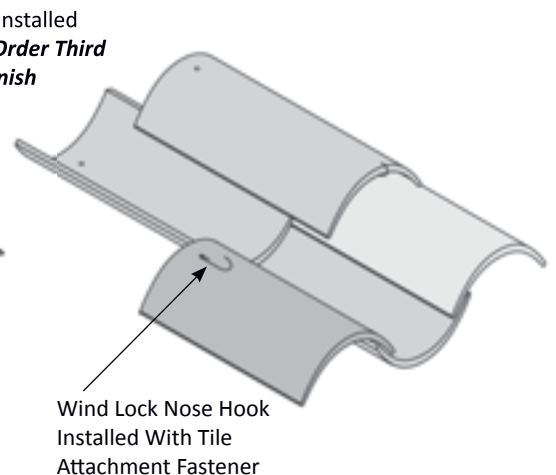


Figure 15.5 Wind Lock Nose Hook for Mission Tile

# Getting Started

## Assemble All Tools and Supplies

The following tools are needed for basic installation of clay roofs:

- Safety equipment as required by OSHA and other local and state agencies
- Rule or tape
- Mason's trowel and bucket
- Chalk line and chalk
- 4" diamond-tipped turbo blade on angle grinder
- Claw hammer
- Protective eye wear/dust mask
- Chipping hammer
- Caulking gun
- Felt knife
- Sheet metal shears
- Roof jacks
- Slate ripper
- Segmented diamond blade (8" to 10" diameter)
- Wet tub saw
- Tile nippers
- Marking pencil
- Sharp steel punch
- Battery-operated, clutch-driven drill (with extra batteries)
- Carbide spear point glass drill bits
- Small steel roller

### **IMPORTANT:**

***All roof work can be hazardous. Safety requirements are spelled out by OSHA and individual state Occupational Safety and Health Administration regulations. It is the responsibility of the installer to take all necessary precautions. Contact the Occupational Safety and Health Administration for complete information.***

### **IMPORTANT:**

***All roofing components should be selected to be compatible with the long service life of a Ludowici roof.***

In addition to tools, the following materials are needed:

- Flashing: use a minimum weight of 16 oz. copper, at least 24" wide with 1/4" edge turned over and fastened with cleats for valleys. Under special circumstances, such as unusual exposure to high wind or heavy snow, this flashing weight should be increased. Lighter weight copper flashings are undesirable because they can puncture too easily and they will not provide the wear life required for a long-life roof system.
- Underlayment: two layers of No. 30# asphalt-impregnated roofing felt or one layer of No. 43# coated base sheet, doubled on rough surfaces, hips, valleys and ridges or one layer of Ice and Water Shield.
- Roofing cement: roofing cement for gable rakes, hip rolls, ridges, stringers and other conditions should be non-running, heavy-body flashing cement composed of mineral ingredients to meet the requirements of ASTM D-4586.
- Cant strips, wood nailers and field tile nailer strips: all should be foundation grade wood.
- Mortar and mortar color to match tiles: Ludowici defines mortar as one part Portland cement and four parts sand (to ASTM specification C-270). Contact your local brick distributor to acquire colorant.
- Silicone sealant or adhesive: the recommended sealant for exposed caulking is Dow Corning® 790 Silicone Building Sealant™ or GE® SilProof™ (ASTM C-920, low modulus). These sealants may be used as hidden adhesives. NP1 or other adhesives may be suitable as well; however, care should be taken to select for maximum durability and also for compatibility with adjacent materials. Some sealants are available in different colors to match tiles.



# Preparing the Roof

## Inspecting the Deck

- Ensure that the roof deck is clean, smooth and dry before roof tiles are applied.
- Verify that there is no significant delamination, warpage, bowing or separation from the rafters or trusses. Check for deck rot.
- If deck is APA 3/4" rated plywood, check that panels are spaced approximately 1/16" to a maximum of 1/8" apart for expansion and H-clips are used between supports when the rafter spacing exceeds 16" O.C. Unsupported end joints must be blocked.

Make repairs to the deck as necessary.

**NOTE: Prior to applying any roofing material, all contractor work above the roofline must be completed.**

## Installing the Underlayment

Most problems with water-shedding roof installations occur from water that migrates through the joints of the tiles through capillary action, wind-driven rain and runoff or ice damming. Because of this possibility, the underlayment is critical to the success of the roof.

At a minimum, all decks must be covered with two layers of No. 30# asphalt-impregnated roofing felt or one layer of No. 43# coated base sheet.

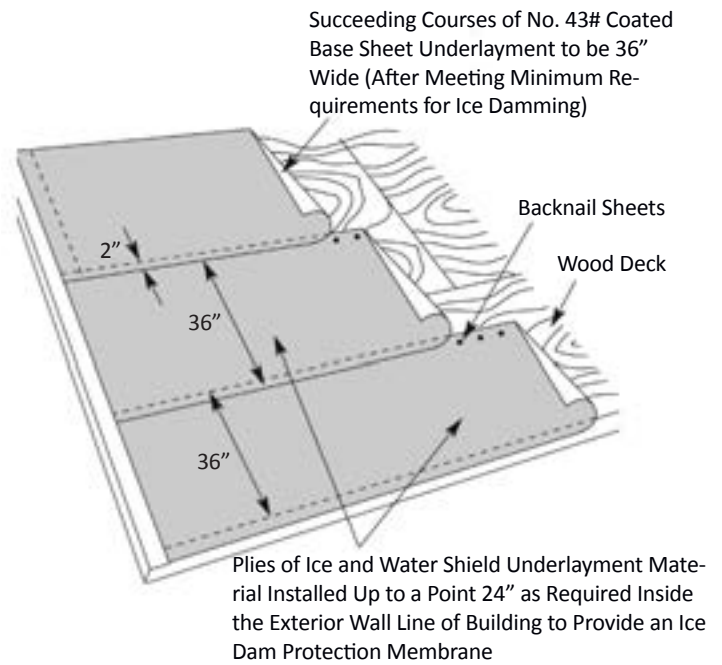
**NOTE: Underlayment materials must be covered with tile as soon as possible to prevent degradation from exposure.**

If wood cant strips and nailers are nailed directly to the deck, they must be covered with waterproof underlayment. If nailed on the underlayment, they should be pressure treated wood.

**NOTE: All roofing underlayment materials should be carried 6" up all vertical surfaces.**

### For single layer of No. 43# coated base sheet:

Lay base sheet parallel to eave. Side lap - 2" and end lap - 6".



**NOTE: All dimensions are approximate**

Figure 17.1 Single Sheet Underlayment

### For Double Layers, follow these steps:

First apply a starter sheet of 1 layer of Ice and Water Shield underlayment per manufacturer's instructions.

Then completely cover the starter sheet with a full-width sheet of No. 43# roofing felt. Lap succeeding sheets 19" over the preceding sheets, leaving a 17" exposure (2" lap). End of roll laps should be a minimum of 6".

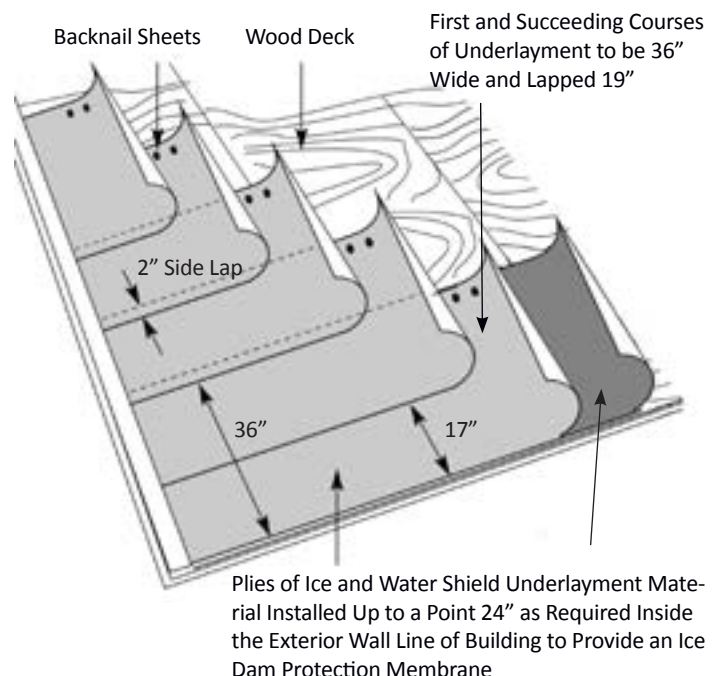


Figure 17.2 Double Sheet Underlayment

## Concrete Deck

For Ice and Water Shield underlayments follow the manufacturer's installation instructions for attachment to concrete. Or, if using asphalt felt, apply No. 43# coated base sheet and fasten per the architect's instructions. For non-nailable concrete decks a counter batten system will be necessary. Over the underlayment fasten a standard pressure treated 1" x 2" furring strips vertically 20" O.C., apply pressure treated 1" x 2" wood strips horizontally across lath spaced to accommodate the correct tile exposure and proceed as directed for a sheathed roof (see Figure 18.1).

**NOTE: Flashing dimensions will have to be adjusted to accommodate the thicker assembly.**

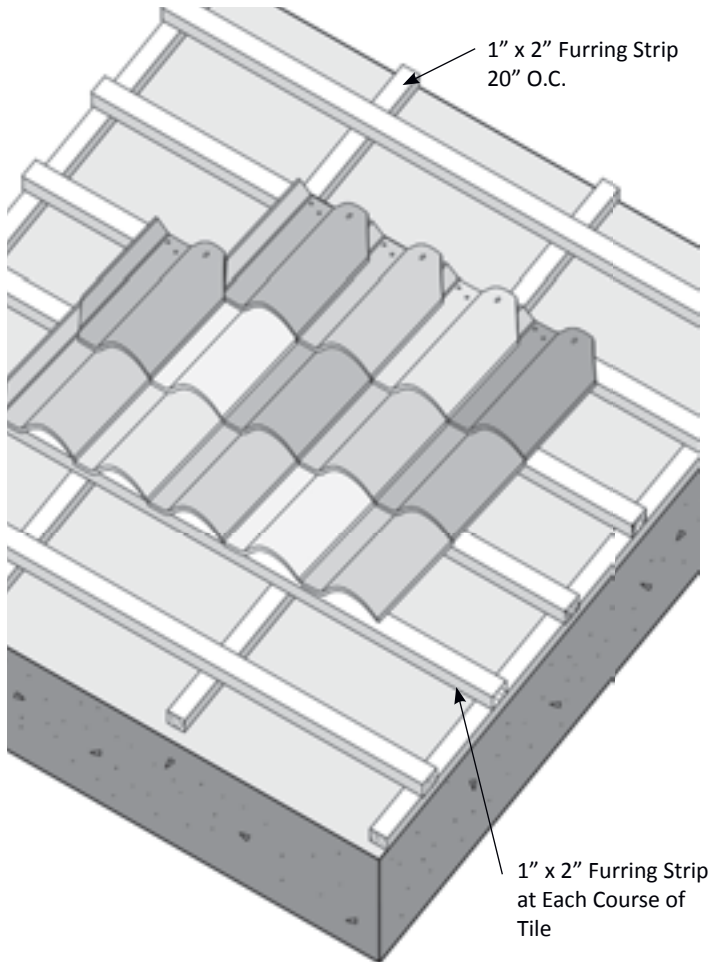


Figure 18.1 Batten System of Attachment for Concrete Deck

## Ice Dam Protection

Ice dam protection is recommended in areas where the January mean temperature is 30° F. or less and on all pitches below the standard minimums. This protection must be installed wherever there is a possibility of ice forming along the eaves which will cause a back-up of water and may cause building and interior damage. Consider your local weather conditions.

Apply self-adhering Ice and Water Shield, or equivalent, directly to the deck according to application instructions provided with the product. Self-adhering underlayment must extend up the roof to a point at least 24" beyond the interior wall line and in areas of severe icing at least up to and above the highest water level expected to occur from ice dams (see Figure 18.2).

*Please note that the 24" point beyond the interior wall line is a minimum recommendation. Self-adhering Ice and Water Shield underlayment should be applied to all roof decking, which past history and professional experience suggest, might be subject to ice dam back-up. If considering using ice dam protection on the entire surface of the roof deck, insure that adequate ventilation is present to prevent the development of damaging condensation on the underside of the roof deck.*

If a wide eave overhang requires flashing wider than 36", the necessary 6" minimum horizontal lap must be located on the overhang outside the structure walls. End laps must be a 6" minimum. Underlayment should meet ASTM D-1970.

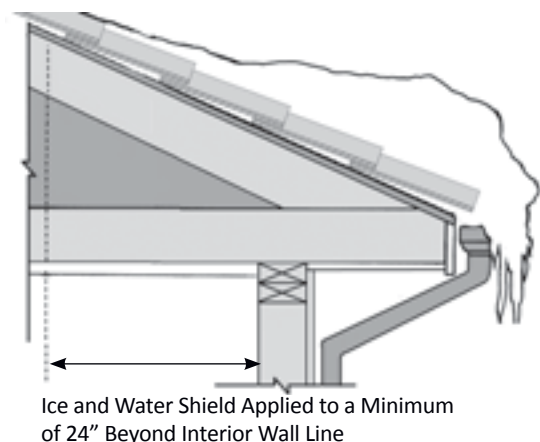


Figure 18.2 Ice Dam Protection

## Applying Wood Nailers and Battens

After lining the roof with underlayment, install wood stringers for ridges and hips. Next install stringers for Mission tile or battens for Spanish field tile nailer strips (required for certain applications). The heights of the stringers are determined by the tile pattern and the type of fittings to be used.

### Stringers for Hip and Ridge

Attached Ridge and Hip Stringers with corrosion resistant fasteners 2' O.C. (see Figure 19.1).

All Hip and Ridge wood stringers must be covered with two layers of coated base sheet or a self-adhesive Ice and Water Shield. Stringers must be pressure treated and foundation grade wood. The sizes for stringers vary with tile and Ridge Cap type. Wood stringers must be a minimum of 1-1/2" thickness and of proper height to carry hip and ridge pieces.

Stringer height for hip and ridge vary depending on the tile profile, hip and ridge type and roof pitch. To determine proper stringer heights for your application lay field tile and hip on the roof deck in the correct configuration and measure the gap between the underside of the hip tile to the apex of the hip on the roof deck, this will be your stringer height.

### Nailer Strips (Field Tile Stringers)

Mission tile require a nominal 2" x 4" wood stringer to serve as a nailer board and to support the cover tile. The stringer should be a pressure-treated, foundation-grade wood.

**NOTE: Hip caps should just rest on the bottom edge of the field tile and run in a straight line parallel to the roof slope.**

Follow the same procedure for the ridge stringer. For Vented Ridge adjust Ridge Riser Bracket to correct height. Even in conditions where the stringer height is minimal it is important to install them to provide a straight surface for the hip tile to rest. Do not eliminate the stringer and just let the hip tile rest on the field tile. This will produce an irregular hip that snakes up and down.

### Battens

For applications where Battens are specified, use nominal 1" x 2" pressure treated wood. Vertical battens should be spaced no further than 20" on center. Horizontal battens are applied one per course of tiles (see Fig 18.1).

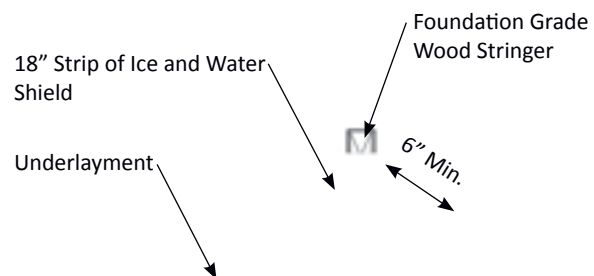


Figure 19.1 Ridge and Hip Stringer Detail

## Measuring and Chalking the Roof

Layout and chalking the roof accurately are critical to the roof's performance and appearance. If the eaves are straight and level, all horizontal lines must be parallel to the eaves and all vertical lines must be perpendicular to the eaves. Check the roof deck to determine if the deck is square prior to layout.

### Step 1: Determine Width and Length Exposure

Clay tiles, depending on the style and profile, vary in exposure and recommended head lap. Ludowici Spanish and Mission tile are laid with a minimum headlap of 3". Before chalking the roof the installer should verify the tile pattern being installed, and measure, noting average length and width exposures of the tile shipped.

The usual overhang at the eave is 2"; however, this may be adjusted slightly to accommodate full courses.

### Step 2: Chalking Vertical Lines

Vertical lines are chalked first. In the case of a hip roof, the first line is struck in the center of the roof equidistant from each hip. The remaining vertical lines are then struck to the right and left at intervals equal to your average width exposure x 5. Care must be taken to ensure that all vertical lines are parallel to the water flow.

### Step 3: Chalking Horizontal Lines

Horizontal lines are struck after the vertical lines are struck.

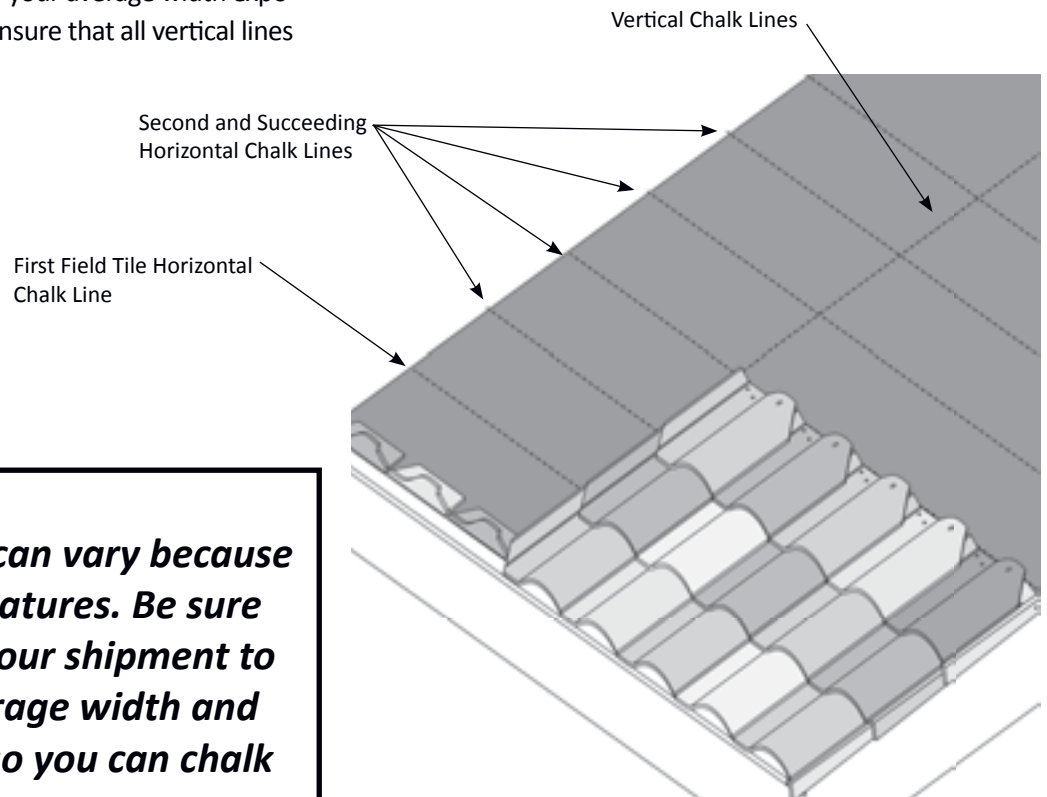
Strike a line for the under eave tile. Subtract 2" (for overhang) from the under eave to determine distance.

For Spanish and Mission tile the first field tile line will equal the average length of the tile minus the overhang (typically 2").

Successive lines are then struck at intervals equal to your average length of exposure. Length exposure is determined by subtracting 3" (for headlap) from the tile length.

**NOTE: Do not adjust exposure to a headlap less than 3".**

Care must be taken to ensure that all horizontal lines are perpendicular to the water flow.



### **IMPORTANT:**

**The tile dimensions can vary because of clay firing temperatures. Be sure to measure tiles in your shipment to determine their average width and length dimensions, so you can chalk your roof properly.**

Figure 20.1 Chalk Line Layout

## Tile Distribution Over Deck

After all roof preparation has been completed, the tiles are evenly distributed on the roof, if pitch permits.

**NOTE:** *Stacking distribution will depend on the number of tiles per square and the number of tiles per stack.*

Spacing of the tiles is determined by the width of the exposed tile times the number of courses being fed per stack. If the tiles are stacked 8 tiles high and the tile exposure is 10" and the stack feeds 2 courses, then the stacks would be placed 40" O.C.

Tile stacks normally start at the third course from the eave and continue with alternate courses.

The important aspect of tile loading is to evenly spread the load across all surfaces of the roof using the proper spacing to assure the proper amount of tile is loaded on the roof.

Remember to utilize the color blending instructions (see Page 23).

### **WARNING:**

***Do not leave stacked tiles on the roof for extended periods of time. The concentrated load can begin to slide on the heated underlayment sheet. This sliding could cause injury to persons or damage to nearby property.***

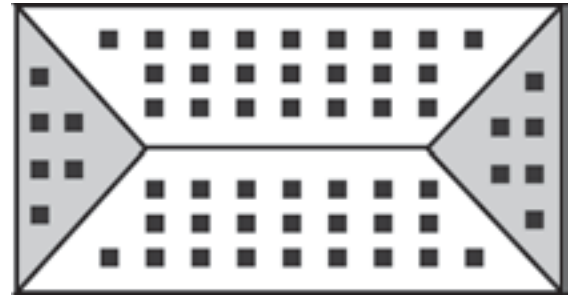


Figure 21.1 Distribution of Tile Over Roof

### **WARNING:**

#### ***Roof Loaded Tile During Severe Weather***

It is possible that strong winds could lift tiles off the piles and send them flying off the roof, resulting in injury to persons or damage to nearby property.

- If tiles have been pre-loaded onto the roof deck and strong winds or severe storms are predicted, remove the tiles and place them on ground level.
- If tiles have not yet been loaded, then it is recommended not to do so until the threat of bad weather has disappeared.

Pre-loading the roof deck with tiles prior to starting the actual installation will provide convenience and faster installation, but should only be done if weather conditions permit. Use common sense so that you do not become liable for damage or personal injury.

## Cutting, Notching and Drilling

### Cutting

**NOTE: Unnecessary cutting and drilling time can add substantial cost to the job. Carefully consider tile layout before starting the work to minimize cutting and drilling.**

Tiles should be cut wet on the job with a masonry or tile saw equipped with a diamond blade. Segmented blades will be the most efficient. Slight surface chipping will occur during the cutting operation. The sliding saw table and tub should be as large as possible to accommodate cutting the tiles diagonally.

Ludowici tiles are extremely hard, which provides the tiles with low moisture absorption and long life. Dry cutting techniques used on softer tile products will not work as fast with Ludowici's hard tile. Dry cutting with a good segmented "turbo" diamond blade is possible. Best results have been obtained using a 4" diamond tipped segmented blade mounted on a small right angle grinder motor.

### Notching

One time saving option to drilling through the tiles is to notch it with the small 4" diamond blade saw and then nail or wire in place. If using a field tile for the starter course or ridge, "dovetail" notches are cut. Make sure cuts are wide enough for a nail or screw (see Figure 22.1).

### Drilling

Additional nail holes may also be drilled if necessary. High torque electric drills may snap the carbide bits in the extremely hard Ludowici tile. Drills should be battery-powered, adjustable clutch-driven types. To drill out holes, the tile should be set in a pan with water to extend bit life and avoid the risk of eye injury due to fragments. Expect to drill only about 6 holes per carbide bit.

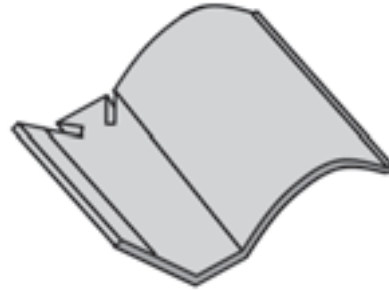


Figure 22.1 Examples of Cut and Notched Tile

**WARNING:**  
**Dry drilling may result in serious eye injury. Always use protective eye and face wear when drilling tile or operating a masonry saw.**

**Never use 115-240 volt AC-operated drills in water. Electrical shock could result.**

## Blending

Blending is one of the most important aspects of correctly installing a Ludowici tile roof.

### ***Whether installing a single color or multiple colors ALL LUDOWICI ROOFS MUST BE BLENDED.***

Colors within a given shipment of Ludowici clay roof tile will vary slightly due to subtle changes in clay composition and kiln firing temperatures. Such color variances are not a defect but a natural desirable feature that gives roofs depth and character.

Unless the architect or owner specifies a pattern, there should be no visible pattern or hot spots on the roof.

Ludowici does not pre-blend the tile. It is the roofers responsibility to evaluate the tiles for color shade and range and then properly blend them to achieve a harmonious color roof without blotches, hotspots or patterns.

The person responsible for the blending of the shades of color should randomly select tiles from at least four different pallets.

After the installation of about 75-100 tiles, the roof should be inspected from the ground at a distance greater than 40 feet to determine that there are no streaks or blotches. To ensure a good range of tones, this inspection must be done at regular intervals.

***NOTE: When nearing the end of the project if its determined that additional material will be needed to complete the roof, reserve several pallets of the initial shipment to blend with later shipments to maintain a consistent range.***

## Color Blending with Different Color Tile

Blending different tile colors can provide a unique and aesthetically pleasing roof.

Make a drawing to detail the layout and to help determine the proper number of tiles of each color.

In order to maintain the correct color blend, pull tiles from the different pallets of each color. Premix these piles in the desired percentage and load the roof one square at a time. This will provide even distribution. Additional care should be taken by the roofer laying the tiles to avoid clumping of a single color or range.

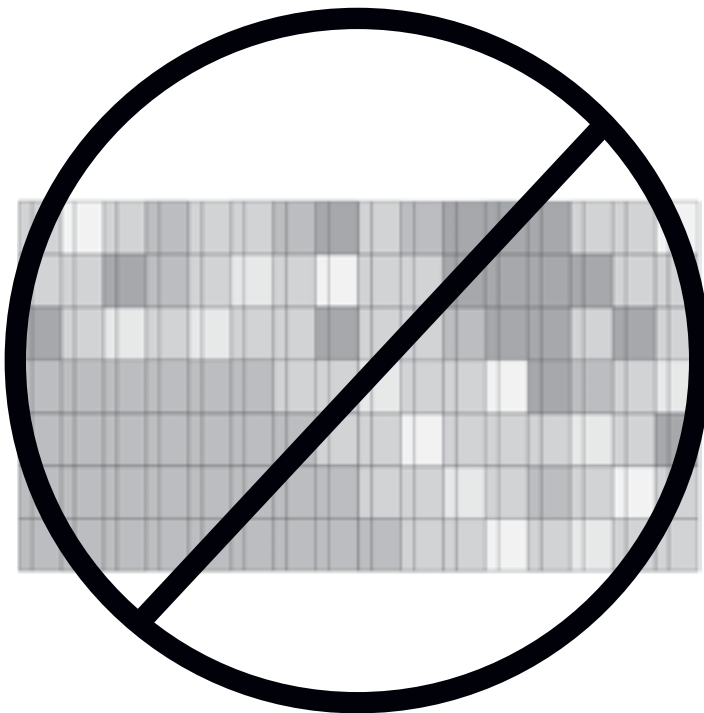
After the installation of about 75-100 tiles, the roof should be inspected from the ground at a distance greater than 40 feet to determine that there are no streaks or blotches. To ensure a good color blend, this inspection must be done at regular intervals.

***NOTE: It may be helpful to lay the tile blend out on the ground so the installer has a visual example. Make one person responsible for the ongoing and end result of the blending.***

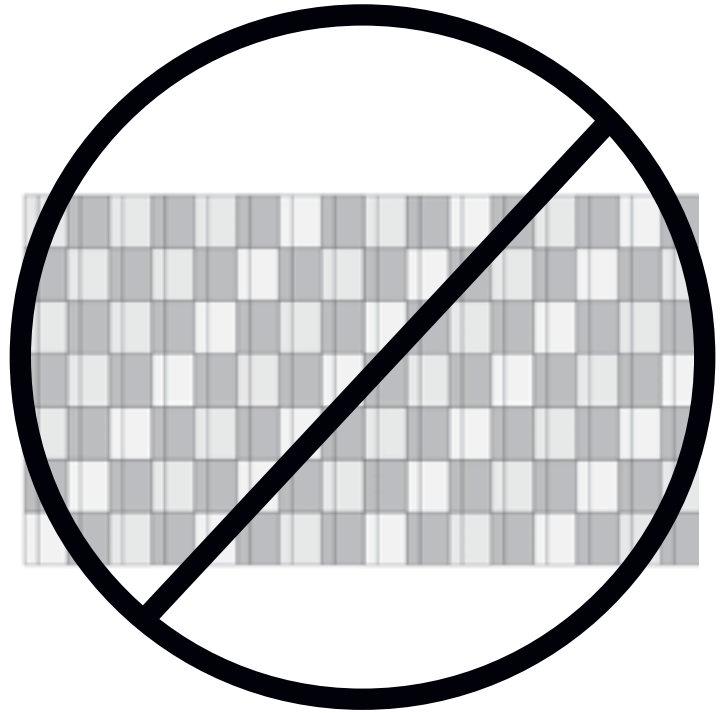


***NOTE: For mission tile roofs with multiple colors care should be taken to mix the colors so adjacent pans and caps are randomly blended.***

*Figure 24.1 Properly Blended Spanish Tile*



*Figure 24.2 Improperly Blended Spanish Tile. There Should Be No Hotspots or Diagonal Patterns Visible.*



*Figure 24.3 Improperly Blended Spanish Tile. Do Not Install the Tiles in a Repetitious Pattern.*



# Installing the Flashing

## IMPORTANT:

Where roofs intersect other roofs, parapet walls, chimneys, ventilators, vent pipes and similar projections, flashings are required. There is a natural weakness at these intersections and properly installed flashings are required to make the intersection watertight. Expansion and Contraction due to temperature changes contribute to the weakness, so it is extremely important to correctly design and install the flashings and to use durable flashing material (a minimum of 16 oz. sheet copper is recommended).

General flashing details are shown in this section but many more exist for each particular situation which cannot be covered in the context of this tile installation manual. Proper flashing installations are critical for a watertight roof.

## Eave Flashing

Where eave metal flashing is used, it should be formed using a minimum of 16 oz. sheet copper with a drip edge along the bottom to allow water to drip off the edge of the roof (see Figure 25.2).

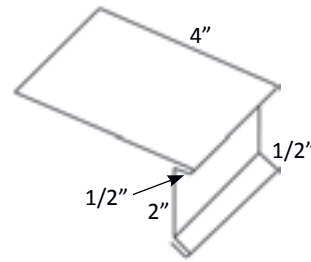


Figure 25.2 Eave Flashing Dimensions

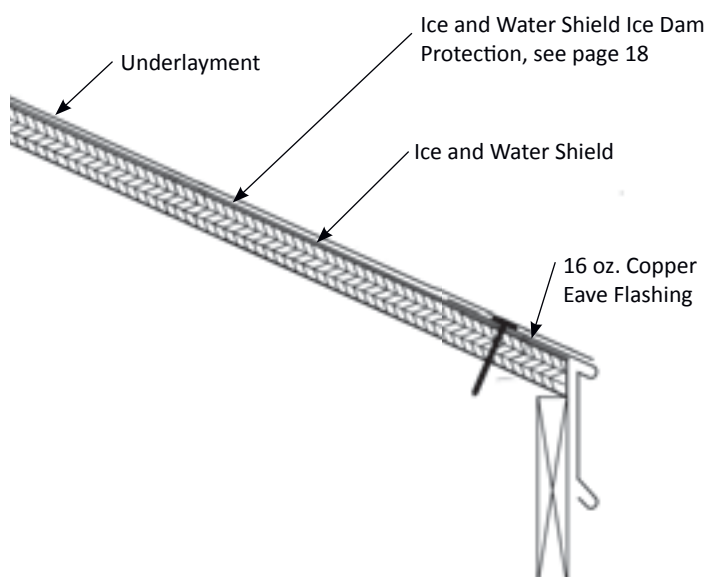


Figure 25.1 Copper Flashing Eave Detail

**Rake Edge Flashing**

The use of Ludowici detached gable rakes, rolled rakes and attached rakes precludes the need for rake flashing. However, in conditions where the normal tile spacing doesn't work out to use a gable rake tile a rake flashing edge may be needed.

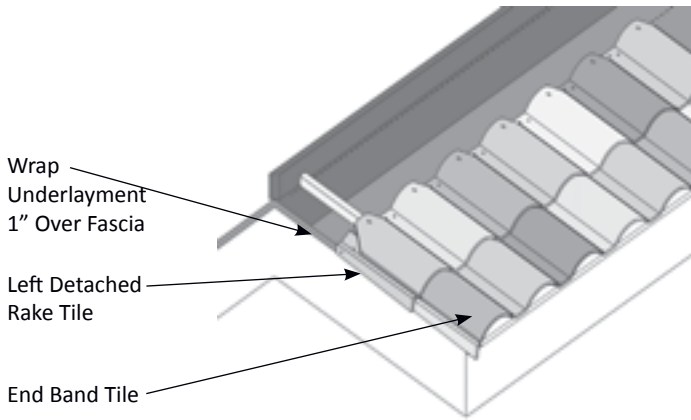


Figure 26.1 Spanish Left Detached Rake Detail  
No Flashing Required \*

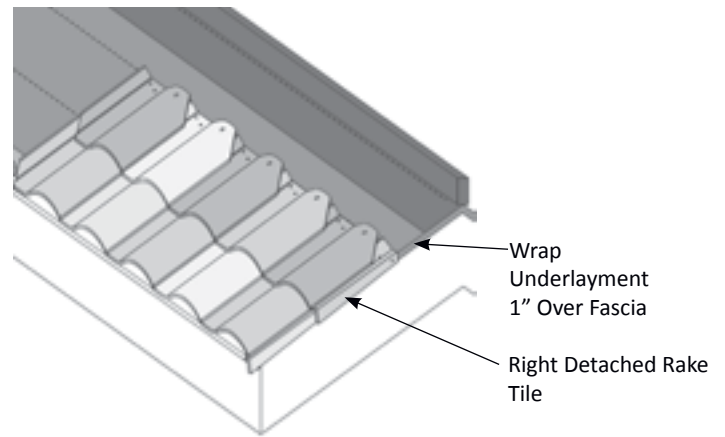


Figure 26.3 Spanish Right Detached Rake Detail  
No Flashing Required

\* See Detail 26.2 for Flashing Detail Where Spacing Conditions Do Not Work Out to Full Tile

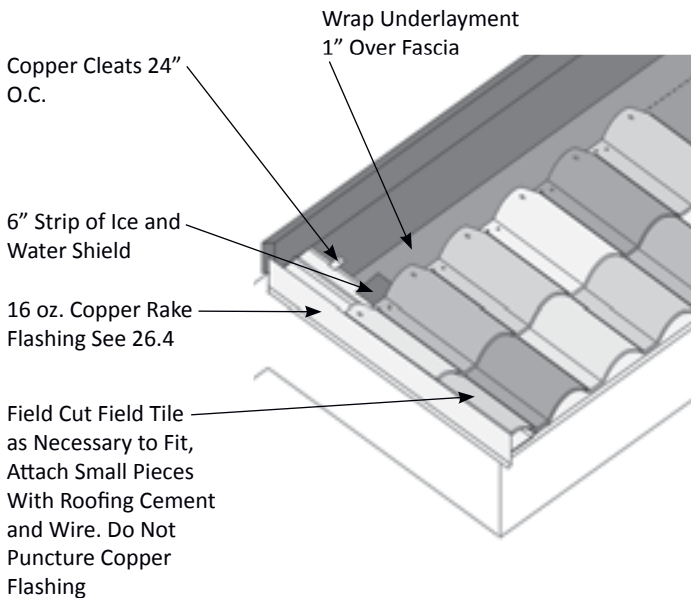


Figure 26.2 Spanish Non Standard Left Rake Detail

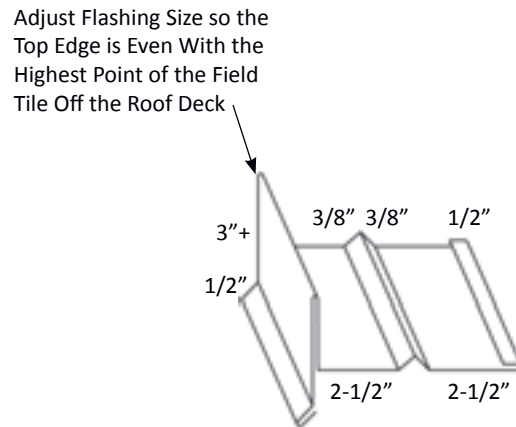


Figure 26.4 Closed Rake  
Flashing Dimensions

## Flashing at Valleys

Valleys, since they collect the water runoff from the portions of the roof sloping into them, are particularly prone to water migration and leakage. A clear and unobstructed pathway for quick water drainage is essential in valleys. There are two basic types of valleys in tile roof installation: open and closed valleys. Open valleys are the standard and preferred choice as they reduce debris collection and potential water infiltration.

### Open Valleys

In an open valley construction the tiles are held back from the center of the valley to expose the copper flashing. The advantage of an open valley is that it permits unobstructed drainage. Open valleys are recommended in areas with surrounding foliage where the leaves, needles and other debris can fall on the roof and potentially slow or block the runoff of water from the roof (see Figure 40.1).

The valley metal is to be secured with approved fasteners. At no time are nails to be placed in the area of the valley that will be carrying water.

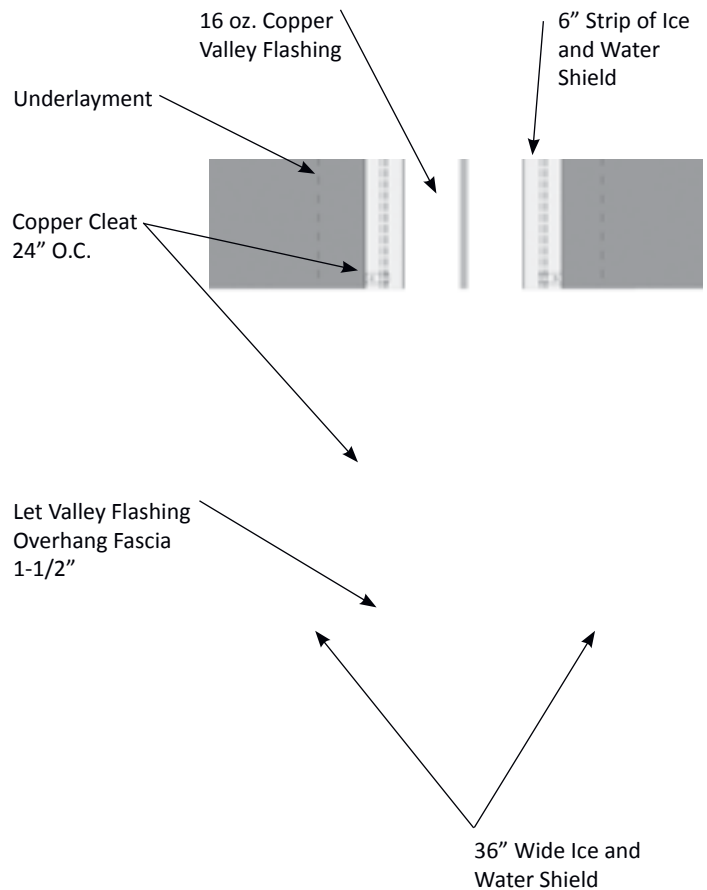


Figure 27.2 Open Valley Flashing Detail

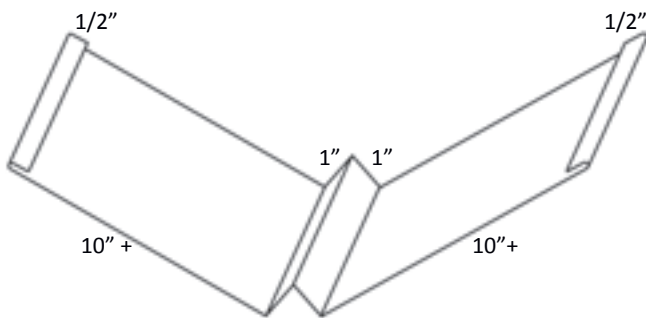


Figure 27.1 Valley Flashing Dimensions

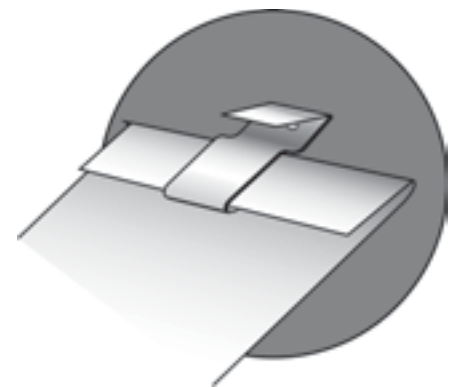


Figure 27.3 Copper Cleat Detail

**Closed Valleys**

In a closed valley, the tiles from the adjoining roof are mitered and abutted. Since water migrates through a closed valley onto the sheet copper flashing which carries the runoff, this type of construction is considered decorative. Closed valleys should not be used where the rafter length or pitch varies on adjacent roof planes. It is important that corresponding courses align coming into the valley.

**NOTE: Underlayment for all valleys must be a full width sheet (36") of two layers of No. 43# coated base sheet or a layer of self-adhesive modified bitumen membrane. Each course from the adjoining fields must overlap the valley underlayment by at least 12".**

**NOTE: Closed valleys should not be used where foliage debris can fall onto the roof, accumulate and cause water backup in the valley.**

**Ludowici strongly discourages the use of closed valleys in areas with snow fall. Snow accumulation in a closed valley can cause ice dams, damaging the roof tile and creating potential leaks.**

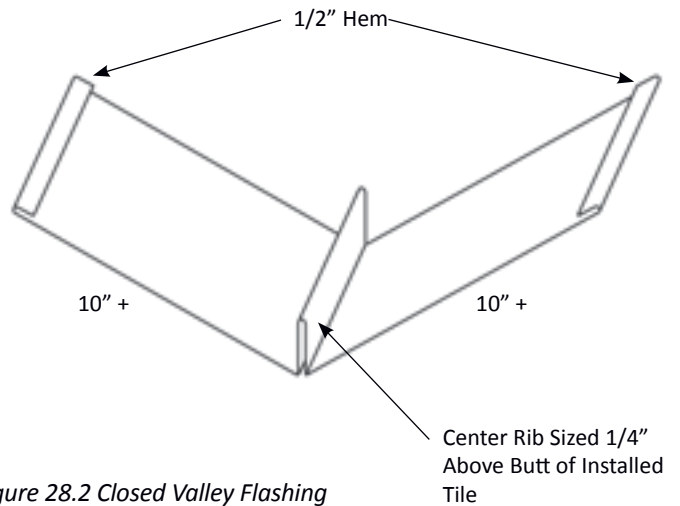


Figure 28.2 Closed Valley Flashing

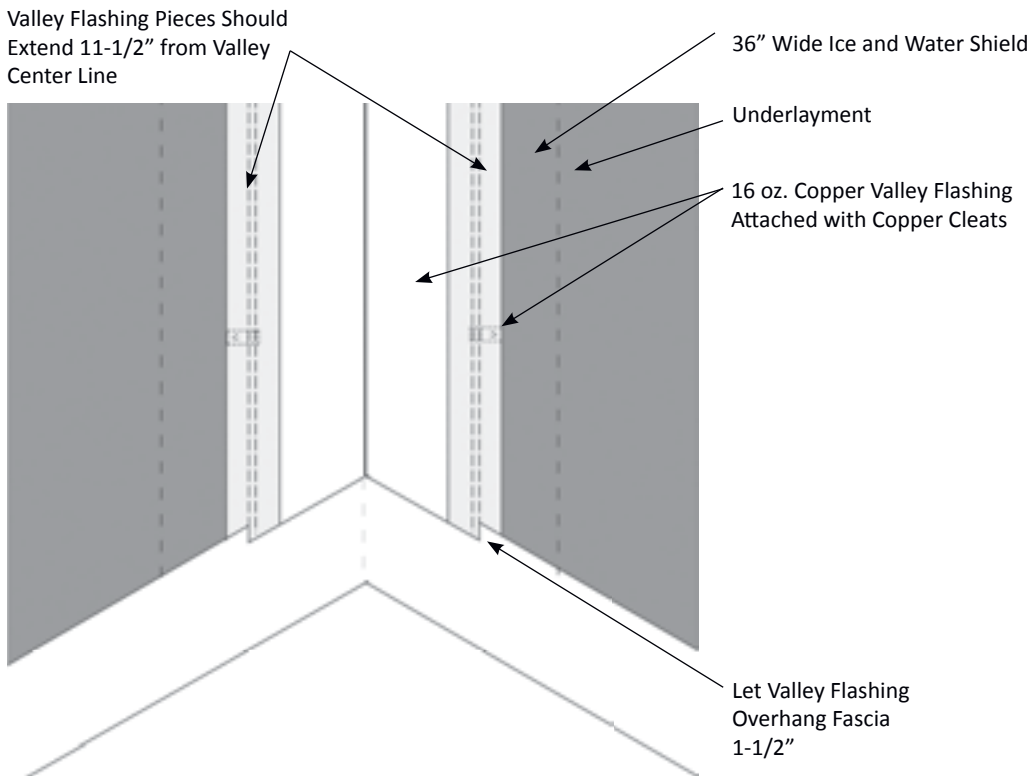


Figure 28.1 Closed Valley Detail

## Flashing at Side Walls

The transition from roof to side wall is flashed with Counter Flashing and Channel flashing.

### Channel or Pan Flashing

Channel or pan flashing, used with profile tiles, is designed to extend under the tiles rather than being interwoven between courses (see Figures 29.2, 29.3 & 29.4).

**The following procedures are used to install channel or pan flashing:**

1. Waterproof underlayment should be extended 6" up the vertical wall.
2. The copper flashing's vertical flange should extend approximately 4" up the wall.
3. Each length of copper channel flashing should extend a minimum of 8" over the underlying length of copper channel flashing.
4. The copper flashing channel should extend a minimum of 3" under the tile.
5. The copper flashing should be fastened through the vertical flange, near the upper portion at approximately 12" on center. (The flashing channel should not be penetrated with fasteners since it is acting as a gutter.)
6. The wall underlayment and the siding or cladding should be brought down a minimum of 2" over the upper portion of the vertical flange.

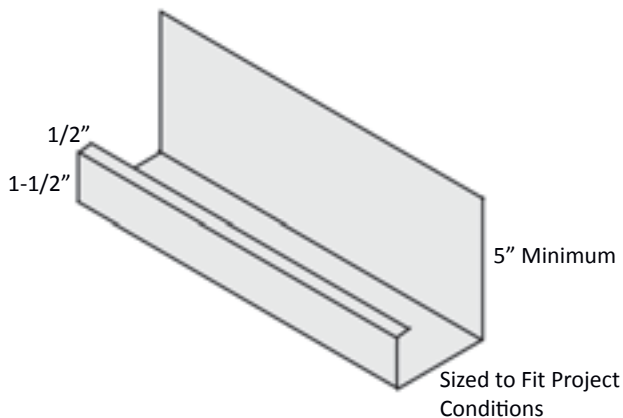


Figure 29.1 Side Wall Copper Channel Flashing

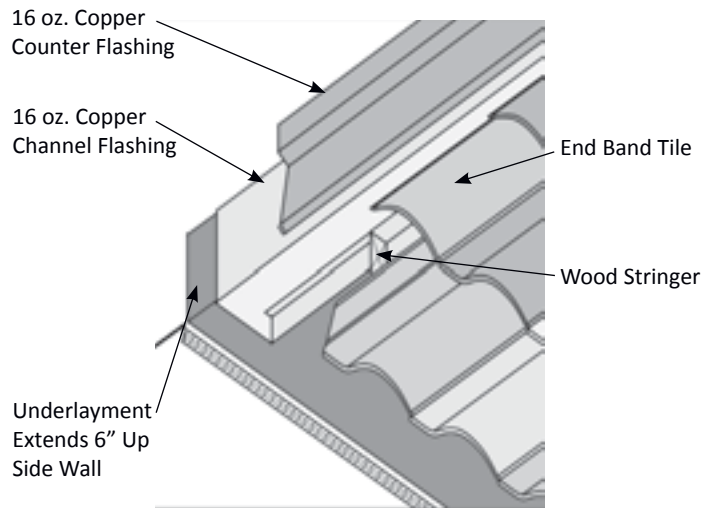


Figure 29.2 Left Side Wall Copper Flashing for Spanish Tile

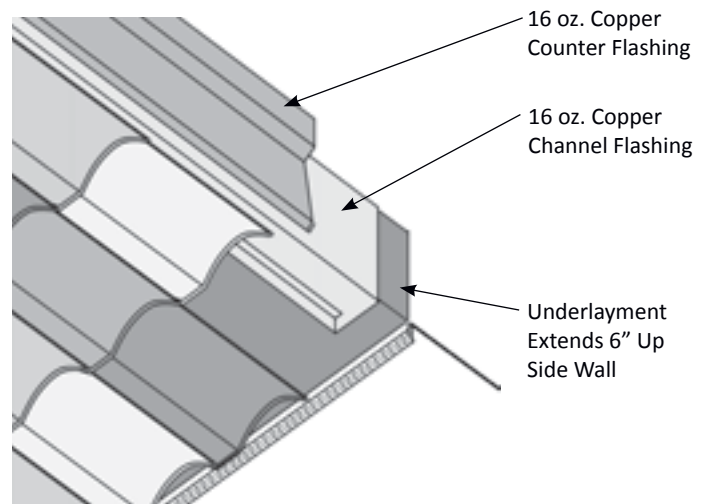


Figure 29.3 Right Side Wall Copper Flashing for Spanish Tile

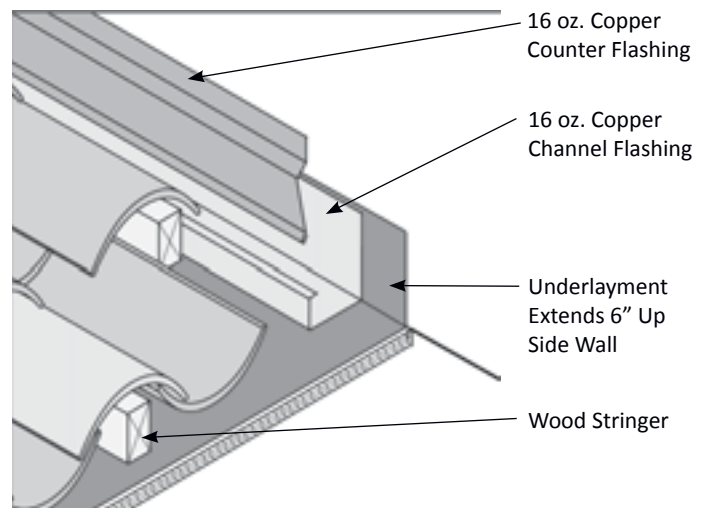


Figure 29.4 Side Wall Copper Flashing for Mission Tile

## Flashing at Open Valley at Main Roof to Dormer Juncture

For flashing where an open valley occurs at the intersection of a dormer roof and the main roof, the following steps should be taken.

1. The main roof tiles should be installed to just above the lower end of the valley, where the valley and the main roof intersect. Along the roof and wall juncture, channel flashing must be used and the last tile in the course should fit closely against the wall of the dormer. (see Figure 30.1).

2. The bottom end of the copper valley flashing should be cut so that it extends 1/2" below the down-slope edge of the dormer roof deck at the bottom of the valley. This lower cut edge should project a minimum of 2" below the intersection of the dormer and main roof.

