

# Installation Manual for Moderate Climate Regions



Design Criteria

FIELD TILE



*Imagine the Possibilities  
Realize the Benefits*



**TILE ROOFING**  
INSTITUTE



Western States Roofing  
Contractors Association

## FOREWORD

The Tile Roofing Institute (TRI) is the premier resource for technical information on the proper design and installation of concrete and clay roof tile systems. The Tile Roofing Institute in partnership with the Western States Roofing Contractors Association (WSRCA) assembled a task group in 1991 to develop an installation manual that would provide a representation proper installation practices, industry standards, and code requirements. These recommendations have provided successful installations of roof tile which have endured the test of time.

During the last year the TRI and WSRCA technical committees reviewed the existing 2006 manual and solicited valuable input from the entire roofing community. The culmination of those efforts has been the creation of the 2010 Edition of the Installation Manual for Moderate Climate Regions. As with the previous editions, the TRI has submitted the manual for formal review and issuance of an ICC-ES Evaluation Report number ICC-ES- ESR 2015P to help provide a stronger foundation to the formal practices and recommendations included in this manual.

The Tile Roofing Institute offers additional installation manuals Concrete and Clay Tile Roof Design Criteria Manual for Cold and Snow Regions and FRSA/TRI Concrete and Clay Roof Tile Installation Manual. All of our publications can be ordered through the publication page on our website ([www.tilerroofing.org](http://www.tilerroofing.org)). The TRI will be offering formal installer training programs based upon the manuals to allow roofing professionals to become certified tile installers.

TRI continues to provide the leading edge technology for roof innovations that will provide the highest quality, energy efficient roofing systems available in the market today. Tile roofing systems provide one of the most durable, energy efficient roofing systems found anywhere in the world.

Updates and Bulletins - The Tile Roofing Institute would like to make sure that we provide the latest information and updates available directly to you. If you would like to receive notices of any changes, updates, or provide comments on this manual please visit our website [www.tilerroofing.org](http://www.tilerroofing.org) or email us at [info@tilerroofing.org](mailto:info@tilerroofing.org) and ask to be placed on our email listing for future notices.

### **LIMITATIONS ON USE AND DISCLAIMER FOR THIS TRI/WSRCA INSTALLATION MANUAL**

These drawings and recommendations are the compilation of the individual experiences of industry members and the Technical Committee of the TRI/WSRCA. It is intended to be used with the judgment and experience of professional personnel competent to evaluate the significance and limitations of the material contained and who will accept responsibility for its application. The TRI/WSRCA expressly disclaims any guarantees or warranties, expressed or implied, for anything described or illustrated herein; and assumes no responsibility for error or omissions.

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## INTRODUCTION

These recommendations are meant for areas with moderate climates that may experience occasional storms, but not regular repetitive freeze thaw cycling. In locations where the January mean temperature is 25 deg. F (-4 deg C) or less or where ice damming often occurs, the TRI/WSRCA suggests reference to the Concrete and Clay Tile Roof Design Criteria Manual for Cold and Snow Regions. While generally considered the minimum standard, proper adherence to these recommendations and attention to detail and workmanship provide a functional roof in most all moderate climate conditions. Local building officials should be consulted for engineering criteria or other special requirements.

The manner in which tile roofs are installed makes them a highly effective water shedding assembly that affords years of service and protection. The effectiveness of a tile roof system as a weather resistant assembly however depends on the proper installation of all the tile roof components, and installing them properly is critical to the performance of the installed system.

Since tile is installed across a wide range of climatic and geographic conditions, there are a variety of details that must be considered in preparing an effective installation. The minimum recommendations shown for moderate regions are effective for a relatively wide range of conditions including occasional storms or snow. While it is not practical to prescribe precise solutions for all conditions, the following has been provided to offer suggestions for various treatments in a moderate climate application. Local building officials should always be consulted to learn of special requirements that may exist. Some of the changes contained will require code approval.

This manual provides the minimum design recommendations with optional upgrades for the installation of underlayment, flashings, fastening and related measures to provide a weather resistant roofing assembly for concrete and clay tile.

Designers should be familiar with local climatic conditions and make sure that they are reviewing the proper design manual. Please see the following list of reference publications for additional information.