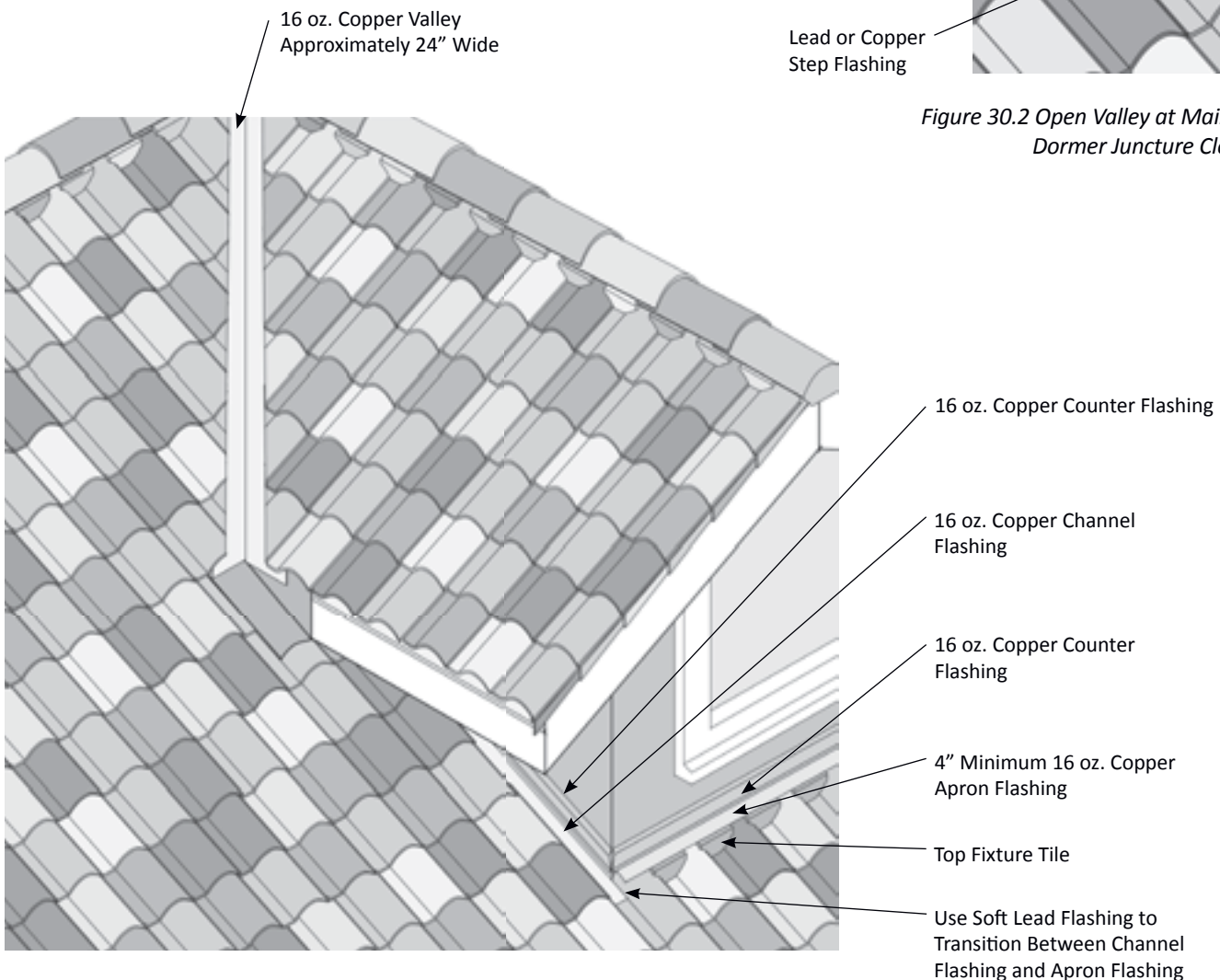


Figure 30.1 Open Valley at Main Roof to Dormer Juncture

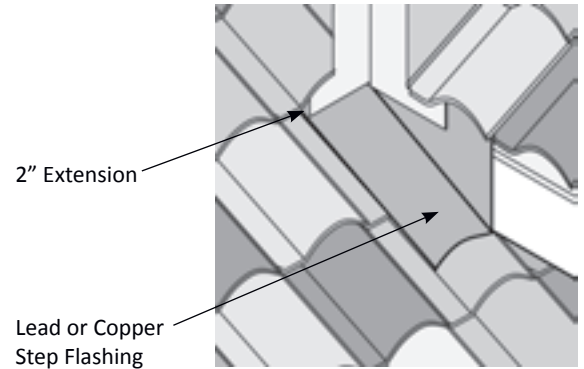


Figure 30.2 Open Valley at Main Roof to Dormer Juncture Close-up

## Flashing at Head Wall

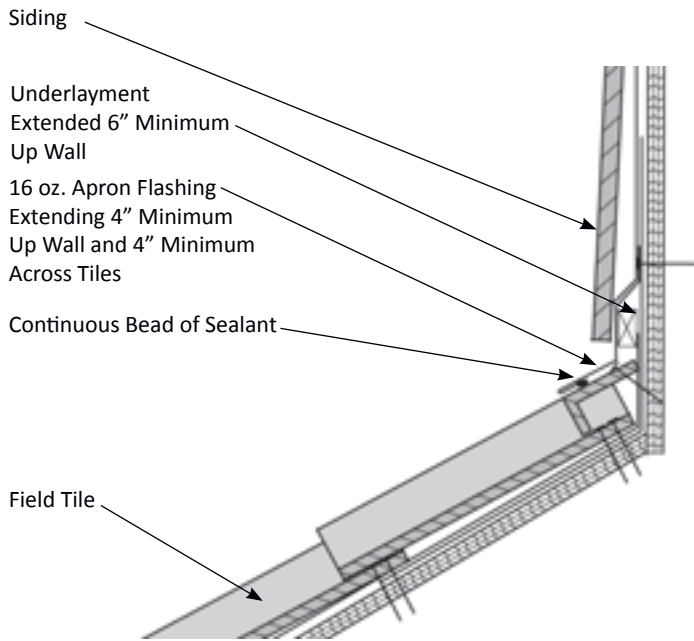


Figure 31.1 Apron Flashing at Siding Head Wall Detail

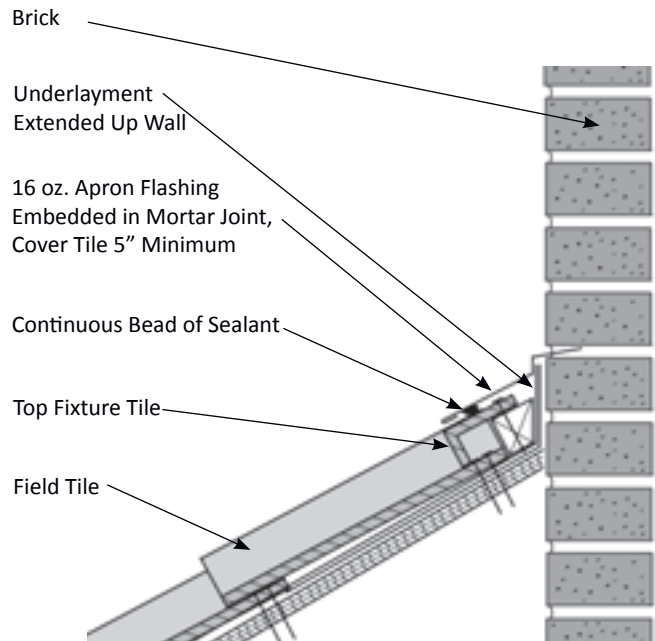


Figure 31.3 Apron Flashing at Brick Head Wall Detail

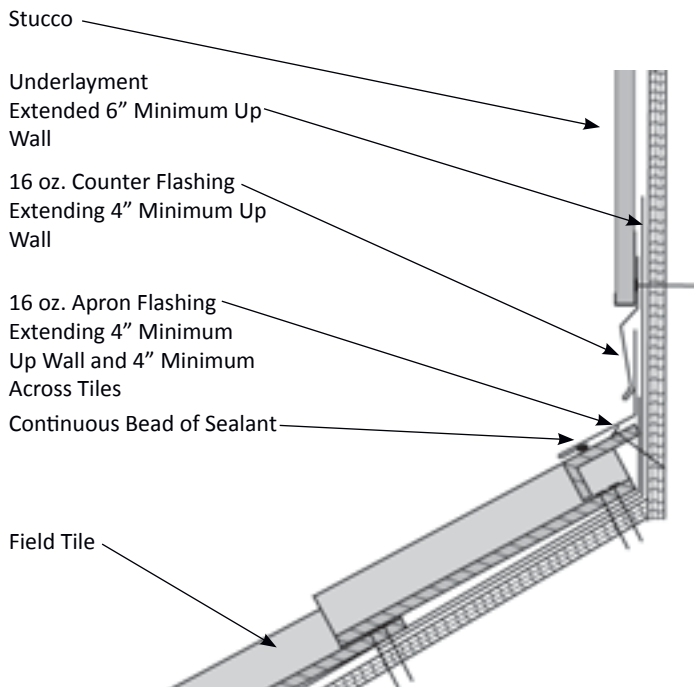


Figure 31.2 Counter Flashing & Apron Flashing at Stucco Head Wall

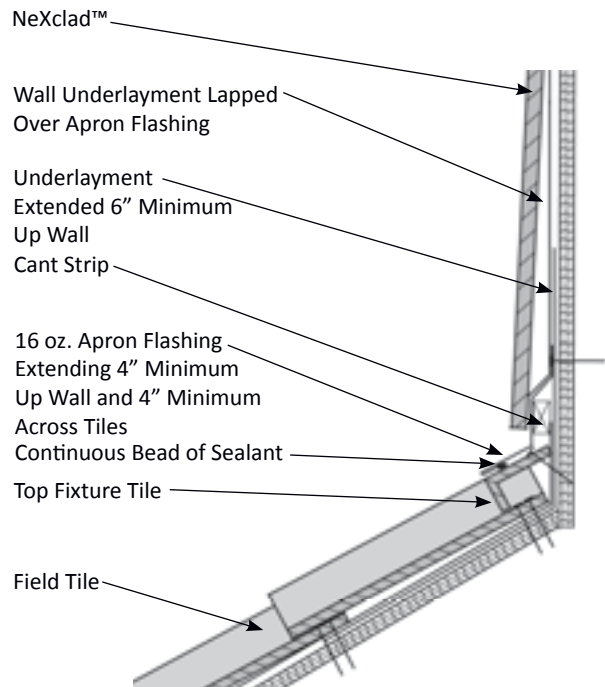


Figure 31.4 Apron Flashing at NeXclad™ Head Wall

## Flashing at Chimney

Since the foundations of chimneys are usually structurally separate, the flashing around chimneys needs to be able to accommodate movement from differential settlement without compromising the watertightness of the roof. Regardless of the climate, install self-adhering Ice and Water Shield membrane around the base of the chimney before the underlayment is applied as a protection against ice dams. Four types of flashing are required to properly flash around chimneys.

1. Apron flashing at the down slope face over the installed tiles – 4" minimum exposed width, 4" up the face of the chimney and continuously counter flashed.
2. Channel flashing along the sides of the chimney (see Figures 32.1 and 32.2).

3. Cricket or backer flashing on the upslope side or back.
4. Continuous counterflashing embedded in masonry joints.

### Counterflashing

Sheet copper counterflashing should be installed to overlap all vertical flashing flanges extended up the sides of chimneys. This is best accomplished by the mason during construction.

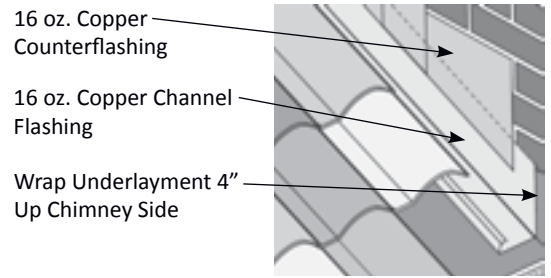


Figure 32.2 Chimney Side Flashing

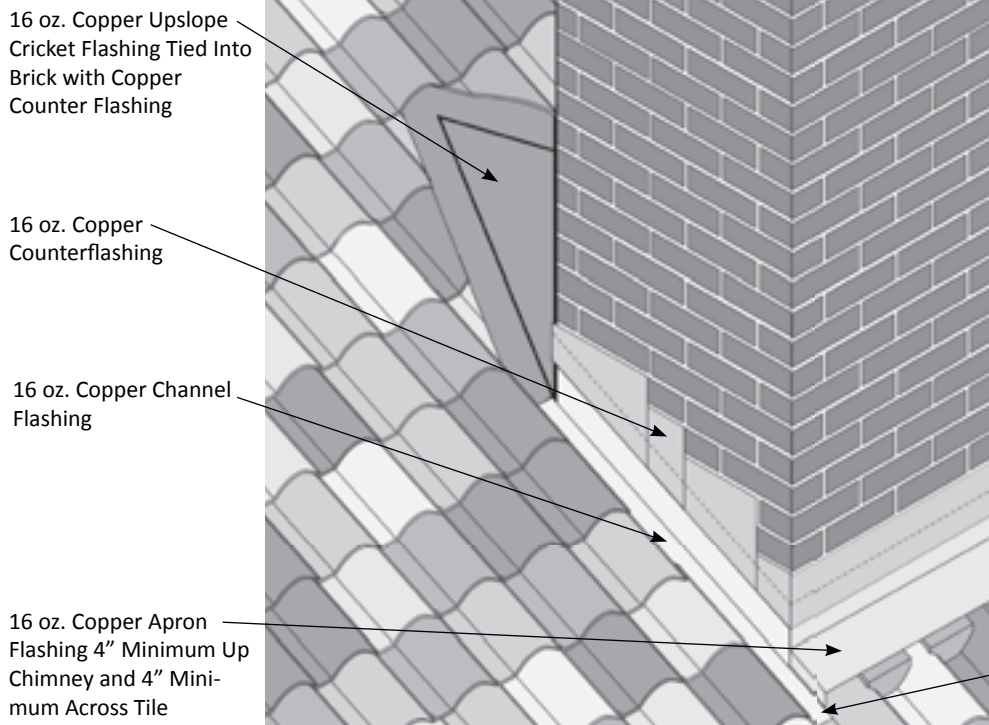


Figure 32.1 Chimney Flashing

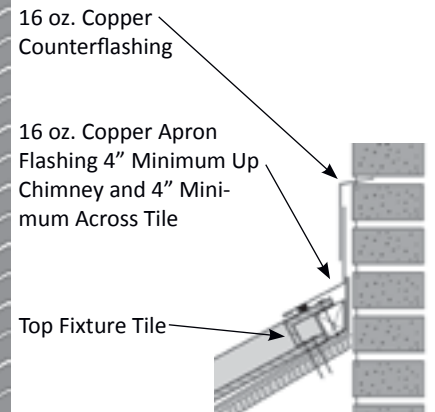


Figure 32.3 Chimney Face Flashing

Use Soft Lead Flashing to Transition Between Channel Flashing and Apron Flashing



## Additional Flashing Details

Plumbing pipe vents and stacks, skylights, roof-to-roof transition and other penetrations all require special flashing.

**NOTE: Be sure to order Skylights with a flashing package specifically designed for tile roofs and to accommodate the combined thickness of the layers of Barrel tile specified.**

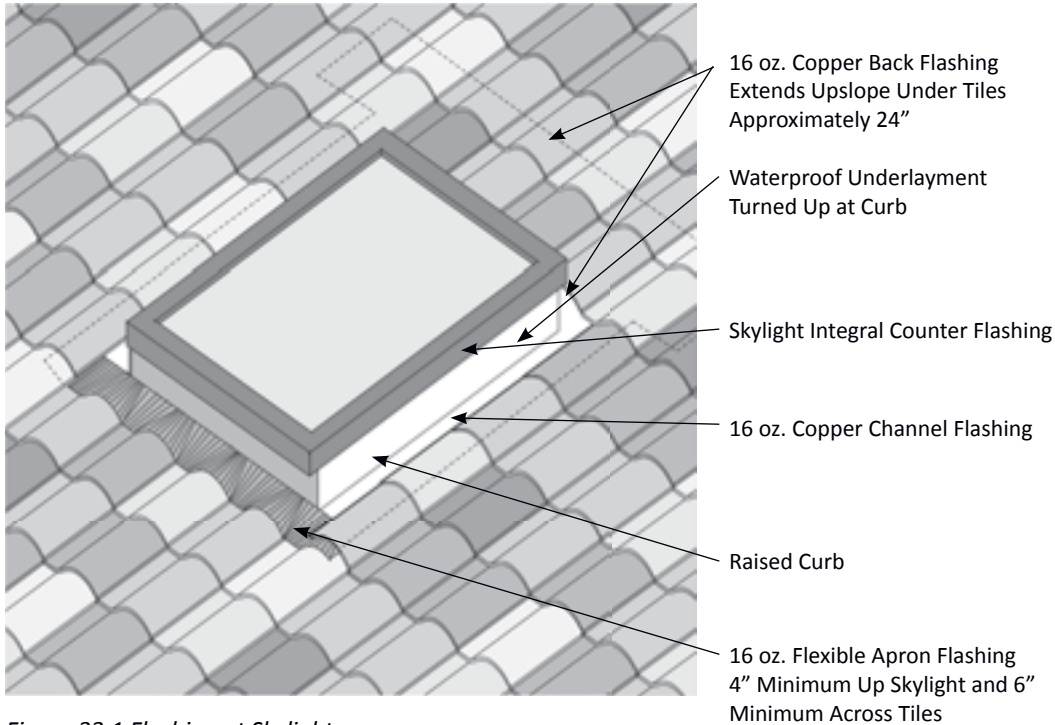


Figure 33.1 Flashing at Skylights

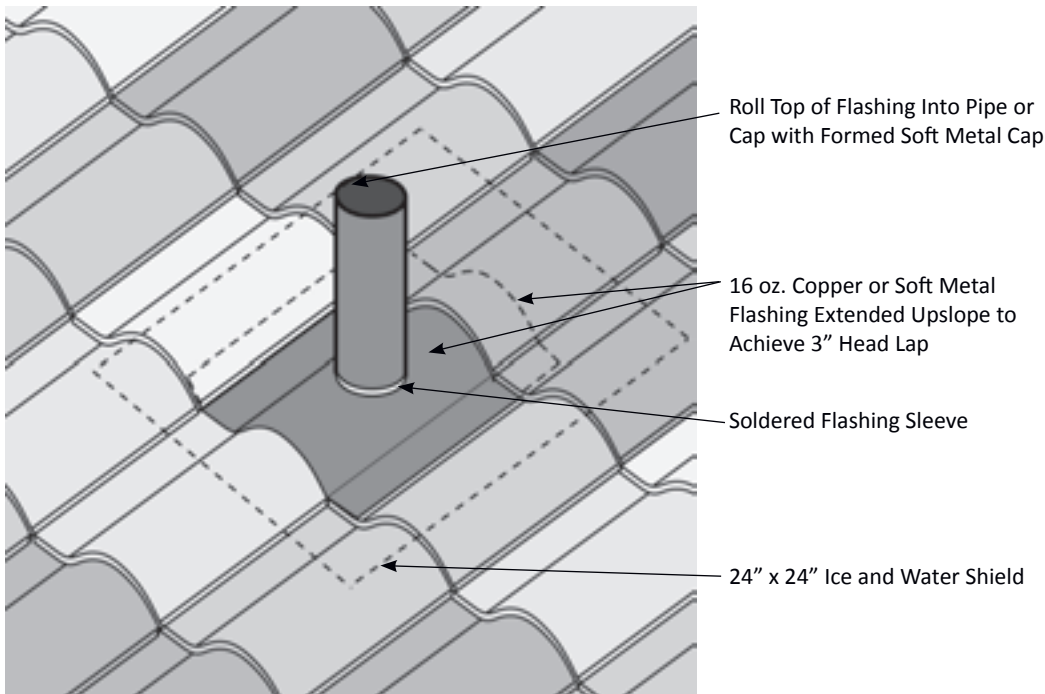


Figure 33.2 Flashing at Vents

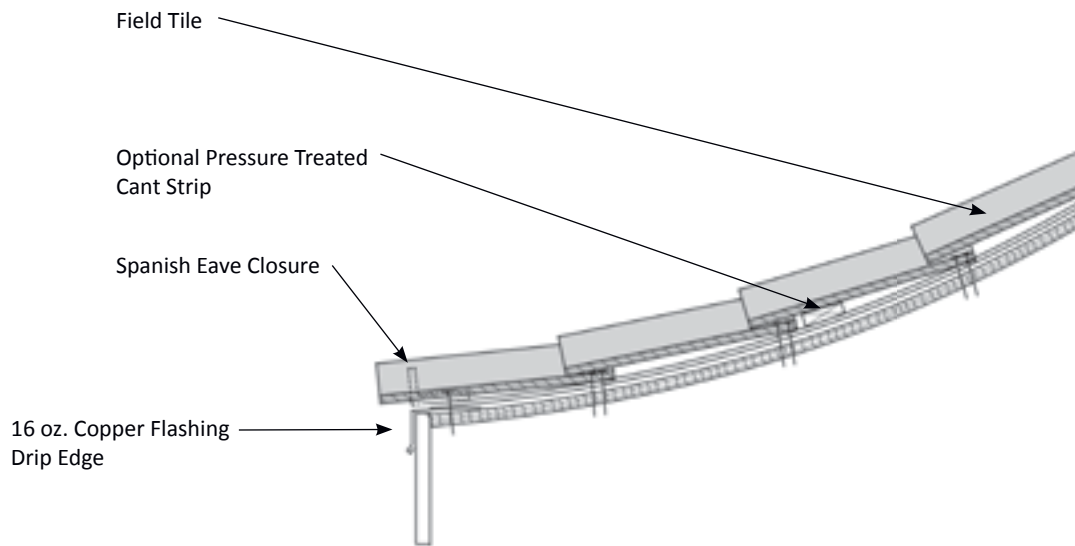


Figure 34.1 Curved Rafter Section

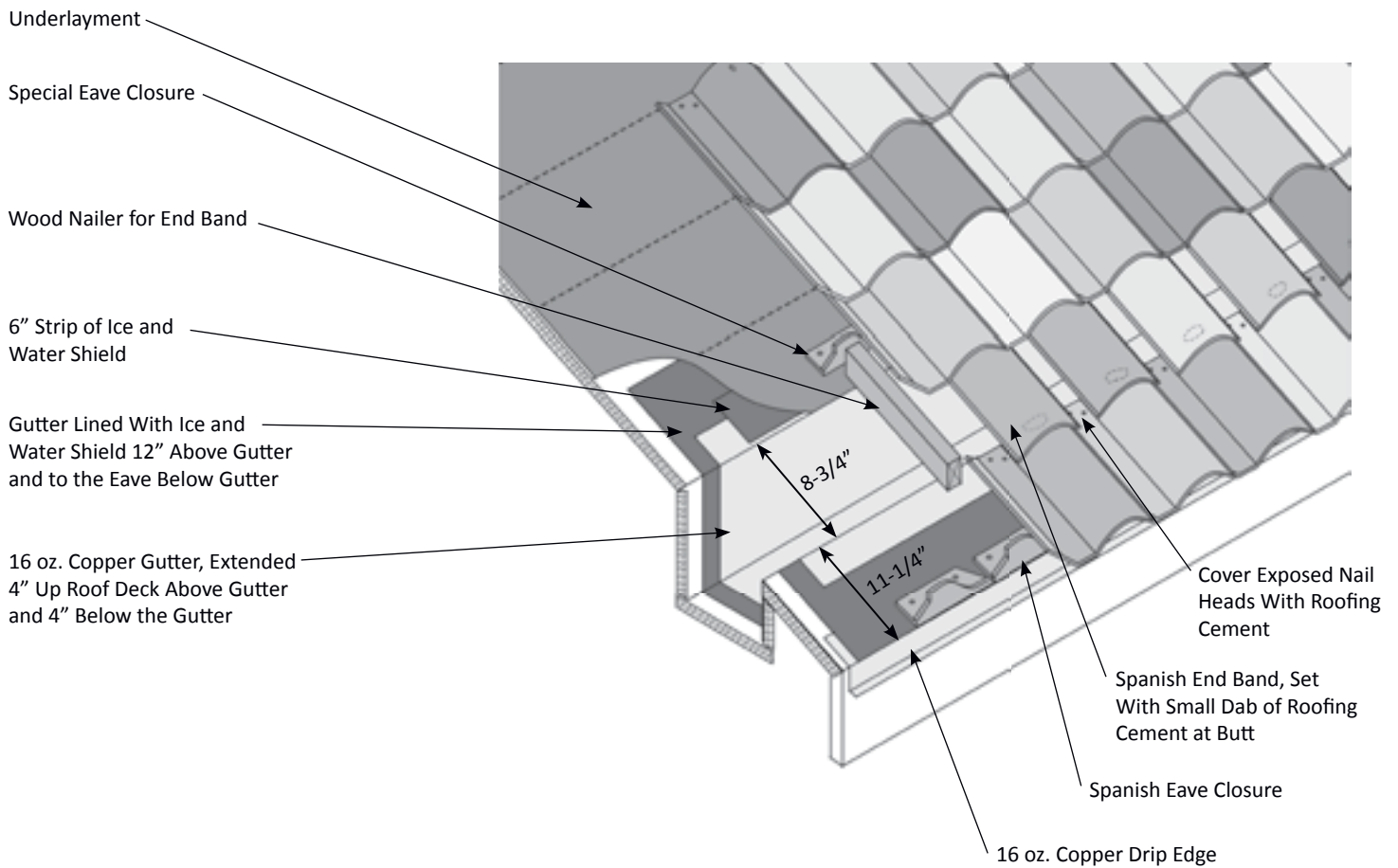


Figure 34.2 Built in Gutter Detail for Spanish Tile

# Spanish Tile Installation

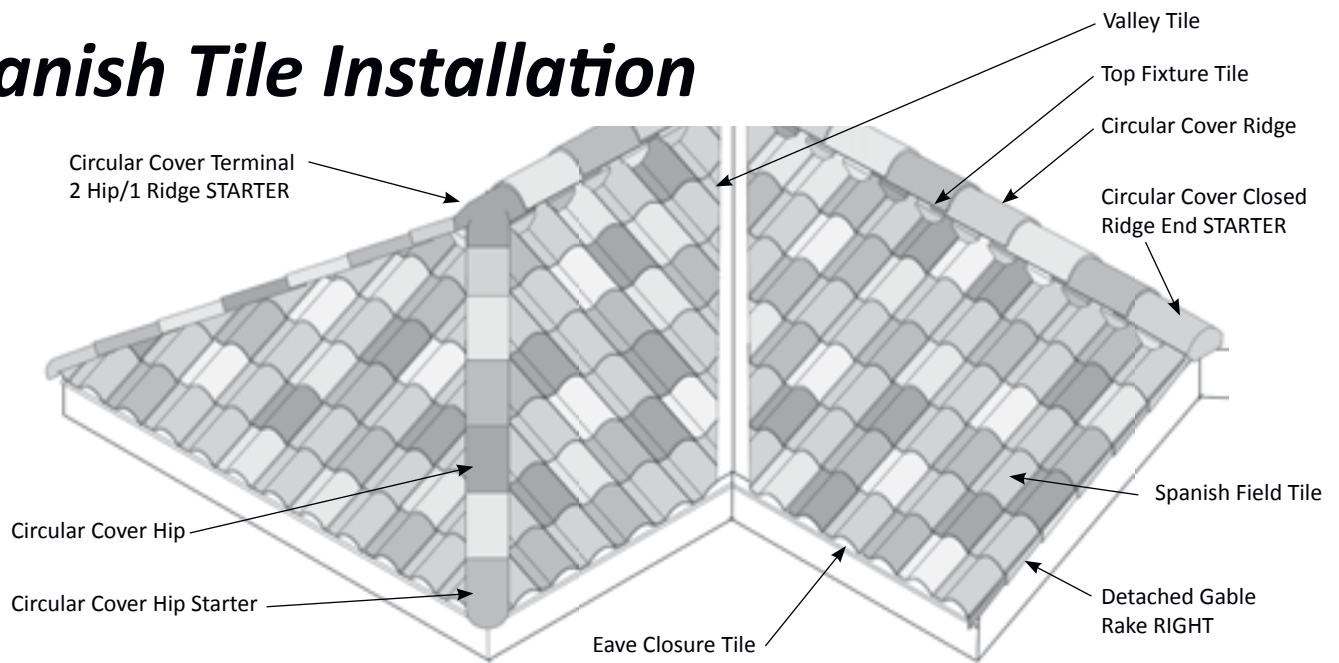


Figure 35.1 Spanish Tile

## **IMPORTANT:**

**Before starting tile installation, it is important that the roofer understand how the Spanish tile pattern being installed relates to the roof design.**

**The following roof preparations must be completed before installing any roof tile.** For detailed information on these items refer to the previous sections in this book or the NRCA Manual on Steep Roofing. The NRCA Roofing Manual: Steer Sloper, Reckne Systems.

- Install the flashings required for ensuring watertightness:
  - Eave Flashing
  - Rake Edge Flashing (if required)
  - Valley Flashing
  - Dormer and Sidewall Flashing, Skylight Flashing, Chimney and Cricket Flashing
  - Vent Flashing
- Underlayment for the entire roof deck, including the appropriate waterproof underlayments required for all flashing and, where required, the ice dam membrane
- All cant strips and Hip and Ridge stringers should be installed and covered in underlayment

- Roof surface chalked with vertical and horizontal lines
- **To avoid damaging the new roof adjoining walls, chimneys and other above the roof line components of the structure should be complete prior to installing the tile to minimize other trades traversing the completed roof.**

**NOTE: Spanish tile utilizes either rolled rake tiles or detached gable rake tiles for both the right and left sides of the gables. Therefore, rake edge flashing is not required when these tiles are used.**

**NOTE: Especially Watch this tile for unsightly “snaking” that can occur due to size variations in the tile. Adjust as necessary using chalk lines as guides.**

**NOTE: Each Spanish field tile is provided with (2) two fastening nail holes. When installing field tiles or accessories care should be taken to fasten each tile with nails or screws in every provided fastening hole.**

## Instructions Specific to Installing Spanish Tile (S-Tile)

### End Band Nailer Strips (Stringers)

Spanish Tile (S-Tile) require only one nailer strip within the field of tile and it is to serve as a nailer strip and support for the end band tile. This nailer strip should be pressure treated wood sized nominal 2" x 2" or 1 1/2" x 2" (actual size).

**NOTE: The use of an end band with Spanish tiles is only required on the left side vertical termination or interruption of the field tile; ie. gable rake, chimney, dormer or a parapet wall.**

The nailer strip should be a pressure treated foundation-grade wood.

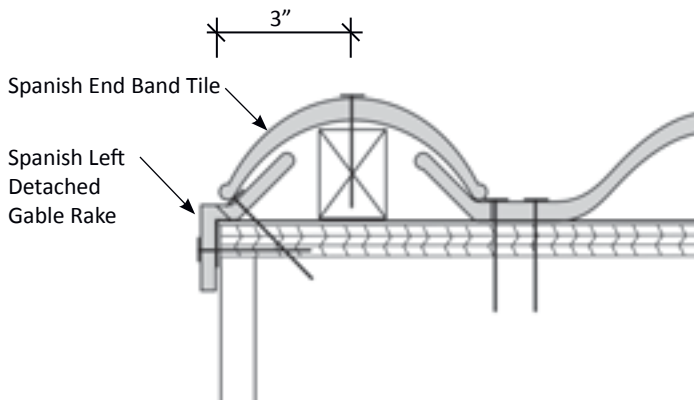


Figure 36.1 Spanish End Band Stringer Detail

### Hip and Ridge Stringers

Spanish tile requires a Hip and Ridge tile to complete the roof and are installed with a nominal 2" wide wood stringer. All stringers should be pressure-treated foundation-grade wood and should be covered with an 18" wide, self-adhesive modified bitumen membrane (Ice and Water Shield). See Chart 36.3 to determine the correct height of the nominal 2" wide material for the type of tile to be used at the hip and ridge. All wood stringers should be pressure-treated, foundation-grade wood. Roof pitch exceeding 14" rise to 12" run requires the contractor to measure the roof for stringer height.

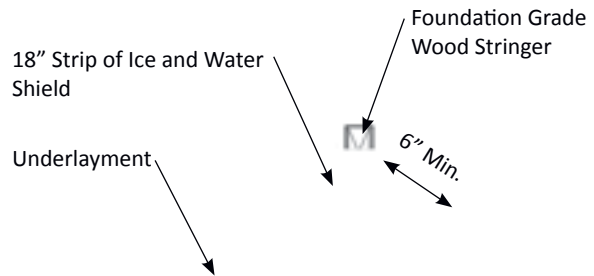


Figure 36.2 Ridge and Hip Stringer Detail

**Eave**

Installation of all the Ludowici Spanish tile requires Eave Closure Tile, Beveled Eave Tile or Mission Eave Tile. All three options are normally laid right to left. Normal practice requires the Eave Closure tiles to be laid flush with the eave and adjusted in from the right to allow for proper layup of the right rake tile and the first cover tile. Beveled Eave Tile are laid with a 2" overhang at the eave. Lay the Eave tile loose across the slope to the provided center to center width before nailing to determine what adjustments, if any, are needed in the course before nails or screws are installed.

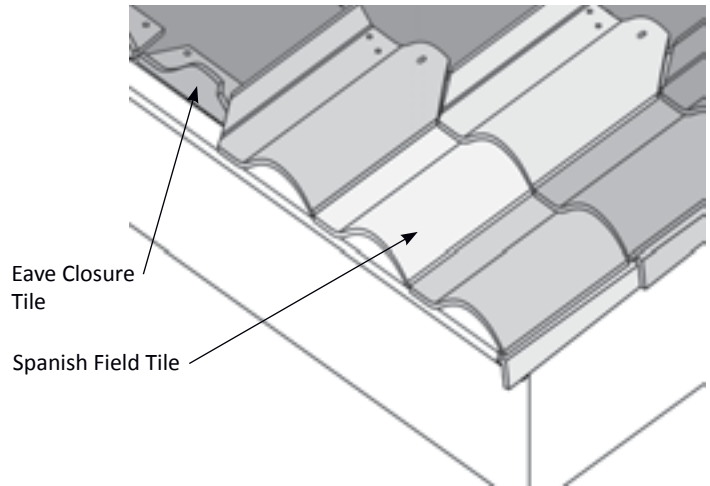


Figure 37.1 Spanish Eave Closure

**NOTE:** If the eave closures are being applied to a deck which includes a valley, and if special factory cut and closed valley tiles have been manufactured for the job, it is necessary to see special instructions provided on page 40.

**NOTE:** When rolled rakes are being installed in the first course of the tile, whether left or right, the eave closure next to these rake pieces will require some slight nipping and clipping for proper fit and installation.

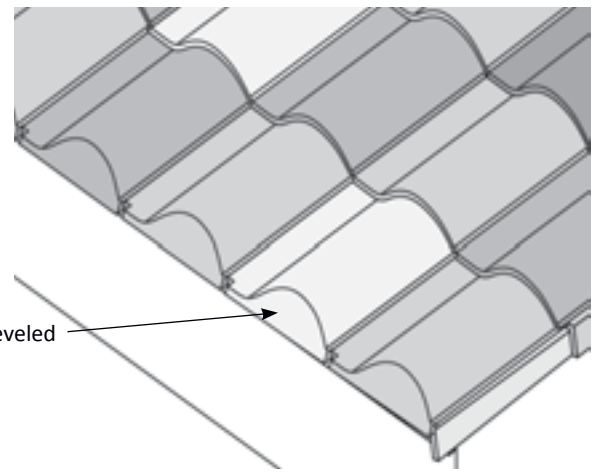


Figure 37.2 Spanish Beveled Eave Closure

After installing the right rake tile, the starter course will begin with a full tile placed directly over the first eave closure tile. The second course of the tile will lay up directly over the previously installed field tile to the proper exposure and with the normal 3" head lap.

**NOTE:** Each Spanish Field Tile is provided with (2) two holes in the flat portion of the tile for installation with nails or screws. A third hole (elongated) in the tile's barrel portion can be Special ordered for installation with the wire-tie system. When installing the field tile, care should be taken to fasten tiles through the specific required nail holes. Also, when accessories are installed every tile shall be fastened through each of the provided fastening holes.

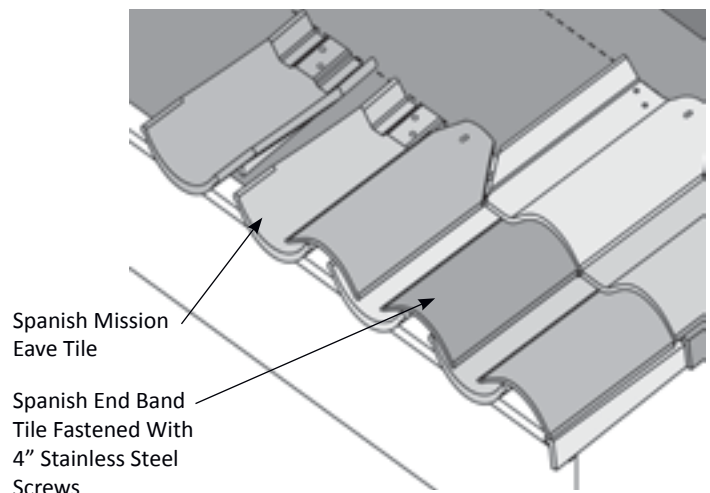


Figure 37.3 Spanish Mission Eave

### First and Succeeding Courses of Tile

Spanish tiles are normally laid from right to left starting with a Right Detached Gable Rake or Rolled Rake Tile. This first rake tile will need to be installed allowing a 2" overhang at the eave. The detached gable rakes are available in left and right hand versions. The rolled rakes are universal for both left and right gable rakes. All gable rake tiles shall be installed with fasteners typical of the field tile installations, but also require flashing cement (meeting ASTM D-4586 requirements) applied between all contact areas of the field tile and gable rakes. The Detached Gable Rake Tile to the right, when looking at the eave courses into the field tile, are the rights and vice versa.

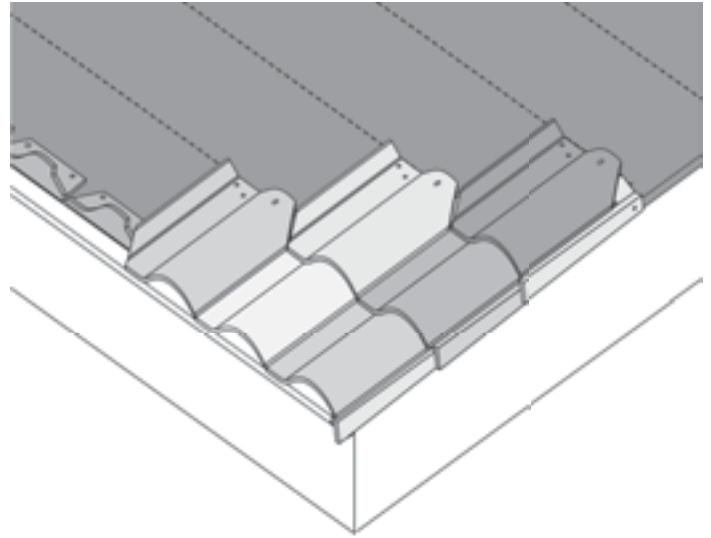


Figure 38.2 Spanish Field Tile Installation Sequence

### Ridge Closure

The void between the pan portion of a Spanish tile and the underside of the ridge is typically filled with a Spanish Top Fixture Tile or Spanish Flat Top Tile. The Spanish Top Fixture Tile is attached to the ridge stringer or can be attached to a deck mounted wood stringer, while the

Flat Top Tile is attached to a wood stringer under the top portion of the Flat Top Tile. If Top Fixtures are not specified, Portland Cement Mortar Type M and/or specialty metal closures also may be used. (Mortars shall meet requirements of ASTM specification C-270.)

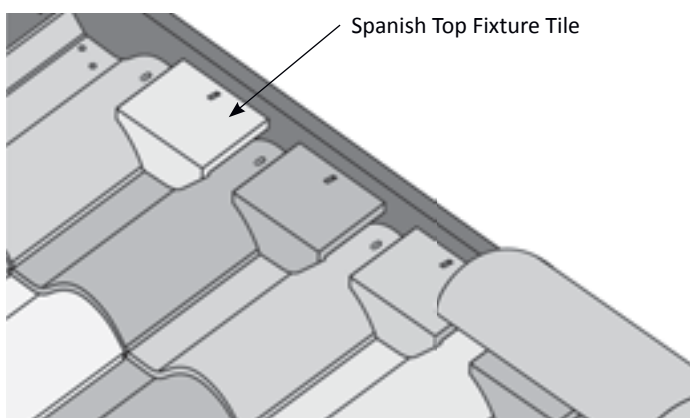


Figure 38.1 Spanish Top Fixture Detail

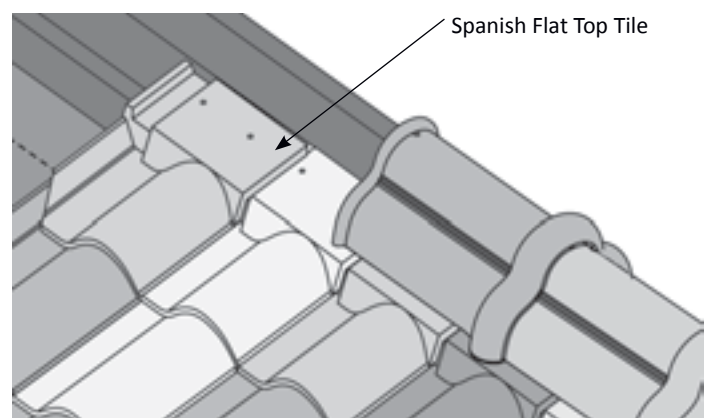


Figure 38.3 Spanish Flat Top Detail

**Rakes**

Before layout verify rake tiles furnished. Detached gable rake tiles are available for Spanish 13-1/4" tile. Rolled rakes are available for both Spanish 13-1/4" and 18-3/8". Scandia tile utilizes an attached gable rake that is integral to the first field tile adjacent to the rake. Careful spacing is required for a proper fit and look.

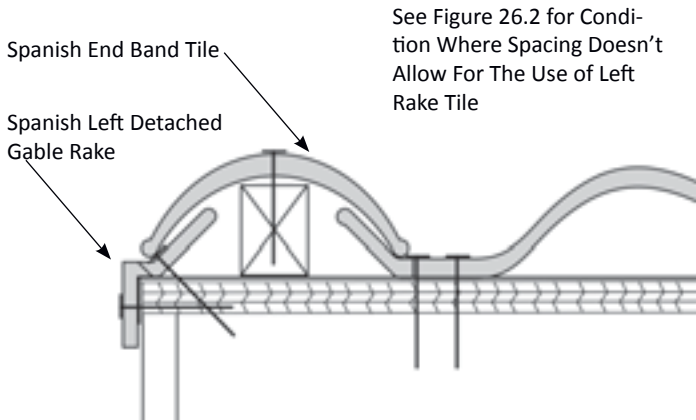
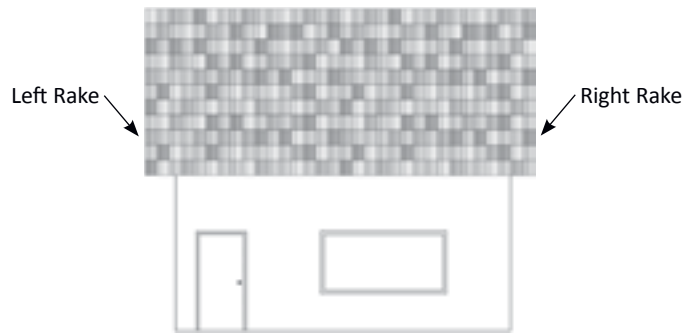


Figure 39.1 Spanish Left Detached Gable Rake Detail

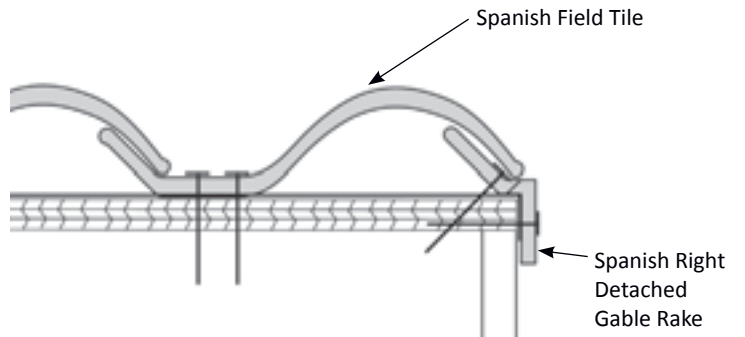


Figure 39.2 Spanish Right Detached Gable Rake Detail

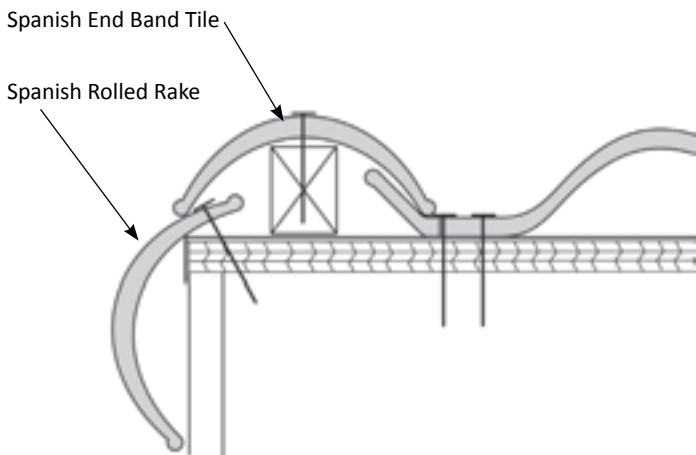


Figure 39.3 Spanish Left Rolled Rake Detail

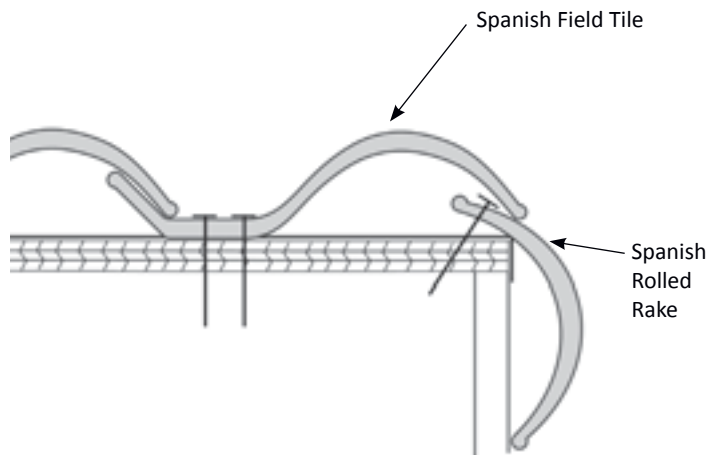


Figure 39.4 Spanish Right Rolled Rake Detail

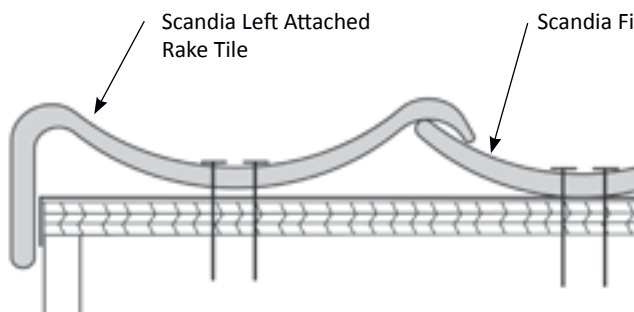


Figure 39.5 Scandia™ Left Attached Rake Detail

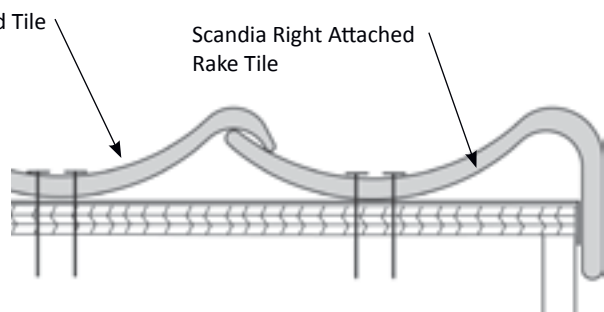


Figure 39.6 Scandia™ Right Attached Rake Detail

**Valley Tiles**

Tiles to be installed in valleys can be mitered in the field or special factory-manufactured cut and closed tiles can be used. These special cut and closed valley tiles generally result in less water entering underneath the tile. Whether field miter cut or special factory cut tiles are used, the tile fasteners should never penetrate the valley flashings. Tile to be installed over the copper valley flashing should be drilled or notched and wired with solid 16 gauge copper wire to fasteners driven into the deck beyond the flashing.

**NOTE: In situations where valley tile pieces are so small that it is not practical to notch or drill, use the adhesive RT600 (an OSI product) or its equivalent.**

If special factory cut and closed valley fittings are being applied, it will be beneficial to loose lay the entire eave closure course, including the valley tile prior to installation. This loose laying process of the valley's left side will advance as a typical installation would, from right to left. But when loose laying the valley's right side, it will

advance from left to right. The installation of the Spanish tiles will slow the process initially. Each tile when spaced on the deck will require a slightly upward lifting to allow for the proceeding tile to be laid into the next channel. Once the spacing is approved, the pace can return to the standard. The tiles can be fastened in the typical right to left pattern.

The loose laying process becomes vitally important when the roof deck runs from valley-to-valley. The focus must be to space the eave course so it consists of all full field tile and is finished on both ends with the special cut and closed valley tiles. Keep in mind not to allow any more than 5 pieces pulled to the extreme or crowded together.

If field mitered valley tiles are applied, they should be trimmed to provide a clean, even, continuous edge along the entire valley length.

**To encourage leaves and snow to slide down the valley, the gap between the Valley Tiles and the center line of the valley should be tapered from 3" at the top to 4" at the bottom, this can be increased for longer valleys.**

Chalk Line for Valley Tile Cut Line, Tapered

Underlayment

DO NOT Nail Through Copper Valley. Attach Small Valley Tiles With Copper Wire and Fasteners Placed Above Flashing, Apply Small Dab of Roofing Cement to Prevent Migration

Apply a Bed of Roofing Cement at the Lap to Small Valley Tiles to Prevent Migration

**NOTE: The Open Cavity at Field Cut Valley Tiles can be Pointed With Type "M" Mortar**

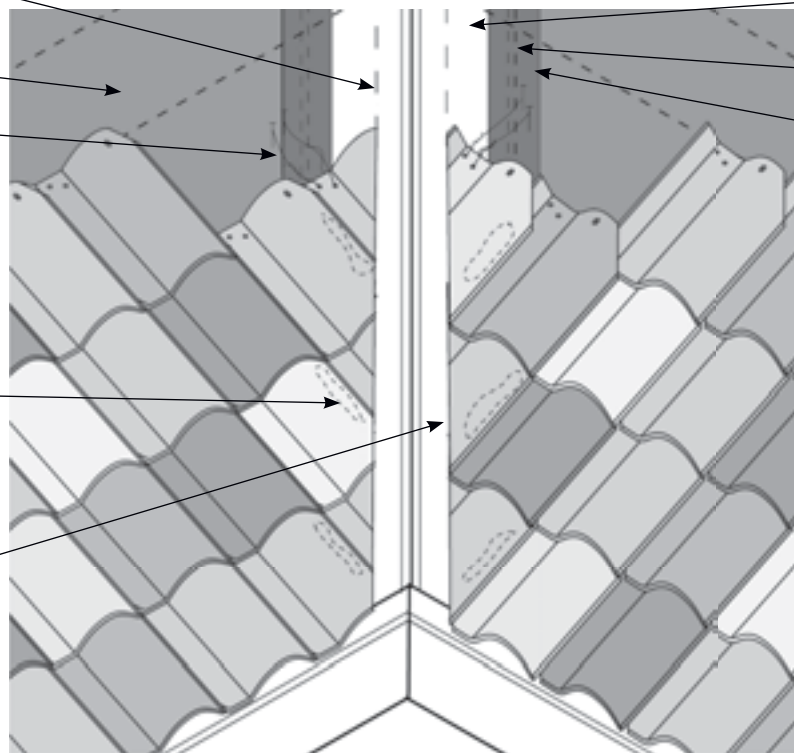


Figure 40.1 Spanish Valley

16 oz. Copper Valley Flashing With Hem  
Copper Cleats 24" O.C.  
6" Strip of Ice and Water Shield



Figure 40.2 Spanish Cut and Closed Valley Tile



Figure 40.3 Spanish Field Cut Valley Tile



**Hip Tiles**

The hip area is typically finished by using a combination of either a Circular Cover Hip Starter, Circular Cover and a Circular Cover Terminal or a 152 Hip Starter Tile, 102 Hip Roll Tile and 102/206 Hip and Ridge Terminal. Hips are started with a special Circular Cover Hip Starter Tile or 152 Hip Starter Tile covering the Field Tile approximately 3" on both sides. The hip tiles are then installed. The Circular Cover Tile creates a 3" head lap on the starter while the 102 tile creates an approximate 2" head lap over the starter tile. The specified head lap per tile is then

continued up the hip. Flashing cement must be used at the overlap of each hip tile. The gaps created between the Hip Roll and the Field Tile can be pointed with mortar tinted to match. The last fastener on the upslope end of the hip typically is covered with a Circular Cover Terminal or a 102/206 Hip and Ridge Terminal. These terminals must be specified as a starter or finisher depending on the direction of the ridge layout. Some roof termination may require a combination of typical flashing details or a special tile piece. Consult the local Ludowici sales representative with the project's special roof requirements.

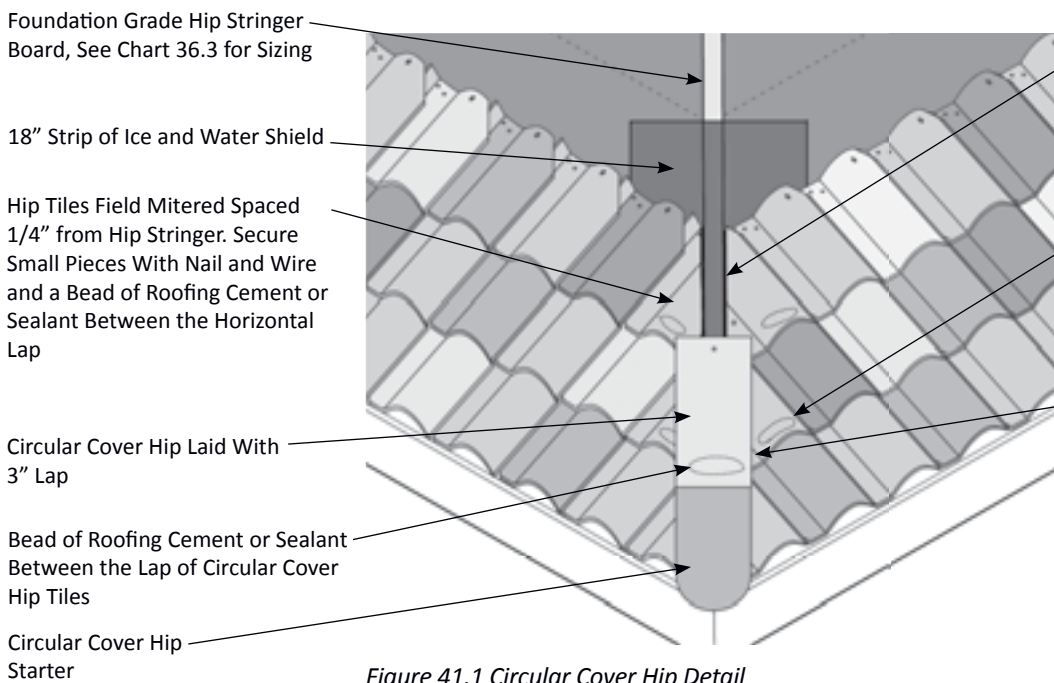


Figure 41.1 Circular Cover Hip Detail

Foundation Grade Hip Stringer Board See Chart 36.3 for Sizing  
 18" Strip of Ice and Water Shield  
 Hip Tiles Field Mitered Spaced 1/4" from Hip Stringer. Use Nail and Wire For Small Pieces. Also Secure With a Bead of Roofing Cement or Sealant Between the Horizontal Lap

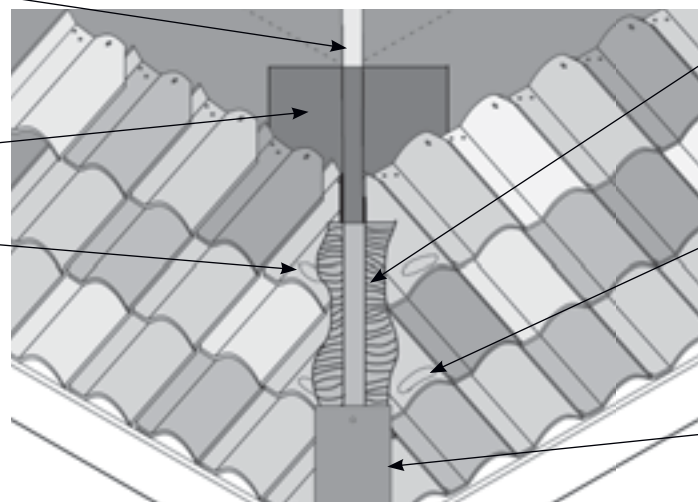


Figure 41.2 Circular Cover Hip Detail With FlexSeal™

Gap Between Hip Tile and Stringer Filled With Roofing Cement or Sealant Compatible with Ice and Water Shield  
 Apply a Bead of Roofing Cement or Sealant at The Horizontal Lap to Small Pieces to Prevent Migration

**NOTE: The Open Cavity Between the Field Tile Pan and Circular Cover Hip can be Pointed With Type "M" Mortar**



Figure 41.3 Mortared Hip Detail

FlexSeal™ Corrugated Flexible Copper Flashing with Integral Butyl Strip to Seal Flashing to Field Tile  
 Apply a Bead of Roofing Cement or Sealant at the Horizontal Lap to Small Pieces to Prevent Migration

Circular Cover Hip Starter

**Ridge Tiles**

The ridge for Spanish tile must be finished with a Circular Cover Tile, 206 Ridge Tile or one of Ludowici’s many historic ridge caps or cresting.

Circular Cover Tile or 206 Ridge Tile, see Chart 36.3 for dimensions of the stringers required.

Roofing cement must be used at the overlap of each Ridge Tile and where they rest on the field tile. Closed Ridge Ends, Circular Cover or 206 Ridge, or Terminal Circular Cover or 102/206 Hip and Ridge Tile are used to start and finish the ridge. The ridge finisher will have an exposed fastener which should be sealed with roofing cement meeting the requirements of ASTM D-4586. Some roof termination may require a combination of typical flashing details or a special tile piece. Consult the local Ludowici sales representative with the project’s special roof requirements.

**NOTE: It may be beneficial to lay out the chosen ridge system on the stringer to determine lap (no less than 2”). This will prevent having to traverse the installed tiles later.**

**Applying ridge tiles with the lap facing away from the prevailing winds helps the tile shed wind-driven rain.**

**NOTE: Circular covers are 16” Straight Barrel Mission field tile covers.**

Chart 42.1 Spanish Ridge and Hip Stringer Heights

Roof Pitch Rise:Run	102 Hip Roll	206 Ridge	Circular Cover Hip	Circular Cover Ridge
4:12	5”	6-1/2”	4-9/16”	3-3/4”
5:12	4-7/8”	6-1/4”	4-1/2”	3-5/8”
6:12	4-7/8”	6”	4-3/8”	3-1/2”
7:12	4-3/4”	5-3/4”	4-1/4”	3-3/8”
8:12	4-3/4”	5-1/2”	4-1/8”	3-1/4”
9:12	4-5/8”	5-3/8”	4”	3-1/8”
10:12	4-5/8”	5-1/4”	3-15/16”	2-7/8”
11:12	4-5/8”	5-1/8”	3-15/16”	2-3/4”
12:12	4-1/2”	5”	3-7/8”	2-5/8”
13:12	4-1/2”	4-7/8”	3-7/8”	2-1/2”
14:12	4-3/8”	4-3/4”	3-13/16”	2-1/4”

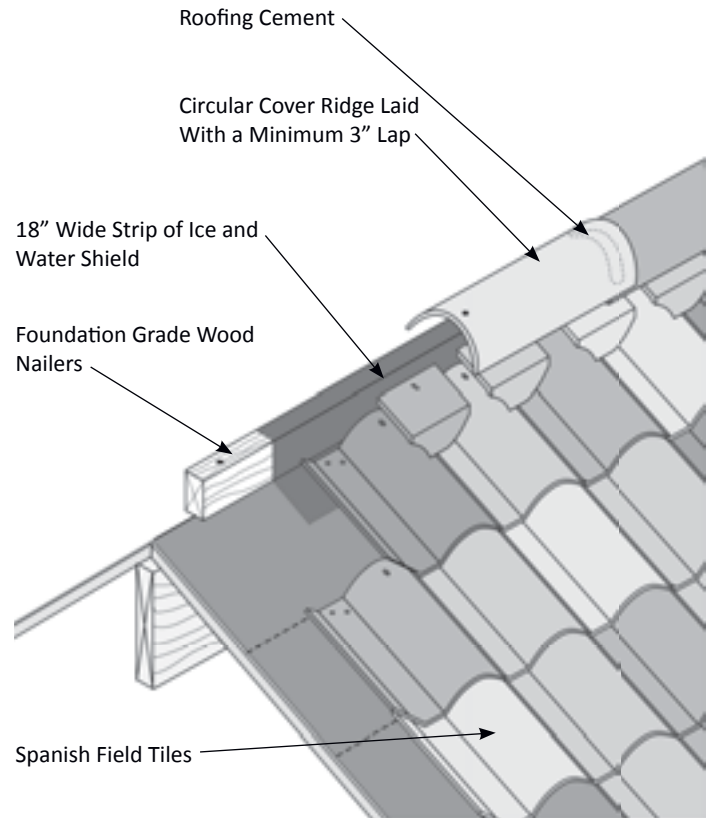


Figure 42.1 Circular Cover Ridge Detail

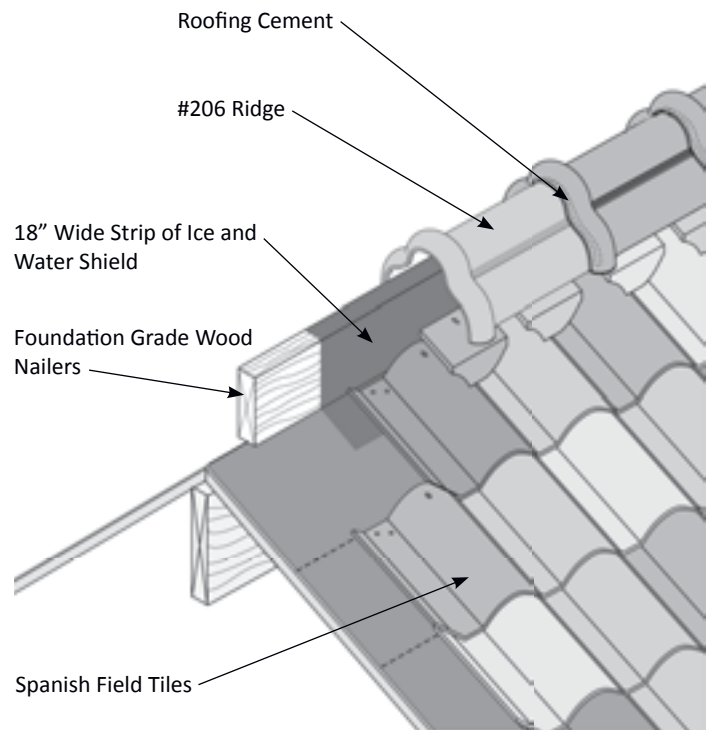


Figure 42.2 #206 Ridge Detail

**Circular Cover Vented Ridge**

This ridge vent allows 6.27 square inches of ventilation per foot of ridge.

**Minimum Roof Pitch 6:12**

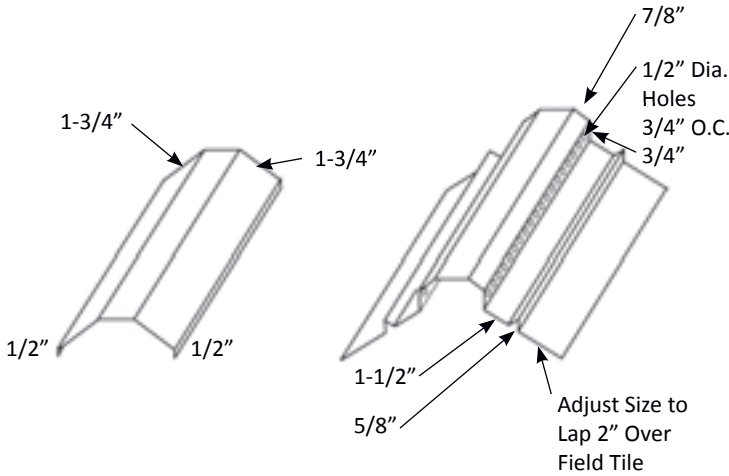


Figure 43.1 Circular Cover Vented Ridge Cap Flashing

Figure 43.2 Circular Cover Vented Vent Flashing

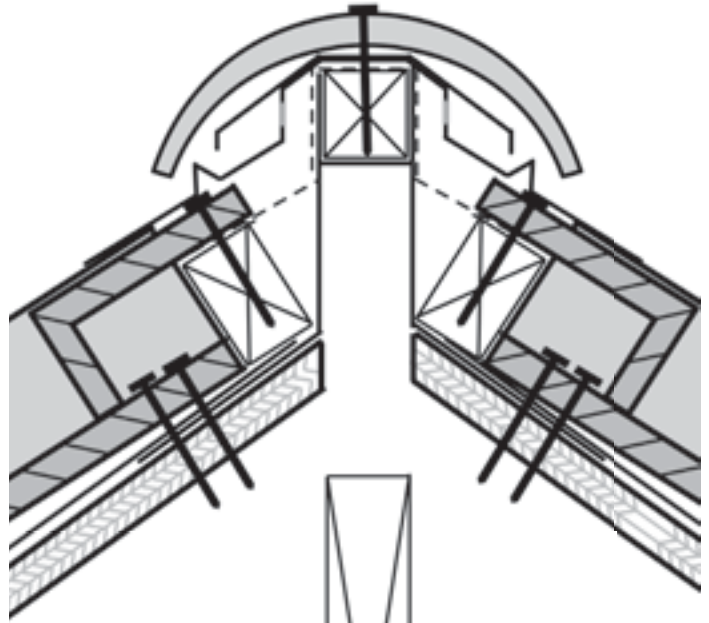


Figure 43.3 Circular Cover Vented Ridge Section

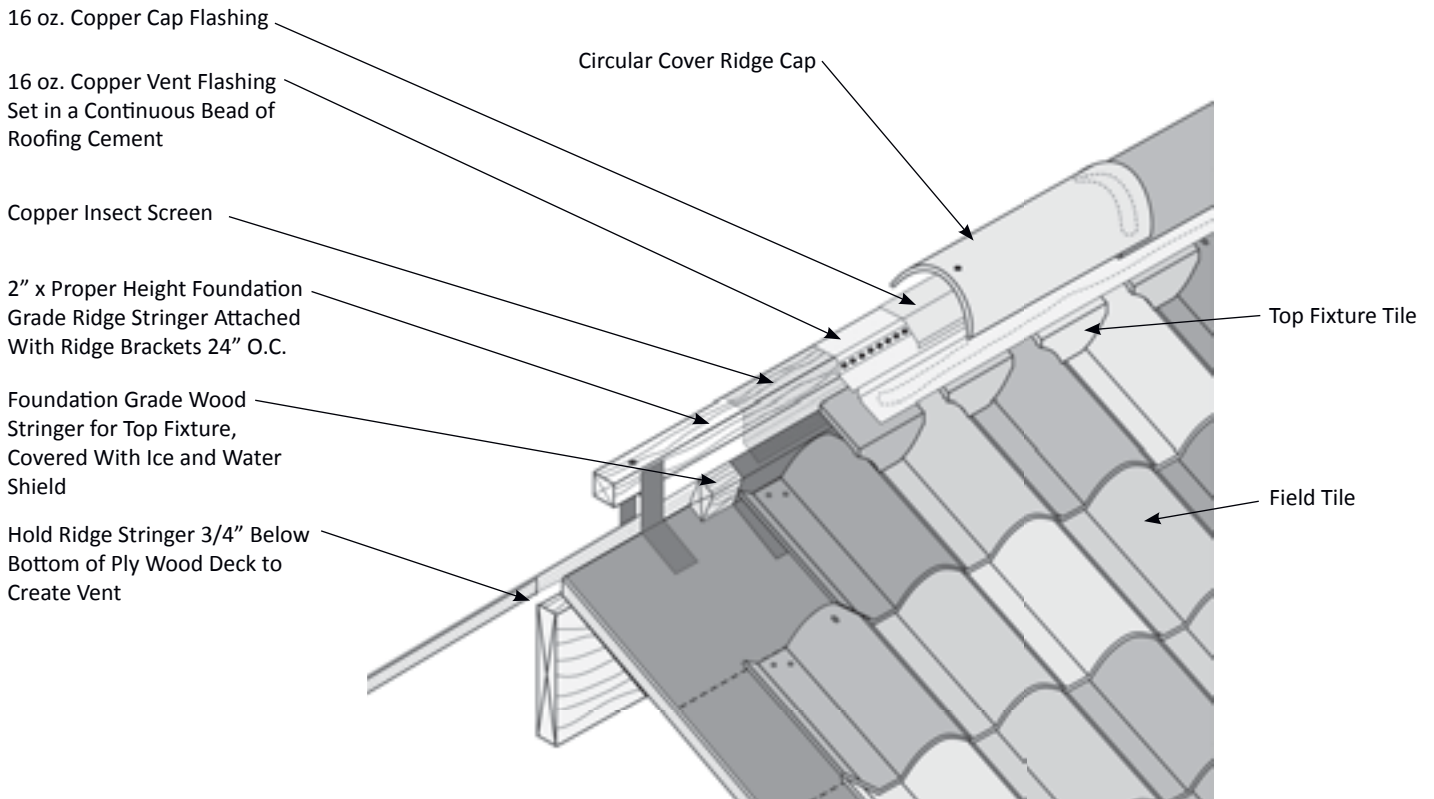


Figure 43.4 Circular Cover Vented Ridge

**#206 Ridge Vented Type-1**

This ridge vent allows 6.27 square inches of ventilation per foot of ridge.

**Minimum Roof Pitch 6:12**

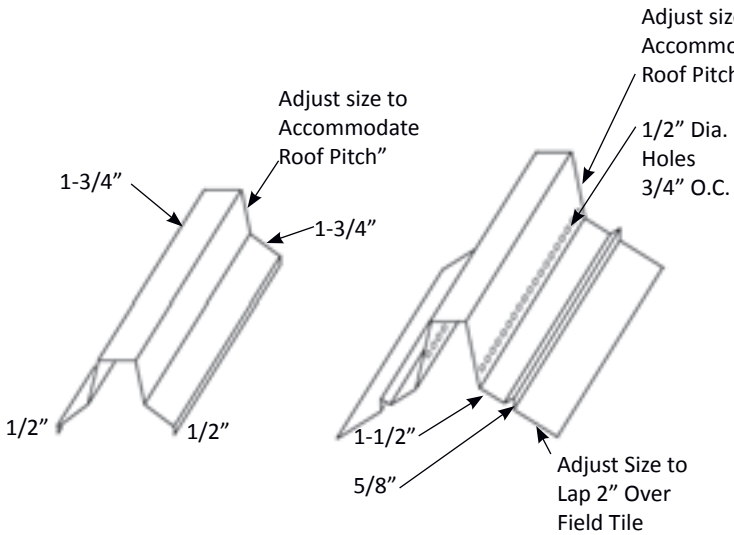


Figure 44.1 #206 Ridge Vented Ridge Cap Flashing

Figure 44.2 #206 Ridge Vent Flashing

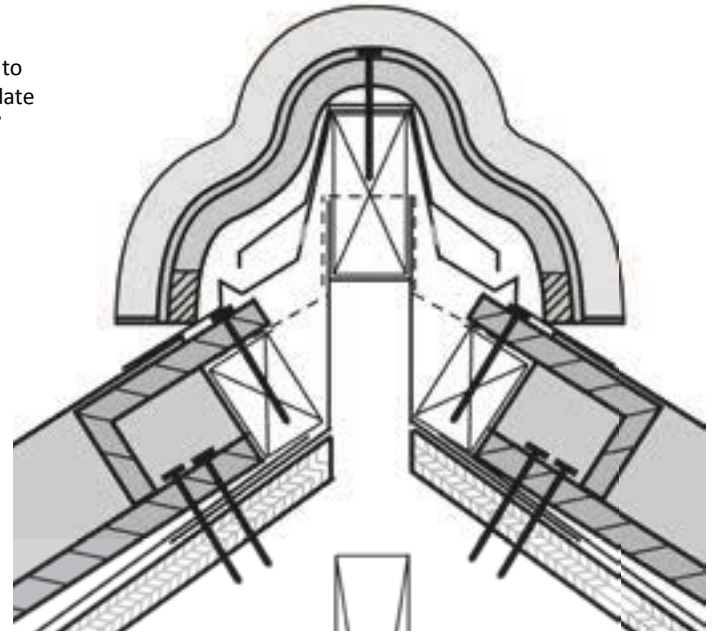


Figure 44.3 Valley Detail

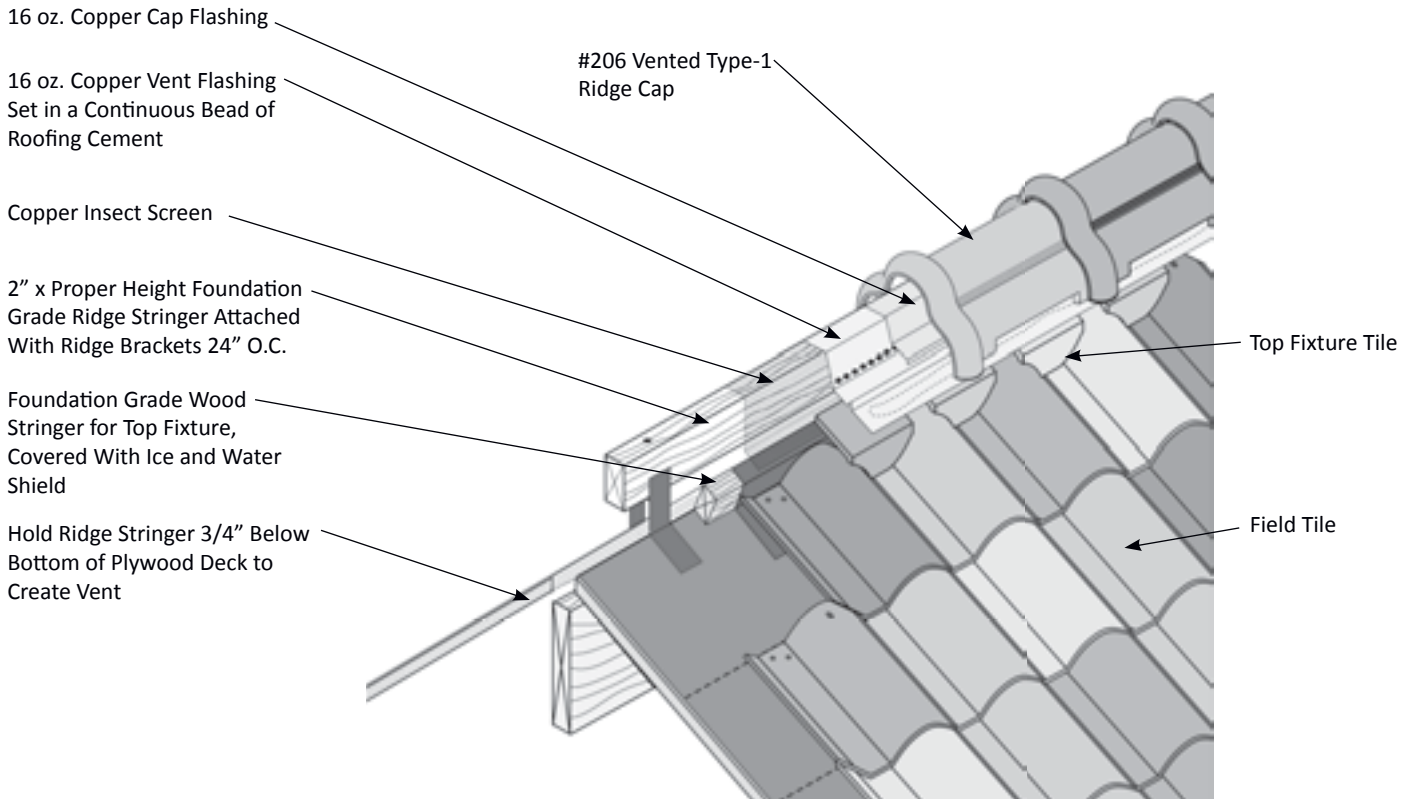


Figure 44.4 #206 Ridge Vented Type-1

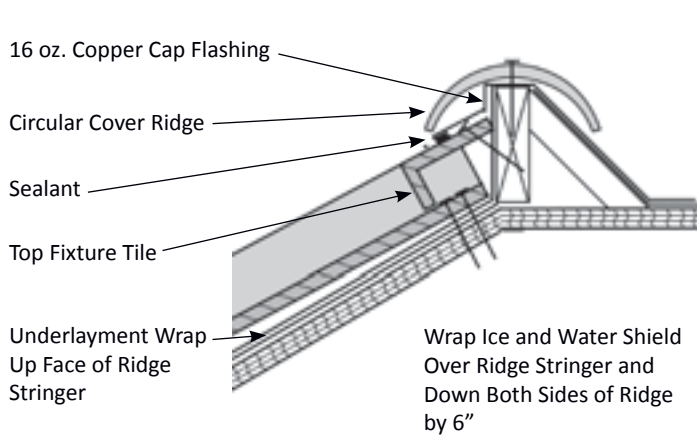


Figure 45.1 Deck Section With Circular Cover Ridge

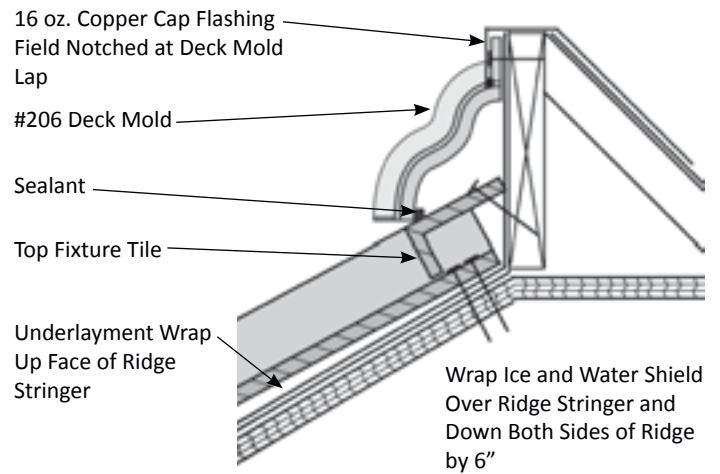


Figure 45.3 Deck Section With #206 Deck Mold

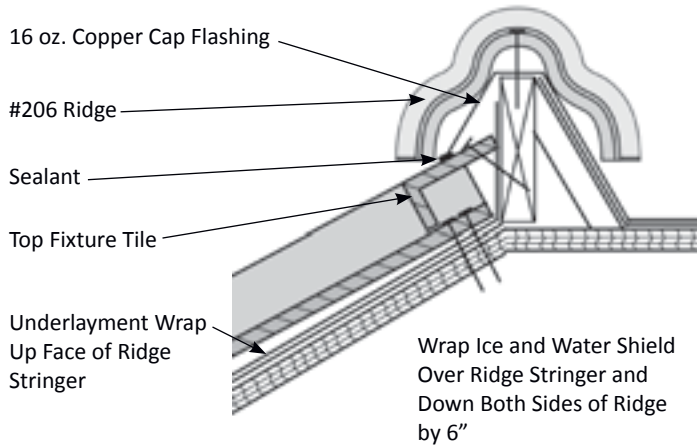


Figure 45.2 Deck Section With #206 Ridge

**Points to Remember During Tile Installation**

Field tile installation will generally progress in a diagonal fashion, moving from right to left. The installer applying the lower course will always be to the left of those applying succeeding courses.

- Use the chalk lines as a guide.
- Watch for any irregularities in the roof deck construction.
- After the installation of about 75-100 tiles, the roof should be inspected from the ground at a distance greater than 40 feet to determine that there are no streaks or blotches. To ensure a good range of tones, this inspection must be done at regular intervals.
- When each course is 10-12 tiles from the end of the course, check the distance to the end with the width of the tile to determine if a slight crowding or stretching of the tile may be required to ensure a proper fit or size of the final piece of tile installed in that course. DO NOT crowd or pull to the extreme anymore than 5 or 6 pieces positioned side by side.

**Terminals**

Ludowici makes ridge end caps for all trim groups. Ridge end caps come as a starter or finisher, (a male/female lap). Care should be taken to determine correct orientation of the parts ordered and the proper installation sequence to accommodate the installation with minimal cutting.

Ludowici manufactures Terminals to accommodate Ridge and Hip transitions. These are the most effective way to waterproof the transition and finish it in an aesthetically pleasing manner. Terminals are also made with a starter/finisher.

**Vertical Wall Application**

Flat Shingle or Interlocking tile can be used on a vertical surface. For shingle tile, short tops and long tops and under eave cant strips are used. For interlocking tile, use cant strips where needed.

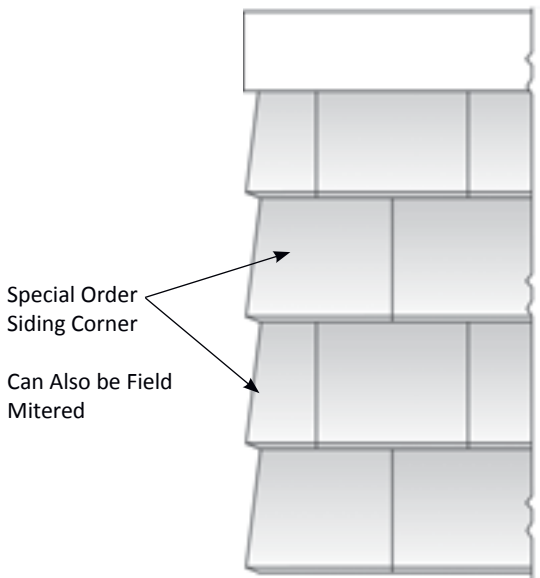


Figure 46.1 Vertical Wall Corner



Figure 46.2 Ridge Starter Finisher Diagram

**Examples of Some Typical Terminals:**



Figure 46.3 102/206 2 Hip/1 Ridge Terminal FINISHER



Figure 46.4 102/206 2 Hip/1 Ridge High-Bump Terminal FINISHER



Figure 46.5 #405 Gable Terminal STARTER



Figure 46.6 102/206 1 Hip/2 Ridge Terminal

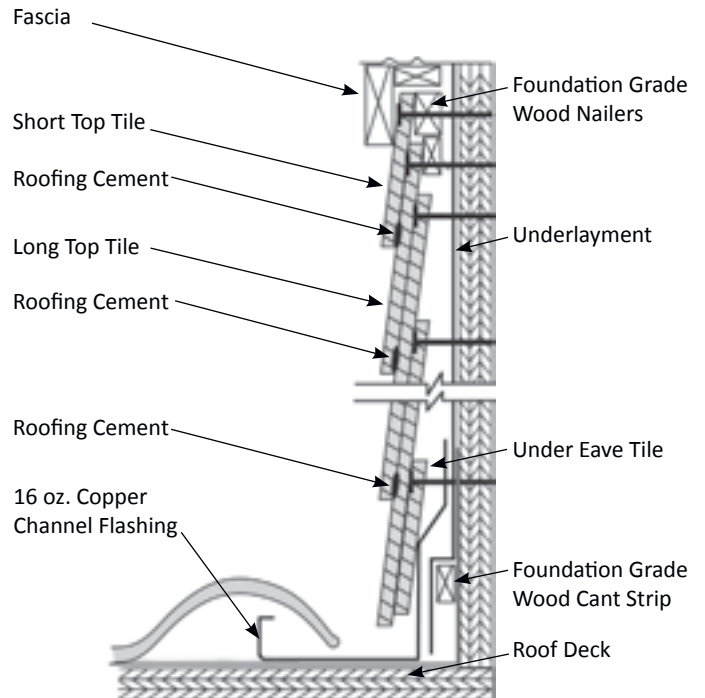


Figure 46.7 Vertical Wall Section

### Snow Guards

Snow guards are generally required in areas where snow and ice may accumulate on the roof. Snow guards are sometimes used on sloped roofs to prevent a mass of snow or ice from sliding off the roofs and injuring persons, damaging gutters or plants and blocking walks and driveways. Snow guards hold the snow in place above the eaves until it can melt and the water runs off.

It is recommended that snow guards should be installed on at least 3 or 4 courses, offset from course to course and spaced in staggered interval rows; begin with the third or fourth row. However, spacing and quantity of snow guards is a matter of judgement based on local weather conditions (see Figure 47.1).

Alpine conditions will require a professional engineer to design the required snow retainage system. Tile should not be exposed to ice and snow loads exceeding 100 pounds per square foot.

***A snow guard must be made of nonferrous material to prevent possible rust stains.***

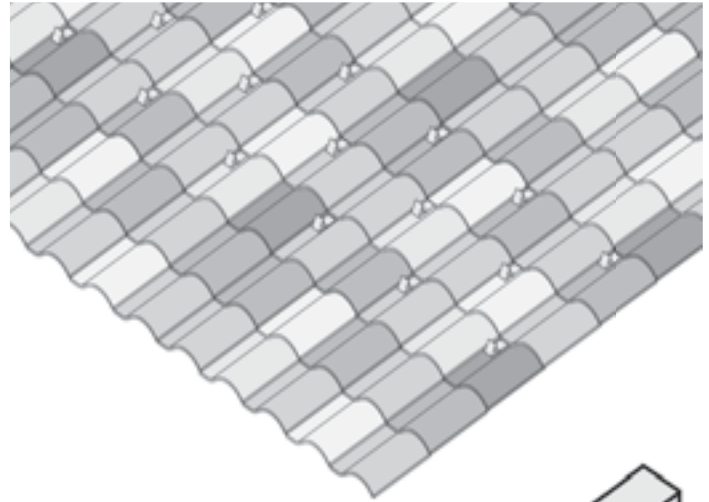


Figure 47.1 Snow Guard Spacing

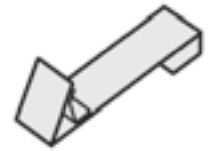


Figure 47.2 Ludowici Spanish Snow Guard

### Repair

To replace a broken or damaged tile do not use an exposed Copper strap. These are unsightly and can work loose allowing the replacement tile to slide out.

Ludowici's Quik-Tach™ Brackets are a quick, efficient and concealed method for tile replacement. Follow these steps:

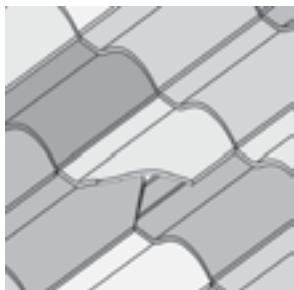


Figure 47.3 Damaged Tile



Figure 47.4 Remove Damaged Tile

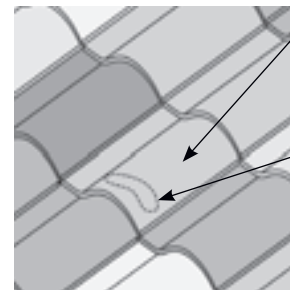


Figure 47.5 Finished Tile Replacement

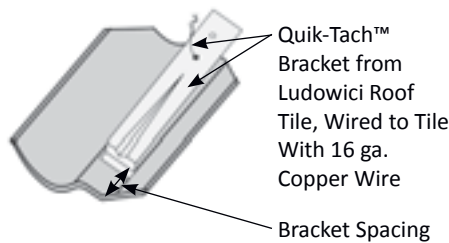


Figure 47.6 Replacement Tile with Quik-Tach™ Bracket

Completely remove damaged tile and fasteners. A slate ripper will facilitate removal of fasteners. Measure the distance from the top of the course below to the bottom of the adjacent tile to the replacement.

Lift the tile in the course above and slide the replacement tile into place so the bracket engages the top of the tile below the replacement. Apply a small bead of Sealant or roofing Cement under replacement tile.

# Mission Tile Installation

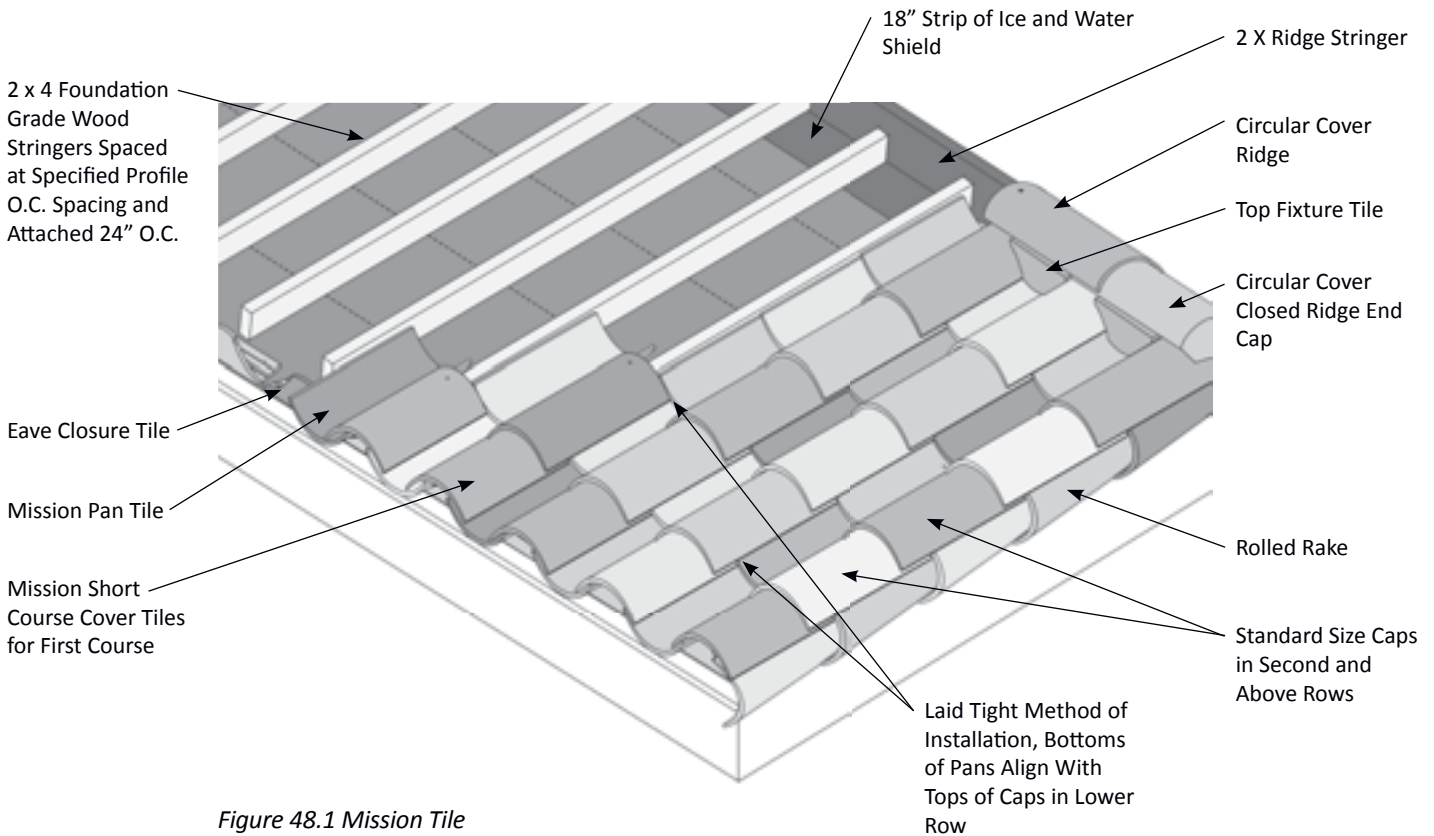


Figure 48.1 Mission Tile

**IMPORTANT:**

***Before starting tile installation, it is important that the roofer understand how the Mission tile pattern being installed relates to the roof design.***

***The following roof preparations must be completed before installing any roof tile.***

For detailed information on these items refer to the previous sections in this book or the NRCA Manual on Steep Roofing.

- The flashings required for ensuring watertightness:
  - Eave Flashing
  - Valley Flashing
  - Dormer and Sidewall Flashing, Skylight Flashing, Chimney and Cricket Flashing
  - Vent Flashing

- Underlayment for the entire roof deck, including the appropriate waterproof underlayment required for all flashing, and, where required, the ice dam membrane
- All Hip and Ridge Stringers should be installed and covered in underlayment
- Roof surface chalked with vertical and horizontal lines

***NOTE: Mission tile utilize rolled rake tile for both the right and left sides of the gables. Therefore, rake edge flashing is not required when these tiles are used.***



## Instructions Specific to Installing Mission Tile

### Nailer Strips (Stringers)

Mission tile require a nominal 2" x 4" wood stringer to serve as a nailer board and to support the cover tile. The stringer should be a pressure-treated, foundation-grade wood. Fastened to the deck 24" O.C. with non corrosive fasteners.

**NOTE: If the wood stringers are being applied to a deck which includes a valley, and if special factory cut and closed valley tiles have been manufactured for the job, it is necessary to see special instructions provided in Valley Tiles.**

Coordinate stringer spacing with eave closure layout and factory cut valley tiles (if used).

### Hip and Ridge Stringers

Mission tile requires a hip and ridge tile to complete the roof and are installed on nominal 2" wide wood stringers. All stringers should be pressure treated, foundation-grade wood and should be covered with an 18" Wide Strip of Ice and Water Shield. For all Mission styles tiles, the contractor is responsible to measure the roof for stringer height.

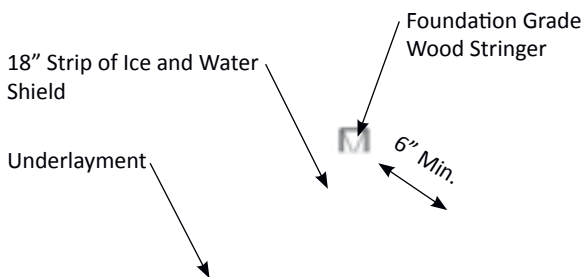


Figure 49.1 Ridge and Hip Stringer Detail

### Eave Closure Tile

Required with the installation of all Ludowici Mission tile is an Eave Closure Tile. The Eave Closure Tiles are normally laid right to left or from gable end to a valley. Eave Closure tiles are to be laid flush with the eave and adjusted in from the right to allow for proper lay up of the rolled rake tile and the first cover tile. Lay the Eave Closure Tile course loose across the slope to the provided center to center width before nailing to determine what adjustment, if any, are needed in the course before nails or screws are installed. Once layout is established, install the Eave Closure tile in the normal right to left fashion.

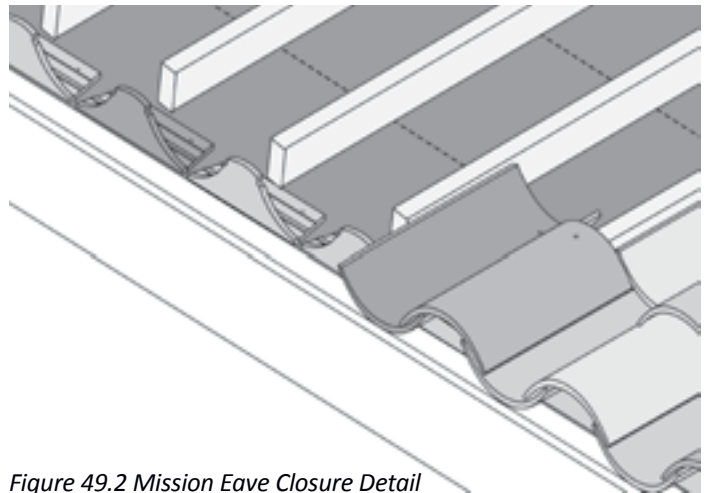


Figure 49.2 Mission Eave Closure Detail

Roof Pitch Rise:Run	Roman 102 Hip	Roman 206 Hip	Greek 118 Hip Cover	Greek 211 Ridge
4:12	6 3/8"	7 1/4"	7"	6"
5:12	6 1/4"	7"	7"	5 3/4"
6:12	6 1/4"	6 3/4"	7"	5 1/2"
7:12	6 1/4"	6 1/2"	6 7/8"	5 1/4"
8:12	6 1/8"	6 1/4"	6 7/8"	5 1/8"
9:12	6 1/8"	6 1/8"	6 7/8"	5"
10:12	6 1/8"	6"	6 7/8"	4 7/8"
11:12	6 1/8"	5 7/8"	6 7/8"	4 3/4"
12:12	6"	5 3/4"	6 3/4"	4 5/8"
13:12	6"	5 5/8"	6 3/4"	4 1/2"
14:12	6"	5 1/2"	6 3/4"	4 3/8"

### First and Succeeding Courses of Tile

Mission tile are normally laid from right to left starting with a Rolled Rake Tile. This first rake tile will need to be installed allowing a 2" overhang at the eave. The Rolled Rakes are universal for both left and right gable edges. All gable rake tiles shall be installed with fasteners typical of the field tile installation, but also require flashing cement (meeting ASTM D-4586 requirements) applied between all contact areas of the field tile and gable rake tile.

**NOTE: When Rolled Rake Tile are being installed in the first course of tile, whether lefts or rights, the eave closure next to these rake pieces will require some slight nipping and chipping for proper fit and installation.**

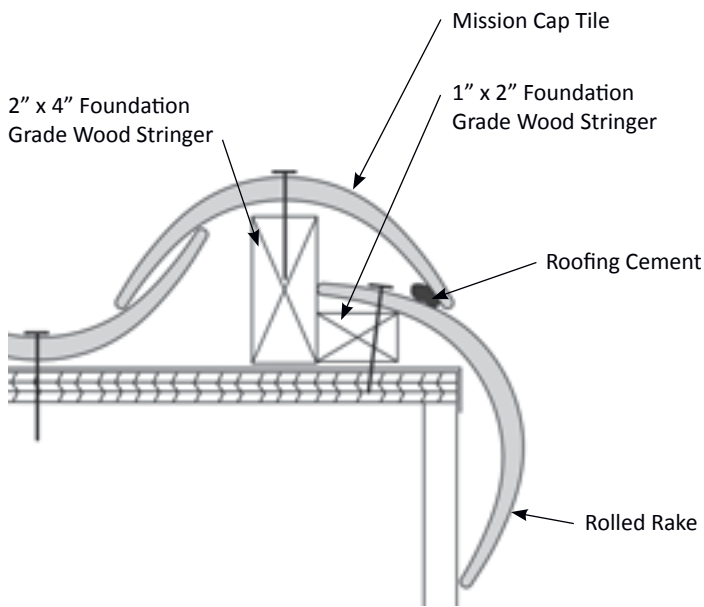


Figure 50.1 Mission Right Rolled Rake Detail

After installing the rake tiles, the starter course may be laid. There are various ways to continue the Mission tile installation. One option is to run several courses of pans across the roof deck still working from right to left up the deck installing the tile to the proper 3" head lap. Then return to the starting point to continue with several courses of covers (must lay one course less of covers than pans to keep the lay up flowing). When installing the covers, care shall be taken not to attach them snug to the stringer. Leaving space allows for expansion and contraction of the nailer board. The progression of the installation shall still continue in a diagonal fashion (see Valley Tiles, Page 52 for more information on installing tiles on roofs which include valleys).

**NOTE: Most Mission field tile are provided with (1) one fastening hole, but a few select pan tiles have (2) two holes. When installing field tile and accessories, care should be taken to fasten each tile with nails or screws in every provided fastening hole.**

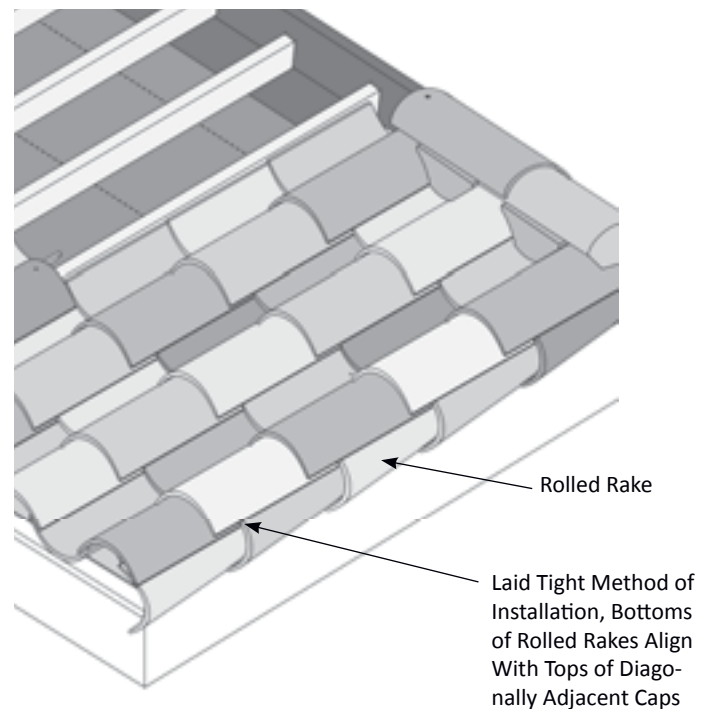


Figure 50.2 Mission Right Rolled Rake

### Laid Tight Method

When tiles are applied using the laid tight method, install field cut or factory cut short course covers at the eave over regular pans. If field cutting, 3" should be removed from the length of the covers. The top edge of the covers will abut the pan's bottom edge in the succeeding course. This continues throughout the roof field so that the long edge of the cover lays tight to the pan. As the installation approaches the ridge, the last course of tile will consist of a course of short pans (by 3") and a course of regular covers (see Figure 51.1).

### Top Fixture Tile

Recommended with the installation of all Ludowici Mission tile is a top fixture. This tile is attached to the ridge stringer to fill the void area left between the field and the ridge cover. If top fixtures are not specified, void areas should be filled with Portland cement mortar Type M and/or specialty metal closures also may be used. (Mortars shall meet requirements of ASTM C-270.)

#### Points to Remember During Tile Installation

Tile installation will generally progress in a diagonal fashion, moving from the right to left. The installer applying the lower course will always be to the left of those applying succeeding courses.

- Use the chalk lines as a guide.
- Watch for any irregularities in the roof deck construction.
- After the installation of about 75-100 tiles, the roof should be inspected from the ground at a distance greater than 40 feet to determine that there are no streaks or blotches. To ensure a good range of tones, this inspection must be done at regular intervals.

Repeat the inspection each 75-100 tiles.

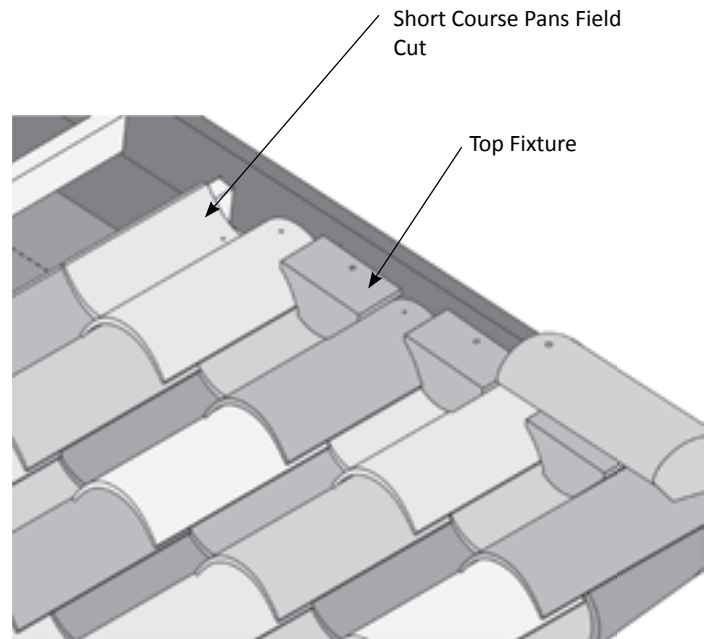


Figure 51.1 Mission Top Fixture Detail

**Valley Tile**

Tiles to be installed in valleys can be mitered in the field or special factory cut and closed tiles can be ordered. These special cut and closed valley tiles generally result in less water entering underneath the tile. Whether field miter cut or factory cut tiles are used, the tile fasteners should never penetrate the valley flashings. Tile to be installed over the valley flashing should be drilled or notched and wired with solid 16 gauge copper wire to fasteners driven into the deck beyond the flashing.

**NOTE: In situations where valley tile pieces are so small that it is not practical to notch or drill, use the adhesive RT600 (an OSI product) or its equivalent.**

If special factory cut and closed valley tiles are being applied, prior to installation, it will be beneficial to loose lay the vertical stringers, the entire eave closure, including the valley tile, and a few rows of pans and covers. This loose laying process of the valley's left side will advance as a typical installation would, from right to left. But, when

loose laying the valley's right side, it will advance from left to right. With the installation of Mission tiles, this should not create any concerns. Start by loose laying the valley tile to the already chalked valley line and continue away from the valley with the first course of tile. Once the layout is established, install the tiles in the typical Mission tile manner.

The loose laying process becomes vitally important when the roof runs from valley-to-valley. The focus must be to space the eave course so it consists of a full tile and is finished on both ends with special cut valley tiles. Keep in mind not to allow any more than (5) five pieces pulled to the extreme or crowded there.

If field mitered valley tiles are applied, they should be trimmed to provide a clean, even, continuous edge along the entire valley length.

**To encourage leaves and snow to slide down the valley, the gap between the Valley Tiles and the center line of the valley should be tapered from 3" at the top to 4" at the bottom, this can be increased for longer valleys.**

16 oz. Copper Valley Flashing With Hem and Cleats 24" O.C.

6" Strip of Ice and Water Shield

Chalk Line for Valley Tile Cut Line, Tapered

Underlayment

DO NOT Nail Through Copper Valley. Attach Small Valley Tiles With Copper Wire and Fasteners Placed Above Flashing

**NOTE: The Open Void at Field Cut Valley Tiles Can be Pointed With Type "M" Mortar**

Apply a Bed of Roofing Cement at the Lap to Small Valley Tiles to Prevent Migration

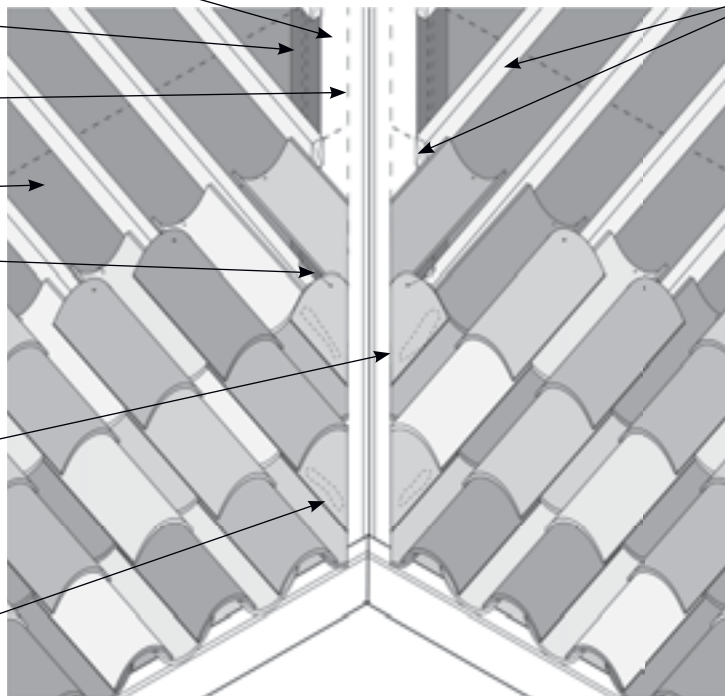


Figure 52.1 Mission Valley

2" x 4" Foundation Grade Wood Stringers, Hold Back 4" from Valley Tile Cut Line



Figure 52.2 Mission Factory Cut and Closed Valley Tile



Figure 52.3 Mission Field Cut Valley Tile

**Hip Tile**

The hip area is typically finished by using a combination of either a Circular Cover Hip Starter, Circular Cover and a Circular Cover Hip and Ridge Terminal, or 152 Hip Starter Tile, 102 Hip Roll Tile and 102/206 Hip and Ridge Terminal.

Hips are started with a Circular Cover Hip Starter tile or 152 Hip Starter tile covering the field tile approximately 3" on both sides. The hip tile covers are then installed. The Circular Cover tile creates an approximate 3" head lap on

the Starter tile, while the 102 tile creates an approximate 2" head lap over the starter tile. The last fastener on the upslope end of the hip typically is covered with a Circular Cover Terminal or a 102/206 Hip and Ridge Terminal. These terminals must be specified as a starter or finisher depending on the direction of the ridge layout. Some roof termination may require a combination of typical flashing details or a special tile piece. Consult the local Ludowici sales representative with the project's special roof requirements.

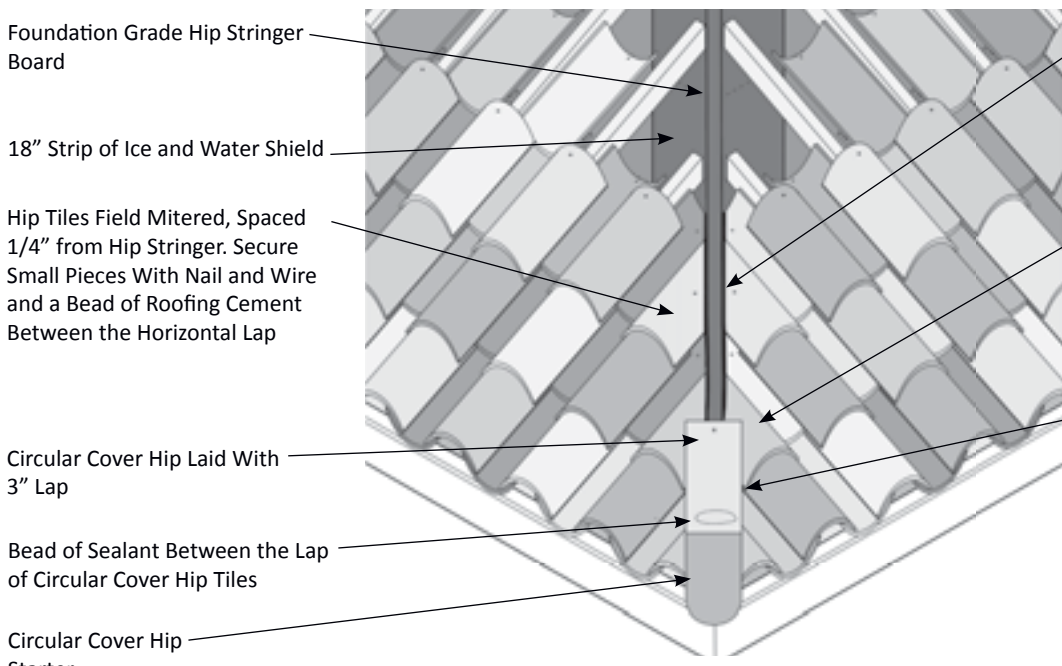


Figure 53.1 Mission Tile Circular Cover Hip Detail

Gap Between Hip Tile and Stringer Filled with Roofing Cement or Sealant Compatible With Ice and Water Shield

Apply a Bead of Roofing Cement at The Horizontal Lap to Small Pieces to Prevent Migration

**NOTE: The Open Void Between the Field Tile Pan and Circular Cover Hip Can be Pointed With Type "M" Mortar**



Figure 53.3 Mortared Hip Detail

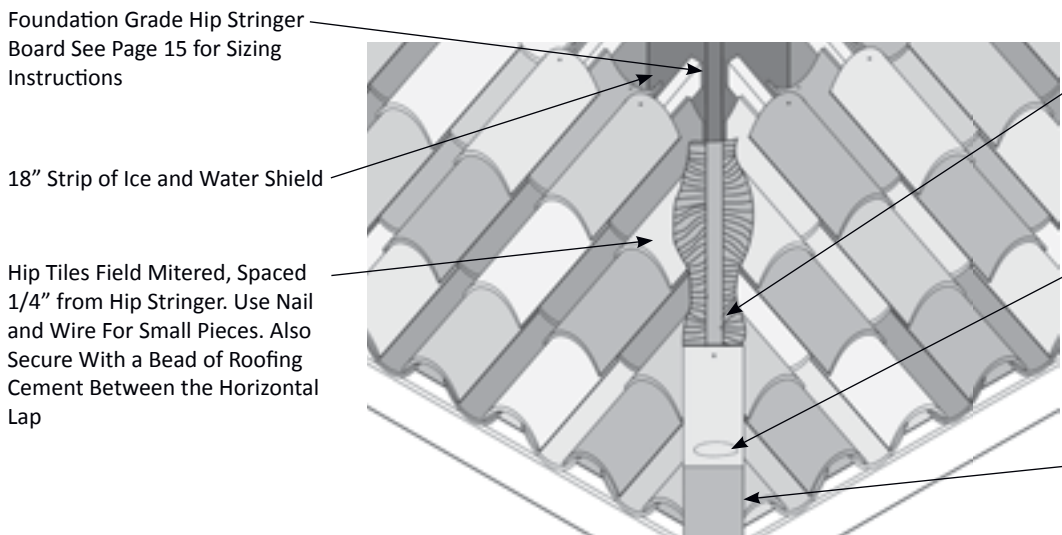


Figure 53.2 Mission Tile Circular Cover Hip Detail with FlexSeal™

Flexseal™ Corrugated Flexible Copper Flashing with Integral Butyl Strip to Seal Flashing to Field Tile

Apply a Bead of Roofing Cement at the Horizontal Lap to Small Pieces to Prevent Migration

Circular Cover Hip Starter

**Ridge Tile**

The ridge for Mission tile is finished with a Circular Cover Tile or a 206 Ridge Tile.

Roofing cement must be used at the overlap of each ridge tile and where they rest on the field tile. Closed Ridge Ends, Circular Cover Closed Ridge End, 206 Ridge, Circular Cover Terminal, or 102/ 206 Hip and Ridge Terminal Tile are used to start and finish the ridge. The ridge finisher will have an exposed fastener which should be sealed with roofing cement meeting the requirements of ASTM D-4586. Some roof termination may require a combination of typical flashing details or a special tile piece. Consult the local Ludowici sales representative with the project's special roof requirements.