## TOOLS REQUIRED (Other items may be required per field conditions)

Basic Hand Tools			Power Tools		
Tape Measure	Crayon	Hammer	Drill	3/16" Masonry Bit	Screw Gun
Tin Snips	Felt Knife	Nail Bag	Power Cords	Compressor w/ Hose	Nail Gun
Chalkline	Chalk	Pry Bar	Tile Saw	Diamond Saw Blade	
Metal Crimper	Mortar Trowel	Mastic trowel			
Caulking Gun	Hand Saw	Roller			
Brush	Broom				
Specialty Tools & Equipment			Safety & Personal Protective Equipment Per Federal & State OSHA Requirements		
Forklift	Conveyor	Tile Cutter			
Ladder	Tile Nippers				

## SAFETY WARNING - TILE DUST

Roofing tiles contain crystalline silica (quartz) and traces of other hazardous substances which are released as dust and can be inhaled when dry-cutting or grinding this product.

WARNING: Crystalline silica is a substance known to cause cancer. Other chemicals contained in these products are known to cause cancer, birth defects and other reproductive harm. Please refer to Federal and State OSHA requirements for proper compliance.

## REFERENCE PUBLICATIONS

Standard Installation Guides for Concrete and Clay Roof Tile in Cold Weather Applications. Published 1998 by the NTRMA/WSRCA

Concrete and Clay Roof Tile Installation Manual Fourth Edition (For Florida only) Published August 2005 by the FRSA/TRI

CAN/CSA-A220.1-M91 – Installation of Concrete Roof Tiles, by the Canadian Standards Association

The European Standards Association, Australian Standards Association, Japanese Standards Association

## TERMINOLOGY

Please see Appendix C for a listing of terms associated with roof tile.

## GOVERNING CODE BODIES

Information contained herein is based on values and practices consistent with provisions of the major building codes such as the International Building Code (IBC), International Residential Code (IRC), as promulgated by the

International Code Council (ICC). For ICC-ES evaluation reports for concrete and clay roof tiles that specifically reference this manual, installation shall be in accordance with this manual and the applicable code, unless otherwise noted in the ICC-ES roof tile evaluation report.

## ENVIRONMENTAL STATEMENT

The members of the TRI/WSRCA are environmentally conscious companies whose policies and practices reflect a commitment to the preservation and welfare of our environment. Our roofing tiles are manufactured in accordance with all prevailing environmental guidelines

and are composed of sand, cement, natural clay materials and natural pigments. Because roofing tiles are designed to last long term, they will not add to the tremendous volume of other roofing materials that burden our landfills.

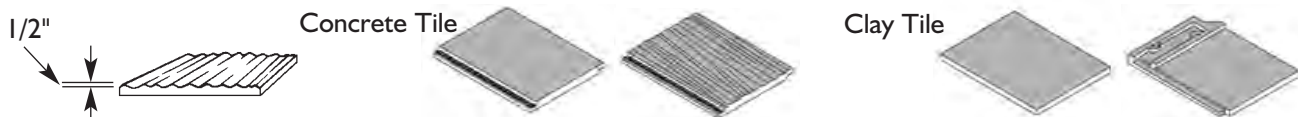
## MATERIAL CHECKLIST (Other options/upgrades may be allowed per codes)

<b>Decking:</b>	Sheathing must be adequate to support the loads involved, but not less than nominal 1-inch-thick lumber or nominal 1 <sup>5</sup> / <sub>32</sub> -inch-thick plywood or other decking material recognized in a code evaluation report or by the local building official.	<b>Roof To Wall:</b>	Minimum 3" coverage over tile or flexible flashing. See Table A on page 4 for more details.
<b>Underlayment:</b>	ASTM D226 Type II (No. 30 felt) /ASTM D4869 Type IV or ASTM D 1970 (self adhering), meeting AC 150.	<b>Pipe Flashing:</b>	Deck & Tile flashing is required. Profile tile flashing to be malleable metal flashings. See Table A on page 4 for more details.
<b>Battens:</b>	Nominal 1" x 2" complying with IBC Chapter 23, section 2302 (nominal size).	<b>In wall Counter Flashing:</b>	Z bar recommended or surface mount reglet (pin) Flashing for re-roof. See Table A for more details.
<b>Eave Treatments:</b>	Bird Stop/Eave riser.	<b>Fasteners:</b>	See page 6 and Table IA/IB for requirements.
<b>Valley Flashing:</b>	Shall extend each way 11" from center and have a splash diverter rib 1" high. See Table A on page 4 for more details.	<b>Ventilation:</b>	Per local building code requirements.
<b>Wall Trays (Pans):</b>	Minimum 6" trough. See Table A on page 4 for more details.		

## ROOF TILE CLASSIFICATIONS

Roof tiles manufactured are typically of the following types:

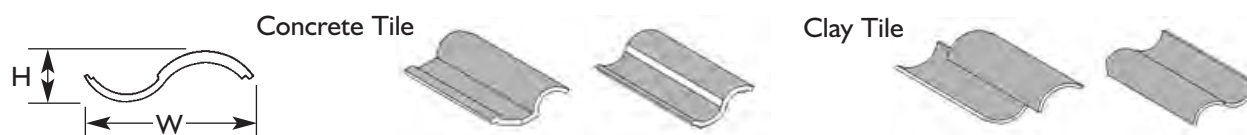
**Low Profile Tile** – Tiles, such as flat tile that have a top surface rise of 1/2" or less.



**Medium Profile Tile** – Tiles having a rise to width ratio equal to or less than 1:5



**High Profile Tile** – Tiles having a rise to width ratio greater than 1:5 (measured in installed condition)



**Accessory Tile** – Shall include those tile such as ridge, rake, hip, valley and starter tile used in conjunction with those tile listed above.

**TABLE A**

**REFERENCE TABLE FOR DRAWING DETAILS**

TYPE	SPECIFICATIONS	DETAILS
VALLEY FLASHING	NO. 26 GALVANIZED SHEET GAUGE NOT LESS THAN 0.019" ASTM A653 G90	MC-12B, MC-17, MC-17A, MC-17B
PAN FLASHING CHANNEL FLASHING WALL TRAYS FLASHING		MC-12, MC-12A, MC-12B, MC-13, MC-13A
HEADWALL FLASHING ROOF TO WALL FLASHING APRON FLASHING		MC-11, MC-11A
COUNTER FLASHING Z BAR FLASHING		MC-11, MC-12, MC-13, MC-13A
DRIP EDGE FLASHING EAVE FLASHING		MC-10, MC-10A, MC-10B, MC-10C, MC-10D
RAKE FLASHING		MC-12B, MC-19, MC-19A
CHIMNEY FLASHING SKYLIGHT FLASHING SADDLE FLASHING		MC-14, MC-14A, MC-15, MC-15A, MC-16A, MC-16B
PIPE FLASHING DECK FLASHING		MC-02, MC-21
ROOF VENTS ATTIC VENTS		MC-21
PROFILE TILE FLASHING		SOFT LEAD NOT LESS THAN 3 LBS / SQ.FT DEAD SOFT ALUMINUM NOT LESS THAN 0.019" SOFT COPPER NOT LESS THAN 16 OZ/SQ.FT

**ACCESSORIES**

TYPE	SPECIFICATIONS	DETAILS
BIRDSTOP EAVE RISER WEATHER BLOCKING	PER MANUFACTURER	MC-10A, MC-10B, MC-10C, MC-23, MC-25 PER MANUFACTURER'S SPECIFICATIONS MC-18, MC-18A, MC-18B

\* All flashings above are considered minimums.

\* For other special metal type upgrades see IBC Tables 1507.4.3(1) and 1507.4.3(2) or IRC Tables R 905.10.3(1) and R 905.10.3(2), as applicable.



## TILE SPECIFICATIONS/ RECOMMENDATIONS

**Freeze Thaw** – Different climatic conditions will result in the need for different roofing materials that will allow the success of the roofing system over the long-term. Resistance to freeze/thaw is very important in weathering situations where the roofing material is expected to withstand repetitive freezing and thawing cycles. Both Concrete and Clay Tile must have passed the requirements of ASTM C1492 (Concrete) ASTM C1167 (Clay) for freeze thaw regions.

**Strength** – A Concrete (ASTM C1492) or Clay tile's (ASTM C1167) transverse strength will meet or exceed requirements of the specified codes.

**Thickness** – Roof tile typically ranges in thickness from  $3/8"$  to  $1\ 1/2"$ , depending upon composition, type and style.

**Quantities of Tile Per Square** – The size of the tile and the exposure of each course of tile determines the number of tile needed to cover one square (100 sq. ft.) of roof area. When the tile is installed at the manufacturer's maximum exposure, the number of tile needed to cover one square of roof area may range from 75 to over 400 pieces.

**Tile Weight** – The size of the tile and the exposure of each course will determine the installed weight of the roof tile. In general, the amount of tile to cover one square (100 sq ft.) set at the standard 3 inch head lap, will depend on the thickness, length, width, shape and aggregate materials used in the manufacturing process of the tile. Please consult with the tile manufacturer when determining the weight of the specific tile that will be used. As with any roofing material the designer should always consider the weight of the underlayment, fastening system, roof accessories and special hip/ridge treatments.

## MATERIALS AND MANUFACTURE

**Concrete Tile** – Cementitious materials such as portland cement, blended hydraulic cements and fly ash, sand, raw or calcined natural pozzolans and aggregates shall conform to the following applicable ASTM specifications.