**NOTE: It may be beneficial to lay out the chosen ridge system on the stringer to determine lap (no less than 2"). This will prevent having to traverse the installed tiles later.**

**Applying ridge tiles with the lap facing away from the prevailing winds helps the tile shed wind-driven rain.**

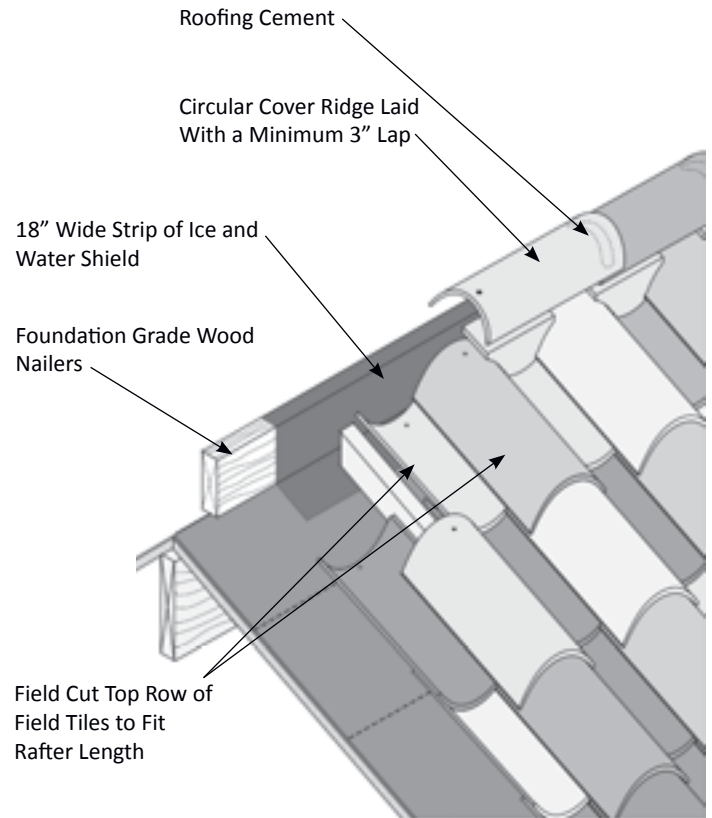


Figure 54.1 Circular Cover Ridge Mission Tile Detail

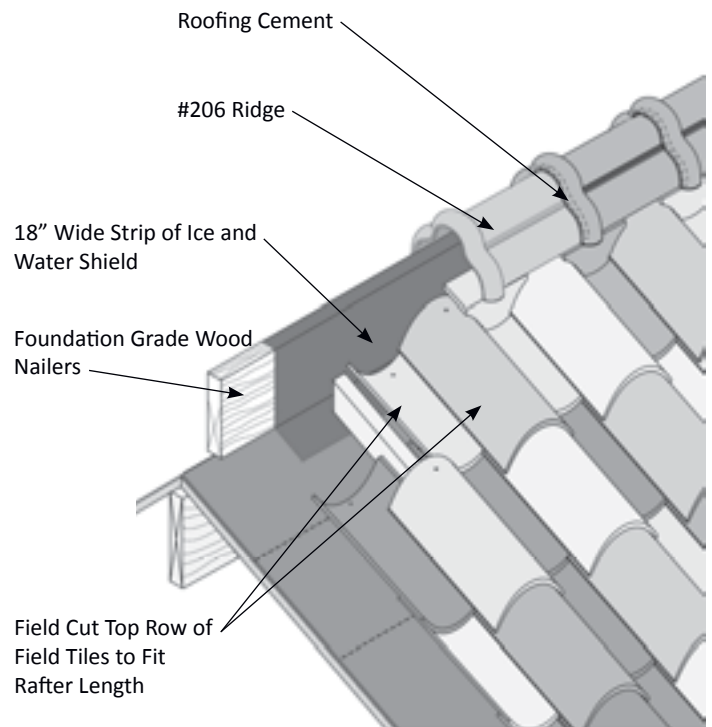


Figure 54.2 #206 Ridge Mission Tile Detail

**Circular Cover Ridge Vented**

This ridge vent allows 6.27 square inches of ventilation per foot of ridge.

**Minimum Roof Pitch 6:12**

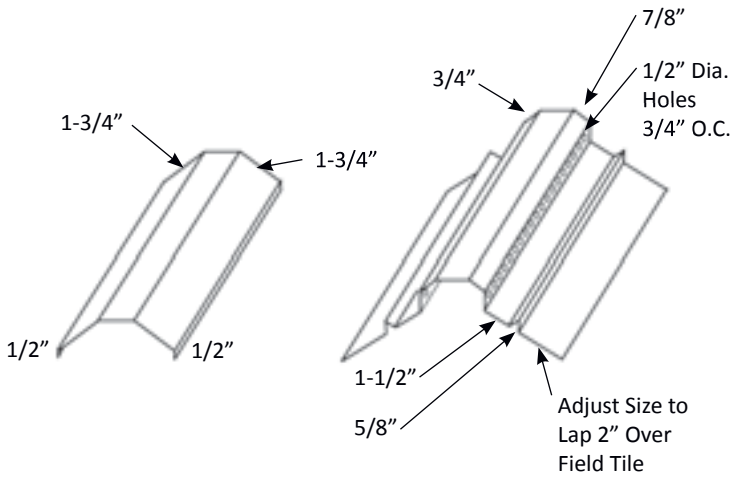


Figure 55.1 Circular Cover Vented Ridge Cap Flashing

Figure 55.2 Circular Cover Vent Flashing

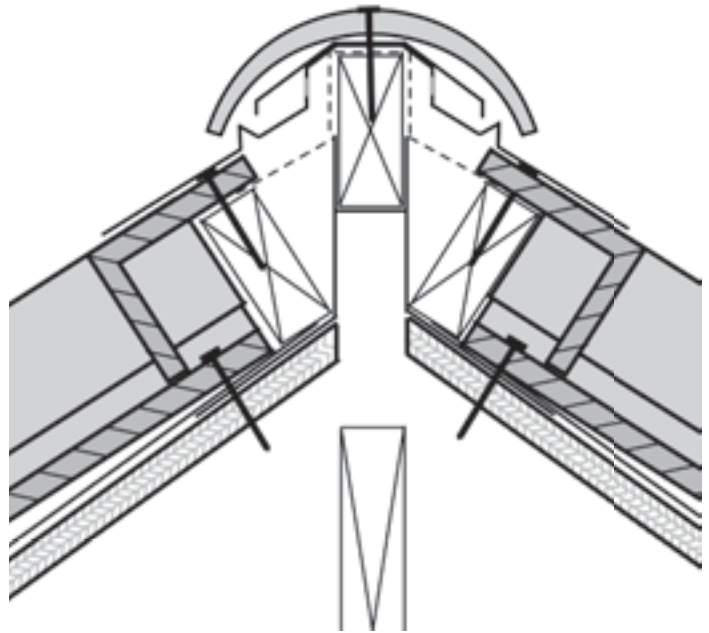


Figure 55.3 Mission Tile Circular Cover Vented Ridge Section

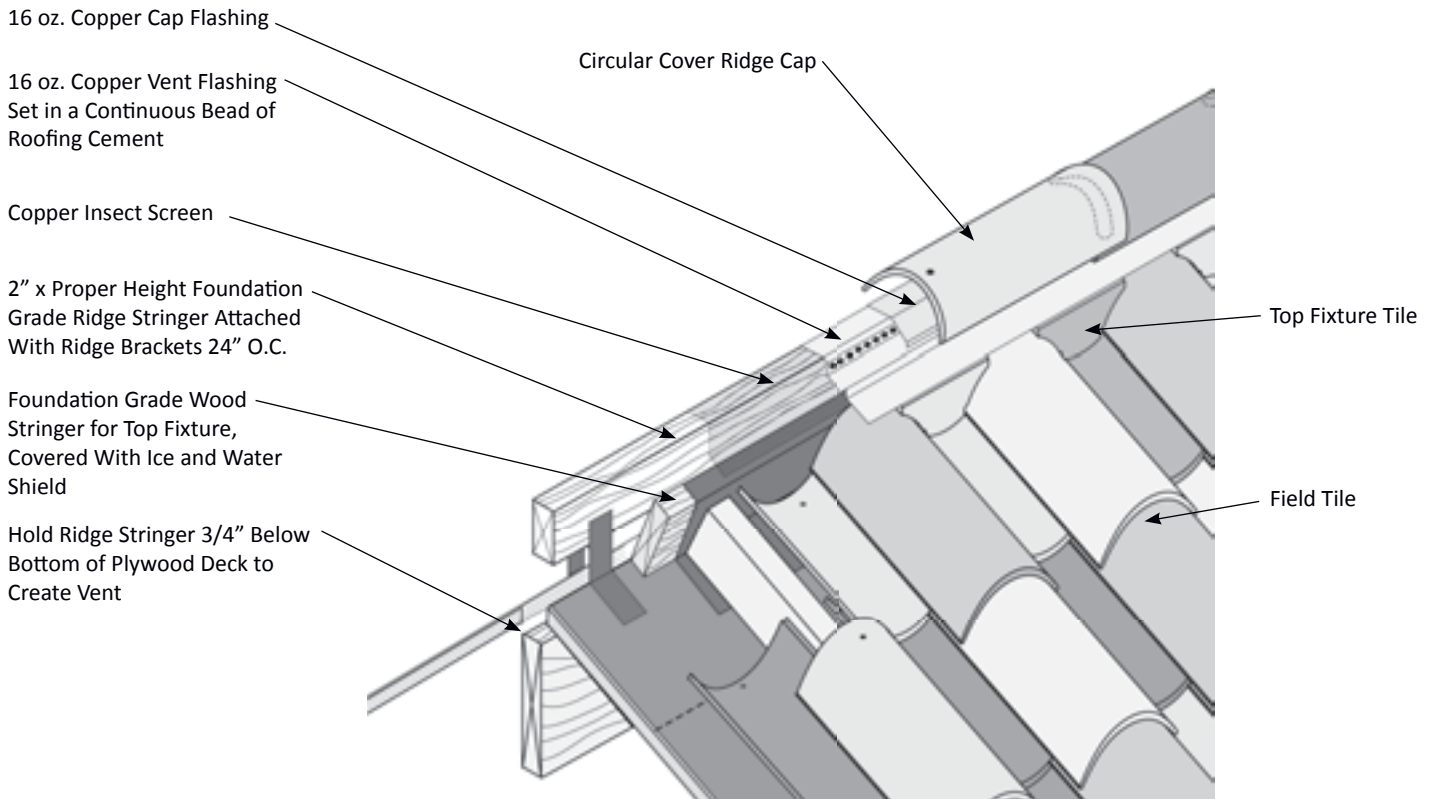


Figure 55.4 Mission Tile Circular Cover Vented Ridge

**#206 Ridge Vented Type-1**

This ridge vent allows 6.27 square inches of ventilation per foot of ridge.

**Minimum Roof Pitch 6:12**

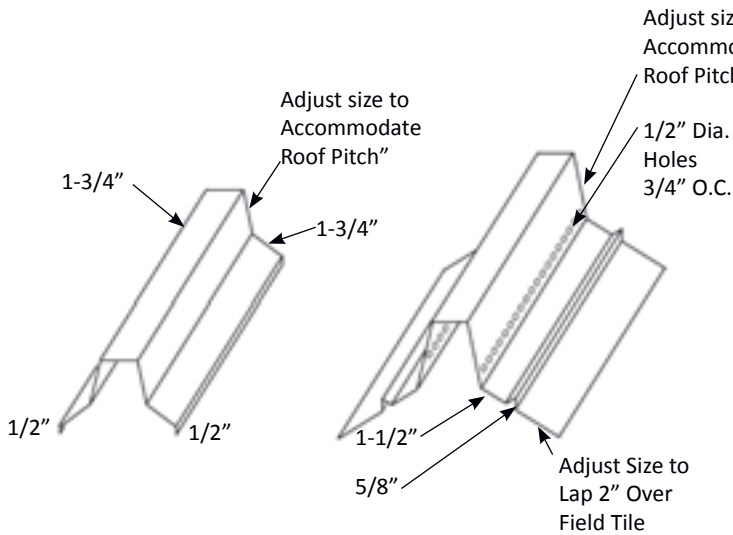


Figure 56.1 #206 Ridge Vented Ridge Cap Flashing

Figure 56.2 #206 Ridge Vent Flashing

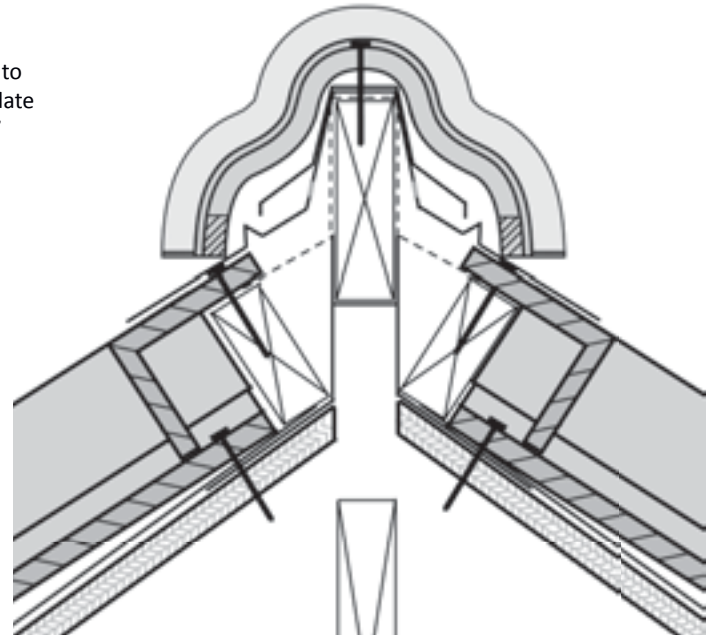


Figure 56.3 Mission Tile #206 Vented Ridge Section

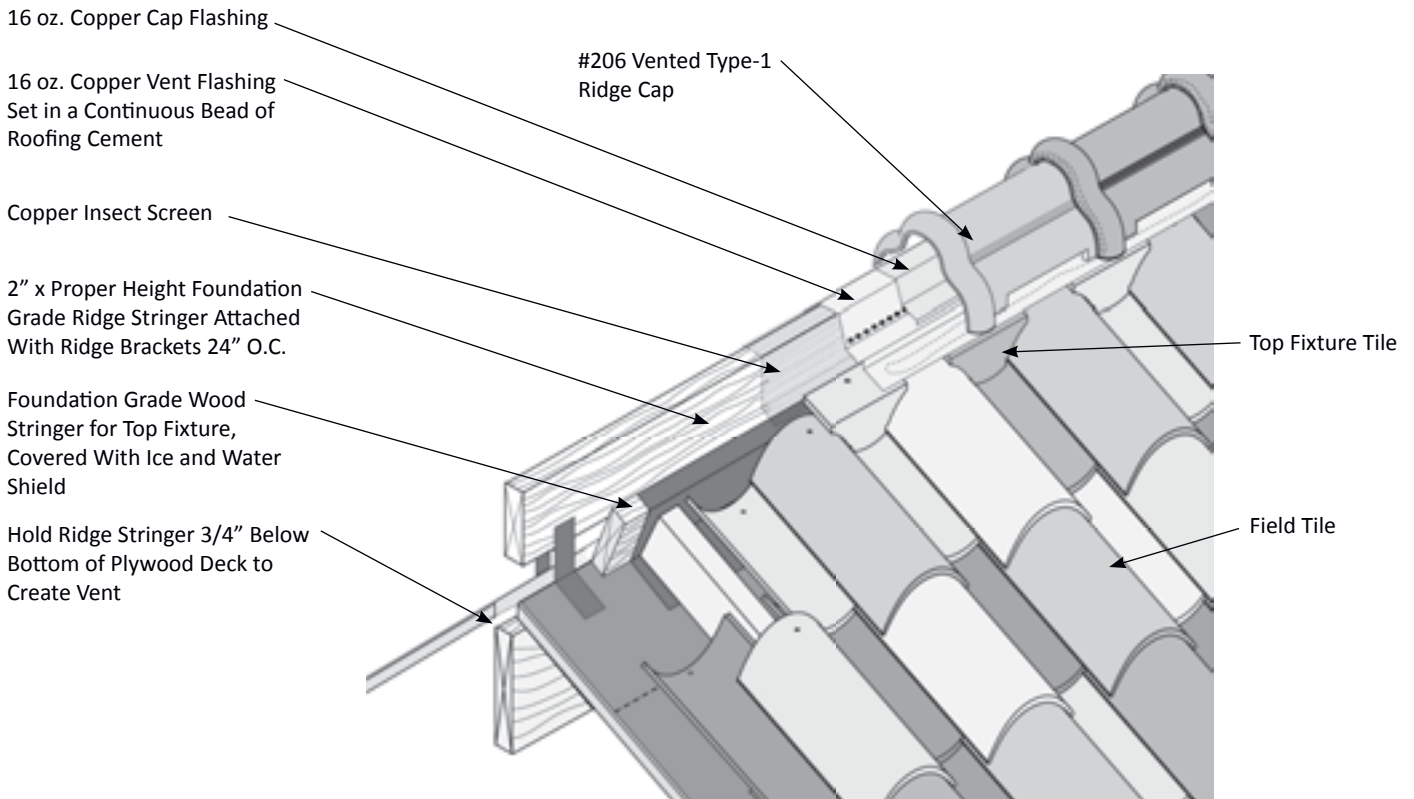


Figure 56.4 #206 Ridge Vented Type-1



**Tapered Mission Tile**

Ludowici’s 14-1/4” and Cubana 18-3/8” Tapered Barrel Mission tile have clipped corners on the narrow end of the tile. They install so that the clipped corner of the pan tile align with the clipped corner of the diagonally adjacent cover tile. No short course starter tile is used.

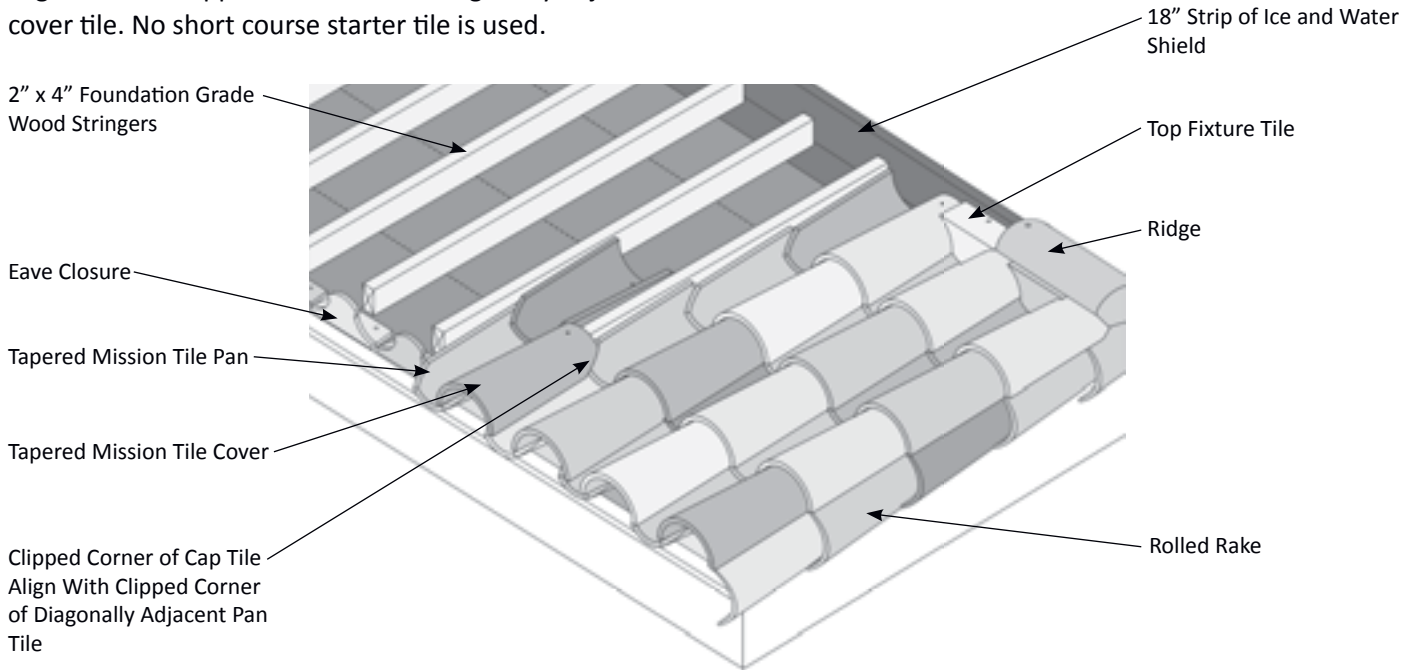


Figure 57.1 Tapered Mission Tile

**Staggered Mission Tile**

Ludowici’s Straight Barrel Mission tile can be laid in a staggered pattern, either by laying with a random headlap between 3” and 6” or by mixing the three different lengths of Straight Barrel Mission tiles.

Palm Beach Mission Tile can also be laid staggered by laying with a random headlap of between 3” and 6”.

Both installation methods are NOT laid tight and small gaps between the underside of the cap edge and the pan will be present.

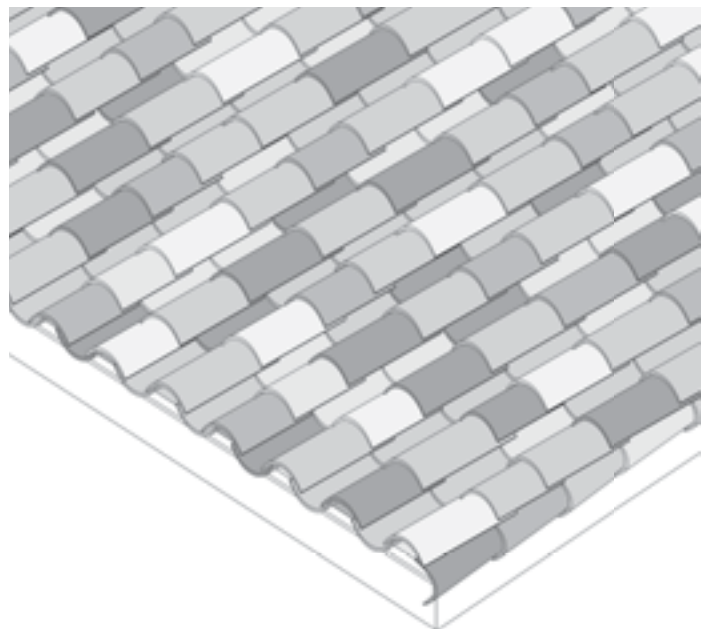
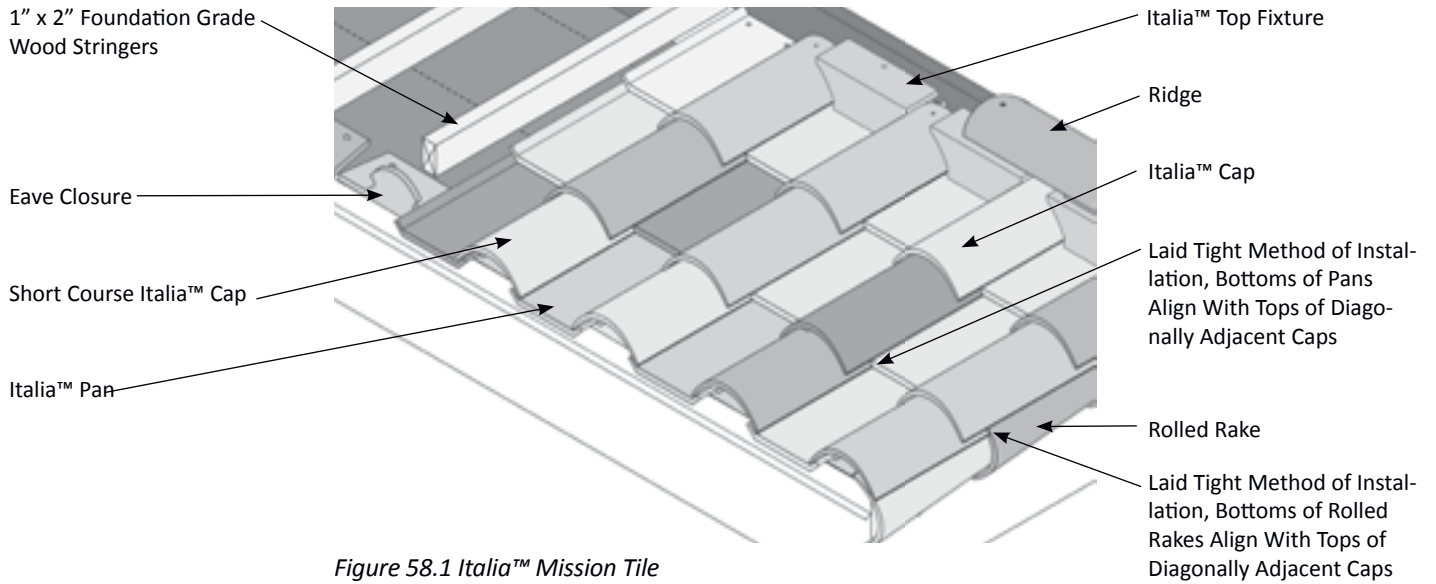
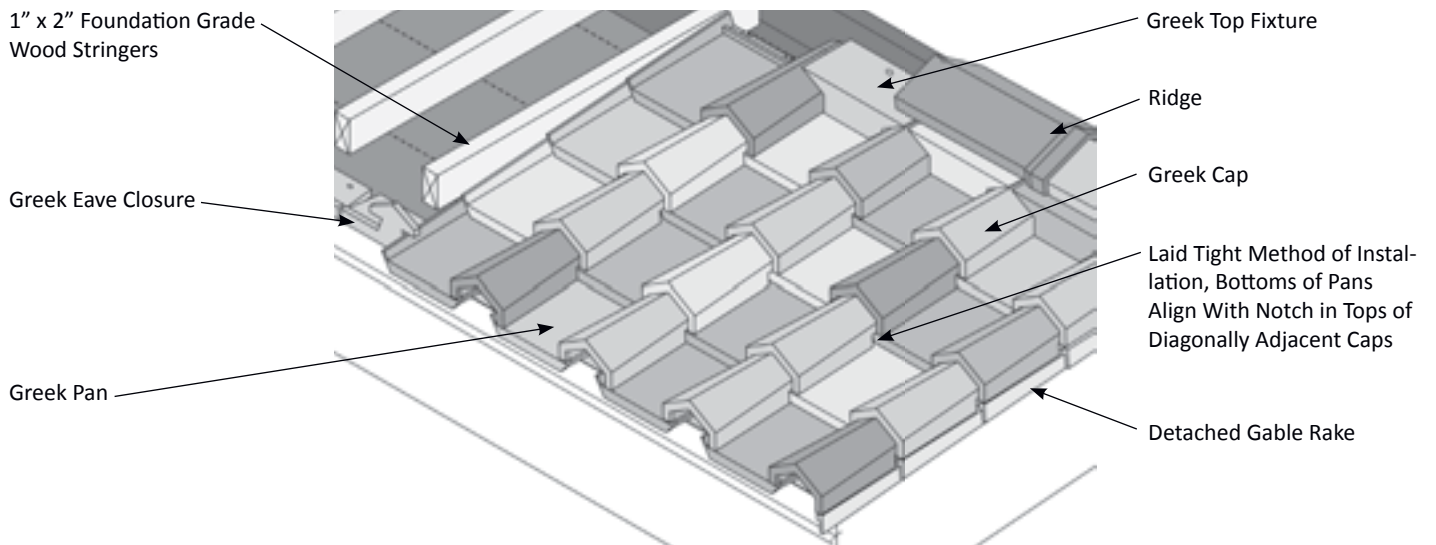


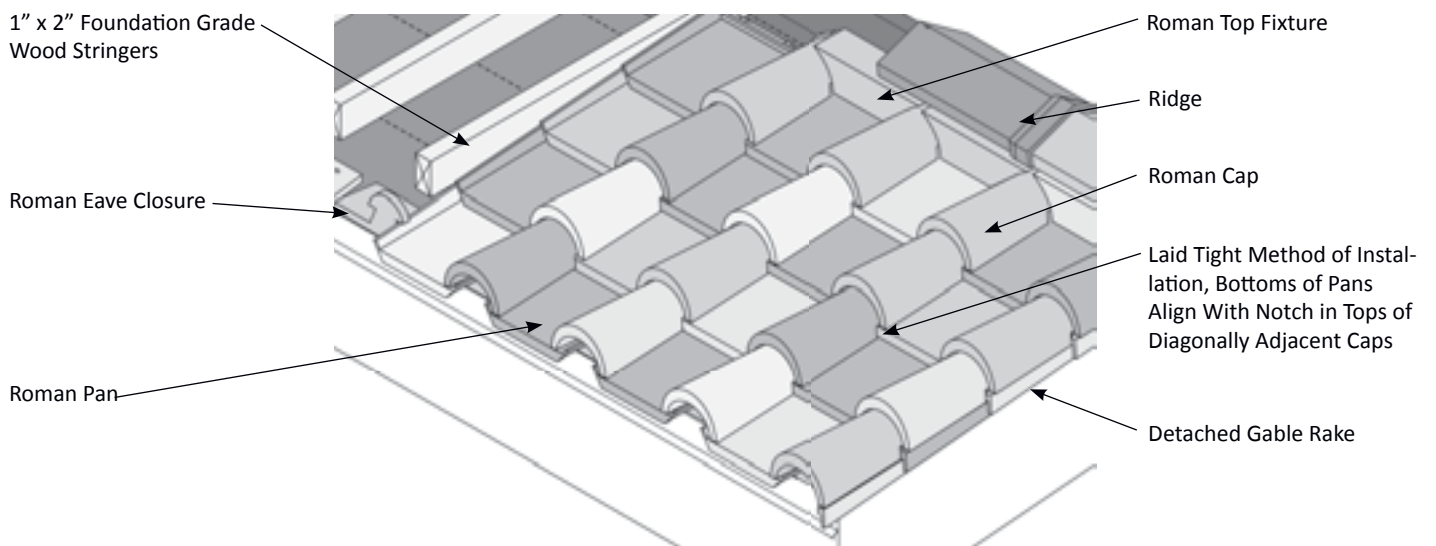
Figure 57.2 Staggered Mission Tile  
Mixed Lengths Shown



*Figure 58.1 Italia™ Mission Tile*



*Figure 58.2 Greek Tile*



*Figure 58.3 Roman Tile*

### Snow Guards

Snow guards are generally required in areas where snow and ice may accumulate on the roof. Snow Guards are sometimes used on sloped roofs to prevent a mass of snow or ice from sliding off the roofs and injuring persons, damaging gutters or plants, and blocking walks and driveways. Snow guards hold the snow in place above the eaves until it can melt and the water runs off.

It is recommended that snow guards should be installed on at least 3 or 4 courses, offset from course to course; begin with the third or fourth row. However, spacing and quantity of snow guards is a matter of judgement based on local weather conditions (see Figure 59.1).

Alpine conditions will require a professional engineer to design the required snow retainage system. Tile should not be exposed to ice and snow loads exceeding 100 pounds per square foot.

**A Snow Guard must be made of nonferrous material to prevent possible rust stains.**

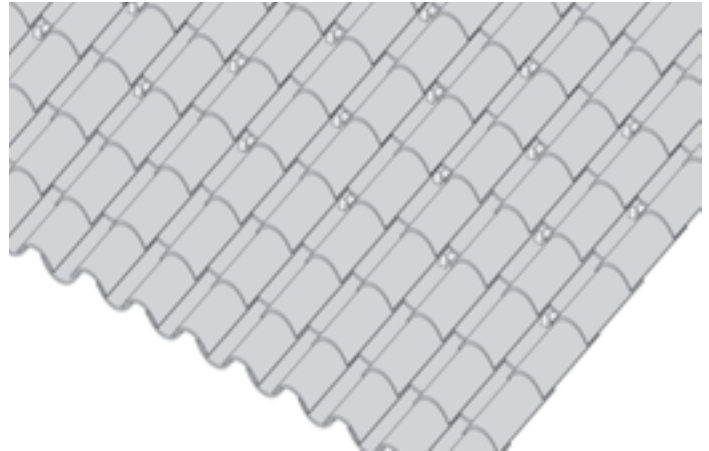


Figure 59.1 Snow Guard Spacing

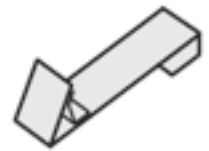


Figure 59.2 Ludowici Mission Snow Guard

### Repair

To replace a broken or damaged tile do not use an exposed Copper strap. These are unsightly and can work loose allowing the replacement tile to slide out.

Ludowici's Quik-Tach™ Brackets are a quick, efficient and concealed method for tile replacement. Follow these steps:

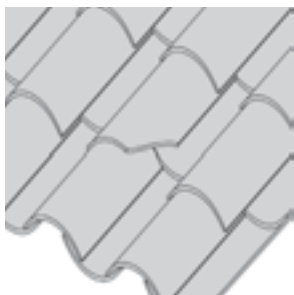


Figure 59.3 Damaged Tile

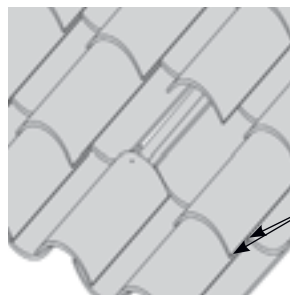


Figure 59.4 Remove Damaged Tile

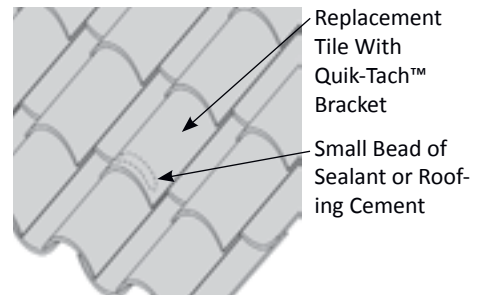


Figure 59.5 Finished Tile Replacement

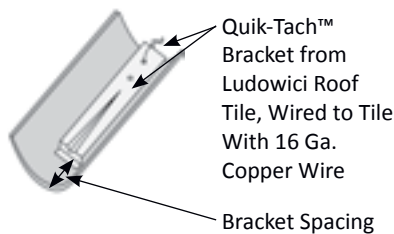


Figure 59.6 Replacement Tile With Quik-Tach™ Bracket

Completely remove damaged tile and fasteners. A slate ripper will facilitate removal of fasteners. Measure the distance from the top of the course below to the bottom of the adjacent tile to the replacement.

Lift the tile in the course above and slide the replacement tile into place so the bracket engages the top of the tile below the replacement. Apply a small bead of Sealant or roofing Cement under replacement tile.

**NOTE: Replacement of a Mission Pan tile does not require the use of a Quik-Tach™ Bracket**

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**This manual includes the basic installation instructions from start to finish in an easy-to-read format. However, the applicator must always give consideration to regional climactic conditions and code requirements.**

**For Alpine or Tropical installations contact the Ludowici Technical Service Department for assistance.**

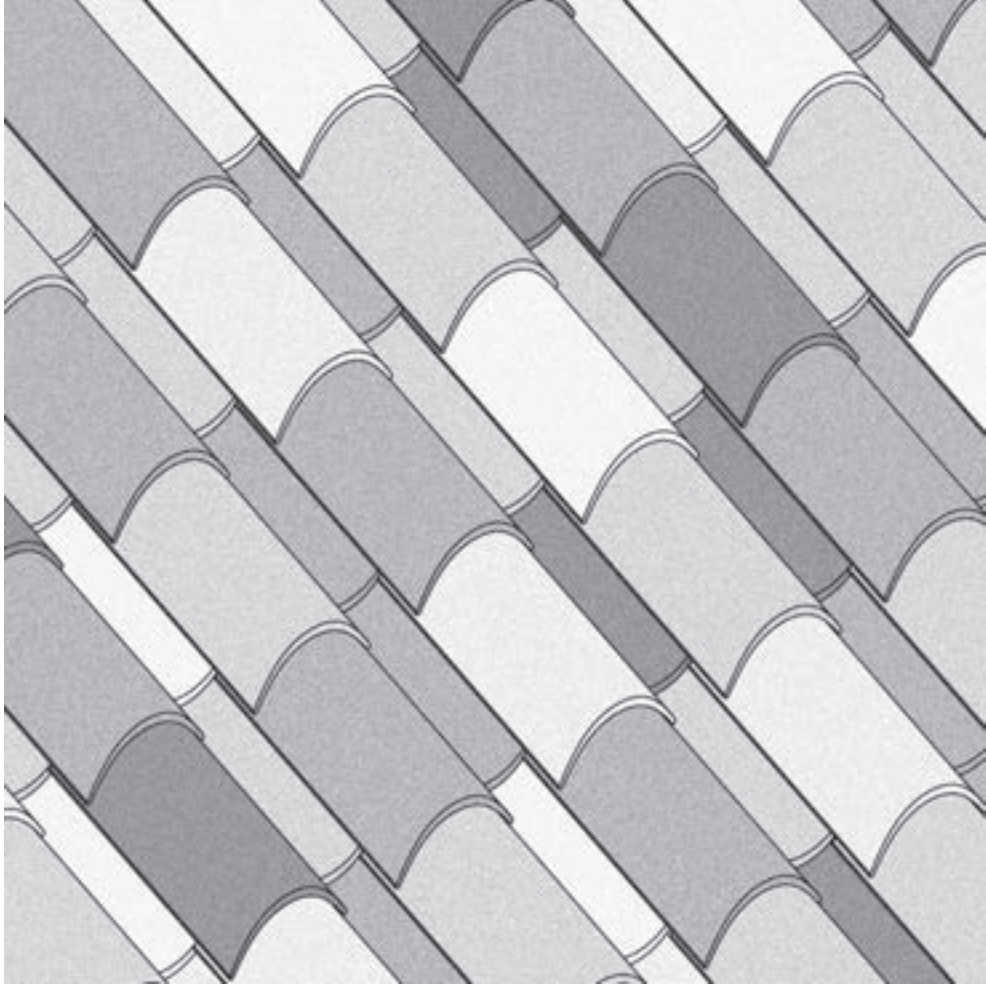
**Have a question about how to install Ludowici tile?**

**Contact your local Ludowici Sales Representative or the Ludowici Technical Service Department at**

**1-800-945-8453**

  
**LUDOWICI®**  
**Ludowici Roof Tile, Inc.**  
**4757 Tile Plant Rd.**  
**P.O. Box 69**  
**New Lexington, OH 43764**  
**1-800-945-8453**  
**[www.Ludowici.com](http://www.Ludowici.com)**

**LUDOWICI®**



# **Barrel Tile Installation Manual**

[www.Ludowici.com](http://www.Ludowici.com)

## CLAY TILE ROOFING

has been in existence for over a millennium. In the last few decades, clay tile roof installation techniques have been refined to protect your project while retaining the aesthetic, “of the earth”, characteristics that make up the roof’s appeal. The purpose of this manual is to provide technical information and installation instructions for Ludowici clay tile. It is intended to serve as a guide for proper techniques for typical installations. Ludowici clay tile is a versatile roofing material and can be applied on complex, original designed roofs. Installers are encouraged to contact Ludowici representatives for any question not covered in this manual. Some techniques may vary from region to region and other sound installation techniques may also be acceptable.

A Ludowici roof installed today will last over 100 years, be sure that all other roof components and installation techniques are as durable.

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## Field Tile Physical Characteristics

Chart 4.1 Spanish and Scandia™ Field Tile Characteristics



**Spanish 13 1/4"**



**Spanish 18 3/8"**



**Scandia™**

	<b>Spanish 13 1/4"</b>	<b>Spanish 18 3/8"</b>	<b>Scandia™</b>
Weight/Square	900 lbs.	900 lbs.	900 lbs.
Pieces/Square	171	114	185
Overall Size	9 3/4" x 13 1/4"	9 3/4" x 18 3/8"	9 3/4" x 13 1/4"
Exposure	8 1/4" x 10 1/4"	8 1/4" x 15 3/8"	7 9/16" x 10 1/4"
Minimum Slope	4:12	4:12	4:12

Chart 4.2 Straight Barrel Mission Field Tile Characteristics



**14 1/4"**  
**Straight Barrel Mission**



**16"**  
**Straight Barrel Mission**



**18 3/8"**  
**Straight Barrel Mission**

	<b>14 1/4"</b> <b>Straight Barrel Mission</b>	<b>16"</b> <b>Straight Barrel Mission</b>	<b>18 3/8"</b> <b>Straight Barrel Mission</b>
Weight/Square	1,250 lbs.	1,190 lbs.	1,165 lbs.
Pieces/Square	225	192	163
Overall Size	8" x 14 1/4"	8" x 16"	8" x 18 3/8"
Exposure	P = 3 1/2" x 11 1/4" C = 8" x 11 1/4"	P = 3 1/2" x 13" C = 8" x 13"	P = 3 1/2" x 15 3/8" C = 8" x 15 3/8"
Center to Center	11 1/2"	11 1/2"	11 1/2"
Minimum Slope	5:12	5:12	5:12



## Field Tile Physical Characteristics

Chart 5.1 Tapered Barrel Mission Field Tile Characteristics

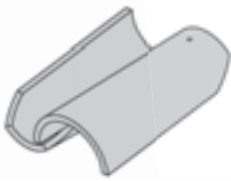

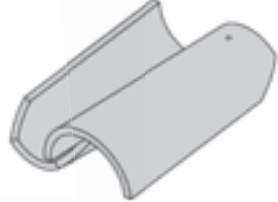


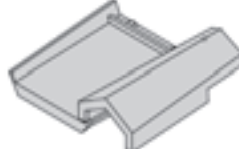

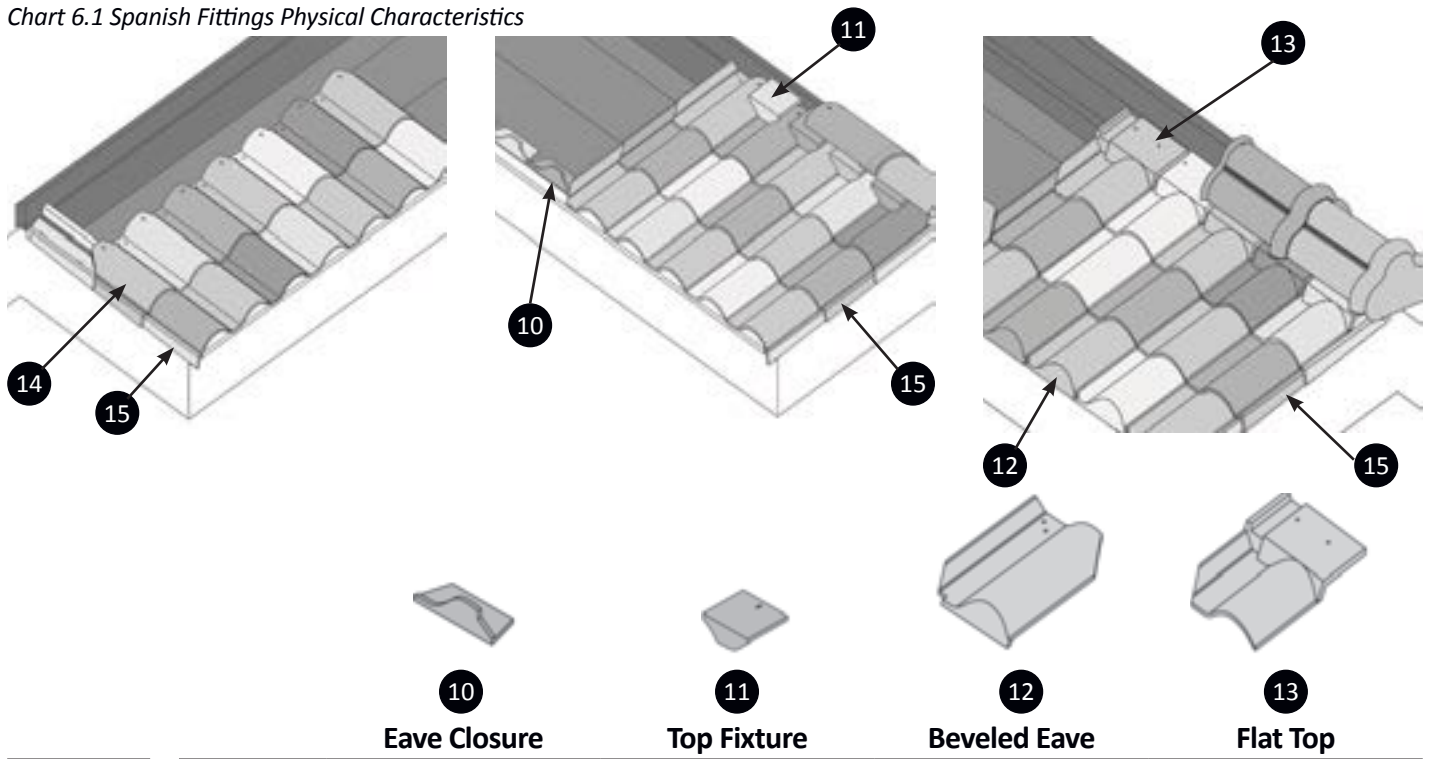
				
	<b>14 <sup>1/4</sup>" Tapered Barrel Mission</b>	<b>16" Tapered Barrel Mission</b>	<b>Cubana 18 <sup>3/8</sup>" Tapered Barrel Mission</b>	<b>18 <sup>3/8</sup>" Palm Beach Mission</b>
Weight/Square	1,345 lbs.	1,230 lbs.	1,200 lbs.	1,165 lbs.
Pieces/Square	270	212	163	163
Overall Size	P = 7" x 14 <sup>1/4</sup> " C = 7" x 14 <sup>1/4</sup> "	P = 8" x 16" C = 7" x 16"	P = 7" x 18 <sup>3/8</sup> " C = 7" x 18 <sup>3/8</sup> "	8" x 18 <sup>3/8</sup> "
Exposure	P = 3-1/2" x 11 <sup>1/4</sup> " C = 7" x 11 <sup>1/4</sup> "	P = 3 <sup>1/2</sup> " x 13" C = 7" x 13"	P = 4" x 15 <sup>3/8</sup> " C = 7" x 15 <sup>3/8</sup> "	P = 3 <sup>1/2</sup> " x 15 <sup>3/8</sup> " C = 8" x 15 <sup>3/8</sup> "
Center to Center	10 <sup>1/2</sup> "	10 <sup>1/2</sup> "	11"	11-1/2"
Minimum Slope	5:12	5:12	5:12	5:12

Chart 5.2 Special Profile Mission Field Tile Characteristics

			
	<b>Italia™</b>	<b>Greek</b>	<b>Roman</b>
Weight/Square	900 lbs.	1,510 lbs.	1,415 lbs.
Pieces/Square	125	240	240
Overall Size	P = 9 <sup>3/4</sup> " x 18 <sup>3/8</sup> " C = 8" x 18 <sup>3/8</sup> "	P = 11 <sup>1/2</sup> " x 12 <sup>5/8</sup> " C = 6 <sup>3/8</sup> " x 13"	P = 11 <sup>1/2</sup> " x 12 <sup>5/8</sup> " C = 6" x 13"
Exposure	P = 7" x 15 <sup>3/8</sup> " C = 8" x 15 <sup>3/8</sup> "	P = 5 <sup>5/8</sup> " x 10" C = 6 <sup>3/8</sup> " x 10"	P = 6" x 10" C = 6" x 10"
Center to Center	15"	12"	12"
Minimum Slope	5:12	5:12	5:12

# Spanish Tile Fittings Physical Characteristics

Chart 6.1 Spanish Fittings Physical Characteristics



	<b>Eave Closure</b>	<b>Top Fixture</b>	<b>Beveled Eave</b>	<b>Flat Top</b>
<b>Spanish 13-1/4"</b>	Overall Size	-	9 3/4" x 13 1/4"	9 3/4" x 13 1/4"
	Exposure	8 1/4"	8 1/4" x 10 1/4"	8 1/4"
	Weight/Pc.	1.2 lbs.	6 lbs.	6 lbs.
<b>Spanish 18-3/8"</b>	Overall Size	-	9 3/4" x 18 3/8"	9 1/4" x 18 3/8"
	Exposure	8 1/4"	8 1/4" x 15 3/8"	8 1/4" x 15 3/8"
	Weight/Pc.	1.2 lbs.	8 lbs.	8 lbs.

	<b>End Band</b>	<b>Detached Gable Rake</b>	<b>Rolled Rake</b>	
<b>Spanish 13-1/4"</b>	Overall Size	13 1/4"	13 1/4"	
	Exposure	10 1/4"	10 1/4"	
	Weight/Pc.	4.5 lbs.	2.1 lbs.	5.7 lbs.
<b>Spanish 18-3/8"</b>	Overall Size	18 3/8"	NA	18 3/8"
	Exposure	15 3/8"	NA	15 3/8"
	Weight/Pc.	4.6 lbs.	NA	6.8 lbs.

# Scandia™ Tile Fittings Physical Characteristics

Chart 7.1 Scandia™ Fittings Physical Characteristics

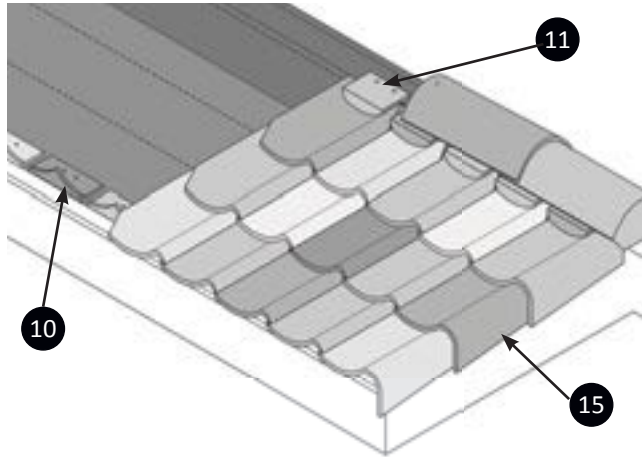
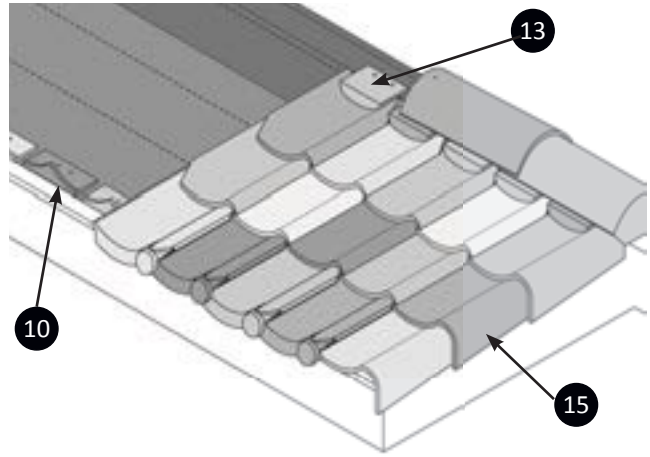


Chart 7.2 Scandia™ Fittings Physical Characteristics



10

Eave Closure



11

Top Fixture



Left Rake



Right Rake



13

Decorative Eave

15

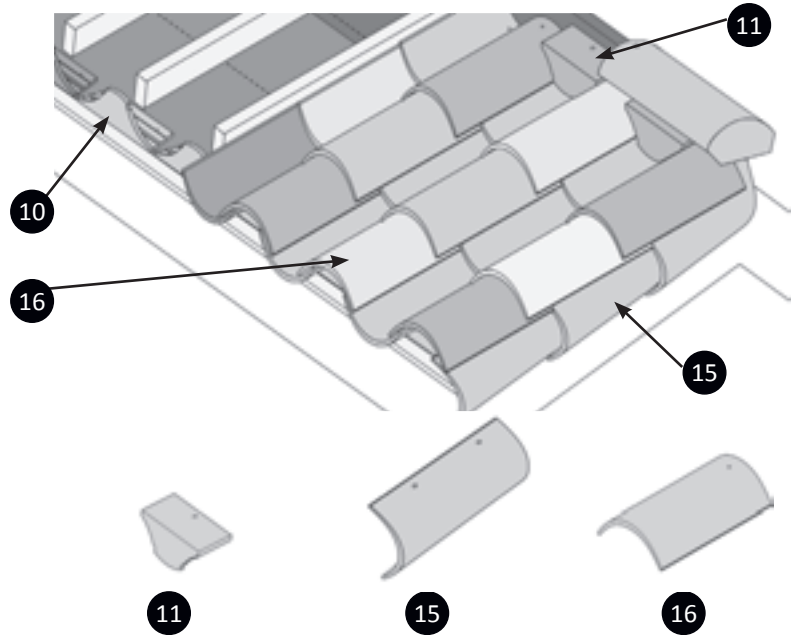
Attached Gable Rake

<b>Scandia™</b>	Overall Size	-	-	-	9 3/4" x 13 1/4"
	Exposure	7 9/16"	7 9/16"	10 1/4"	7 9/16" x 10 1/4"
	Weight/Pc.	1.2 lbs.	1.2 lbs.	7 lbs.	7 lbs.

# Mission Tile Fittings

## Physical Characteristics

Chart 8.1 Mission Tile Fittings  
Physical Characteristics



	10	11	15	16
	Eave Closure	Top Fixture	Rolled Rake	Short Course Cover
<b>Straight Barrel Mission 14-1/4"</b>	Overall Size	11"	7-1/4"	8" x 11 1/4"
	Exposure	11 1/2"	11 1/2"	11 1/4"
	Weight/Pc.	1.7 lbs.	1.7 lbs.	6 lbs.
<b>Straight Barrel Mission 16"</b>	Overall Size	11"	7 1/4"	8" x 16"
	Exposure	11 1/2"	11-1/2"	13"
	Weight/Pc.	1.7 lbs.	1.7 lbs.	6.2 lbs.
<b>Straight Barrel Mission 18-3/8"</b>	Overall Size	11"	7 1/4"	8" x 18 3/8"
	Exposure	11 1/2"	11 1/2"	15 3/8"
	Weight/Pc.	1.7 lbs.	1.7 lbs.	7.1 lbs.
<b>Tapered Barrel Mission 14-1/4"</b>	Overall Size	-	-	8" x 14 1/4"
	Exposure	10 1/2"	10 1/2"	11 1/4"
	Weight/Pc.	3.1 lbs.	2.2 lbs.	5.8 lbs.
<b>Tapered Barrel Mission 16"</b>	Overall Size	-	-	8" x 16"
	Exposure	10 1/2"	10 1/2"	13"
	Weight/Pc.	3.1 lbs.	2.1 lbs.	6.2 lbs.
<b>Cubana Mission 18-3/8"</b>	Overall Size	-	-	18 3/8"
	Exposure	11"	11"	15 3/8"
	Weight/Pc.	1.7 lbs.	1.7 lbs.	7.1 lbs.
<b>Palm Beach Mission 18-3/8"</b>	Overall Size	11"	7 1/4"	8" x 18 3/8"
	Exposure	11 1/2"	11 1/2"	15 3/8"
	Weight/Pc.	1.7 lbs.	1.7 lbs.	7.1 lbs.

## Mission Profile Tile Fittings Physical Characteristics

Chart 9.1 Italia™ Fittings  
Physical Characteristics

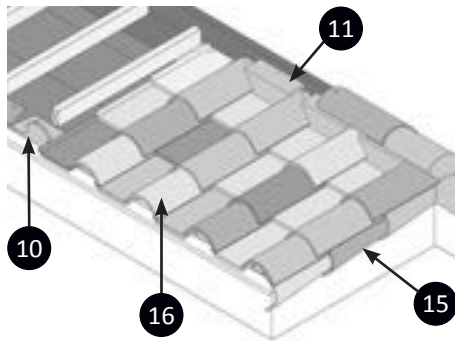


Chart 9.2 Greek Fittings  
Physical Characteristics

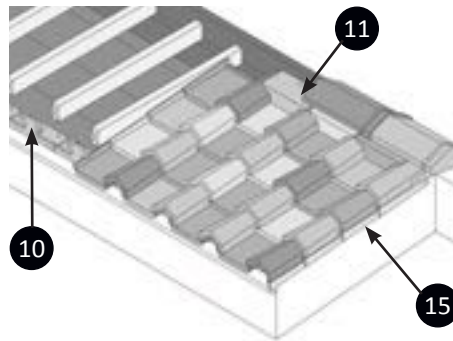
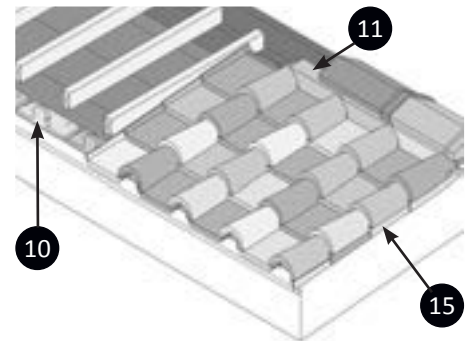


Chart 9.3 Roman Fittings  
Physical Characteristics



10

Eave Closure



11

Top Fixture



15

Rolled Rake



16

Short Course Cap

<b>Italia™</b>	Overall Size	-	-	8" x 18 <sup>3</sup> / <sub>8</sub> "	8" x 15 <sup>3</sup> / <sub>8</sub> "
	Exposure	12"	12"	18 <sup>3</sup> / <sub>8</sub> "	12 <sup>3</sup> / <sub>8</sub> "
	Weight/Pc.	2.5 lbs.	2.5 lbs.	7.1 lbs.	6.0 lbs.



10

Eave Closure



11

Top Fixture



15

Detached Rake

<b>Greek</b>	Overall Size	-	-	12 <sup>5</sup> / <sub>8</sub> "	
	Exposure	12"	12"	10"	
	Weight/Pc.	2.5 lbs.	2.5 lbs.	2.1 lbs.	



10

Eave Closure



11

Top Fixture



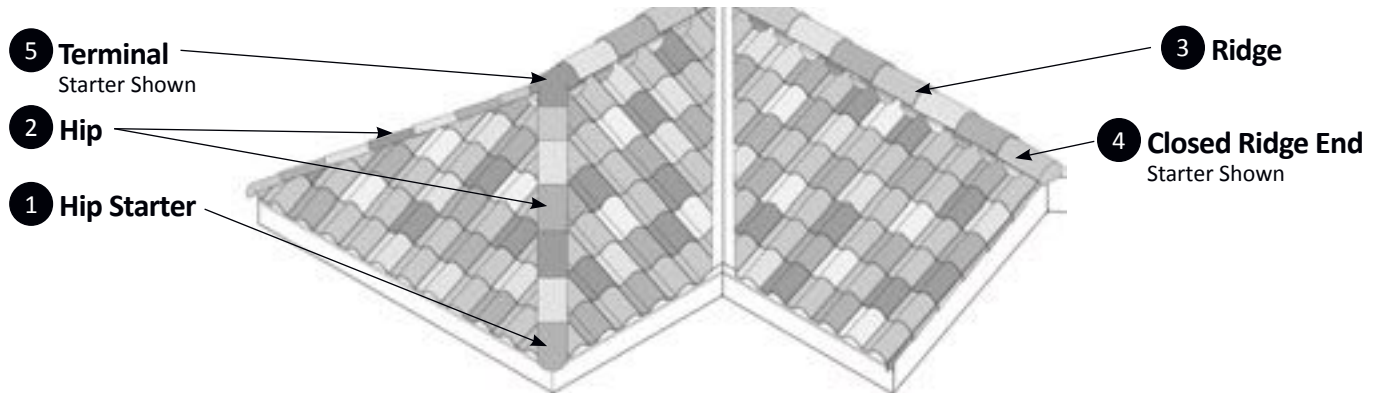
15

Detached Rake

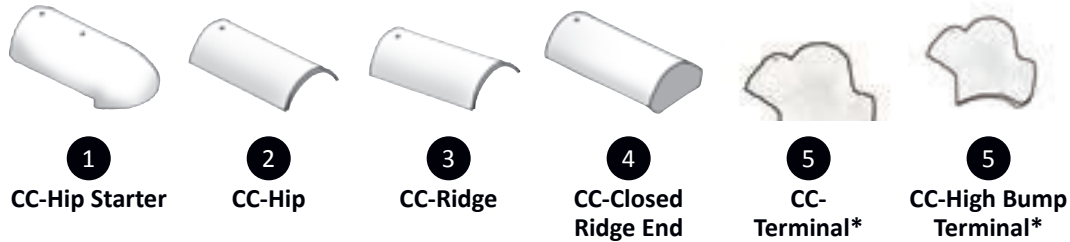
<b>Roman</b>	Overall Size	-	-	12 <sup>5</sup> / <sub>8</sub> "	
	Exposure	12"	12"	10"	
	Weight/Pc.	2.5 lbs.	2.5 lbs.	2.1 lbs.	

## Hip and Ridge Physical Characteristics

Chart 10.1 Hip and Ridge Physical Characteristics

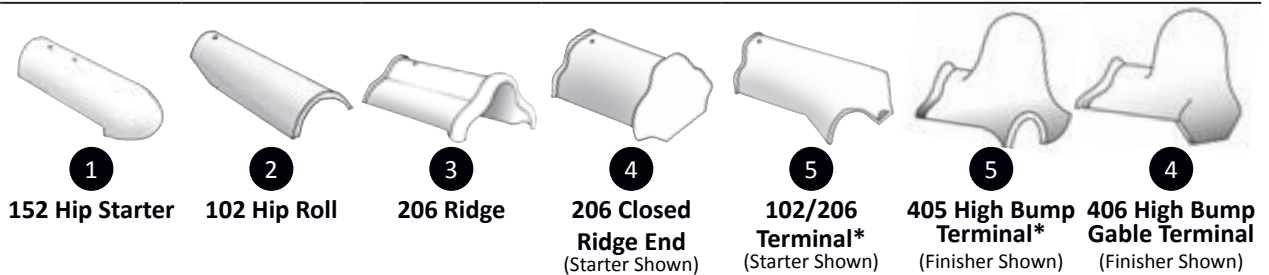


### Circular Cover Hip and Ridge Trim Group



Overall Size	15 1/2"	16"	16"	14 1/4"	-	-
Exposure	12"	13"	13"	12"	-	-
Weight/Pc.	9 lbs.	5.8 lbs.	5.8 lbs.	9.8 lbs.	15 lbs.	25 lbs.

### 102/206 Hip and Ridge Trim Group



Overall Size	14"	14"	13 1/4"	13 1/4"	-	-	-
Exposure	12"	12"	12"	12"	-	-	-
Weight/Pc.	6.3 lbs.	6.2 lbs.	11.5 lbs.	18 lbs.	17 lbs.	35 lbs.	30 lbs.

\* Ludowici makes ridge/hip terminals to fit any roof geometry. Contact your Ludowici representative for assistance.

Chart 11.1 Hip and Ridge Physical Characteristics

**V-Hip and Ridge Trim Group**



Overall Size	15 1/2"	14 1/4"	14 1/4"	14 1/4"	-
Exposure	12"	12"	12"	12"	-
Weight/Pc.	8 lbs.	8.8 lbs.	8.8 lbs.	8 lbs.	15 lbs.

**V-Ridge Angles**

Description	Degree	Roof Pitch
Regular	116°	3:12 to 10:12
Intermediate	90°	11:12 to 20:12
Steep	75°	20:12 +

**V-Hip Angles**

Degree	Roof Pitch
116°	3:12 to 18:12

**118/211 Hip and Ridge Trim Group**



Overall Size	14"	14"	13 1/4"	13 1/4"	-
Exposure	12"	12"	12"	12"	-
Weight/Pc.	5 lbs.	4.8 lbs.	9.7 lbs.	14 lbs.	20 lbs.

**211 Ridge Angles**

Description	Angle	Roof Pitch
Regular	116°	3:12 to 10:12
Intermediate	90°	11:12 to 20:12
Steep	75°	20:12 +

\* Ludowici makes ridge/hip terminals to fit any roof geometry. Contact your Ludowici representative for assistance.

# Before Getting Started

## Roof Slope

Ludowici Roof Tile's recommended minimum slope requirements for Spanish and Scandia™ tile are 4:12 and for Mission tile 5:12. **No clay tile roofs are to be installed below a roof slope of 3:12.**

*There is no maximum slope requirement for tile roofs. However, on extremely steep (above 19:12) or vertical applications, wind current may cause the tiles to rattle. To avoid this, set the butt of each tile with a bead of sealant where it will not be seen.*

## Weight

Proper roof framing is required to carry the weight of a tile roof. The weight of one square (100 sq. ft.) of Barrel tile will range from 800 pounds to over 1,250 pounds. The weight of the roof tile is determined by the type and size of the tile and the exposure of each course of tile. Reducing the exposure of the tile will increase the roof load.

The weight of the underlayment, fastening system, roof accessories and trim tile also needs to be considered when determining the total weight. Check dead load allowances of the applicable local building codes.

It is recommended that the structural design of the roof be evaluated by a registered engineer to determine that it can support the load; most building codes require an engineering review. Getting a written letter of approval is suggested and may be required by local building codes.

If the installation is in a region of seismic activity or heavy wind load, local building codes must be consulted for additional requirements.

## Roof Deck

A design standard for roofing decks is to have a **maximum deflection of L/240 between supports**. A deck will be exposed to live and dead loads. A live load is one that will only be exerting pressure on the roof deck for a short time. Example; Snow or wind loads. A dead load is one that will exert a constant pressure to the roof deck; e.g., underlayments, tile and battens.

**Fastener Pullout Resistance:** Minimum average fastener pullout resistance for clay roofing tile is 180 lbs. with no single value less than 170 lbs. Greater pullout values may be required depending upon the predicted aerodynamic moment expected for the tile shape, building shape and the proximity to the coastline. An engineer should be consulted to assure local building code compliance.

**For Board Plank Deck:** Use well-seasoned plank board (1" full thickness, maximum 6" nominal width) that is not prone to warping, cupping or twisting.

**For Plywood Deck:** APA rated plywood is required for a minimum of 3/4" thick wood decking and must be rated for structural use as roof sheathing. The expansion crack between panels shall be at least 1/16" but no greater than 1/8". H-clips are to be used when rafters are spaced greater than 16" on center to hold the side joints of the plywood together between supports. Unsupported end joints must be blocked.

**Nailable Concrete Decks:** Nailable concrete decks over time may lose their plastic nature, which allows direct nailing. For old decking material, a pullout test should be performed to determine the usefulness of the deck and the appropriate fastener. An engineer should be consulted to assure local building code compliance.

**Non-Nailable Concrete Decks:** For concrete decks that will not accept direct nailing, nailer boards are required. Attachment strips that allow the tile to be fastened to them should be pressure treated wood. These may be a board and batten system or pressure treated wood strips. Other means of attaching tile to a concrete deck include wire-tie systems, foam



adhesive and expanding nail-in anchors.

**NOTE: Ludowici does not recommend applying tile over spaced board sheathing or open battens.**

## Underlayment

Most problems with water-shedding roof installations occur from water that migrates through the joints of the tiles through capillary action, wind driven rain and runoff or ice damming. Because of this possibility, the underlayment is critical to the success of the roof. It is the architect or building owner’s responsibility to select an underlayment product that is suitable to specific location, climate, roof pitch and attic ventilation. When selecting an underlayment remember that Ludowici roof tiles are expected to last over 75 years so the underlayment should be of a comparable lifespan and quality.

Ludowici recommends the following for minimum underlayment:

- All decks shall be covered with two layers of No. 30# asphalt-impregnated roofing felt or one layer of No. 43# coated base sheet or one layer of Ice and Water Shield.

**NOTE: When using non-breathing Ice and Water Shield underlayments to cover the entire roof, the attic space MUST be properly ventilated to prevent moisture buildup.**

- All hips, valleys, rakes and ridges shall be covered with a waterproof underlayment; example: Ice and Water Shield or two layers of No. 43# coated base sheet.
- For proper ice dam protection a layer of Ice and Water Shield underlayment should be installed from the eave to a point 24” beyond the inside of the exterior wall. See page 18 for more information on ice dam protection.

**NOTE: Roofing felt should meet or exceed ASTM standards D226/D2626. Self adhered polymer modified bituminous sheet should meet or exceed ASTM D1970.**

Chart 13.1 Underlayment Characteristics

Type	Pros	Cons
Asphalt Roofing Felt	<ul style="list-style-type: none"> <li>• Long track record</li> <li>• Well suited for most applications</li> <li>• Readily available</li> <li>• Breathable</li> <li>• Less expensive than Synthetics or Self Adhered</li> </ul>	<ul style="list-style-type: none"> <li>• Doesn’t seal around the nail holes</li> <li>• Not as effective on lower pitches</li> <li>• Can tear</li> <li>• Not suitable for long duration exposure directly to the elements</li> </ul>
Ice & Water Shield (Self Adhered Polymer-Modified Bituminous Sheet)	<ul style="list-style-type: none"> <li>• Rubberized material seals around nail holes</li> <li>• Self adhering materials creates a more monolithic water barrier</li> <li>• Ideal for low slope applications</li> </ul>	<ul style="list-style-type: none"> <li>• More expensive</li> <li>• <b>Non breathing requires good attic ventilation</b></li> <li>• Can be damaged by UV if exposed for 180+ days</li> </ul>
Synthetic Underlayments	<ul style="list-style-type: none"> <li>• Purported life span and durability</li> <li>• Some Synthetics are breathable</li> </ul>	<ul style="list-style-type: none"> <li>• Unproven. Most products have been on the market less than 20 years.</li> <li>• Two to three times cost of felt</li> </ul>

## Fastening Methods

Attachment requirements and fastener length are referenced in Chart 15.2

**Nails or Screws:** Nails are the most commonly used fastener for attaching clay tiles. Nails for tiles and cleats must be copper or stainless steel, 11 gauge minimum, .285"-.312" head minimum and proper length to give good penetration. Screws must be stainless steel or brass, #8 or #9, with a minimum .285"-.312" diameter head.

**NOTE: The use of Galvanized, Ceramic coated or any other fastener not mentioned above is not acceptable to Ludowici. All components of the roof should have an expected lifespan of 75+ years.**

**NOTE: When installing field tiles, care should be taken to fasten each tile with nails or screws in every provided fastening hole. Spanish tile can be special ordered with an optional third hole for wind lock installation.**

- For a plywood deck, use ring shank copper nails of the specified length to assure good penetration through underside of deck (see Chart 15.2).
- For board plank deck, use smooth shank copper nails of the specified length. Fasteners should penetrate deck board 3/4". Do not penetrate underside of deck.
- For gypsum plank or nailable concrete deck, use stainless steel or silicon bronze screw shank nails of length to penetrate half to three-quarters the thickness of the deck. Never penetrate underside of deck.
- When insulation is applied over the deck, observe the following:
  - Minimum slope 4:12 for Spanish tile and 5:12 for Mission tile - The tile can be nailed through underlayment and insulation into the deck with a sufficient length fastener.
  - On 6:12 or greater, a tile-tie system should be used.
- For metal decks, use sheet metal screws and the proper mastic.

- For fibrous cement decks, use a tile-tie system.

**NOTE: When using stainless steel screws, tile replacement will require the use of a hack saw to remove the screws. A slate ripper may be used with copper or brass fasteners.**

**Wire:** On non-nailable surfaces or some insulated decks or where fastening through the metal flashing needs to be avoided or if underlayment cannot be penetrated, such as special low slope applications, wire and strapping systems are sometimes used. Wire must be 13 gauge stainless steel or 10 gauge solid copper, with or without insulation. Wire-tieing is also usually specified in areas prone to earthquakes. Consult Newportfastener.com for specific design and installation assistance.

**Clips:** Wind clips are often specified and/or required in high wind and seismic areas. They aid in holding the tiles in place and reduce stress at the preliminary fastening point. Refer to local building codes in such areas.

**NOTE: In high wind regions, install each tile with #8 or #9 stainless steel or brass flathead Phillips or square drive screws and/or use Hurricane clips or wind lock nose hook. Hurricane clips, wind lock nose clips and sealants may be required by the local building codes.**

**Bedding Tile:** Where freeze-thaw cycles are not an issue, tile may be laid in a full or partial bed of mortar. This method is best used in combination with other means of attachment.

**Foam Adhesive:** This method of application is approved for use in Sun Belt non freeze-thaw areas and is being tested for use in other areas. Refer to local building codes. Do not use single part foam systems with Ludowici tile. Only two part systems such as Polyset® from Polyfoam are acceptable. Visit Polyfoam.cc for design and installation assistance.

**IMPORTANT:**  
**Before application of Ludowici tiles in Alpine conditions, plans must be submitted to the Ludowici Technical Department for approval. Ludowici will not assume liability or responsibility for damage caused by the application of clay tiles in Alpine conditions.**

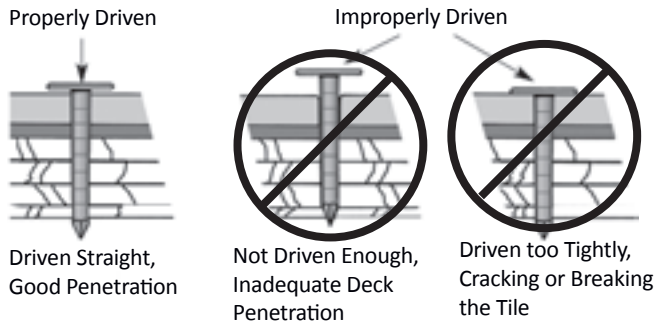


Figure 15.1 Proper Nailing Techniques for Plywood Decks

Chart 15.2 Attachment Requirements

Spanish 13-1/4" Spanish 18-3/8"	<b>Substrate</b>	<b>Field Tile</b>	<b>Hip</b>	<b>Ridge</b>	<b>Quik-Tach™ Bracket</b>	<b>Hurricane Clip</b>
	Boards	1 1/2"	2"	2 1/2"	Type B (13 1/4")	2 5/16"
	3/4" Plywood	1 3/4"	2"	2 1/2"	Type D (18 3/8")	2 5/16"
Scandia™	<b>Substrate</b>	<b>Field Tile</b>	<b>Hip</b>	<b>Ridge</b>	<b>Quik-Tach™ Bracket</b>	<b>Hurricane Clip</b>
	Boards	1 3/4"	2"	2 1/2"	Type B	2 3/8"
	3/4" Plywood	2"	2"	2 1/2"		2 3/8"
Straight Barrel Mission 14-1/4", 16", 18-3/8" & Palm Beach Mission	<b>Substrate</b>	<b>Field Tile</b>	<b>Hip</b>	<b>Ridge</b>	<b>Quik-Tach™ Bracket</b>	<b>Wind Lock</b>
	Boards	1 1/2"	2"	2 1/2"	Type B (14 1/4")	1 1/4"
	3/4" Plywood	1 3/4"	2"	2 1/2"	Type D	1 1/4"
Tapered Barrel Mission 14-1/4", 16" & Cubana	<b>Substrate</b>	<b>Field Tile</b>	<b>Hip</b>	<b>Ridge</b>	<b>Quik-Tach™ Bracket</b>	<b>Wind Lock</b>
	Boards	1 1/2"	2"	2 1/2"	Type B (14 1/4")	1 1/4"
	3/4" Plywood	1 3/4"	2"	2 1/2"	Type D	1 1/4"

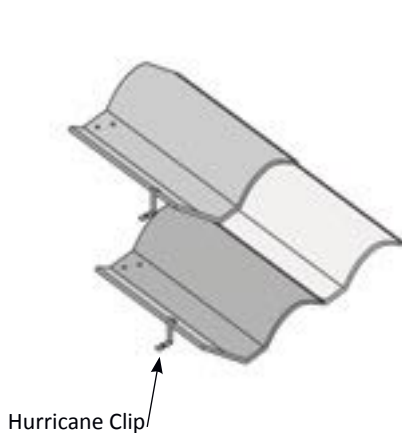


Figure 15.3 Hurricane Clip for Spanish

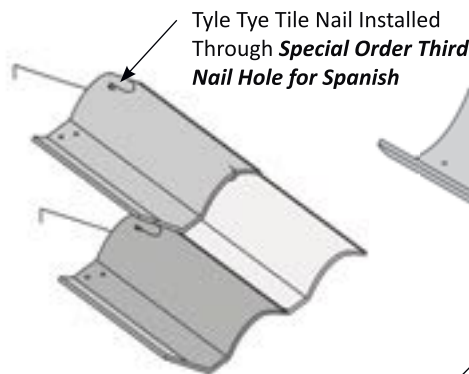


Figure 15.4 Tyle Tye Tile Nail for Spanish

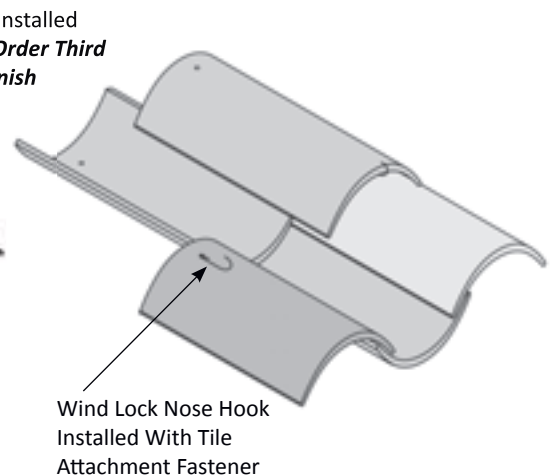


Figure 15.5 Wind Lock Nose Hook for Mission Tile

# Getting Started

## Assemble All Tools and Supplies

The following tools are needed for basic installation of clay roofs:

- Safety equipment as required by OSHA and other local and state agencies
- Rule or tape
- Mason's trowel and bucket
- Chalk line and chalk
- 4" diamond-tipped turbo blade on angle grinder
- Claw hammer
- Protective eye wear/dust mask
- Chipping hammer
- Caulking gun
- Felt knife
- Sheet metal shears
- Roof jacks
- Slate ripper
- Segmented diamond blade (8" to 10" diameter)
- Wet tub saw
- Tile nippers
- Marking pencil
- Sharp steel punch
- Battery-operated, clutch-driven drill (with extra batteries)
- Carbide spear point glass drill bits
- Small steel roller

### **IMPORTANT:**

***All roof work can be hazardous. Safety requirements are spelled out by OSHA and individual state Occupational Safety and Health Administration regulations. It is the responsibility of the installer to take all necessary precautions. Contact the Occupational Safety and Health Administration for complete information.***

### **IMPORTANT:**

***All roofing components should be selected to be compatible with the long service life of a Ludowici roof.***

In addition to tools, the following materials are needed:

- Flashing: use a minimum weight of 16 oz. copper, at least 24" wide with 1/4" edge turned over and fastened with cleats for valleys. Under special circumstances, such as unusual exposure to high wind or heavy snow, this flashing weight should be increased. Lighter weight copper flashings are undesirable because they can puncture too easily and they will not provide the wear life required for a long-life roof system.
- Underlayment: two layers of No. 30# asphalt-impregnated roofing felt or one layer of No. 43# coated base sheet, doubled on rough surfaces, hips, valleys and ridges or one layer of Ice and Water Shield.
- Roofing cement: roofing cement for gable rakes, hip rolls, ridges, stringers and other conditions should be non-running, heavy-body flashing cement composed of mineral ingredients to meet the requirements of ASTM D-4586.
- Cant strips, wood nailers and field tile nailer strips: all should be foundation grade wood.
- Mortar and mortar color to match tiles: Ludowici defines mortar as one part Portland cement and four parts sand (to ASTM specification C-270). Contact your local brick distributor to acquire colorant.
- Silicone sealant or adhesive: the recommended sealant for exposed caulking is Dow Corning<sup>®</sup> 790 Silicone Building Sealant<sup>™</sup> or GE<sup>®</sup> SilProof<sup>™</sup> (ASTM C-920, low modulus). These sealants may be used as hidden adhesives. NP1 or other adhesives may be suitable as well; however, care should be taken to select for maximum durability and also for compatibility with adjacent materials. Some sealants are available in different colors to match tiles.

# Preparing the Roof

## Inspecting the Deck

- Ensure that the roof deck is clean, smooth and dry before roof tiles are applied.
- Verify that there is no significant delamination, warpage, bowing or separation from the rafters or trusses. Check for deck rot.
- If deck is APA 3/4" rated plywood, check that panels are spaced approximately 1/16" to a maximum of 1/8" apart for expansion and H-clips are used between supports when the rafter spacing exceeds 16" O.C. Unsupported end joints must be blocked.

Make repairs to the deck as necessary.

**NOTE:** Prior to applying any roofing material, all contractor work above the roofline must be completed.

## Installing the Underlayment

Most problems with water-shedding roof installations occur from water that migrates through the joints of the tiles through capillary action, wind-driven rain and runoff or ice damming. Because of this possibility, the underlayment is critical to the success of the roof.

At a minimum, all decks must be covered with two layers of No. 30# asphalt-impregnated roofing felt or one layer of No. 43# coated base sheet.

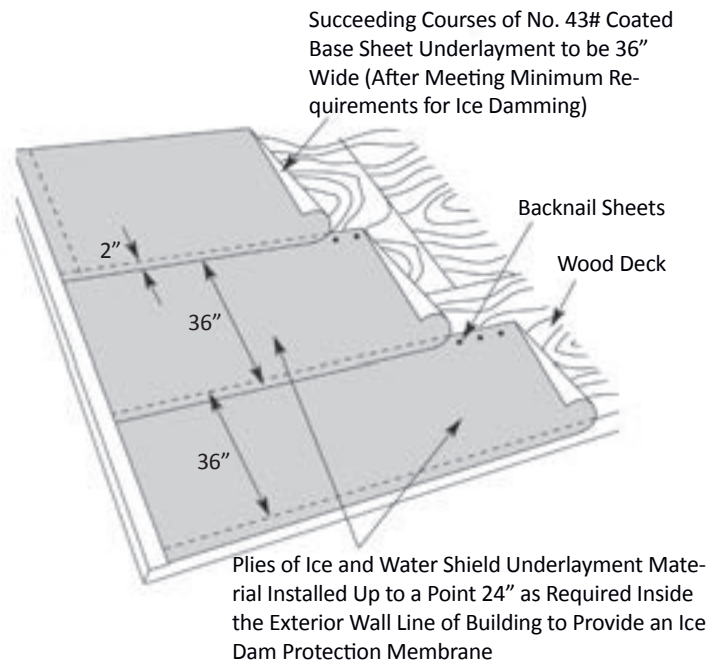
**NOTE:** Underlayment materials must be covered with tile as soon as possible to prevent degradation from exposure.

If wood cant strips and nailers are nailed directly to the deck, they must be covered with waterproof underlayment. If nailed on the underlayment, they should be pressure treated wood.

**NOTE:** All roofing underlayment materials should be carried 6" up all vertical surfaces.

### For single layer of No. 43# coated base sheet:

Lay base sheet parallel to eave. Side lap - 2" and end lap - 6".



**NOTE:** All dimensions are approximate

Figure 17.1 Single Sheet Underlayment

### For Double Layers, follow these steps:

First apply a starter sheet of 1 layer of Ice and Water Shield underlayment per manufacturer's instructions.

Then completely cover the starter sheet with a full-width sheet of No. 43# roofing felt. Lap succeeding sheets 19" over the preceding sheets, leaving a 17" exposure (2" lap). End of roll laps should be a minimum of 6".

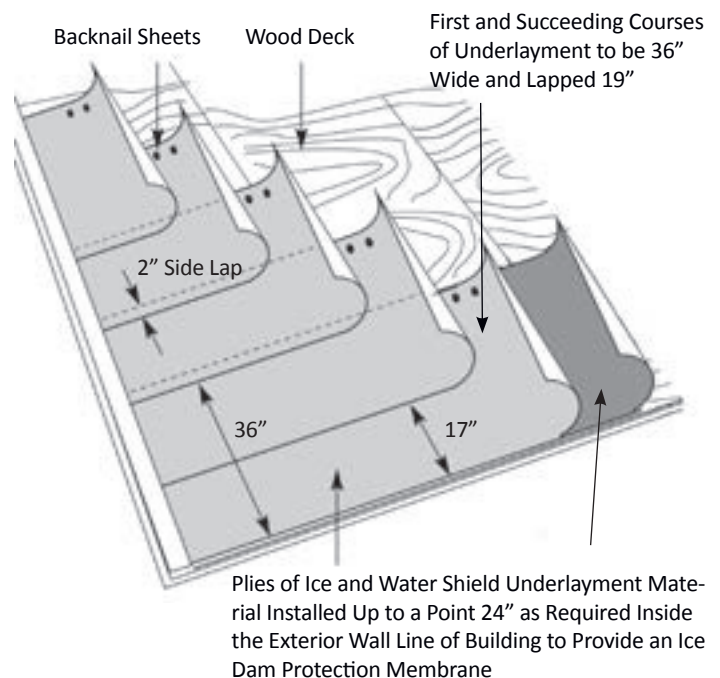


Figure 17.2 Double Sheet Underlayment

## Concrete Deck

For Ice and Water Shield underlayments follow the manufacturer's installation instructions for attachment to concrete. Or, if using asphalt felt, apply No. 43# coated base sheet and fasten per the architect's instructions. For non-nailable concrete decks a counter batten system will be necessary. Over the underlayment fasten a standard pressure treated 1" x 2" furring strips vertically 20" O.C., apply pressure treated 1" x 2" wood strips horizontally across lath spaced to accommodate the correct tile exposure and proceed as directed for a sheathed roof (see Figure 18.1).

**NOTE: Flashing dimensions will have to be adjusted to accommodate the thicker assembly.**

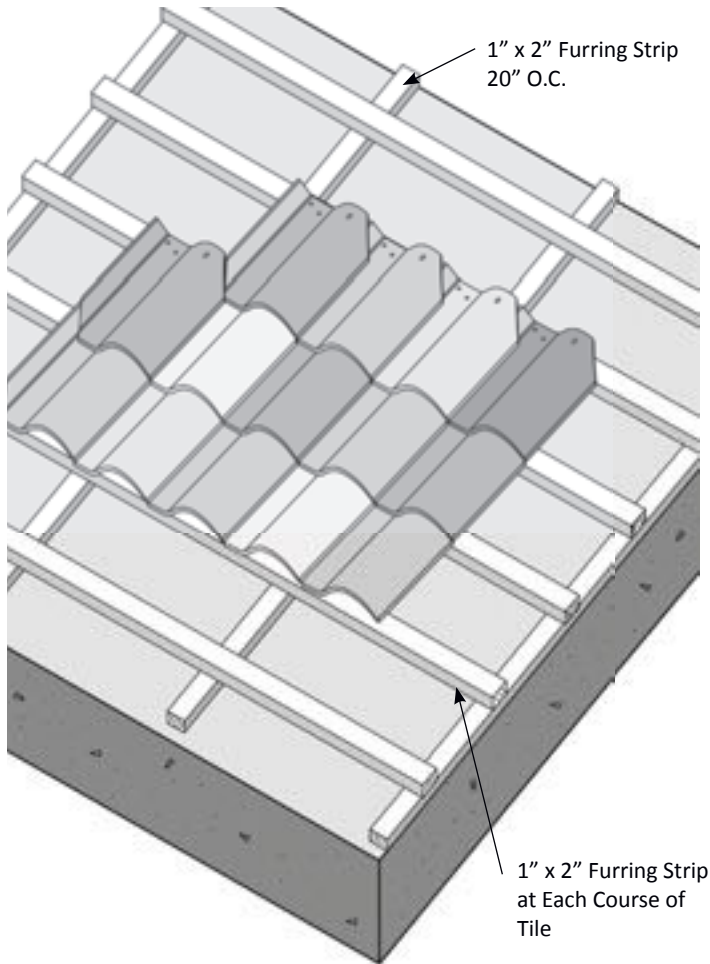


Figure 18.1 Batten System of Attachment for Concrete Deck

## Ice Dam Protection

Ice dam protection is recommended in areas where the January mean temperature is 30° F. or less and on all pitches below the standard minimums. This protection must be installed wherever there is a possibility of ice forming along the eaves which will cause a back-up of water and may cause building and interior damage. Consider your local weather conditions.

Apply self-adhering Ice and Water Shield, or equivalent, directly to the deck according to application instructions provided with the product. Self-adhering underlayment must extend up the roof to a point at least 24" beyond the interior wall line and in areas of severe icing at least up to and above the highest water level expected to occur from ice dams (see Figure 18.2).

*Please note that the 24" point beyond the interior wall line is a minimum recommendation. Self-adhering Ice and Water Shield underlayment should be applied to all roof decking, which past history and professional experience suggest, might be subject to ice dam back-up. If considering using ice dam protection on the entire surface of the roof deck, insure that adequate ventilation is present to prevent the development of damaging condensation on the underside of the roof deck.*

If a wide eave overhang requires flashing wider than 36", the necessary 6" minimum horizontal lap must be located on the overhang outside the structure walls. End laps must be a 6" minimum. Underlayment should meet ASTM D-1970.

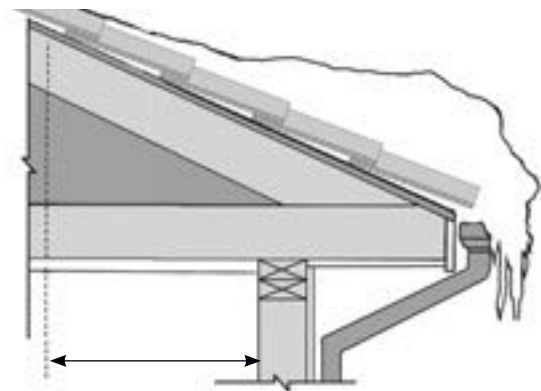


Figure 18.2 Ice Dam Protection

## Applying Wood Nailers and Battens

After lining the roof with underlayment, install wood stringers for ridges and hips. Next install stringers for Mission tile or battens for Spanish field tile nailer strips (required for certain applications). The heights of the stringers are determined by the tile pattern and the type of fittings to be used.

### Stringers for Hip and Ridge

Attached Ridge and Hip Stringers with corrosion resistant fasteners 2' O.C. (see Figure 19.1).

All Hip and Ridge wood stringers must be covered with two layers of coated base sheet or a self-adhesive Ice and Water Shield. Stringers must be pressure treated and foundation grade wood. The sizes for stringers vary with tile and Ridge Cap type. Wood stringers must be a minimum of 1-1/2" thickness and of proper height to carry hip and ridge pieces.

Stringer height for hip and ridge vary depending on the tile profile, hip and ridge type and roof pitch. To determine proper stringer heights for your application lay field tile and hip on the roof deck in the correct configuration and measure the gap between the underside of the hip tile to the apex of the hip on the roof deck, this will be your stringer height.

### Nailer Strips (Field Tile Stringers)

Mission tile require a nominal 2" x 4" wood stringer to serve as a nailer board and to support the cover tile. The stringer should be a pressure-treated, foundation-grade wood.

**NOTE: Hip caps should just rest on the bottom edge of the field tile and run in a straight line parallel to the roof slope.**

Follow the same procedure for the ridge stringer. For Vented Ridge adjust Ridge Riser Bracket to correct height. Even in conditions where the stringer height is minimal it is important to install them to provide a straight surface for the hip tile to rest. Do not eliminate the stringer and just let the hip tile rest on the field tile. This will produce an irregular hip that snakes up and down.

### Battens

For applications where Battens are specified, use nominal 1" x 2" pressure treated wood. Vertical battens should be spaced no further than 20" on center. Horizontal battens are applied one per course of tiles (see Fig 18.1).

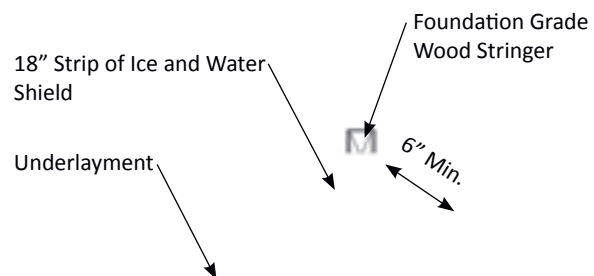


Figure 19.1 Ridge and Hip Stringer Detail

## Measuring and Chalking the Roof

Layout and chalking the roof accurately are critical to the roof's performance and appearance. If the eaves are straight and level, all horizontal lines must be parallel to the eaves and all vertical lines must be perpendicular to the eaves. Check the roof deck to determine if the deck is square prior to layout.

### Step 1: Determine Width and Length Exposure

Clay tiles, depending on the style and profile, vary in exposure and recommended head lap. Ludowici Spanish and Mission tile are laid with a minimum headlap of 3". Before chalking the roof the installer should verify the tile pattern being installed, and measure, noting average length and width exposures of the tile shipped.

The usual overhang at the eave is 2"; however, this may be adjusted slightly to accommodate full courses.

### Step 2: Chalking Vertical Lines

Vertical lines are chalked first. In the case of a hip roof, the first line is struck in the center of the roof equidistant from each hip. The remaining vertical lines are then struck to the right and left at intervals equal to your average width exposure x 5. Care must be taken to ensure that all vertical lines are parallel to the water flow.

### Step 3: Chalking Horizontal Lines

Horizontal lines are struck after the vertical lines are struck.

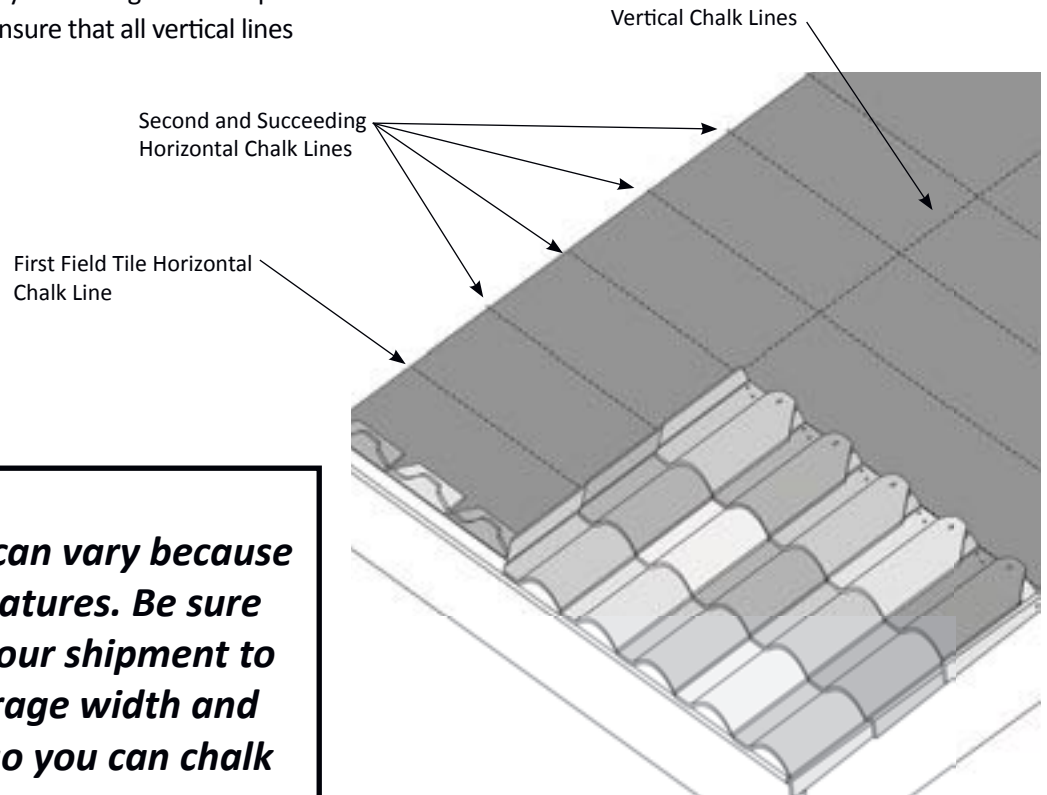
Strike a line for the under eave tile. Subtract 2" (for overhang) from the under eave to determine distance.

For Spanish and Mission tile the first field tile line will equal the average length of the tile minus the overhang (typically 2").

Successive lines are then struck at intervals equal to your average length of exposure. Length exposure is determined by subtracting 3" (for headlap) from the tile length.

**NOTE: Do not adjust exposure to a headlap less than 3".**

Care must be taken to ensure that all horizontal lines are perpendicular to the water flow.



### **IMPORTANT:**

**The tile dimensions can vary because of clay firing temperatures. Be sure to measure tiles in your shipment to determine their average width and length dimensions, so you can chalk your roof properly.**

Figure 20.1 Chalk Line Layout



## Tile Distribution Over Deck

After all roof preparation has been completed, the tiles are evenly distributed on the roof, if pitch permits.

**NOTE:** *Stacking distribution will depend on the number of tiles per square and the number of tiles per stack.*

Spacing of the tiles is determined by the width of the exposed tile times the number of courses being fed per stack. If the tiles are stacked 8 tiles high and the tile exposure is 10" and the stack feeds 2 courses, then the stacks would be placed 40" O.C.

Tile stacks normally start at the third course from the eave and continue with alternate courses.

The important aspect of tile loading is to evenly spread the load across all surfaces of the roof using the proper spacing to assure the proper amount of tile is loaded on the roof.

Remember to utilize the color blending instructions (see Page 23).

### **WARNING:**

***Do not leave stacked tiles on the roof for extended periods of time. The concentrated load can begin to slide on the heated underlayment sheet. This sliding could cause injury to persons or damage to nearby property.***

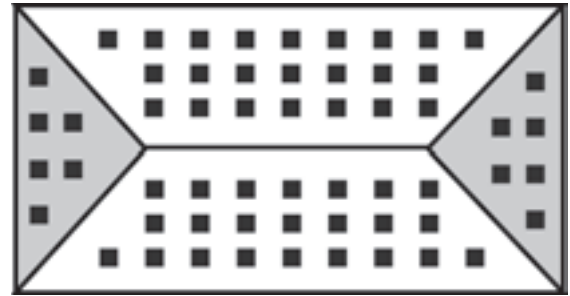


Figure 21.1 Distribution of Tile Over Roof

### **WARNING:**

#### ***Roof Loaded Tile During Severe Weather***

It is possible that strong winds could lift tiles off the piles and send them flying off the roof, resulting in injury to persons or damage to nearby property.

- If tiles have been pre-loaded onto the roof deck and strong winds or severe storms are predicted, remove the tiles and place them on ground level.
- If tiles have not yet been loaded, then it is recommended not to do so until the threat of bad weather has disappeared.

Pre-loading the roof deck with tiles prior to starting the actual installation will provide convenience and faster installation, but should only be done if weather conditions permit. Use common sense so that you do not become liable for damage or personal injury.

## Cutting, Notching and Drilling

### Cutting

**NOTE: Unnecessary cutting and drilling time can add substantial cost to the job. Carefully consider tile layout before starting the work to minimize cutting and drilling.**

Tiles should be cut wet on the job with a masonry or tile saw equipped with a diamond blade. Segmented blades will be the most efficient. Slight surface chipping will occur during the cutting operation. The sliding saw table and tub should be as large as possible to accommodate cutting the tiles diagonally.

Ludowici tiles are extremely hard, which provides the tiles with low moisture absorption and long life. Dry cutting techniques used on softer tile products will not work as fast with Ludowici's hard tile. Dry cutting with a good segmented "turbo" diamond blade is possible. Best results have been obtained using a 4" diamond tipped segmented blade mounted on a small right angle grinder motor.

### Notching

One time saving option to drilling through the tiles is to notch it with the small 4" diamond blade saw and then nail or wire in place. If using a field tile for the starter course or ridge, "dovetail" notches are cut. Make sure cuts are wide enough for a nail or screw (see Figure 22.1).

### Drilling

Additional nail holes may also be drilled if necessary. High torque electric drills may snap the carbide bits in the extremely hard Ludowici tile. Drills should be battery-powered, adjustable clutch-driven types. To drill out holes, the tile should be set in a pan with water to extend bit life and avoid the risk of eye injury due to fragments. Expect to drill only about 6 holes per carbide bit.

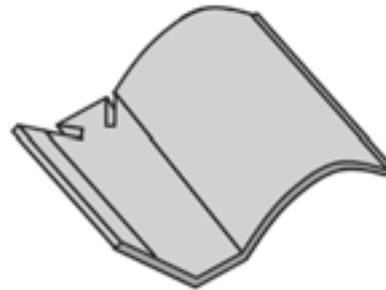
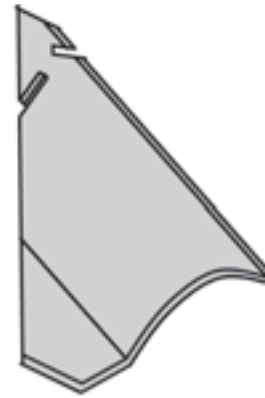


Figure 22.1 Examples of Cut and Notched Tile

**WARNING:**  
**Dry drilling may result in serious eye injury. Always use protective eye and face wear when drilling tile or operating a masonry saw.**

**Never use 115-240 volt AC-operated drills in water. Electrical shock could result.**

## Blending

Blending is one of the most important aspects of correctly installing a Ludowici tile roof.

### ***Whether installing a single color or multiple colors ALL LUDOWICI ROOFS MUST BE BLENDED.***

Colors within a given shipment of Ludowici clay roof tile will vary slightly due to subtle changes in clay composition and kiln firing temperatures. Such color variances are not a defect but a natural desirable feature that gives roofs depth and character.

Unless the architect or owner specifies a pattern, there should be no visible pattern or hot spots on the roof.

Ludowici does not pre-blend the tile. It is the roofers responsibility to evaluate the tiles for color shade and range and then properly blend them to achieve a harmonious color roof without blotches, hotspots or patterns.

The person responsible for the blending of the shades of color should randomly select tiles from at least four different pallets.

After the installation of about 75-100 tiles, the roof should be inspected from the ground at a distance greater than 40 feet to determine that there are no streaks or blotches. To ensure a good range of tones, this inspection must be done at regular intervals.

***NOTE: When nearing the end of the project if its determined that additional material will be needed to complete the roof, reserve several pallets of the initial shipment to blend with later shipments to maintain a consistent range.***

## Color Blending with Different Color Tile

Blending different tile colors can provide a unique and aesthetically pleasing roof.

Make a drawing to detail the layout and to help determine the proper number of tiles of each color.

In order to maintain the correct color blend, pull tiles from the different pallets of each color. Premix these piles in the desired percentage and load the roof one square at a time. This will provide even distribution. Additional care should be taken by the roofer laying the tiles to avoid clumping of a single color or range.

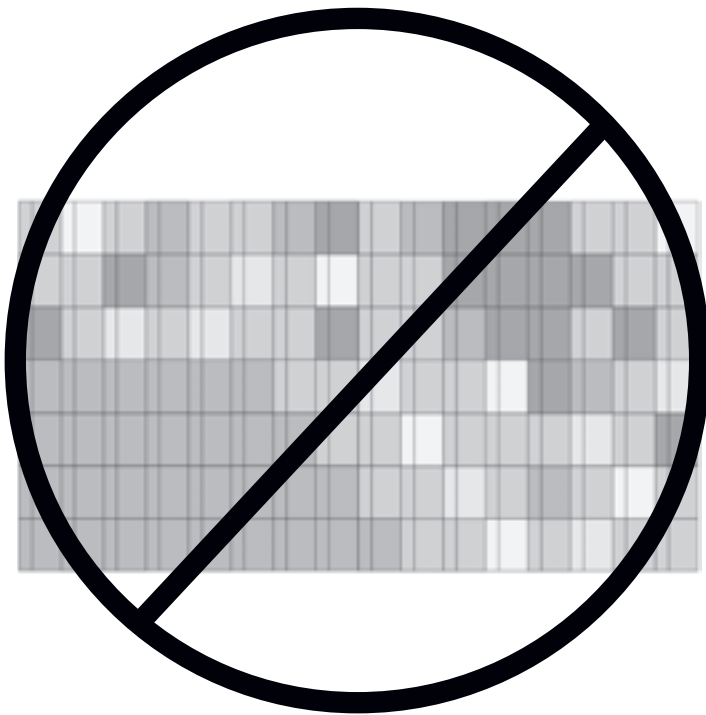
After the installation of about 75-100 tiles, the roof should be inspected from the ground at a distance greater than 40 feet to determine that there are no streaks or blotches. To ensure a good color blend, this inspection must be done at regular intervals.

***NOTE: It may be helpful to lay the tile blend out on the ground so the installer has a visual example. Make one person responsible for the ongoing and end result of the blending.***

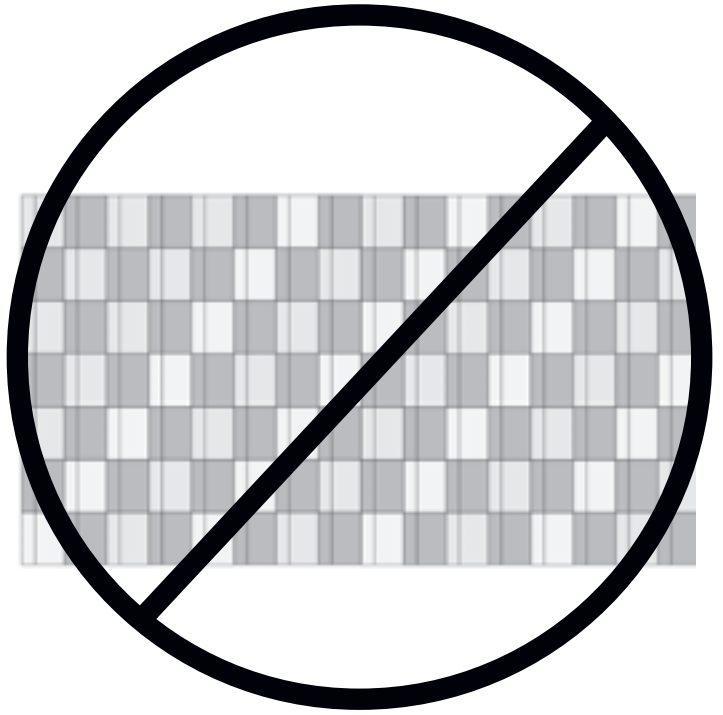


***NOTE: For mission tile roofs with multiple colors care should be taken to mix the colors so adjacent pans and caps are randomly blended.***

*Figure 24.1 Properly Blended Spanish Tile*



*Figure 24.2 Improperly Blended Spanish Tile. There Should Be No Hotspots or Diagonal Patterns Visible.*



*Figure 24.3 Improperly Blended Spanish Tile. Do Not Install the Tiles in a Repetitious Pattern.*

# Installing the Flashing

## IMPORTANT:

Where roofs intersect other roofs, parapet walls, chimneys, ventilators, vent pipes and similar projections, flashings are required. There is a natural weakness at these intersections and properly installed flashings are required to make the intersection watertight. Expansion and Contraction due to temperature changes contribute to the weakness, so it is extremely important to correctly design and install the flashings and to use durable flashing material (a minimum of 16 oz. sheet copper is recommended).

General flashing details are shown in this section but many more exist for each particular situation which cannot be covered in the context of this tile installation manual. Proper flashing installations are critical for a watertight roof.

## Eave Flashing

Where eave metal flashing is used, it should be formed using a minimum of 16 oz. sheet copper with a drip edge along the bottom to allow water to drip off the edge of the roof (see Figure 25.2).

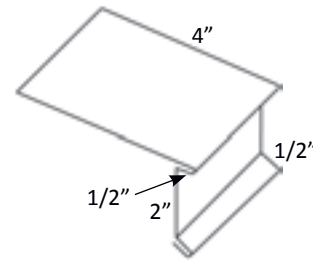


Figure 25.2 Eave Flashing Dimensions

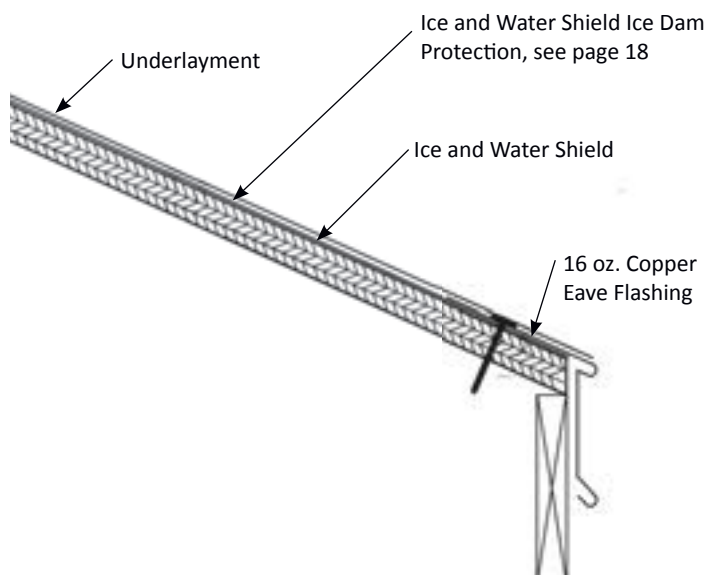


Figure 25.1 Copper Flashing Eave Detail

**Rake Edge Flashing**

The use of Ludowici detached gable rakes, rolled rakes and attached rakes precludes the need for rake flashing. However, in conditions where the normal tile spacing doesn't work out to use a gable rake tile a rake flashing edge may be needed.

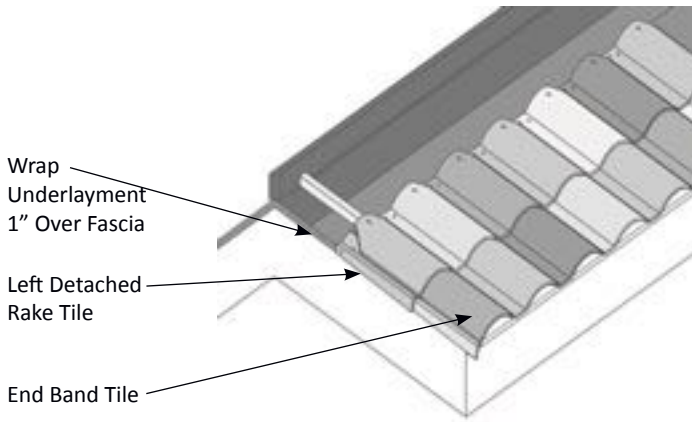


Figure 26.1 Spanish Left Detached Rake Detail  
No Flashing Required \*

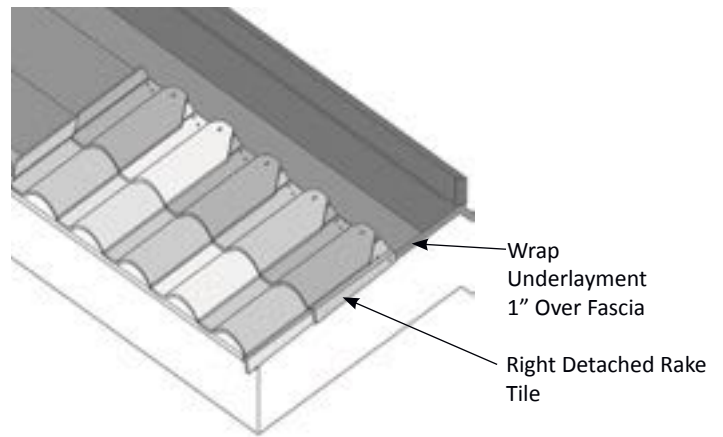


Figure 26.3 Spanish Right Detached Rake Detail  
No Flashing Required

\* See Detail 26.2 for Flashing Detail Where Spacing Conditions Do Not Work Out to Full Tile

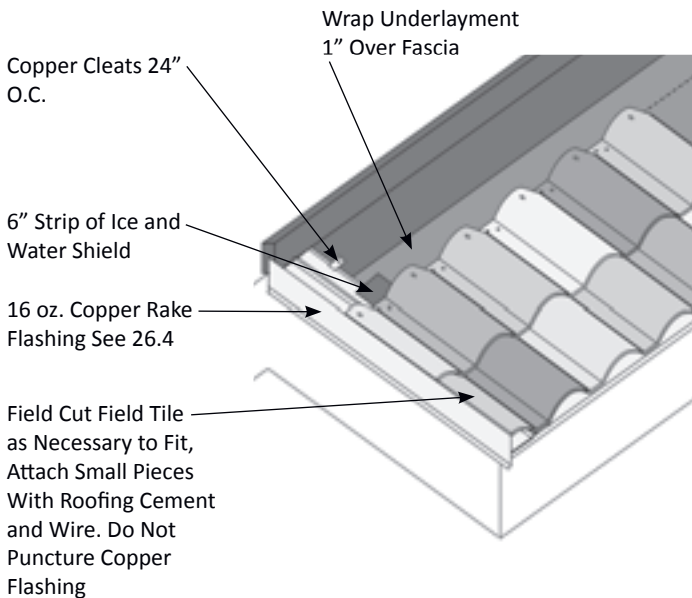


Figure 26.2 Spanish Non Standard Left Rake Detail

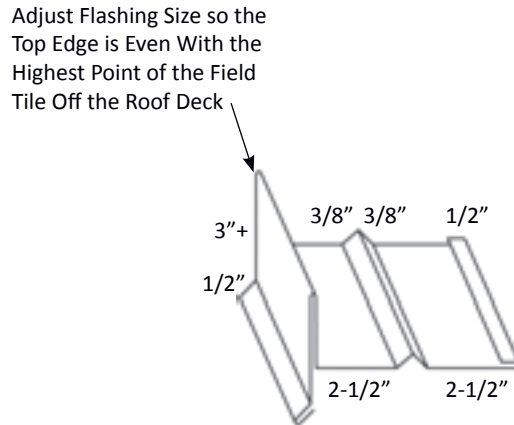


Figure 26.4 Closed Rake  
Flashing Dimensions

## Flashing at Valleys

Valleys, since they collect the water runoff from the portions of the roof sloping into them, are particularly prone to water migration and leakage. A clear and unobstructed pathway for quick water drainage is essential in valleys. There are two basic types of valleys in tile roof installation: open and closed valleys. Open valleys are the standard and preferred choice as they reduce debris collection and potential water infiltration.

### Open Valleys

In an open valley construction the tiles are held back from the center of the valley to expose the copper flashing. The advantage of an open valley is that it permits unobstructed drainage. Open valleys are recommended in areas with surrounding foliage where the leaves, needles and other debris can fall on the roof and potentially slow or block the runoff of water from the roof (see Figure 40.1).

The valley metal is to be secured with approved fasteners. At no time are nails to be placed in the area of the valley that will be carrying water.

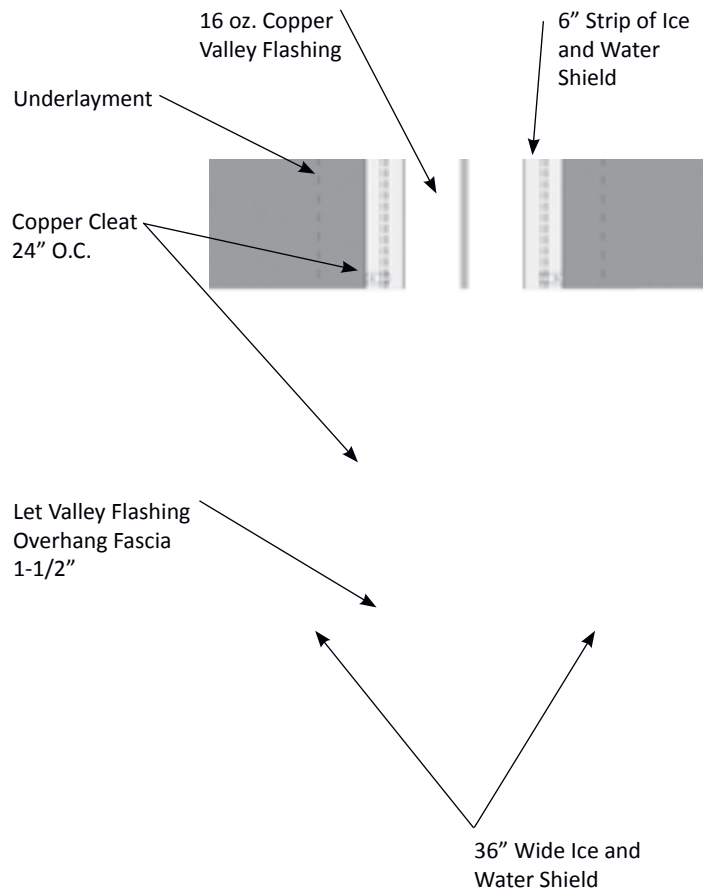


Figure 27.2 Open Valley Flashing Detail

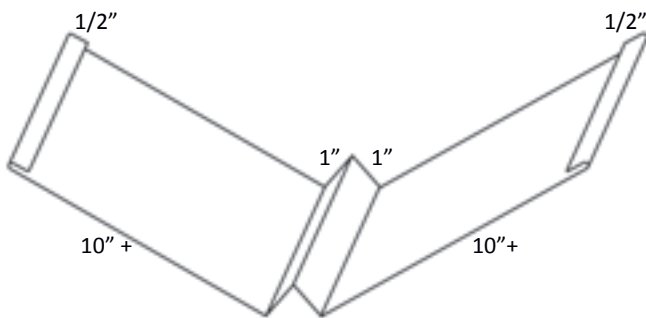


Figure 27.1 Valley Flashing Dimensions

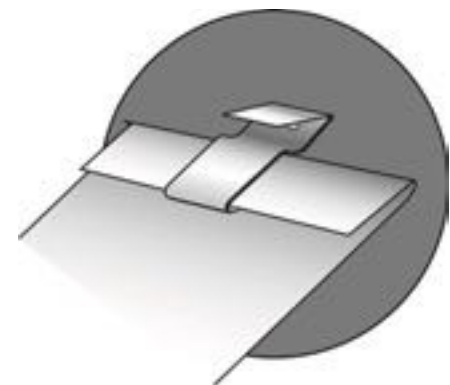


Figure 27.3 Copper Cleat Detail

**Closed Valleys**

In a closed valley, the tiles from the adjoining roof are mitered and abutted. Since water migrates through a closed valley onto the sheet copper flashing which carries the runoff, this type of construction is considered decorative. Closed valleys should not be used where the rafter length or pitch varies on adjacent roof planes. It is important that corresponding courses align coming into the valley.

**NOTE: Underlayment for all valleys must be a full width sheet (36") of two layers of No. 43# coated base sheet or a layer of self-adhesive modified bitumen membrane. Each course from the adjoining fields must overlap the valley underlayment by at least 12".**

**NOTE: Closed valleys should not be used where foliage debris can fall onto the roof, accumulate and cause water backup in the valley.**

**Ludowici strongly discourages the use of closed valleys in areas with snow fall. Snow accumulation in a closed valley can cause ice dams, damaging the roof tile and creating potential leaks.**

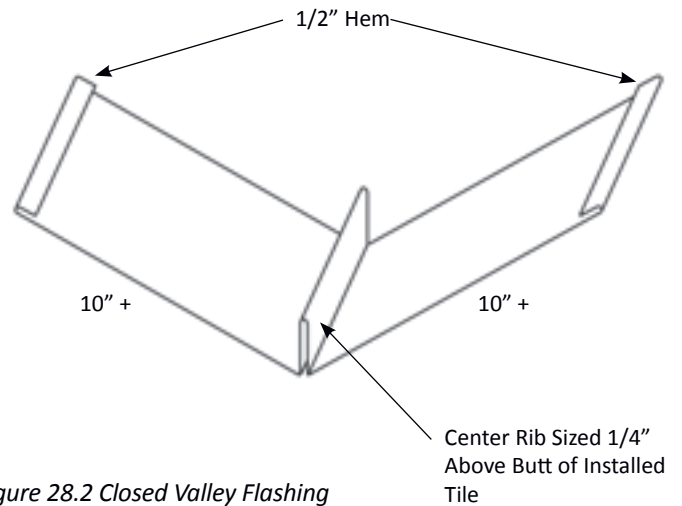


Figure 28.2 Closed Valley Flashing

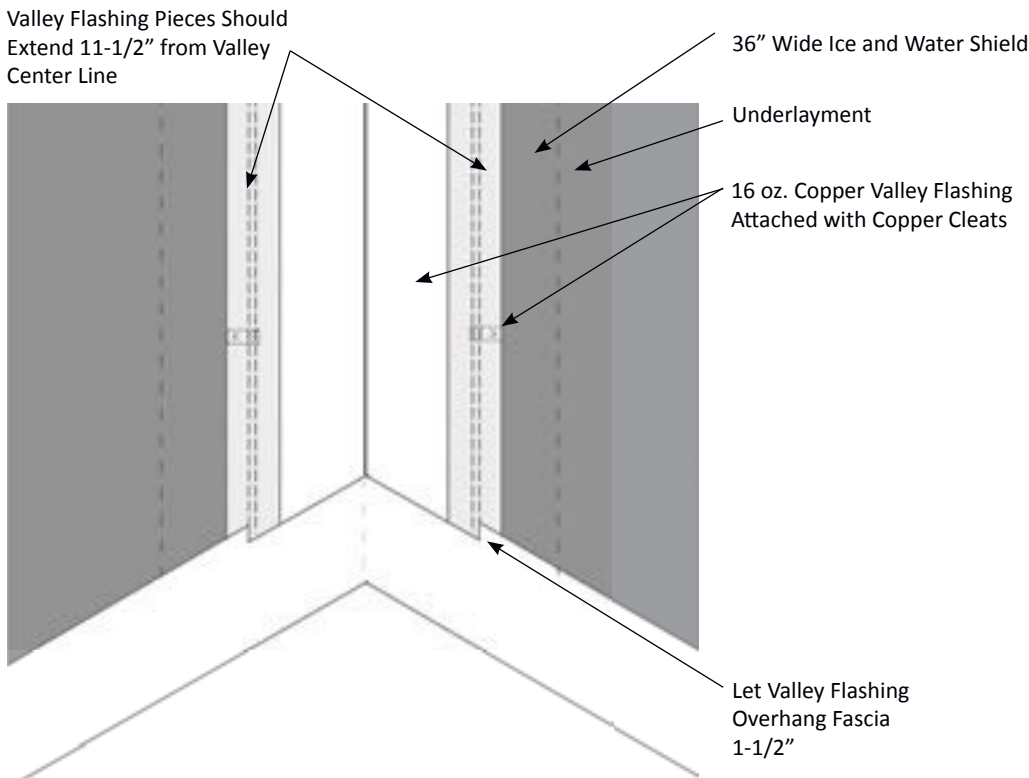


Figure 28.1 Closed Valley Detail



## Flashing at Side Walls

The transition from roof to side wall is flashed with Counter Flashing and Channel flashing.

### Channel or Pan Flashing

Channel or pan flashing, used with profile tiles, is designed to extend under the tiles rather than being interwoven between courses (see Figures 29.2, 29.3 & 29.4).

**The following procedures are used to install channel or pan flashing:**

1. Waterproof underlayment should be extended 6" up the vertical wall.
2. The copper flashing's vertical flange should extend approximately 4" up the wall.
3. Each length of copper channel flashing should extend a minimum of 8" over the underlying length of copper channel flashing.
4. The copper flashing channel should extend a minimum of 3" under the tile.
5. The copper flashing should be fastened through the vertical flange, near the upper portion at approximately 12" on center. (The flashing channel should not be penetrated with fasteners since it is acting as a gutter.)
6. The wall underlayment and the siding or cladding should be brought down a minimum of 2" over the upper portion of the vertical flange.

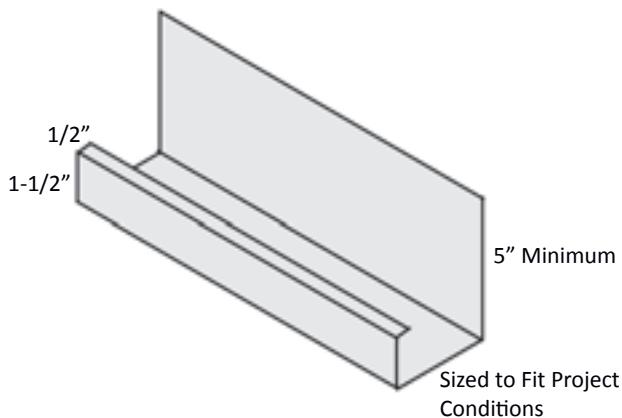


Figure 29.1 Side Wall Copper Channel Flashing

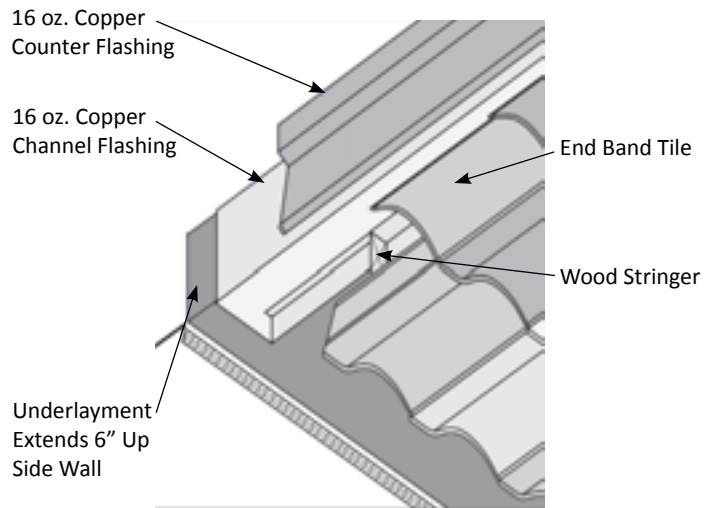


Figure 29.2 Left Side Wall Copper Flashing for Spanish Tile

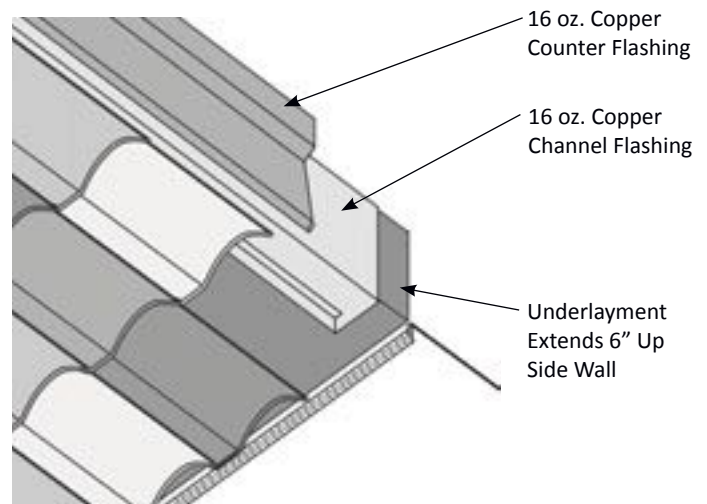


Figure 29.3 Right Side Wall Copper Flashing for Spanish Tile

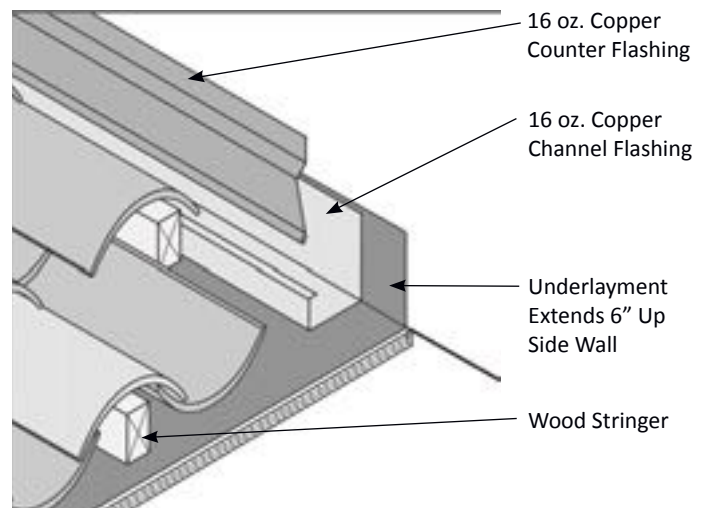


Figure 29.4 Side Wall Copper Flashing for Mission Tile

## Flashing at Open Valley at Main Roof to Dormer Juncture

For flashing where an open valley occurs at the intersection of a dormer roof and the main roof, the following steps should be taken.

1. The main roof tiles should be installed to just above the lower end of the valley, where the valley and the main roof intersect. Along the roof and wall juncture, channel flashing must be used and the last tile in the course should fit closely against the wall of the dormer. (see Figure 30.1).

2. The bottom end of the copper valley flashing should be cut so that it extends 1/2" below the down-slope edge of the dormer roof deck at the bottom of the valley. This lower cut edge should project a minimum of 2" below the intersection of the dormer and main roof.

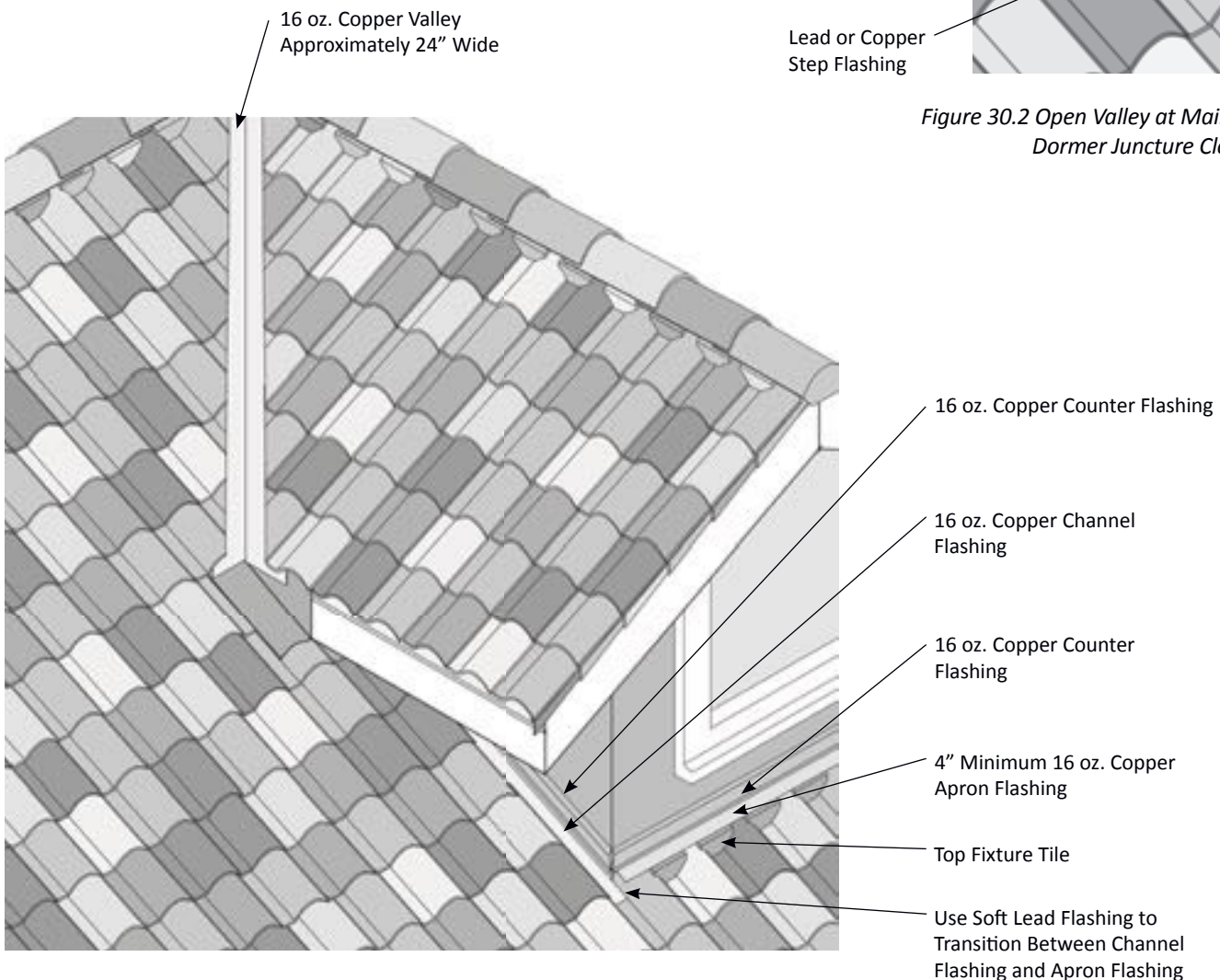


Figure 30.1 Open Valley at Main Roof to Dormer Juncture

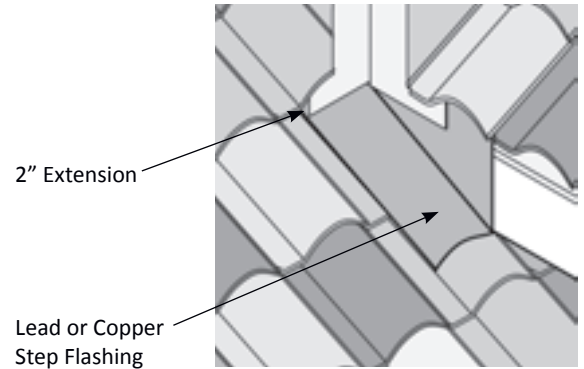


Figure 30.2 Open Valley at Main Roof to Dormer Juncture Close-up

## Flashing at Head Wall

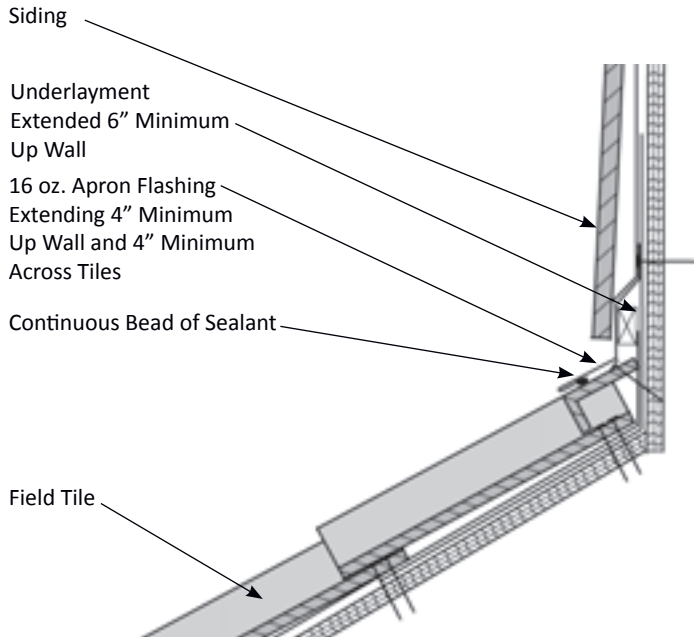


Figure 31.1 Apron Flashing at Siding Head Wall Detail

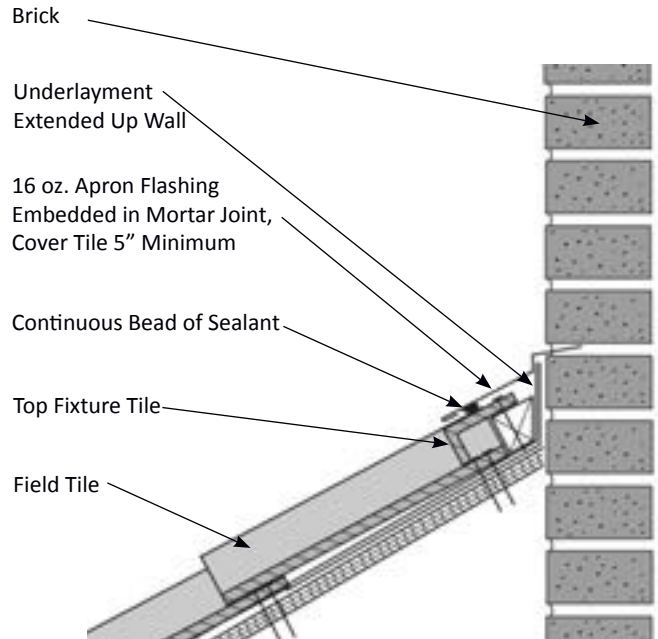


Figure 31.3 Apron Flashing at Brick Head Wall Detail

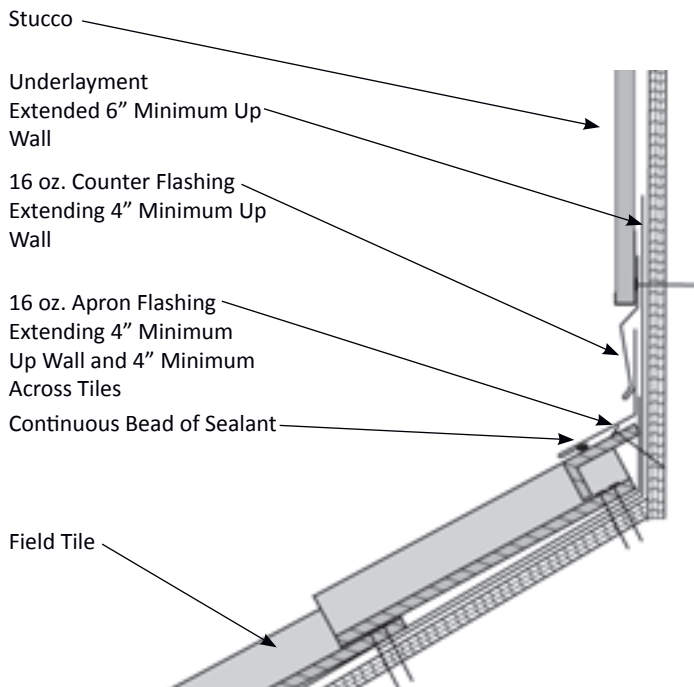


Figure 31.2 Counter Flashing & Apron Flashing at Stucco Head Wall

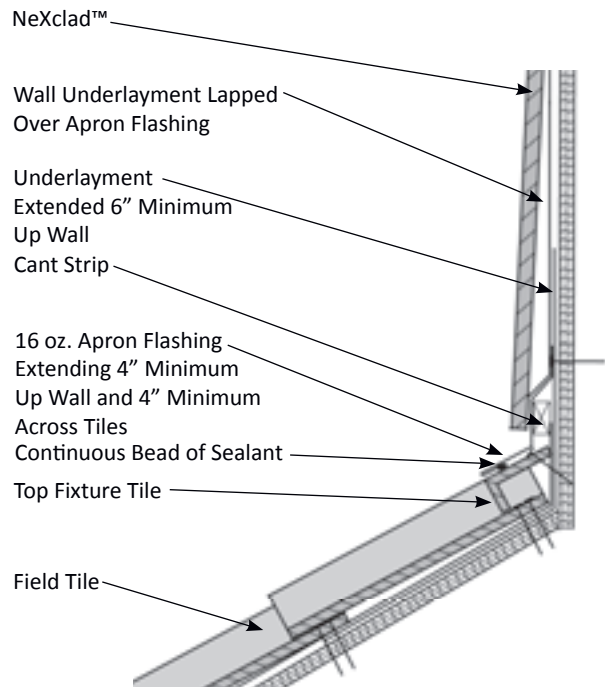


Figure 31.4 Apron Flashing at NeXclad™ Head Wall

## Flashing at Chimney

Since the foundations of chimneys are usually structurally separate, the flashing around chimneys needs to be able to accommodate movement from differential settlement without compromising the watertightness of the roof. Regardless of the climate, install self-adhering Ice and Water Shield membrane around the base of the chimney before the underlayment is applied as a protection against ice dams. Four types of flashing are required to properly flash around chimneys.

1. Apron flashing at the down slope face over the installed tiles – 4" minimum exposed width, 4" up the face of the chimney and continuously counter flashed.
2. Channel flashing along the sides of the chimney (see Figures 32.1 and 32.2).

3. Cricket or backer flashing on the upslope side or back.
4. Continuous counterflashing embedded in masonry joints.

### Counterflashing

Sheet copper counterflashing should be installed to overlap all vertical flashing flanges extended up the sides of chimneys. This is best accomplished by the mason during construction.

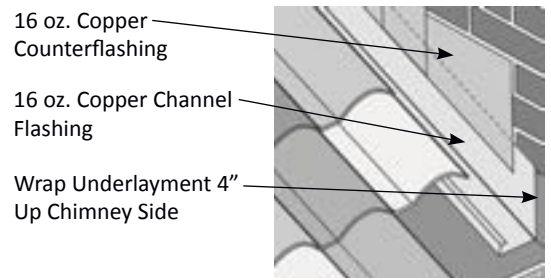


Figure 32.2 Chimney Side Flashing

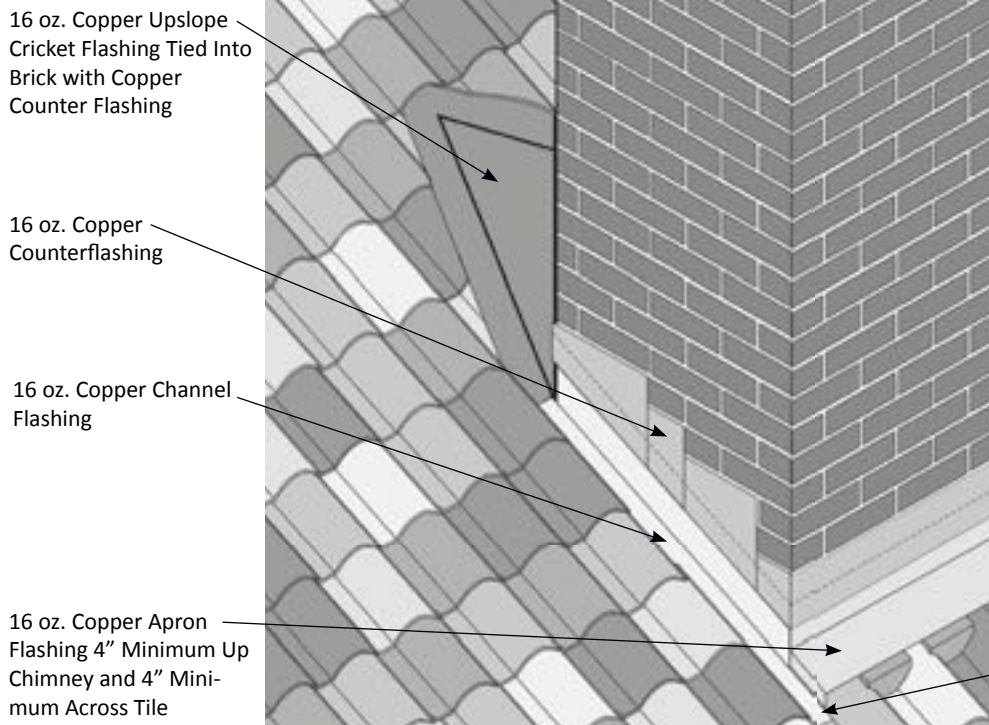


Figure 32.1 Chimney Flashing

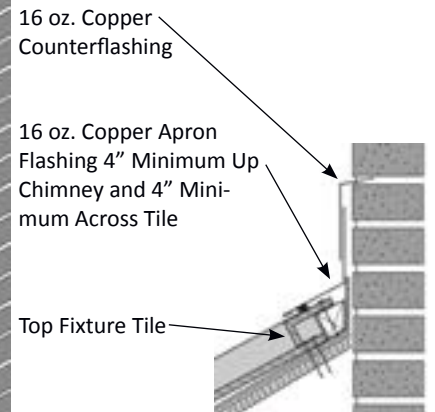


Figure 32.3 Chimney Face Flashing

## Additional Flashing Details

Plumbing pipe vents and stacks, skylights, roof-to-roof transition and other penetrations all require special flashing.

**NOTE: Be sure to order Skylights with a flashing package specifically designed for tile roofs and to accommodate the combined thickness of the layers of Barrel tile specified.**

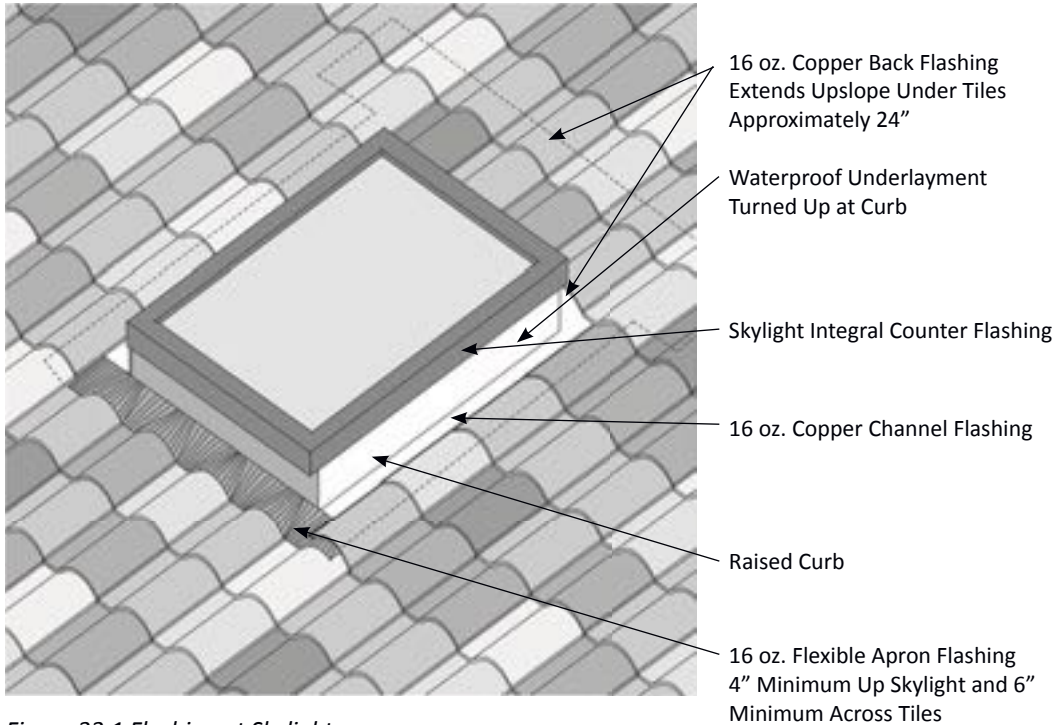


Figure 33.1 Flashing at Skylights

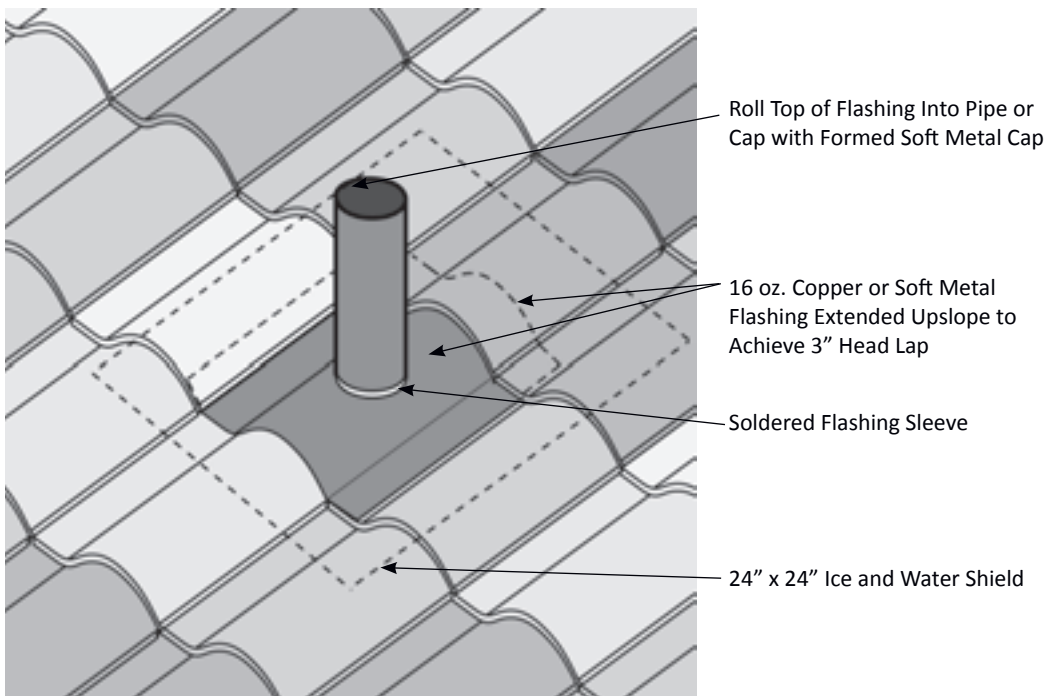


Figure 33.2 Flashing at Vents

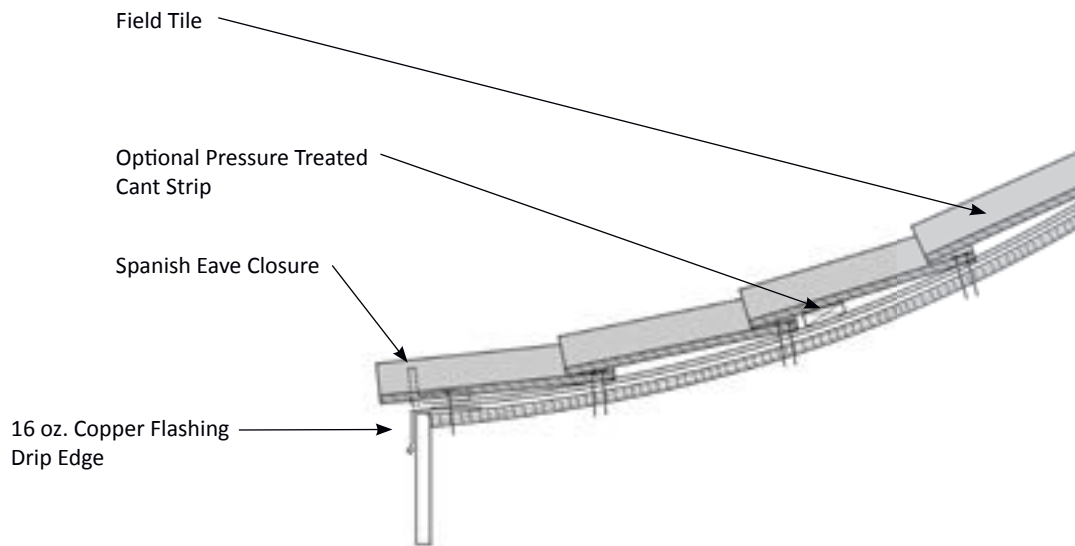


Figure 34.1 Curved Rafter Section

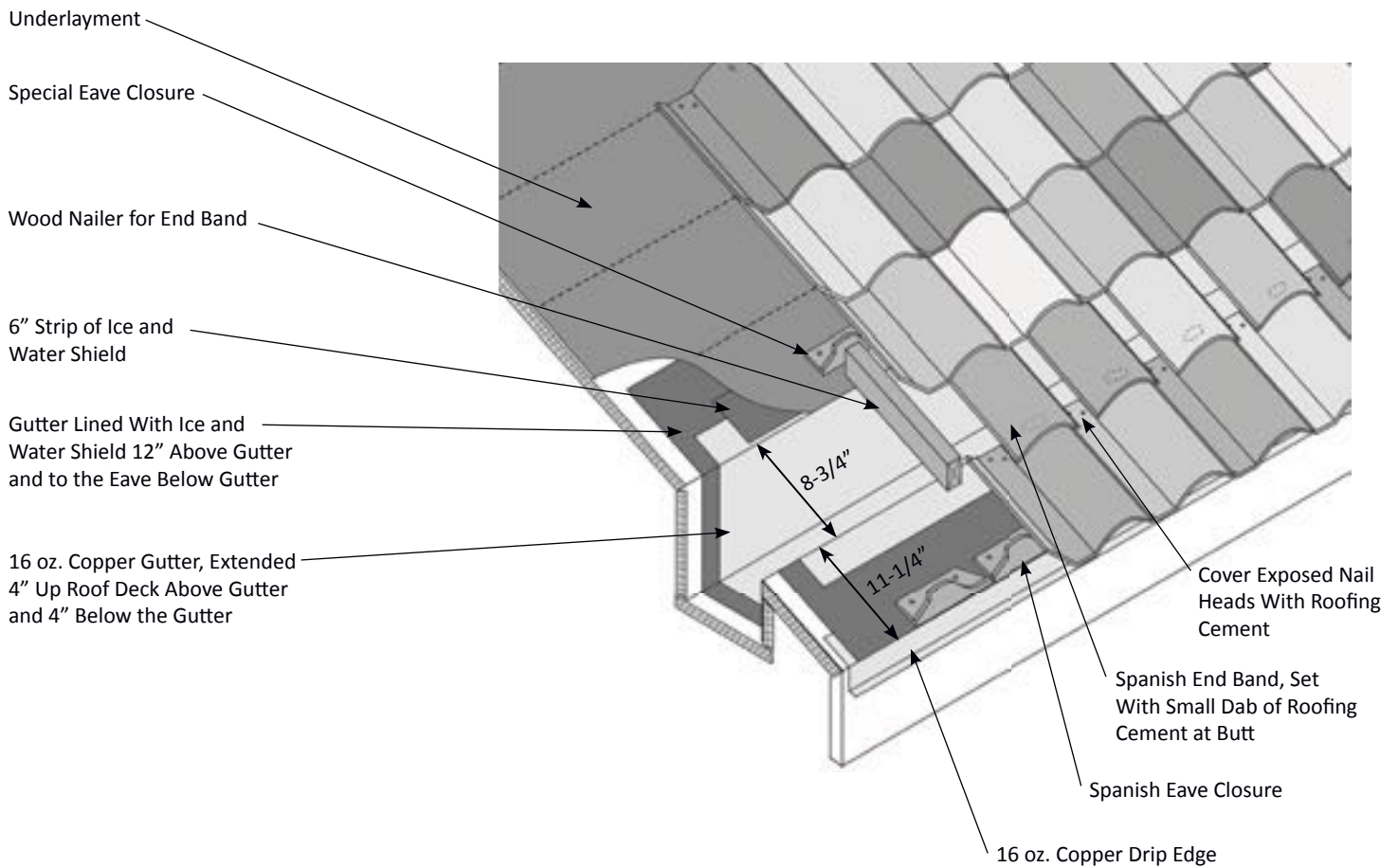


Figure 34.2 Built in Gutter Detail for Spanish Tile

# Spanish Tile Installation

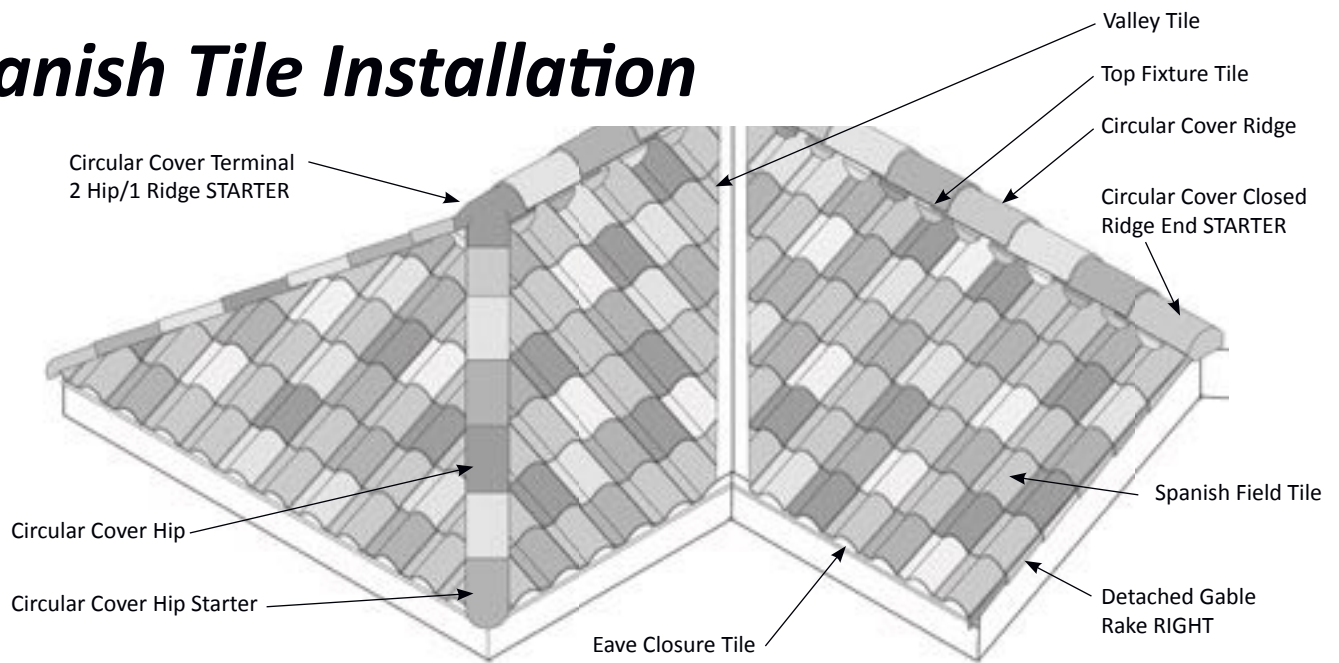


Figure 35.1 Spanish Tile

## IMPORTANT:

**Before starting tile installation, it is important that the roofer understand how the Spanish tile pattern being installed relates to the roof design.**

**The following roof preparations must be completed before installing any roof tile.** For detailed information on these items refer to the previous sections in this book or the NRCA Manual on Steep Roofing. The NRCA Roofing Manual: Steer Sloper, Reckne Systems.

- Install the flashings required for ensuring watertightness:
  - Eave Flashing
  - Rake Edge Flashing (if required)
  - Valley Flashing
  - Dormer and Sidewall Flashing, Skylight Flashing, Chimney and Cricket Flashing
  - Vent Flashing
- Underlayment for the entire roof deck, including the appropriate waterproof underlayments required for all flashing and, where required, the ice dam membrane
- All cant strips and Hip and Ridge stringers should be installed and covered in underlayment

- Roof surface chalked with vertical and horizontal lines
- **To avoid damaging the new roof adjoining walls, chimneys and other above the roof line components of the structure should be complete prior to installing the tile to minimize other trades traversing the completed roof.**

**NOTE: Spanish tile utilizes either rolled rake tiles or detached gable rake tiles for both the right and left sides of the gables. Therefore, rake edge flashing is not required when these tiles are used.**

**NOTE: Especially Watch this tile for unsightly “snaking” that can occur due to size variations in the tile. Adjust as necessary using chalk lines as guides.**

**NOTE: Each Spanish field tile is provided with (2) two fastening nail holes. When installing field tiles or accessories care should be taken to fasten each tile with nails or screws in every provided fastening hole.**

## Instructions Specific to Installing Spanish Tile (S-Tile)

### End Band Nailer Strips (Stringers)

Spanish Tile (S-Tile) require only one nailer strip within the field of tile and it is to serve as a nailer strip and support for the end band tile. This nailer strip should be pressure treated wood sized nominal 2" x 2" or 1 1/2" x 2" (actual size).

**NOTE: The use of an end band with Spanish tiles is only required on the left side vertical termination or interruption of the field tile; ie. gable rake, chimney, dormer or a parapet wall.**

The nailer strip should be a pressure treated foundation-grade wood.

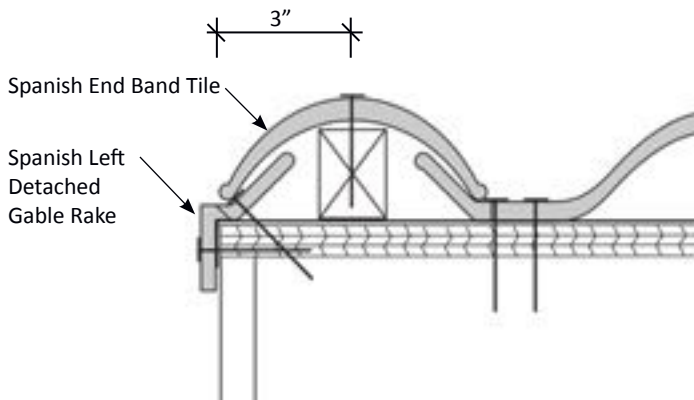


Figure 36.1 Spanish End Band Stringer Detail

### Hip and Ridge Stringers

Spanish tile requires a Hip and Ridge tile to complete the roof and are installed with a nominal 2" wide wood stringer. All stringers should be pressure-treated foundation-grade wood and should be covered with an 18" wide, self-adhesive modified bitumen membrane (Ice and Water Shield). See Chart 36.3 to determine the correct height of the nominal 2" wide material for the type of tile to be used at the hip and ridge. All wood stringers should be pressure-treated, foundation-grade wood. Roof pitch exceeding 14" rise to 12" run requires the contractor to measure the roof for stringer height.

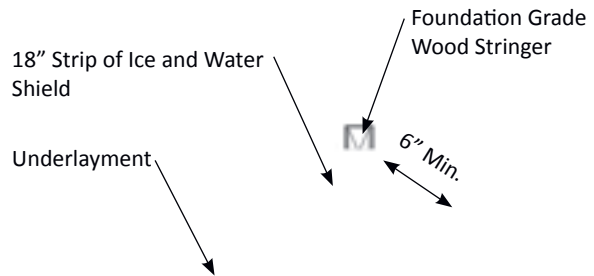


Figure 36.2 Ridge and Hip Stringer Detail



**Eave**

Installation of all the Ludowici Spanish tile requires Eave Closure Tile, Beveled Eave Tile or Mission Eave Tile. All three options are normally laid right to left. Normal practice requires the Eave Closure tiles to be laid flush with the eave and adjusted in from the right to allow for proper layup of the right rake tile and the first cover tile. Beveled Eave Tile are laid with a 2" overhang at the eave. Lay the Eave tile loose across the slope to the provided center to center width before nailing to determine what adjustments, if any, are needed in the course before nails or screws are installed.

**NOTE:** *If the eave closures are being applied to a deck which includes a valley, and if special factory cut and closed valley tiles have been manufactured for the job, it is necessary to see special instructions provided on page 40.*

**NOTE:** *When rolled rakes are being installed in the first course of the tile, whether left or right, the eave closure next to these rake pieces will require some slight nipping and clipping for proper fit and installation.*

After installing the right rake tile, the starter course will begin with a full tile placed directly over the first eave closure tile. The second course of the tile will lay up directly over the previously installed field tile to the proper exposure and with the normal 3" head lap.

**NOTE:** *Each Spanish Field Tile is provided with (2) two holes in the flat portion of the tile for installation with nails or screws. A third hole (elongated) in the tile's barrel portion can be Special ordered for installation with the wire-tie system. When installing the field tile, care should be taken to fasten tiles through the specific required nail holes. Also, when accessories are installed every tile shall be fastened through each of the provided fastening holes.*

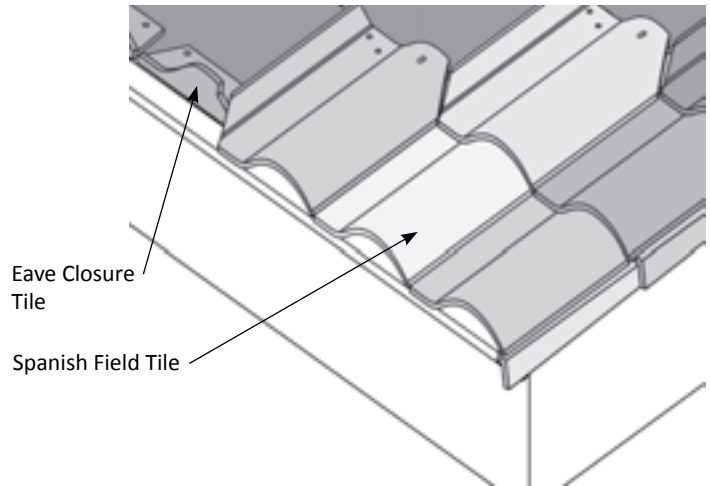


Figure 37.1 Spanish Eave Closure

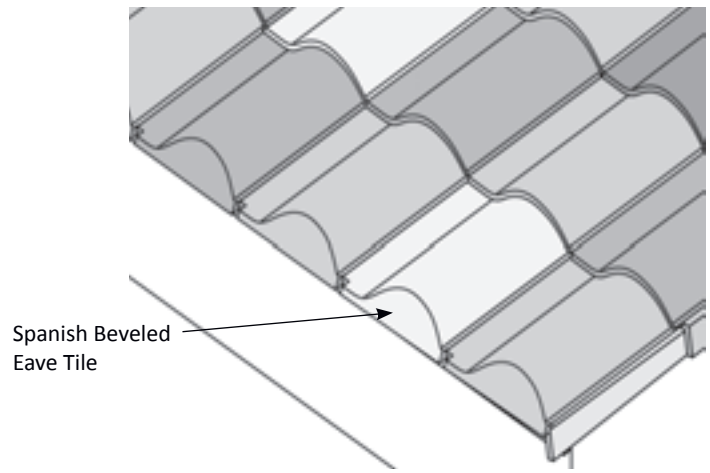


Figure 37.2 Spanish Beveled Eave Closure

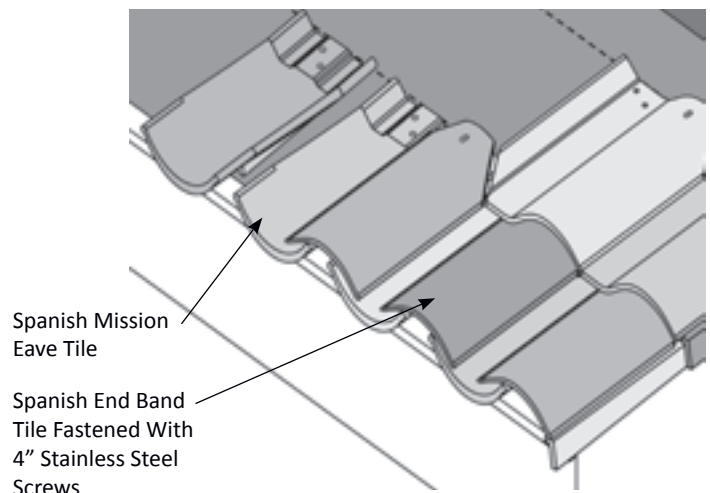


Figure 37.3 Spanish Mission Eave

### First and Succeeding Courses of Tile

Spanish tiles are normally laid from right to left starting with a Right Detached Gable Rake or Rolled Rake Tile. This first rake tile will need to be installed allowing a 2" overhang at the eave. The detached gable rakes are available in left and right hand versions. The rolled rakes are universal for both left and right gable rakes. All gable rake tiles shall be installed with fasteners typical of the field tile installations, but also require flashing cement (meeting ASTM D-4586 requirements) applied between all contact areas of the field tile and gable rakes. The Detached Gable Rake Tile to the right, when looking at the eave courses into the field tile, are the rights and vice versa.

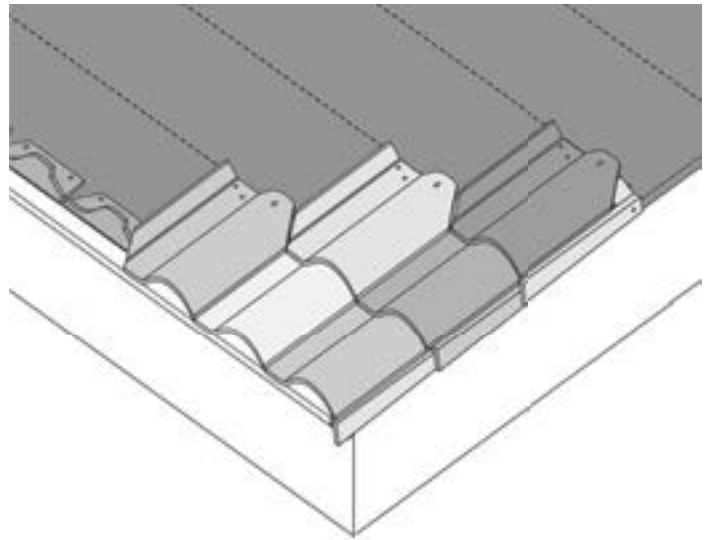


Figure 38.2 Spanish Field Tile Installation Sequence

### Ridge Closure

The void between the pan portion of a Spanish tile and the underside of the ridge is typically filled with a Spanish Top Fixture Tile or Spanish Flat Top Tile. The Spanish Top Fixture Tile is attached to the ridge stringer or can be attached to a deck mounted wood stringer, while the

Flat Top Tile is attached to a wood stringer under the top portion of the Flat Top Tile. If Top Fixtures are not specified, Portland Cement Mortar Type M and/or specialty metal closures also may be used. (Mortars shall meet requirements of ASTM specification C-270.)

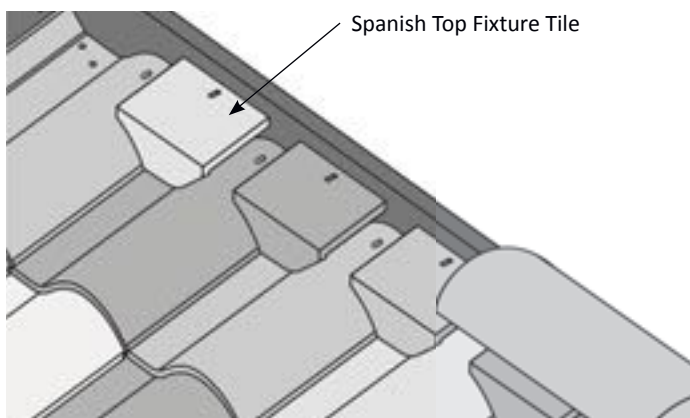


Figure 38.1 Spanish Top Fixture Detail

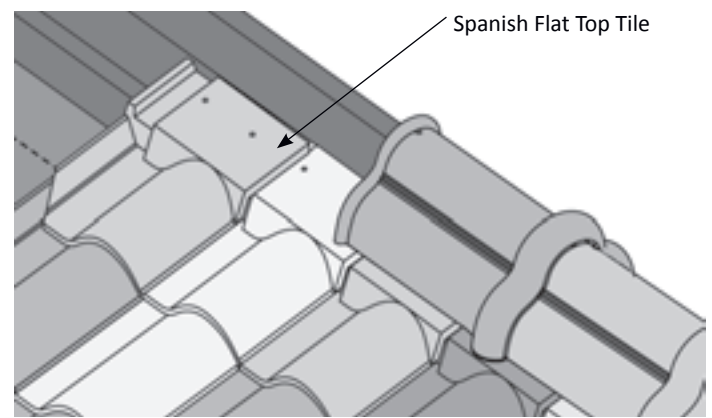
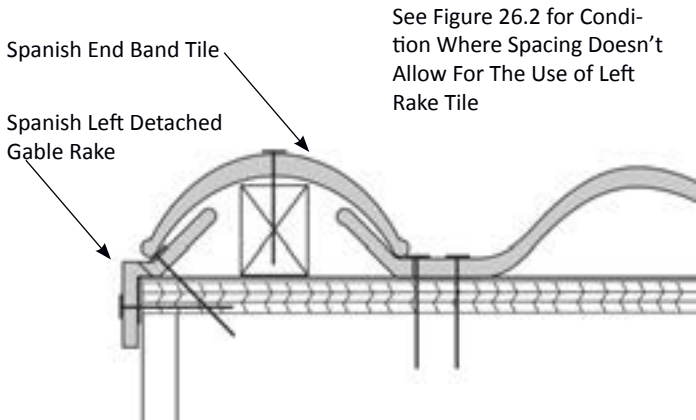
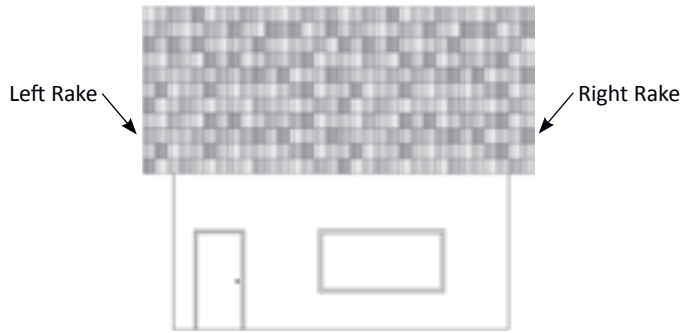


Figure 38.3 Spanish Flat Top Detail

**Rakes**

Before layout verify rake tiles furnished. Detached gable rake tiles are available for Spanish 13-1/4" tile. Rolled rakes are available for both Spanish 13-1/4" and 18-3/8". Scandia tile utilizes an attached gable rake that is integral to the first field tile adjacent to the rake. Careful spacing is required for a proper fit and look.



See Figure 26.2 for Condition Where Spacing Doesn't Allow For The Use of Left Rake Tile

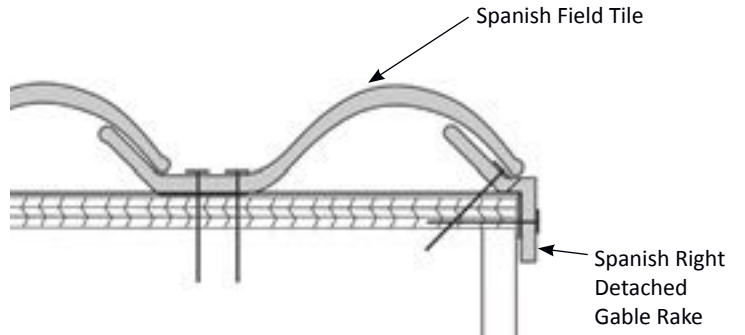


Figure 39.1 Spanish Left Detached Gable Rake Detail

Figure 39.2 Spanish Right Detached Gable Rake Detail

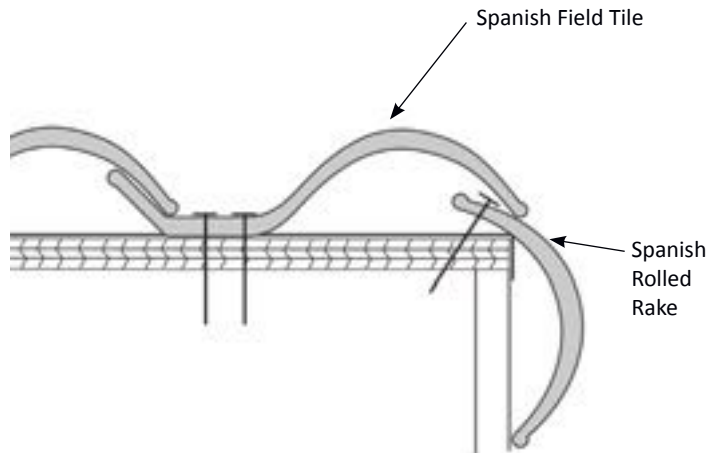
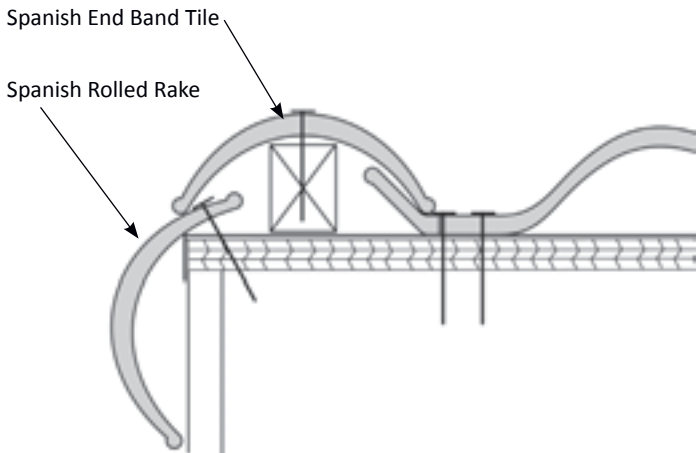


Figure 39.3 Spanish Left Rolled Rake Detail

Figure 39.4 Spanish Right Rolled Rake Detail

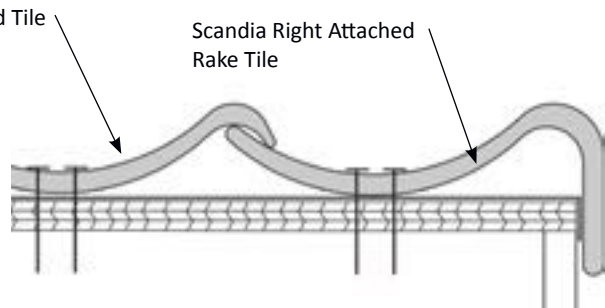
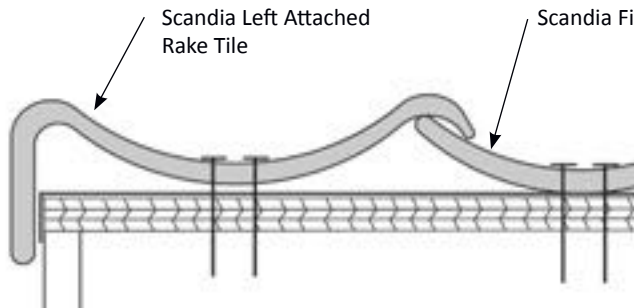


Figure 39.5 Scandia™ Left Attached Rake Detail

Figure 39.6 Scandia™ Right Attached Rake Detail

**Valley Tiles**

Tiles to be installed in valleys can be mitered in the field or special factory-manufactured cut and closed tiles can be used. These special cut and closed valley tiles generally result in less water entering underneath the tile. Whether field miter cut or special factory cut tiles are used, the tile fasteners should never penetrate the valley flashings. Tile to be installed over the copper valley flashing should be drilled or notched and wired with solid 16 gauge copper wire to fasteners driven into the deck beyond the flashing.

**NOTE: In situations where valley tile pieces are so small that it is not practical to notch or drill, use the adhesive RT600 (an OSI product) or its equivalent.**

If special factory cut and closed valley fittings are being applied, it will be beneficial to loose lay the entire eave closure course, including the valley tile prior to installation. This loose laying process of the valley's left side will advance as a typical installation would, from right to left. But when loose laying the valley's right side, it will

advance from left to right. The installation of the Spanish tiles will slow the process initially. Each tile when spaced on the deck will require a slightly upward lifting to allow for the proceeding tile to be laid into the next channel. Once the spacing is approved, the pace can return to the standard. The tiles can be fastened in the typical right to left pattern.

The loose laying process becomes vitally important when the roof deck runs from valley-to-valley. The focus must be to space the eave course so it consists of all full field tile and is finished on both ends with the special cut and closed valley tiles. Keep in mind not to allow any more than 5 pieces pulled to the extreme or crowded together.

If field mitered valley tiles are applied, they should be trimmed to provide a clean, even, continuous edge along the entire valley length.

**To encourage leaves and snow to slide down the valley, the gap between the Valley Tiles and the center line of the valley should be tapered from 3" at the top to 4" at the bottom, this can be increased for longer valleys.**

Chalk Line for Valley Tile Cut Line, Tapered

Underlayment

DO NOT Nail Through Copper Valley. Attach Small Valley Tiles With Copper Wire and Fasteners Placed Above Flashing, Apply Small Dab of Roofing Cement to Prevent Migration

Apply a Bed of Roofing Cement at the Lap to Small Valley Tiles to Prevent Migration

**NOTE: The Open Cavity at Field Cut Valley Tiles can be Pointed With Type "M" Mortar**

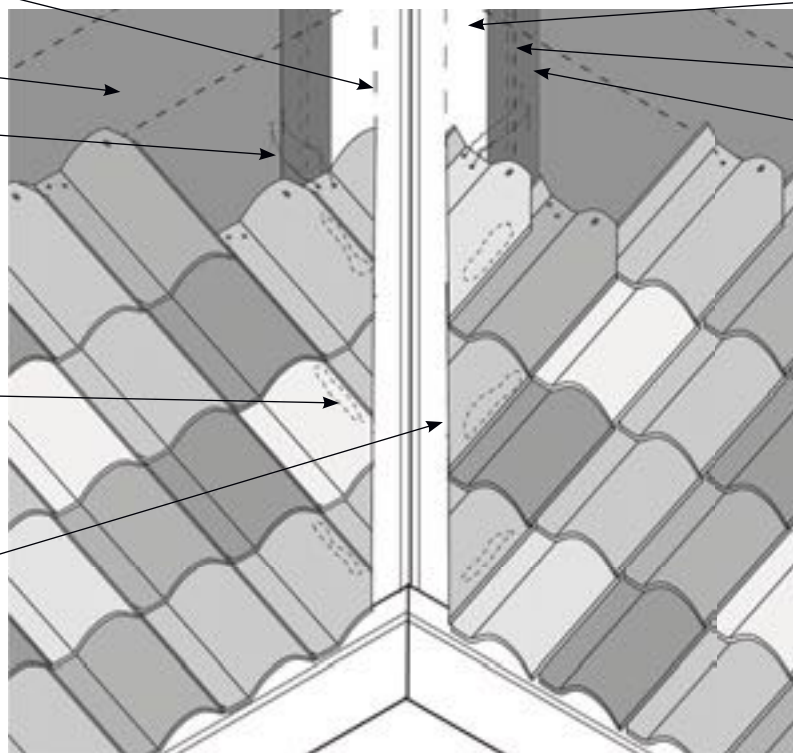


Figure 40.1 Spanish Valley

16 oz. Copper Valley Flashing With Hem  
Copper Cleats 24" O.C.  
6" Strip of Ice and Water Shield



Figure 40.2 Spanish Cut and Closed Valley Tile



Figure 40.3 Spanish Field Cut Valley Tile

**Hip Tiles**

The hip area is typically finished by using a combination of either a Circular Cover Hip Starter, Circular Cover and a Circular Cover Terminal or a 152 Hip Starter Tile, 102 Hip Roll Tile and 102/206 Hip and Ridge Terminal. Hips are started with a special Circular Cover Hip Starter Tile or 152 Hip Starter Tile covering the Field Tile approximately 3" on both sides. The hip tiles are then installed. The Circular Cover Tile creates a 3" head lap on the starter while the 102 tile creates an approximate 2" head lap over the starter tile. The specified head lap per tile is then

continued up the hip. Flashing cement must be used at the overlap of each hip tile. The gaps created between the Hip Roll and the Field Tile can be pointed with mortar tinted to match. The last fastener on the upslope end of the hip typically is covered with a Circular Cover Terminal or a 102/206 Hip and Ridge Terminal. These terminals must be specified as a starter or finisher depending on the direction of the ridge layout. Some roof termination may require a combination of typical flashing details or a special tile piece. Consult the local Ludowici sales representative with the project's special roof requirements.

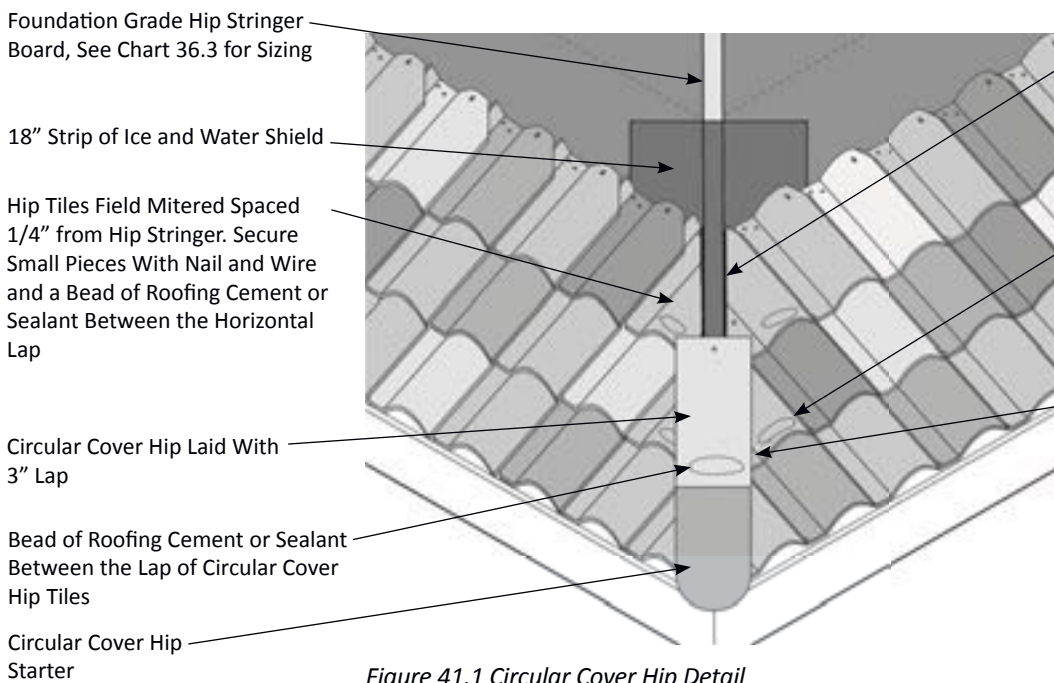


Figure 41.1 Circular Cover Hip Detail

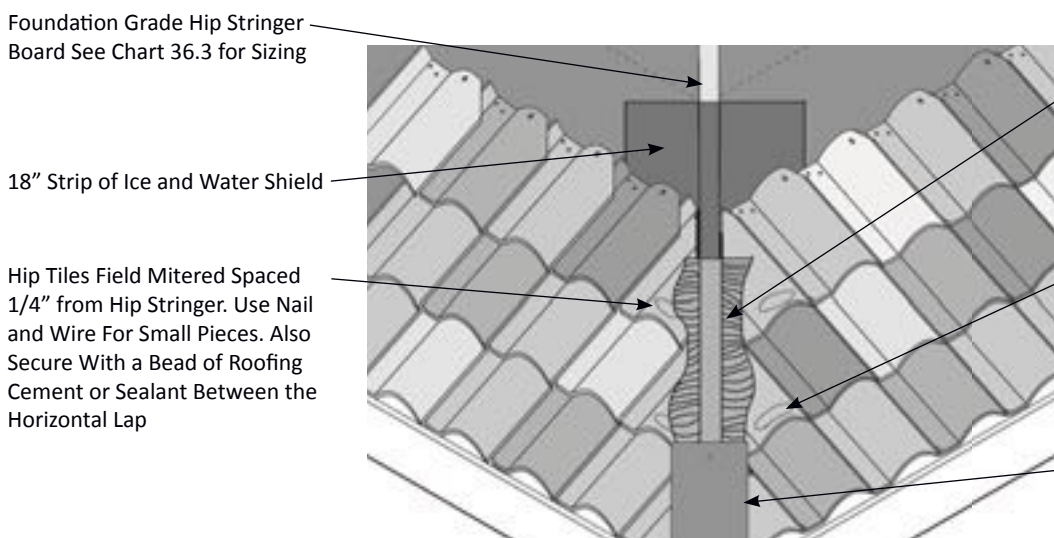


Figure 41.2 Circular Cover Hip Detail With FlexSeal™

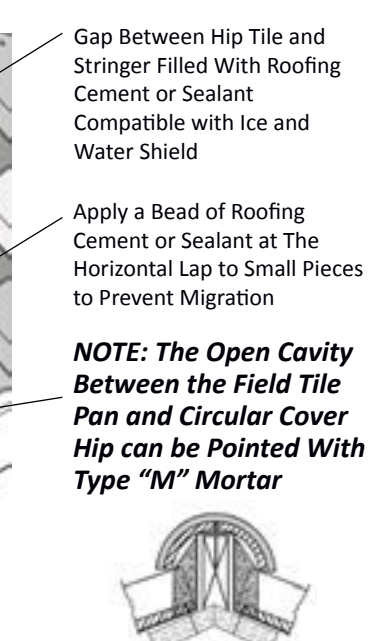


Figure 41.3 Mortared Hip Detail

**Ridge Tiles**

The ridge for Spanish tile must be finished with a Circular Cover Tile, 206 Ridge Tile or one of Ludowici’s many historic ridge caps or cresting.

Circular Cover Tile or 206 Ridge Tile, see Chart 36.3 for dimensions of the stringers required.

Roofing cement must be used at the overlap of each Ridge Tile and where they rest on the field tile. Closed Ridge Ends, Circular Cover or 206 Ridge, or Terminal Circular Cover or 102/206 Hip and Ridge Tile are used to start and finish the ridge. The ridge finisher will have an exposed fastener which should be sealed with roofing cement meeting the requirements of ASTM D-4586. Some roof termination may require a combination of typical flashing details or a special tile piece. Consult the local Ludowici sales representative with the project’s special roof requirements.

**NOTE: It may be beneficial to lay out the chosen ridge system on the stringer to determine lap (no less than 2”). This will prevent having to traverse the installed tiles later.**

**Applying ridge tiles with the lap facing away from the prevailing winds helps the tile shed wind-driven rain.**

**NOTE: Circular covers are 16” Straight Barrel Mission field tile covers.**

Chart 42.1 Spanish Ridge and Hip Stringer Heights

Roof Pitch Rise:Run	102 Hip Roll	206 Ridge	Circular Cover Hip	Circular Cover Ridge
4:12	5”	6-1/2”	4-9/16”	3-3/4”
5:12	4-7/8”	6-1/4”	4-1/2”	3-5/8”
6:12	4-7/8”	6”	4-3/8”	3-1/2”
7:12	4-3/4”	5-3/4”	4-1/4”	3-3/8”
8:12	4-3/4”	5-1/2”	4-1/8”	3-1/4”
9:12	4-5/8”	5-3/8”	4”	3-1/8”
10:12	4-5/8”	5-1/4”	3-15/16”	2-7/8”
11:12	4-5/8”	5-1/8”	3-15/16”	2-3/4”
12:12	4-1/2”	5”	3-7/8”	2-5/8”
13:12	4-1/2”	4-7/8”	3-7/8”	2-1/2”
14:12	4-3/8”	4-3/4”	3-13/16”	2-1/4”

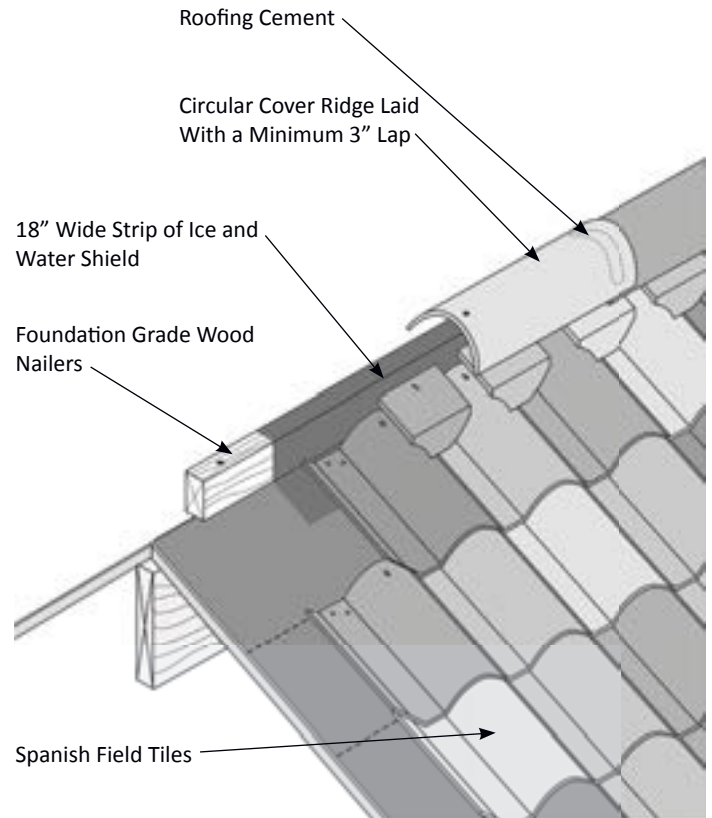


Figure 42.1 Circular Cover Ridge Detail

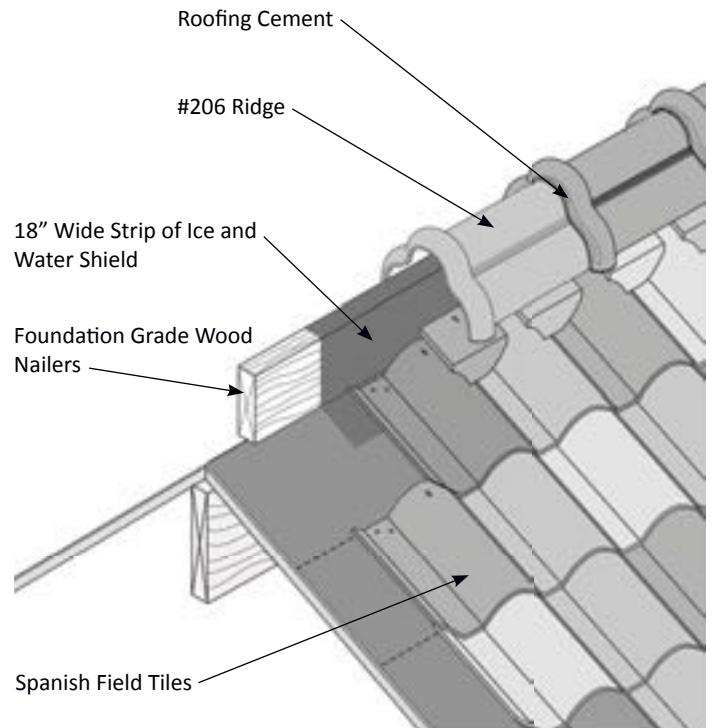


Figure 42.2 #206 Ridge Detail

**Circular Cover Vented Ridge**

This ridge vent allows 6.27 square inches of ventilation per foot of ridge.

**Minimum Roof Pitch 6:12**

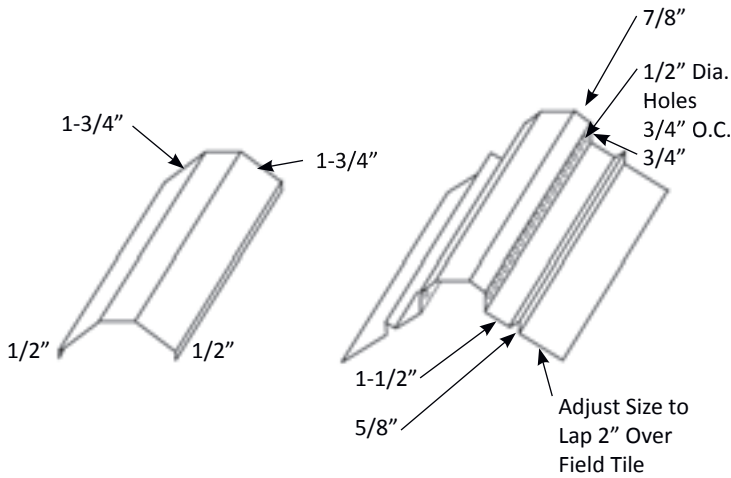


Figure 43.1 Circular Cover Vented Ridge Cap Flashing

Figure 43.2 Circular Cover Vent Flashing

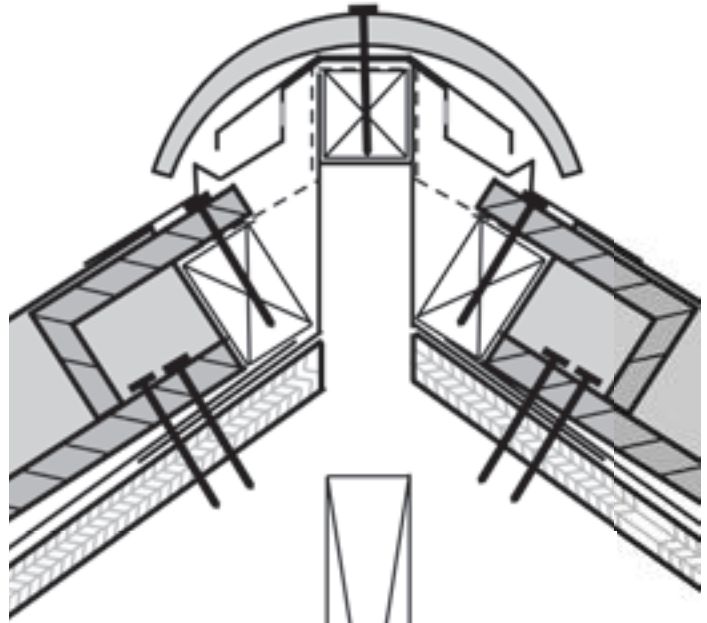


Figure 43.3 Circular Cover Vented Ridge Section

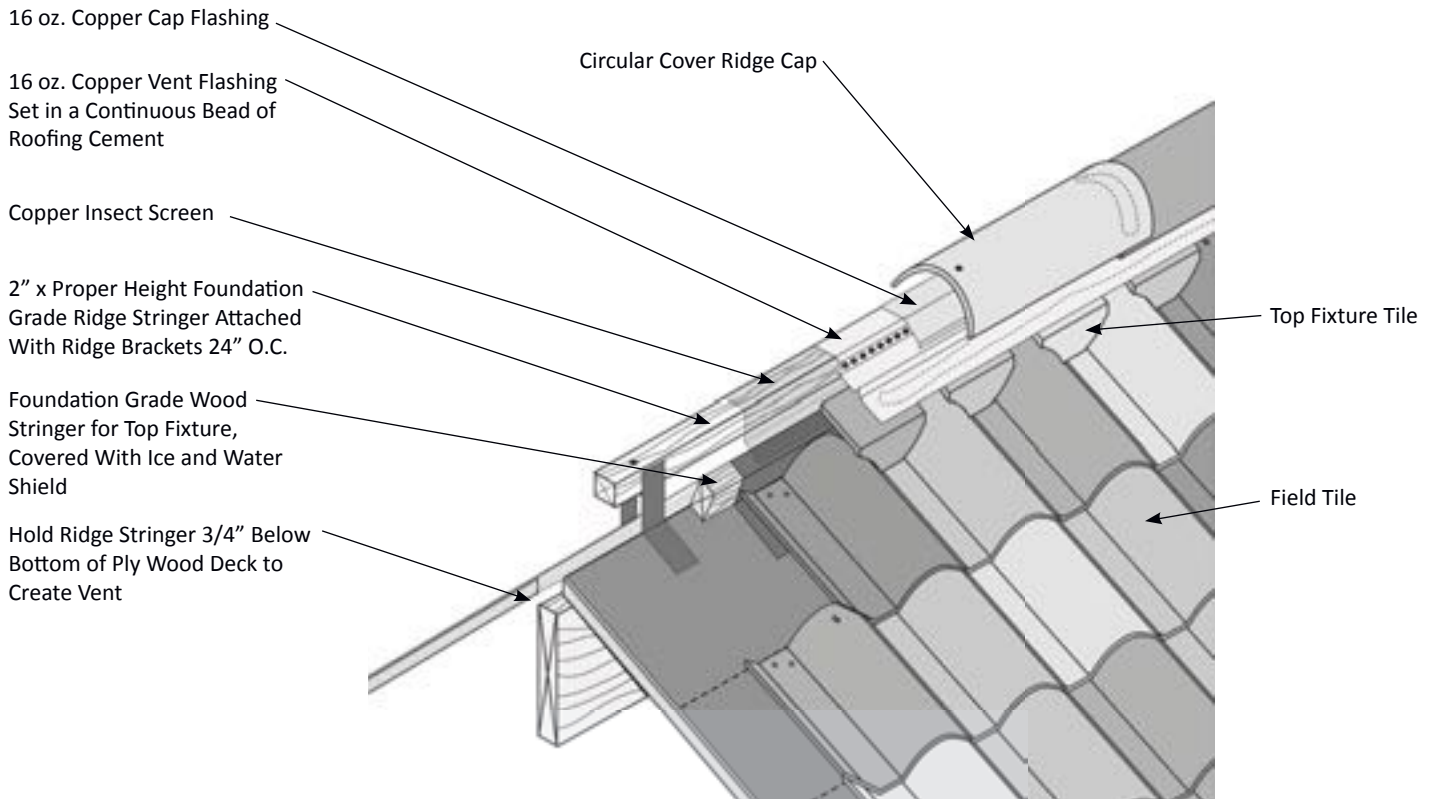


Figure 43.4 Circular Cover Vented Ridge

**#206 Ridge Vented Type-1**

This ridge vent allows 6.27 square inches of ventilation per foot of ridge.

**Minimum Roof Pitch 6:12**

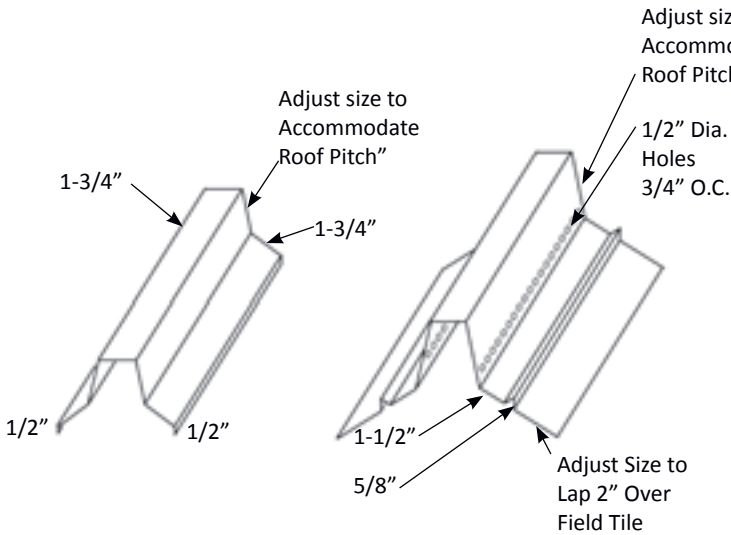


Figure 44.1 #206 Ridge Vented Ridge Cap Flashing

Figure 44.2 #206 Ridge Vent Flashing

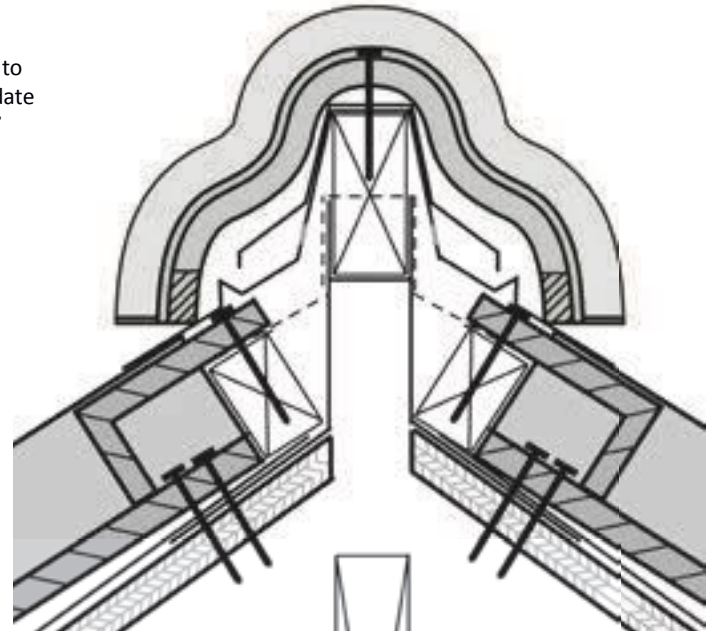


Figure 44.3 Valley Detail

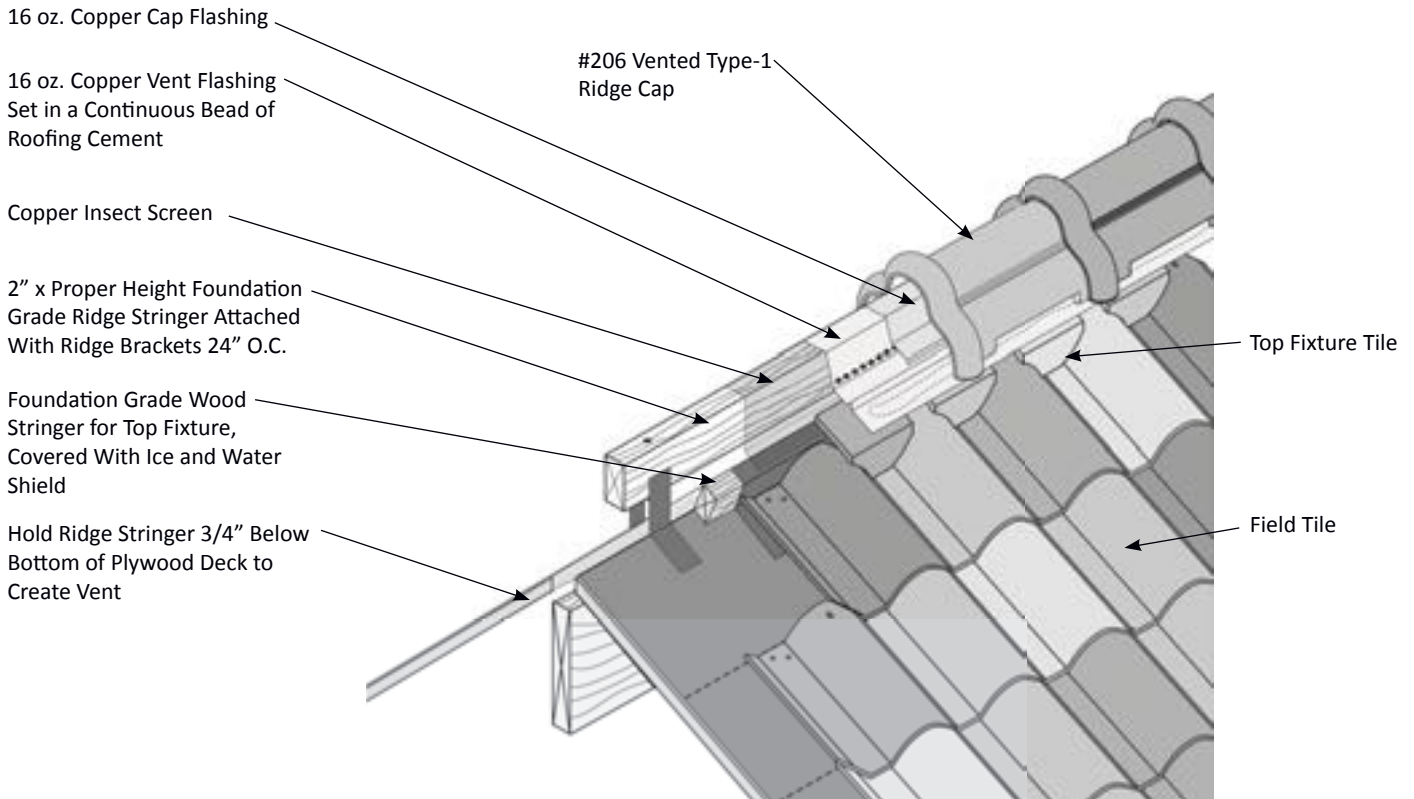


Figure 44.4 #206 Ridge Vented Type-1



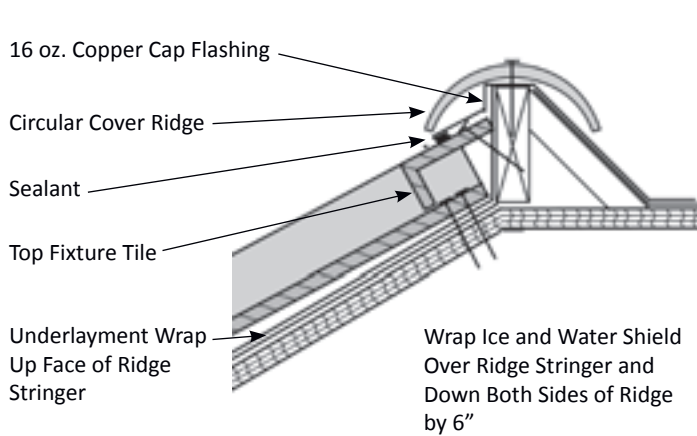


Figure 45.1 Deck Section With Circular Cover Ridge

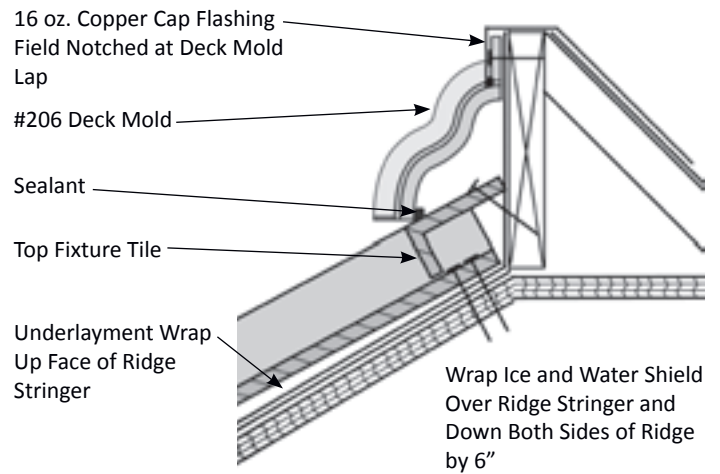


Figure 45.3 Deck Section With #206 Deck Mold

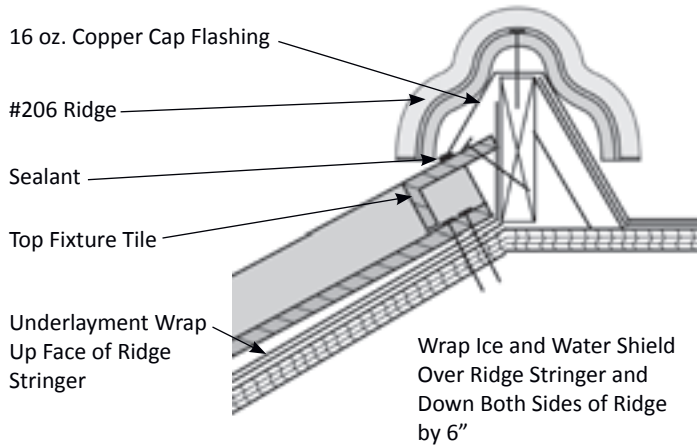


Figure 45.2 Deck Section With #206 Ridge

**Points to Remember During Tile Installation**

Field tile installation will generally progress in a diagonal fashion, moving from right to left. The installer applying the lower course will always be to the left of those applying succeeding courses.

- Use the chalk lines as a guide.
- Watch for any irregularities in the roof deck construction.
- After the installation of about 75-100 tiles, the roof should be inspected from the ground at a distance greater than 40 feet to determine that there are no streaks or blotches. To ensure a good range of tones, this inspection must be done at regular intervals.
- When each course is 10-12 tiles from the end of the course, check the distance to the end with the width of the tile to determine if a slight crowding or stretching of the tile may be required to ensure a proper fit or size of the final piece of tile installed in that course. DO NOT crowd or pull to the extreme anymore than 5 or 6 pieces positioned side by side.

**Terminals**

Ludowici makes ridge end caps for all trim groups. Ridge end caps come as a starter or finisher, (a male/female lap). Care should be taken to determine correct orientation of the parts ordered and the proper installation sequence to accommodate the installation with minimal cutting.

Ludowici manufactures Terminals to accommodate Ridge and Hip transitions. These are the most effective way to waterproof the transition and finish it in an aesthetically pleasing manner. Terminals are also made with a starter/finisher.

**Vertical Wall Application**

Flat Shingle or Interlocking tile can be used on a vertical surface. For shingle tile, short tops and long tops and under eave cant strips are used. For interlocking tile, use cant strips where needed.

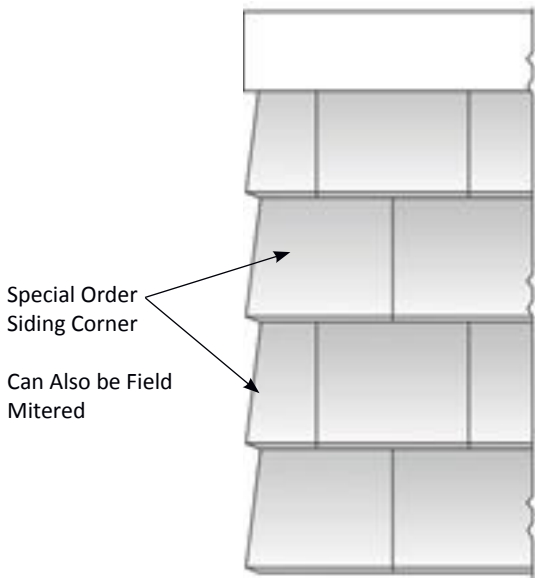


Figure 46.1 Vertical Wall Corner



Figure 46.2 Ridge Starter Finisher Diagram

**Examples of Some Typical Terminals:**



Figure 46.3 102/206 2 Hip/1 Ridge Terminal FINISHER



Figure 46.4 102/206 2 Hip/1 Ridge High-Bump Terminal FINISHER



Figure 46.5 #405 Gable Terminal STARTER



Figure 46.6 102/206 1 Hip/2 Ridge Terminal

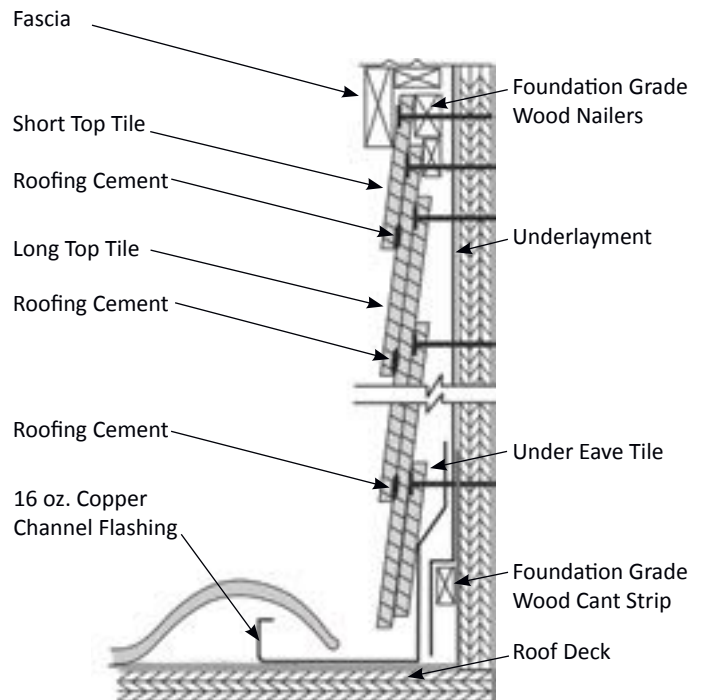


Figure 46.7 Vertical Wall Section

### Snow Guards

Snow guards are generally required in areas where snow and ice may accumulate on the roof. Snow guards are sometimes used on sloped roofs to prevent a mass of snow or ice from sliding off the roofs and injuring persons, damaging gutters or plants and blocking walks and driveways. Snow guards hold the snow in place above the eaves until it can melt and the water runs off.

It is recommended that snow guards should be installed on at least 3 or 4 courses, offset from course to course and spaced in staggered interval rows; begin with the third or fourth row. However, spacing and quantity of snow guards is a matter of judgement based on local weather conditions (see Figure 47.1).

Alpine conditions will require a professional engineer to design the required snow retainage system. Tile should not be exposed to ice and snow loads exceeding 100 pounds per square foot.

**A snow guard must be made of nonferrous material to prevent possible rust stains.**

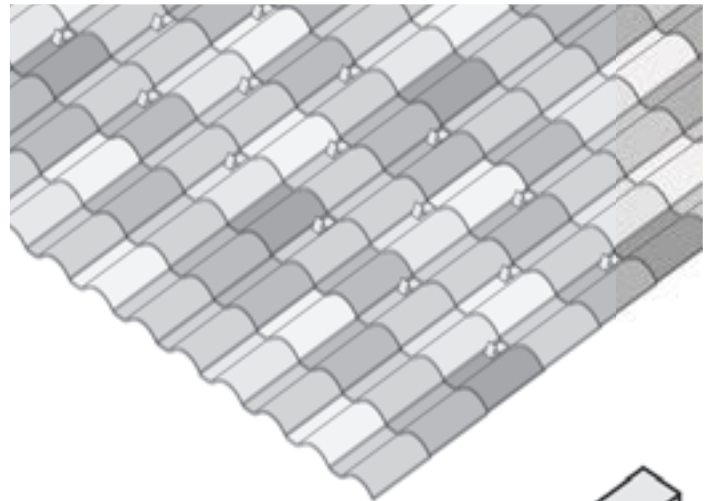


Figure 47.1 Snow Guard Spacing

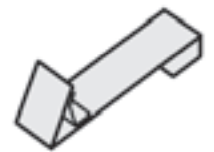


Figure 47.2 Ludowici Spanish Snow Guard

### Repair

To replace a broken or damaged tile do not use an exposed Copper strap. These are unsightly and can work loose allowing the replacement tile to slide out.

Ludowici's Quik-Tach™ Brackets are a quick, efficient and concealed method for tile replacement. Follow these steps:

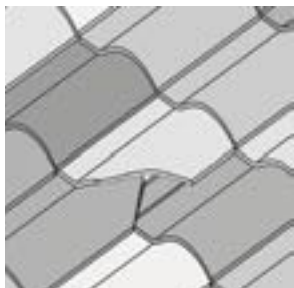


Figure 47.3 Damaged Tile

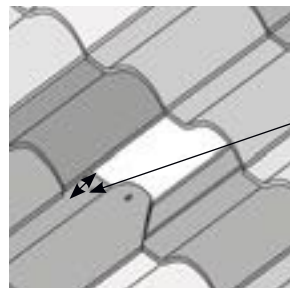


Figure 47.4 Remove Damaged Tile

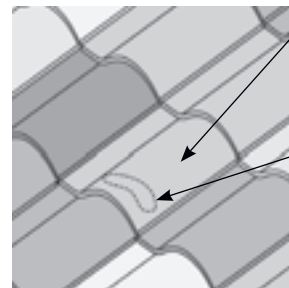


Figure 47.5 Finished Tile Replacement

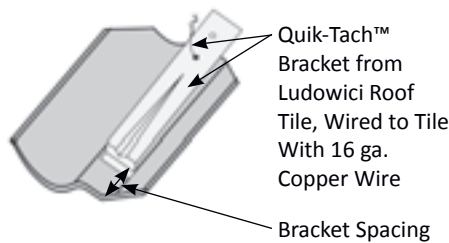


Figure 47.6 Replacement Tile with Quik-Tach™ Bracket

Completely remove damaged tile and fasteners. A slate ripper will facilitate removal of fasteners. Measure the distance from the top of the course below to the bottom of the adjacent tile to the replacement.

Lift the tile in the course above and slide the replacement tile into place so the bracket engages the top of the tile below the replacement. Apply a small bead of Sealant or roofing Cement under replacement tile.

# Mission Tile Installation

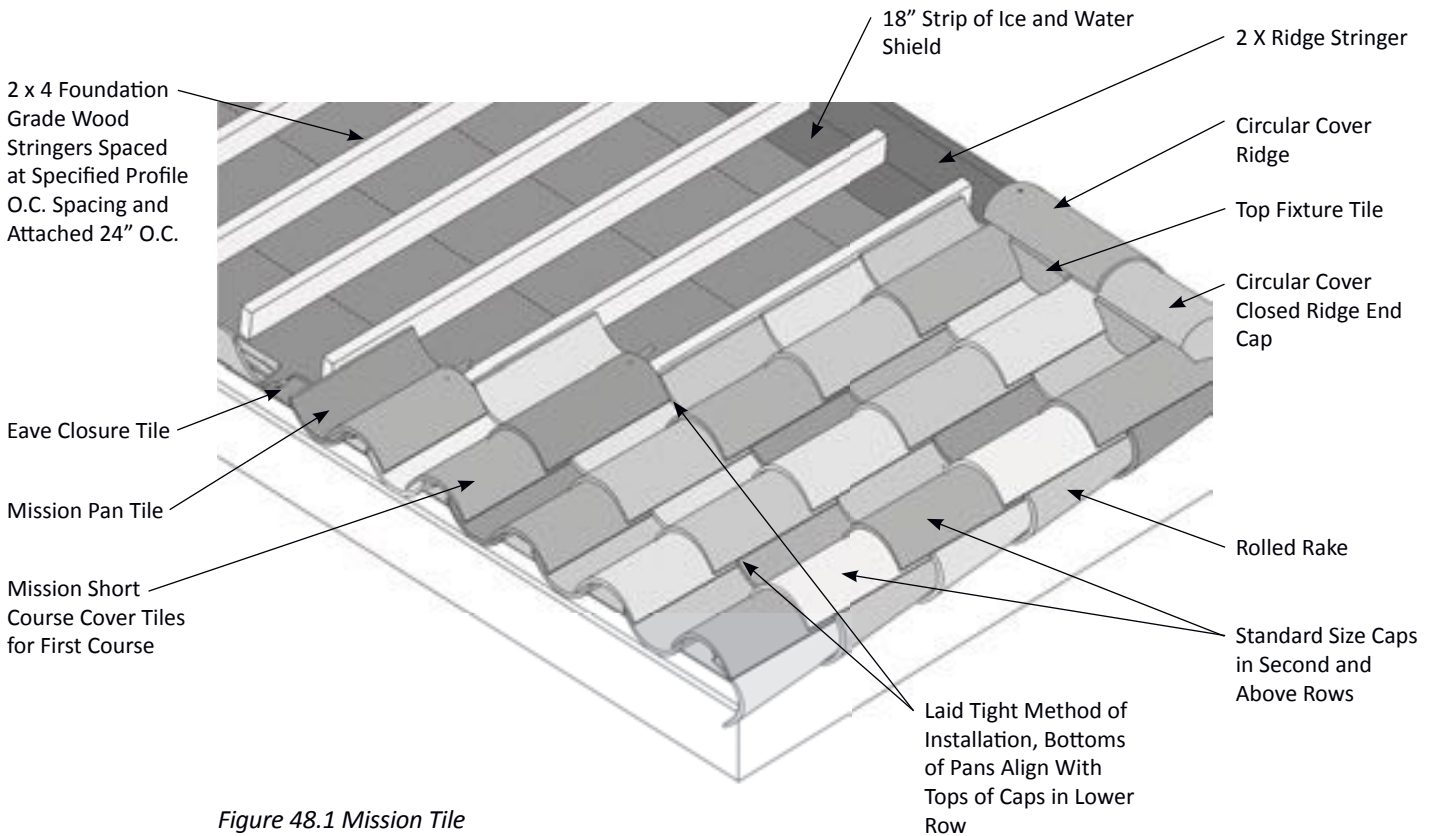


Figure 48.1 Mission Tile

**IMPORTANT:**

**Before starting tile installation, it is important that the roofer understand how the Mission tile pattern being installed relates to the roof design.**

**The following roof preparations must be completed before installing any roof tile.**

For detailed information on these items refer to the previous sections in this book or the NRCA Manual on Steep Roofing.

- The flashings required for ensuring watertightness:
  - Eave Flashing
  - Valley Flashing
  - Dormer and Sidewall Flashing, Skylight Flashing, Chimney and Cricket Flashing
  - Vent Flashing

- Underlayment for the entire roof deck, including the appropriate waterproof underlayment required for all flashing, and, where required, the ice dam membrane
- All Hip and Ridge Stringers should be installed and covered in underlayment
- Roof surface chalked with vertical and horizontal lines

**NOTE: Mission tile utilize rolled rake tile for both the right and left sides of the gables. Therefore, rake edge flashing is not required when these tiles are used.**

## Instructions Specific to Installing Mission Tile

### Nailer Strips (Stringers)

Mission tile require a nominal 2" x 4" wood stringer to serve as a nailer board and to support the cover tile. The stringer should be a pressure-treated, foundation-grade wood. Fastened to the deck 24" O.C. with non corrosive fasteners.

**NOTE: If the wood stringers are being applied to a deck which includes a valley, and if special factory cut and closed valley tiles have been manufactured for the job, it is necessary to see special instructions provided in Valley Tiles.**

Coordinate stringer spacing with eave closure layout and factory cut valley tiles (if used).

### Hip and Ridge Stringers

Mission tile requires a hip and ridge tile to complete the roof and are installed on nominal 2" wide wood stringers. All stringers should be pressure treated, foundation-grade wood and should be covered with an 18" Wide Strip of Ice and Water Shield. For all Mission styles tiles, the contractor is responsible to measure the roof for stringer height.

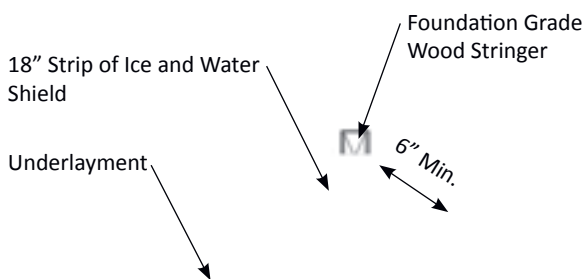


Figure 49.1 Ridge and Hip Stringer Detail

### Eave Closure Tile

Required with the installation of all Ludowici Mission tile is an Eave Closure Tile. The Eave Closure Tiles are normally laid right to left or from gable end to a valley. Eave Closure tiles are to be laid flush with the eave and adjusted in from the right to allow for proper lay up of the rolled rake tile and the first cover tile. Lay the Eave Closure Tile course loose across the slope to the provided center to center width before nailing to determine what adjustment, if any, are needed in the course before nails or screws are installed. Once layout is established, install the Eave Closure tile in the normal right to left fashion.

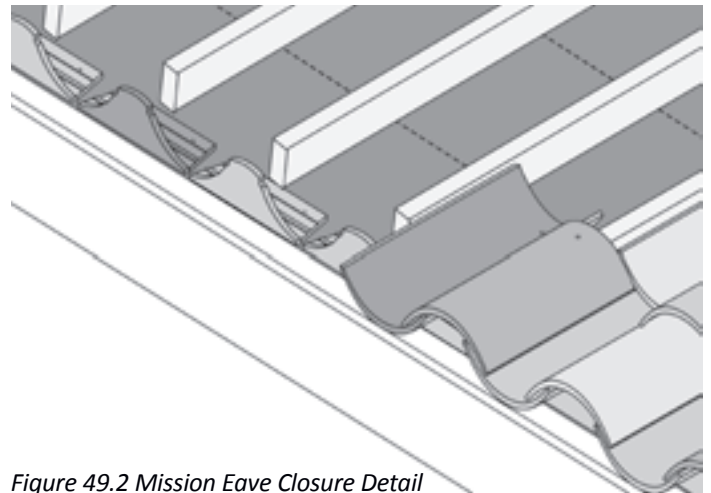


Figure 49.2 Mission Eave Closure Detail

Roof Pitch Rise:Run	Roman 102 Hip	Roman 206 Hip	Greek 118 Hip Cover	Greek 211 Ridge
4:12	6 3/8"	7 1/4"	7"	6"
5:12	6 1/4"	7"	7"	5 3/4"
6:12	6 1/4"	6 3/4"	7"	5 1/2"
7:12	6 1/4"	6 1/2"	6 7/8"	5 1/4"
8:12	6 1/8"	6 1/4"	6 7/8"	5 1/8"
9:12	6 1/8"	6 1/8"	6 7/8"	5"
10:12	6 1/8"	6"	6 7/8"	4 7/8"
11:12	6 1/8"	5 7/8"	6 7/8"	4 3/4"
12:12	6"	5 3/4"	6 3/4"	4 5/8"
13:12	6"	5 5/8"	6 3/4"	4 1/2"
14:12	6"	5 1/2"	6 3/4"	4 3/8"

**First and Succeeding Courses of Tile**

Mission tile are normally laid from right to left starting with a Rolled Rake Tile. This first rake tile will need to be installed allowing a 2" overhang at the eave. The Rolled Rakes are universal for both left and right gable edges. All gable rake tiles shall be installed with fasteners typical of the field tile installation, but also require flashing cement (meeting ASTM D-4586 requirements) applied between all contact areas of the field tile and gable rake tile.

**NOTE: When Rolled Rake Tile are being installed in the first course of tile, whether lefts or rights, the eave closure next to these rake pieces will require some slight nipping and chipping for proper fit and installation.**

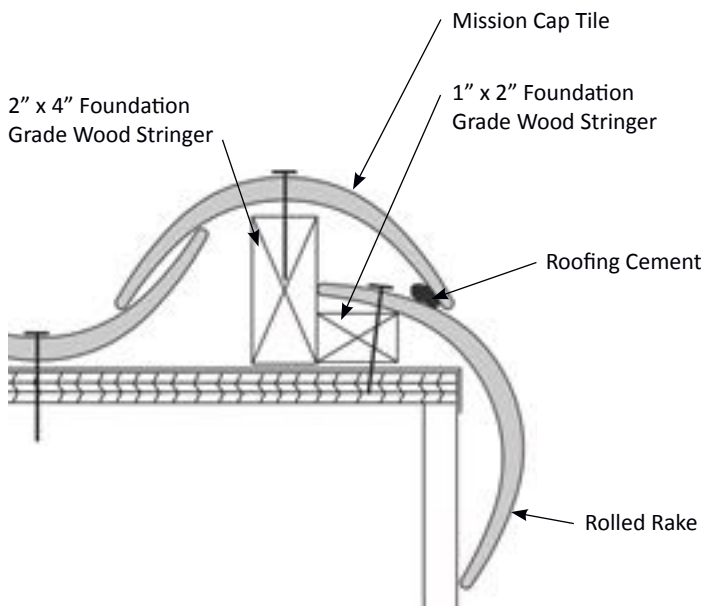


Figure 50.1 Mission Right Rolled Rake Detail

After installing the rake tiles, the starter course may be laid. There are various ways to continue the Mission tile installation. One option is to run several courses of pans across the roof deck still working from right to left up the deck installing the tile to the proper 3" head lap. Then return to the starting point to continue with several courses of covers (must lay one course less of covers than pans to keep the lay up flowing). When installing the covers, care shall be taken not to attach them snug to the stringer. Leaving space allows for expansion and contraction of the nailer board. The progression of the installation shall still continue in a diagonal fashion (see Valley Tiles, Page 52 for more information on installing tiles on roofs which include valleys).

**NOTE: Most Mission field tile are provided with (1) one fastening hole, but a few select pan tiles have (2) two holes. When installing field tile and accessories, care should be taken to fasten each tile with nails or screws in every provided fastening hole.**

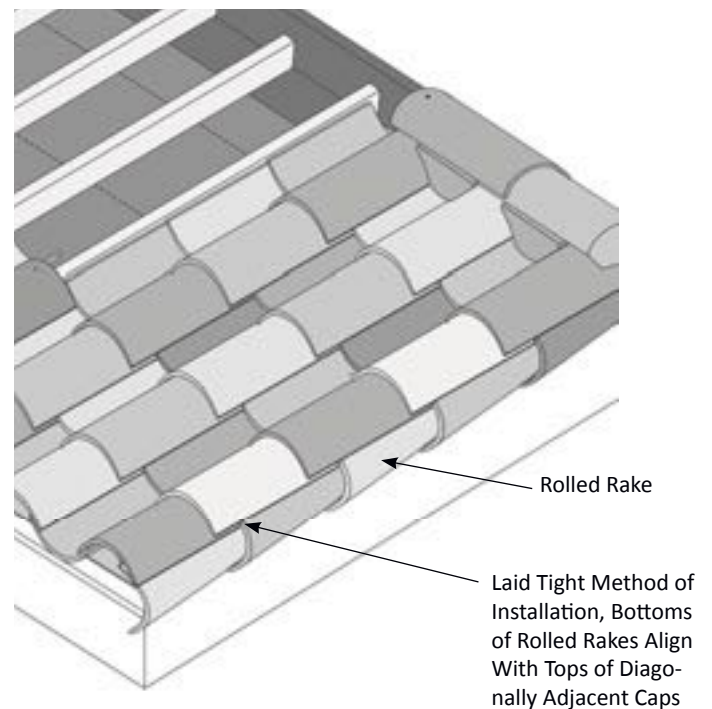


Figure 50.2 Mission Right Rolled Rake

### Laid Tight Method

When tiles are applied using the laid tight method, install field cut or factory cut short course covers at the eave over regular pans. If field cutting, 3" should be removed from the length of the covers. The top edge of the covers will abut the pan's bottom edge in the succeeding course. This continues throughout the roof field so that the long edge of the cover lays tight to the pan. As the installation approaches the ridge, the last course of tile will consist of a course of short pans (by 3") and a course of regular covers (see Figure 51.1).

### Top Fixture Tile

Recommended with the installation of all Ludowici Mission tile is a top fixture. This tile is attached to the ridge stringer to fill the void area left between the field and the ridge cover. If top fixtures are not specified, void areas should be filled with Portland cement mortar Type M and/or specialty metal closures also may be used. (Mortars shall meet requirements of ASTM C-270.)

#### Points to Remember During Tile Installation

Tile installation will generally progress in a diagonal fashion, moving from the right to left. The installer applying the lower course will always be to the left of those applying succeeding courses.

- Use the chalk lines as a guide.
- Watch for any irregularities in the roof deck construction.
- After the installation of about 75-100 tiles, the roof should be inspected from the ground at a distance greater than 40 feet to determine that there are no streaks or blotches. To ensure a good range of tones, this inspection must be done at regular intervals.

Repeat the inspection each 75-100 tiles.

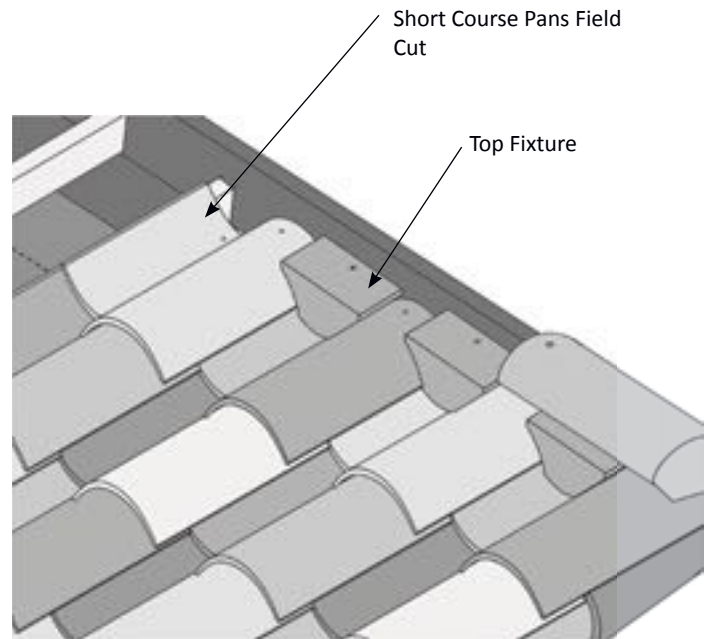


Figure 51.1 Mission Top Fixture Detail

**Valley Tile**

Tiles to be installed in valleys can be mitered in the field or special factory cut and closed tiles can be ordered. These special cut and closed valley tiles generally result in less water entering underneath the tile. Whether field miter cut or factory cut tiles are used, the tile fasteners should never penetrate the valley flashings. Tile to be installed over the valley flashing should be drilled or notched and wired with solid 16 gauge copper wire to fasteners driven into the deck beyond the flashing.

**NOTE: In situations where valley tile pieces are so small that it is not practical to notch or drill, use the adhesive RT600 (an OSI product) or its equivalent.**

If special factory cut and closed valley tiles are being applied, prior to installation, it will be beneficial to loose lay the vertical stringers, the entire eave closure, including the valley tile, and a few rows of pans and covers. This loose laying process of the valley's left side will advance as a typical installation would, from right to left. But, when

loose laying the valley's right side, it will advance from left to right. With the installation of Mission tiles, this should not create any concerns. Start by loose laying the valley tile to the already chalked valley line and continue away from the valley with the first course of tile. Once the layout is established, install the tiles in the typical Mission tile manner.

The loose laying process becomes vitally important when the roof runs from valley-to-valley. The focus must be to space the eave course so it consists of a full tile and is finished on both ends with special cut valley tiles. Keep in mind not to allow any more than (5) five pieces pulled to the extreme or crowded there.

If field mitered valley tiles are applied, they should be trimmed to provide a clean, even, continuous edge along the entire valley length.

**To encourage leaves and snow to slide down the valley, the gap between the Valley Tiles and the center line of the valley should be tapered from 3" at the top to 4" at the bottom, this can be increased for longer valleys.**

16 oz. Copper Valley Flashing With Hem and Cleats 24" O.C.

6" Strip of Ice and Water Shield

Chalk Line for Valley Tile Cut Line, Tapered

Underlayment

DO NOT Nail Through Copper Valley. Attach Small Valley Tiles With Copper Wire and Fasteners Placed Above Flashing

**NOTE: The Open Void at Field Cut Valley Tiles Can be Pointed With Type "M" Mortar**

Apply a Bed of Roofing Cement at the Lap to Small Valley Tiles to Prevent Migration

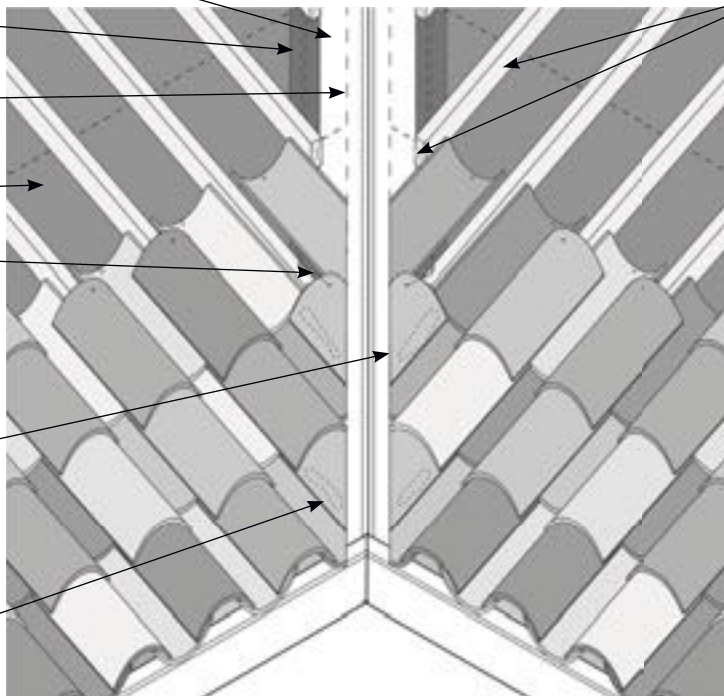


Figure 52.1 Mission Valley

2" x 4" Foundation Grade Wood Stringers, Hold Back 4" from Valley Tile Cut Line



Figure 52.2 Mission Factory Cut and Closed Valley Tile



Figure 52.3 Mission Field Cut Valley Tile



**Hip Tile**

The hip area is typically finished by using a combination of either a Circular Cover Hip Starter, Circular Cover and a Circular Cover Hip and Ridge Terminal, or 152 Hip Starter Tile, 102 Hip Roll Tile and 102/206 Hip and Ridge Terminal.

Hips are started with a Circular Cover Hip Starter tile or 152 Hip Starter tile covering the field tile approximately 3" on both sides. The hip tile covers are then installed. The Circular Cover tile creates an approximate 3" head lap on

the Starter tile, while the 102 tile creates an approximate 2" head lap over the starter tile. The last fastener on the upslope end of the hip typically is covered with a Circular Cover Terminal or a 102/206 Hip and Ridge Terminal. These terminals must be specified as a starter or finisher depending on the direction of the ridge layout. Some roof termination may require a combination of typical flashing details or a special tile piece. Consult the local Ludowici sales representative with the project's special roof requirements.

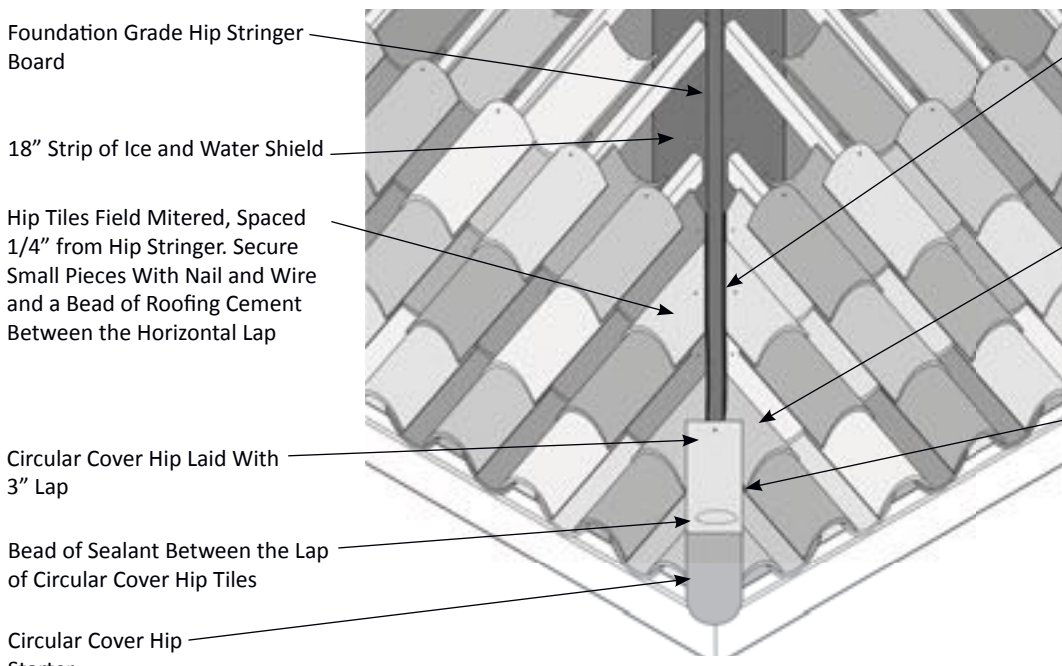


Figure 53.1 Mission Tile Circular Cover Hip Detail

Gap Between Hip Tile and Stringer Filled with Roofing Cement or Sealant Compatible With Ice and Water Shield

Apply a Bead of Roofing Cement at The Horizontal Lap to Small Pieces to Prevent Migration

**NOTE: The Open Void Between the Field Tile Pan and Circular Cover Hip Can be Pointed With Type "M" Mortar**



Figure 53.3 Mortared Hip Detail

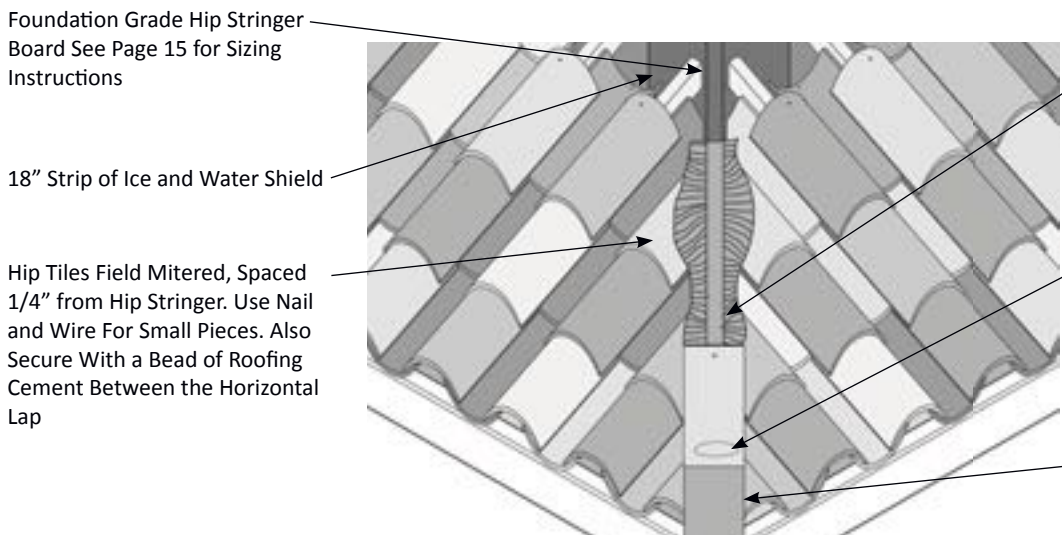


Figure 53.2 Mission Tile Circular Cover Hip Detail with FlexSeal™

Flexseal™ Corrugated Flexible Copper Flashing with Integral Butyl Strip to Seal Flashing to Field Tile

Apply a Bead of Roofing Cement at the Horizontal Lap to Small Pieces to Prevent Migration

Circular Cover Hip Starter

**Ridge Tile**

The ridge for Mission tile is finished with a Circular Cover Tile or a 206 Ridge Tile.

Roofing cement must be used at the overlap of each ridge tile and where they rest on the field tile. Closed Ridge Ends, Circular Cover Closed Ridge End, 206 Ridge, Circular Cover Terminal, or 102/ 206 Hip and Ridge Terminal Tile are used to start and finish the ridge. The ridge finisher will have an exposed fastener which should be sealed with roofing cement meeting the requirements of ASTM D-4586. Some roof termination may require a combination of typical flashing details or a special tile piece. Consult the local Ludowici sales representative with the project's special roof requirements.

**NOTE: It may be beneficial to lay out the chosen ridge system on the stringer to determine lap (no less than 2"). This will prevent having to traverse the installed tiles later.**

**Applying ridge tiles with the lap facing away from the prevailing winds helps the tile shed wind-driven rain.**

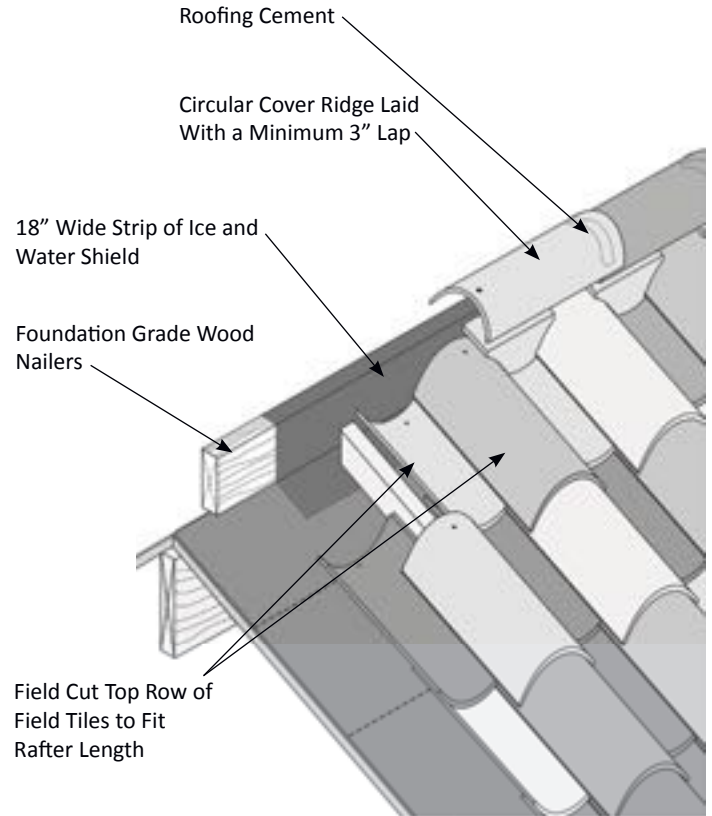


Figure 54.1 Circular Cover Ridge Mission Tile Detail

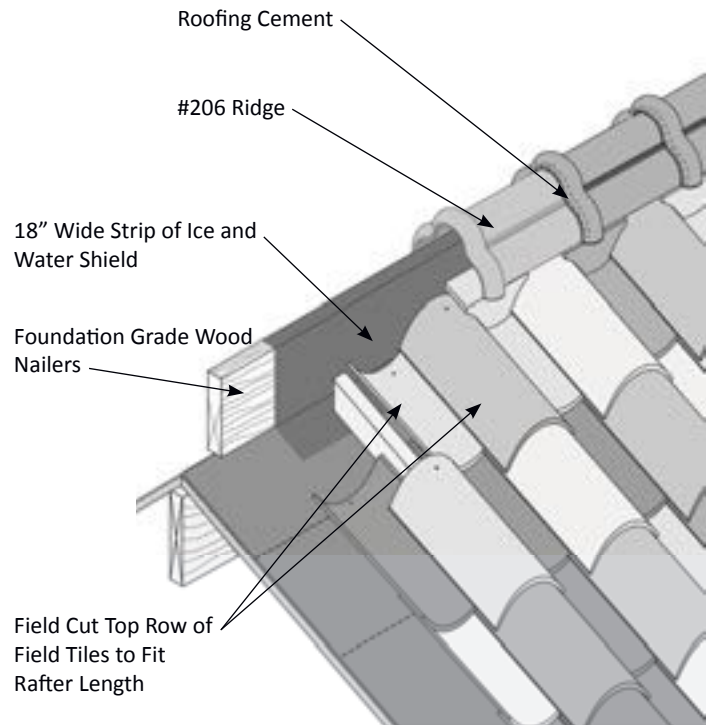


Figure 54.2 #206 Ridge Mission Tile Detail

**Circular Cover Ridge Vented**

This ridge vent allows 6.27 square inches of ventilation per foot of ridge.

**Minimum Roof Pitch 6:12**

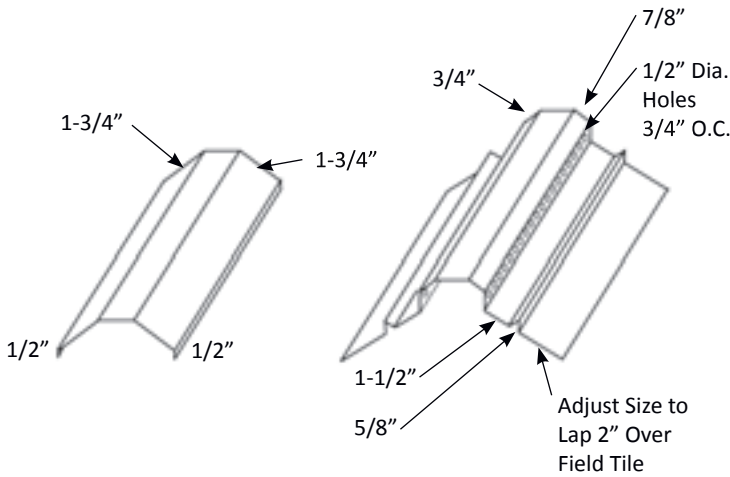


Figure 55.1 Circular Cover Vented Ridge Cap Flashing

Figure 55.2 Circular Cover Vent Flashing

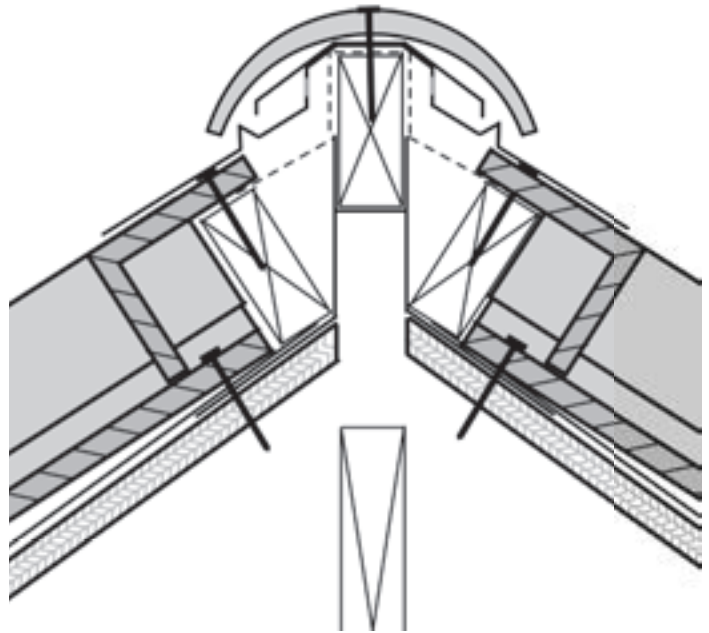


Figure 55.3 Mission Tile Circular Cover Vented Ridge Section

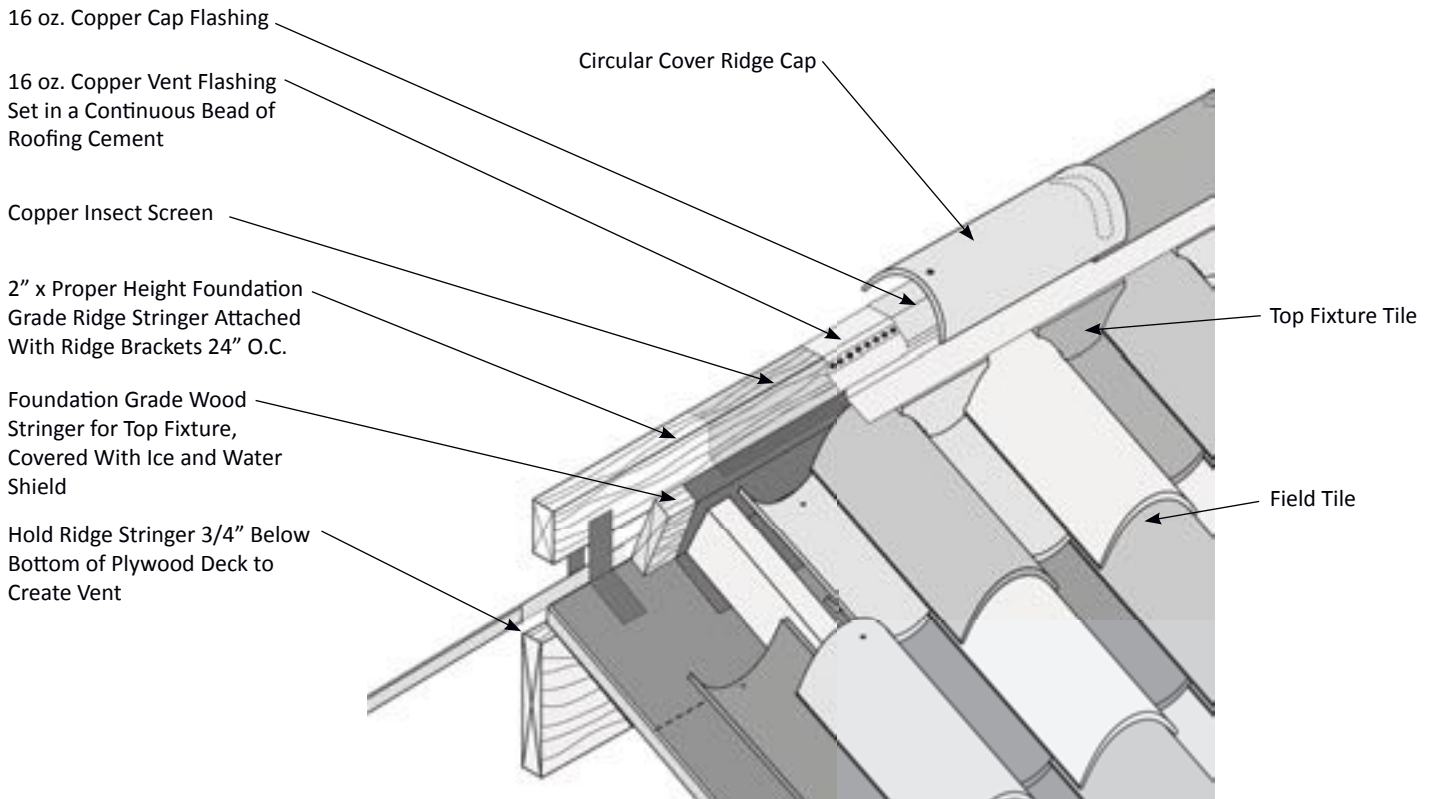


Figure 55.4 Mission Tile Circular Cover Vented Ridge

**#206 Ridge Vented Type-1**

This ridge vent allows 6.27 square inches of ventilation per foot of ridge.

**Minimum Roof Pitch 6:12**

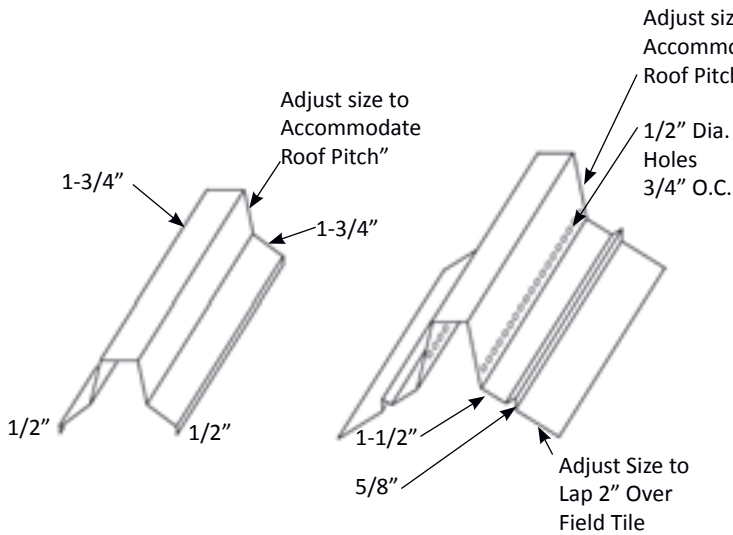


Figure 56.1 #206 Ridge Vented Ridge Cap Flashing

Figure 56.2 #206 Ridge Vent Flashing

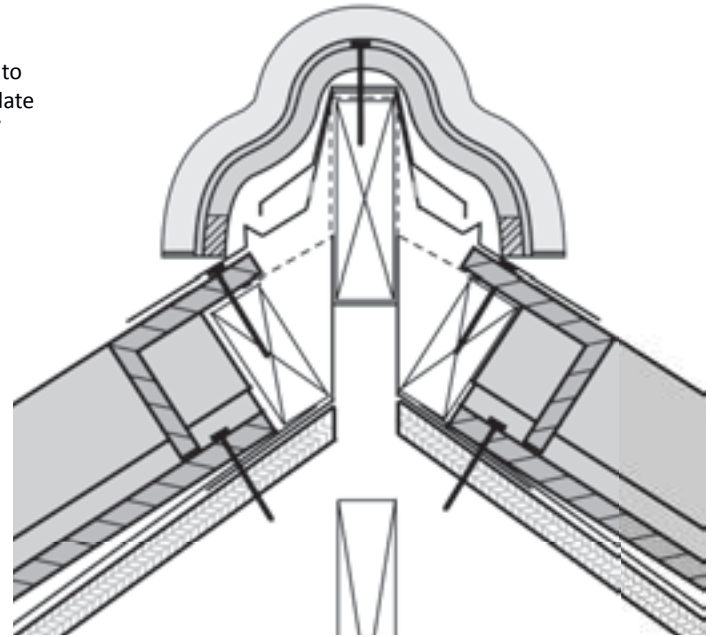


Figure 56.3 Mission Tile #206 Vented Ridge Section

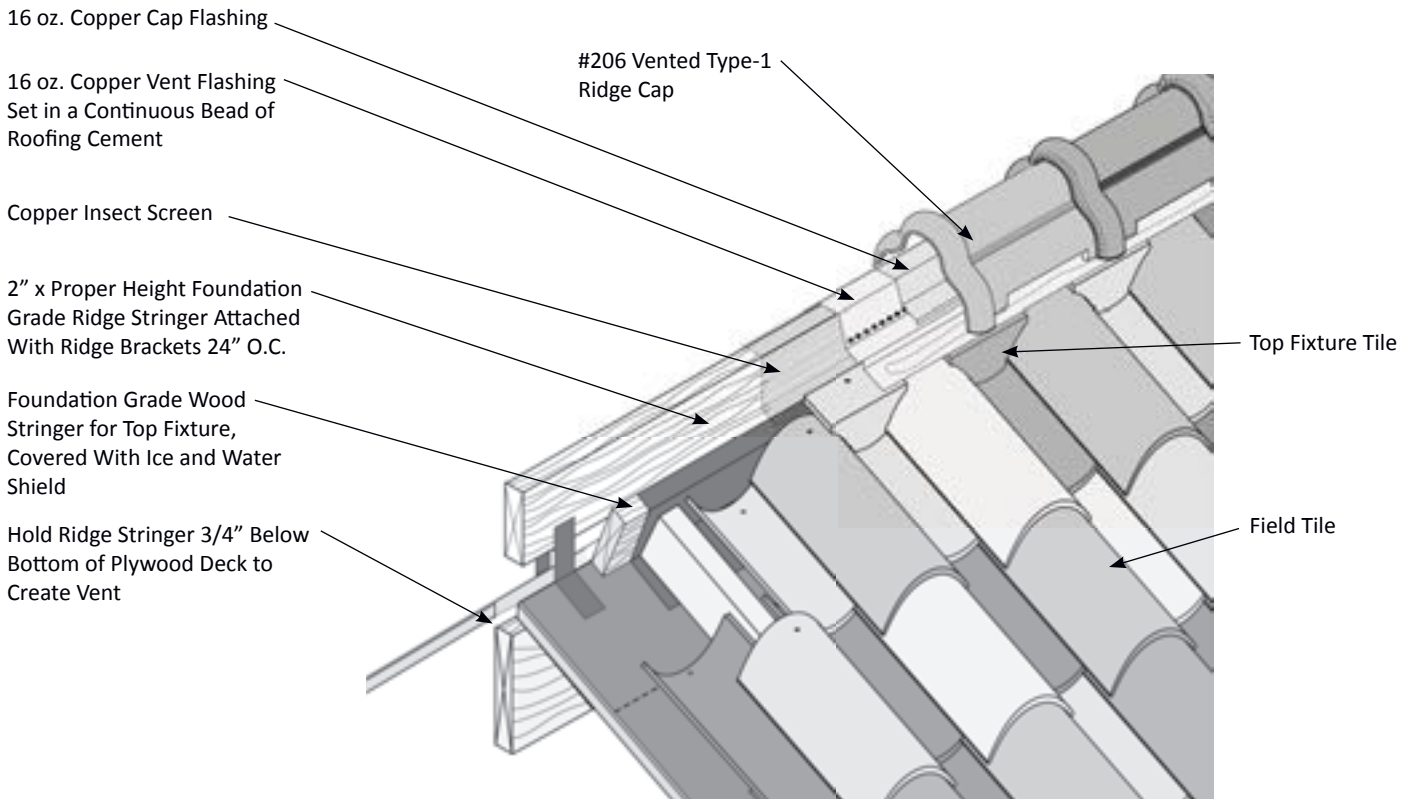


Figure 56.4 #206 Ridge Vented Type-1

**Tapered Mission Tile**

Ludowici’s 14-1/4” and Cubana 18-3/8” Tapered Barrel Mission tile have clipped corners on the narrow end of the tile. They install so that the clipped corner of the pan tile align with the clipped corner of the diagonally adjacent cover tile. No short course starter tile is used.

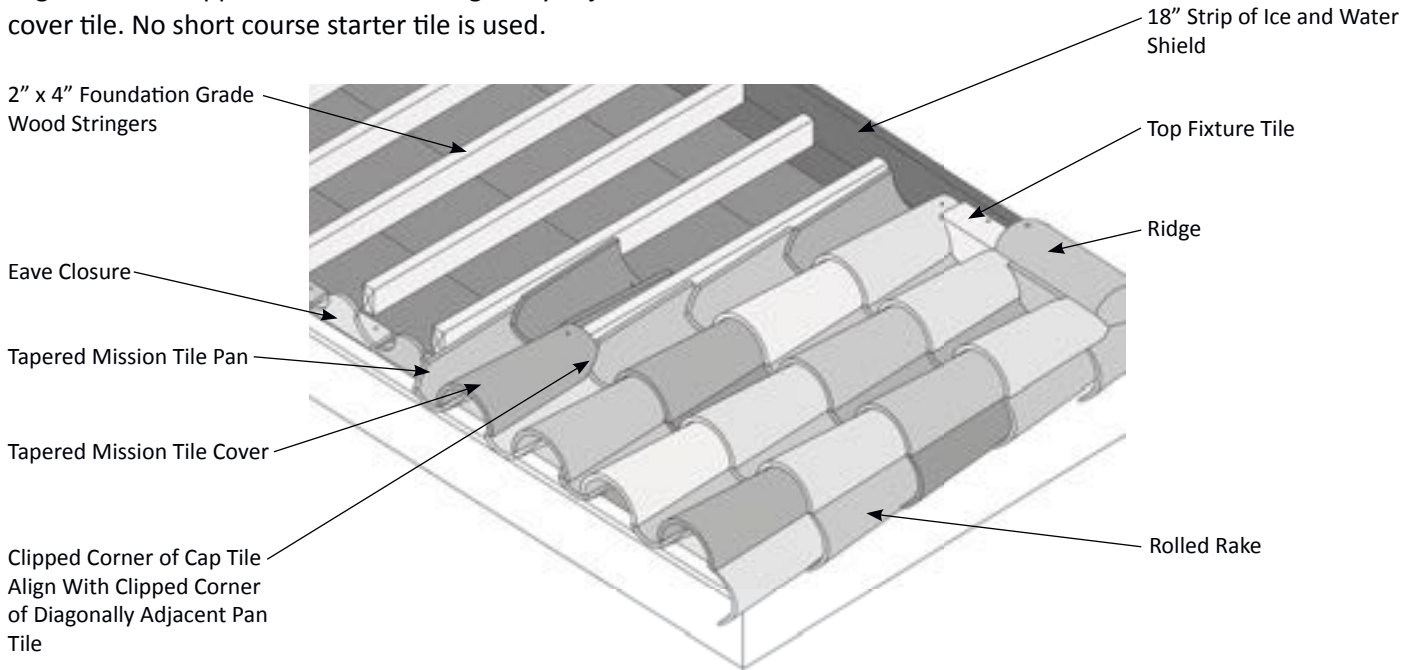


Figure 57.1 Tapered Mission Tile

**Staggered Mission Tile**

Ludowici’s Straight Barrel Mission tile can be laid in a staggered pattern, either by laying with a random headlap between 3” and 6” or by mixing the three different lengths of Straight Barrel Mission tiles.

Palm Beach Mission Tile can also be laid staggered by laying with a random headlap of between 3” and 6”.

Both installation methods are NOT laid tight and small gaps between the underside of the cap edge and the pan will be present.

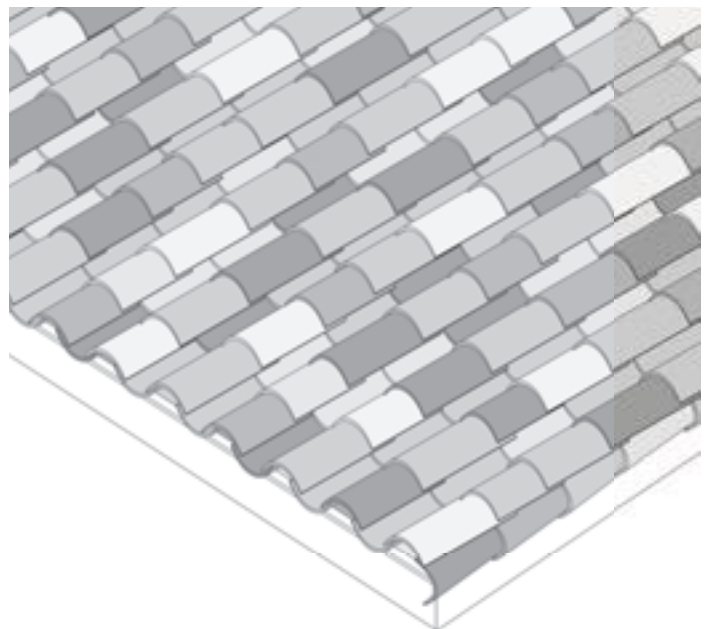
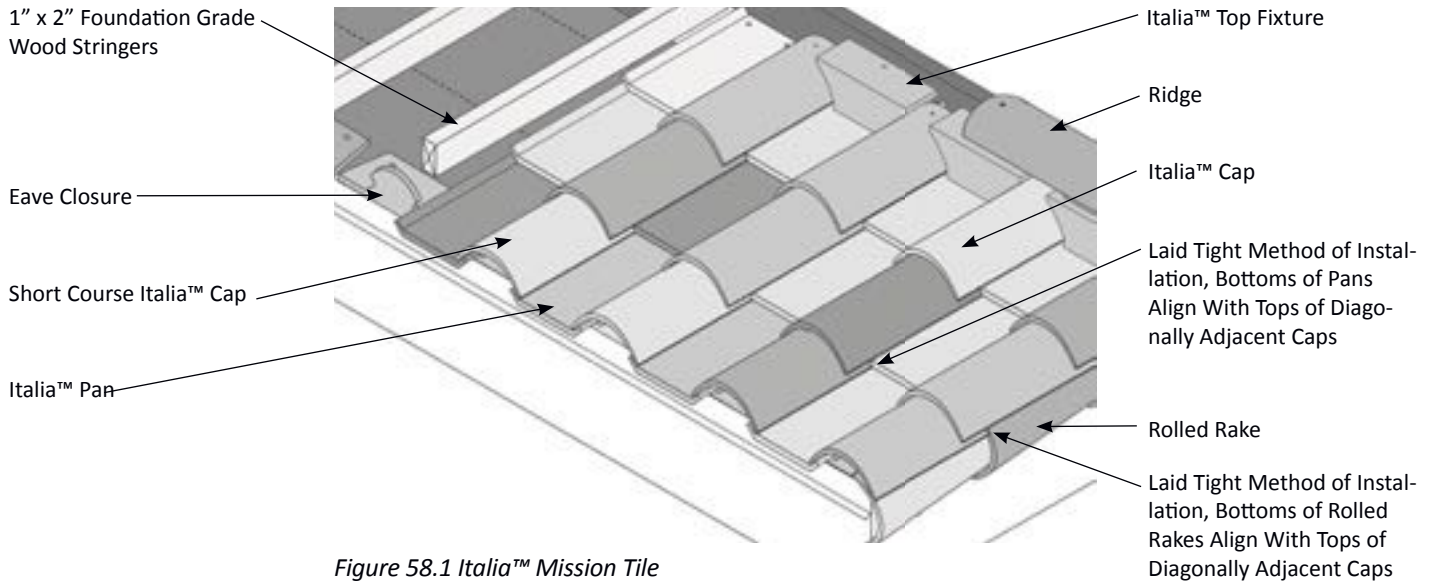
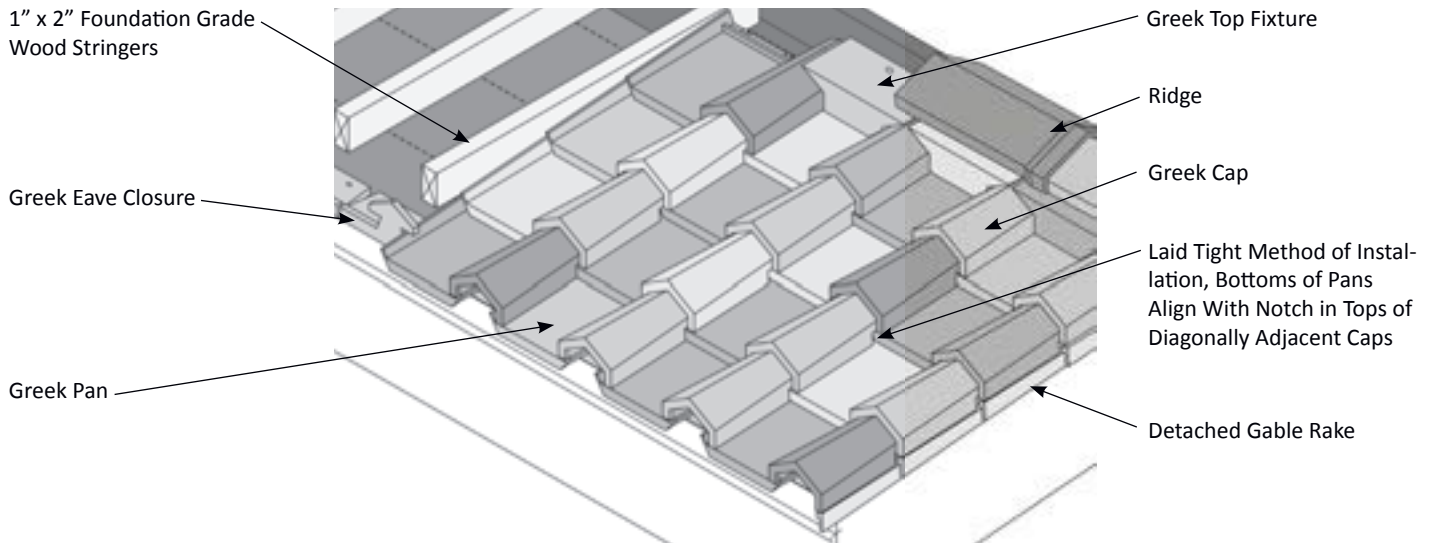


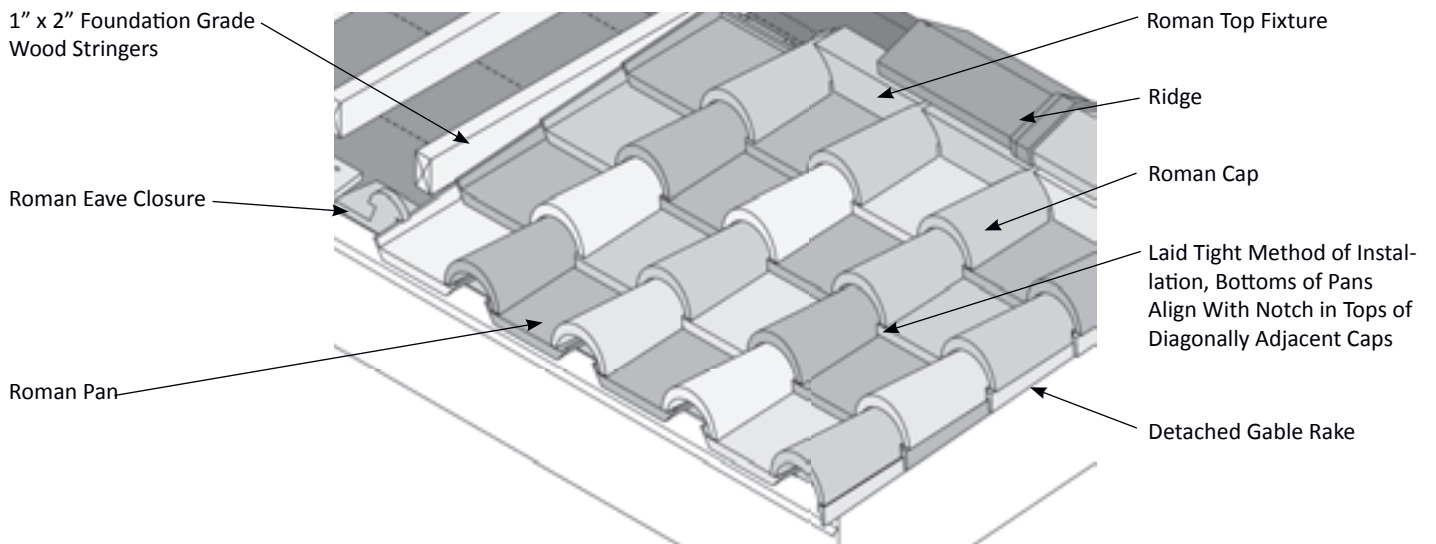
Figure 57.2 Staggered Mission Tile  
Mixed Lengths Shown



*Figure 58.1 Italia™ Mission Tile*



*Figure 58.2 Greek Tile*



*Figure 58.3 Roman Tile*

### Snow Guards

Snow guards are generally required in areas where snow and ice may accumulate on the roof. Snow Guards are sometimes used on sloped roofs to prevent a mass of snow or ice from sliding off the roofs and injuring persons, damaging gutters or plants, and blocking walks and driveways. Snow guards hold the snow in place above the eaves until it can melt and the water runs off.

It is recommended that snow guards should be installed on at least 3 or 4 courses, offset from course to course; begin with the third or fourth row. However, spacing and quantity of snow guards is a matter of judgement based on local weather conditions (see Figure 59.1).

Alpine conditions will require a professional engineer to design the required snow retainage system. Tile should not be exposed to ice and snow loads exceeding 100 pounds per square foot.

**A Snow Guard must be made of nonferrous material to prevent possible rust stains.**

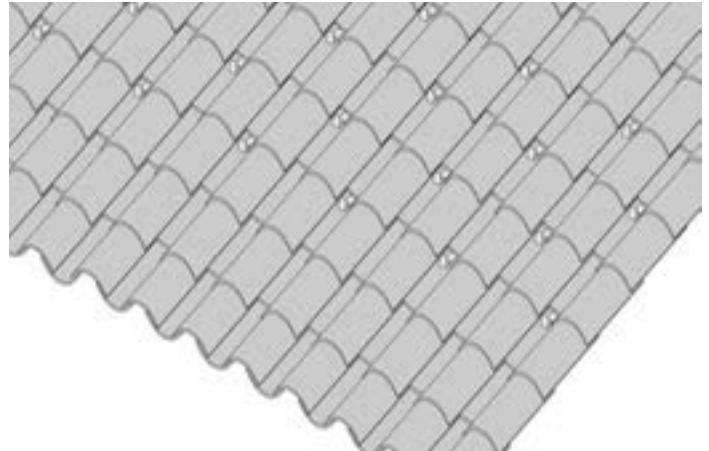


Figure 59.1 Snow Guard Spacing

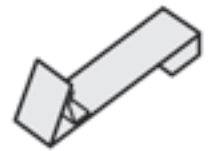


Figure 59.2 Ludowici Mission Snow Guard

### Repair

To replace a broken or damaged tile do not use an exposed Copper strap. These are unsightly and can work loose allowing the replacement tile to slide out.

Ludowici's Quik-Tach™ Brackets are a quick, efficient and concealed method for tile replacement. Follow these steps:

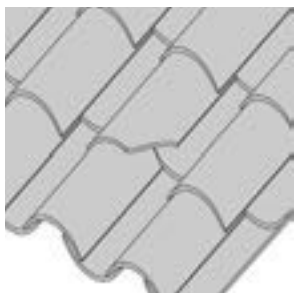


Figure 59.3 Damaged Tile

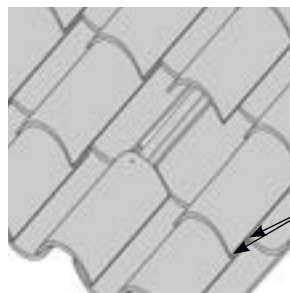


Figure 59.4 Remove Damaged Tile

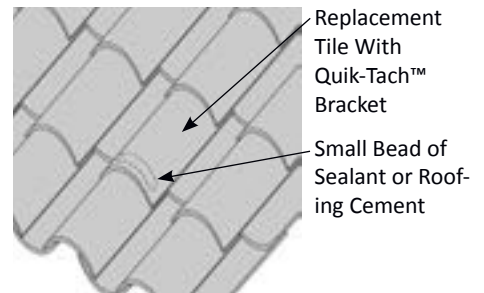


Figure 59.5 Finished Tile Replacement

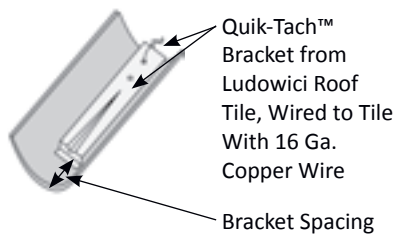


Figure 59.6 Replacement Tile With Quik-Tach™ Bracket

Completely remove damaged tile and fasteners. A slate ripper will facilitate removal of fasteners. Measure the distance from the top of the course below to the bottom of the adjacent tile to the replacement.

Lift the tile in the course above and slide the replacement tile into place so the bracket engages the top of the tile below the replacement. Apply a small bead of Sealant or roofing Cement under replacement tile.

**NOTE: Replacement of a Mission Pan tile does not require the use of a Quik-Tach™ Bracket**

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**This manual includes the basic installation instructions from start to finish in an easy-to-read format. However, the applicator must always give consideration to regional climactic conditions and code requirements.**

**For Alpine or Tropical installations contact the Ludowici Technical Service Department for assistance.**

**Have a question about how to install Ludowici tile?**

**Contact your local Ludowici Sales Representative or the Ludowici Technical Service Department at**

**1-800-945-8453**

  
**LUDOWICI®**  
**Ludowici Roof Tile, Inc.**  
**4757 Tile Plant Rd.**  
**P.O. Box 69**  
**New Lexington, OH 43764**  
**1-800-945-8453**  
**[www.Ludowici.com](http://www.Ludowici.com)**