### Concrete Tile ASTM C1492 Specifications –

Portland Cement – Specification C150 or  
Performance Specification C1157  
Modified Portland Cement – Specification C90  
Blended Cement – Specification C595  
Pozzolans – Specification C618  
Ground Granulated Blast Furnace Slag –  
Specification C989

Aggregates such as normal weight and lightweight shall conform to the following ASTM specifications; except that grading requirements do not apply.  
Normal Weight Aggregates – Specification C33  
Lightweight Aggregates – Specification C331

**Clay Tile** – Tiles are manufactured from clay, shale, or other similar naturally occurring earthly substances and subjected to heat treatment at elevated temperatures (firing). The heat treatment must develop a fired bond between the particulate constituents to provide the strength and durability requirements.

### Clay Tile ASTM C1167 Specifications –

Terminology for structural clay products – C43  
Test methods and sampling and testing brick and structural clay – C67  
Test methods for tensile strength of flat sandwich construction in flat wise plane – C297  
Test method for crazing resistance of fired glazed ceramic whitewares by thermal shock method – C 554

**Additional Standards for Concrete & Clay Tile** may be referenced in the following additional standards:

ASCE-7	Uniform Building Code
IBC/IRC	ICC-ES AC 152 Acceptance Criteria
Standard Building Code	CAN/CSA – A220.1-M91
ICC-ES AC180	Acceptance Criteria

**Adhesive** – Bonding materials designed to stick tiles to tiles, or tiles to a substrate and can include mortar, synthetic mortar, mastics, silicones, polymers, Trig-polymers, or other materials approved by the local building official. Contact the adhesive manufacturer for additional information. Refer to current ICC-ES evaluation reports of roof tile adhesives for installation requirements and conditions of use.

**Batten** – A sawed strip of wood installed horizontally and parallel to the eave line which is mechanically attached to

the roof deck or rafters to engage the anchor lugs to prevent slippage of the roof tile. Battens of nominal 1"x2" lumber complying with IBC Chapter 23, section 2302 may be dimensionally increased in size to accommodate structural loads for snow or unsupported spans over counter battens or rafters. Battens may also be corrosion resistant metal, or other man-made material that meets the approval of the local building official. In dry/low humidity climates moisture resistant battens are not required. See Tables IA and IB on pages 10 and 11.

Battens installed over counter battens or which span over rafters commonly are of soft wood, spruce, pine, or fir type species but may be of any type of lumber, metal or man-made materials that meet the approval of the local building official. See table 2 on page 12.

**Counter Battens** – Additional set of battens installed vertically and parallel to the roof slope and mechanically attached to the roof deck under the batten. Counter battens are commonly 1/4 inch lath but may be dimensionally increased in size to provide a greater flow of air or moisture beneath the horizontal battens. Counter battens do not need to be of moisture resistant lumber as they do not impede moisture flow. Counter battens may also be of corrosion resistant metal or other man-made materials that meet the approval of the local building official. See table 2 on page 12.

*Note: If counter battens are installed under the underlayment, caution must be used to prevent damage to underlayment or reinforced underlayment shall be used.*

*Note: Care should be taken in selecting the proper batten design. Excessive deflection of the batten may lead to tile breakage. See table 2 on page 12.*

### Caulking and Sealant

Caulking and sealants shall be suitable for exterior use and be resistant to weathering. The caulking and sealants shall be compatible with and adhere to the materials to which they are applied.

### Nails and Fastening Devices

Corrosion resistant meeting ASTM A641 Class I or approved corrosion resistance, of No. 11 gauge diameter and of sufficient length to properly penetrate 3/4" into or through the thickness of the deck or batten, whichever is less.

The head of the nail used for tile fastening shall not be less than 5/16" (.3125") and complying with ASTM F 1667 for dimensional tolerances (+0%, -10%).

### Nail Length –

#### Nailing of Batten

Nails for fastening battens shall have sufficient length to penetrate at least 3/4" into the roof frame or sheathing.

#### Nailing Tile to Batten and Direct Deck Systems

Nails for fastening roof tiles shall penetrate at least 3/4" into the batten or through the thickness of the deck, whichever is less. Once the batten is installed it becomes part of the deck for fastening purposes.

#### Nailing Tile to Battens on Counter Batten or Draped Underlayment Systems

Nails for fastening roof tiles shall penetrate at least 3/4" but should not penetrate the underlayment.

#### Nailing Accessories

Where nail(s) are required for fastening accessories, such nails shall have sufficient length to penetrate at least 3/4" into the supporting member.

**Screws** – Corrosion resistant meeting code approval equal of sufficient length to properly penetrate 3/4" into or through the thickness of the deck or batten, whichever is less. Screw diameter and head size should be selected to meet good roofing practices and the screw manufacturer's recommendations. See above section on nail length for additional requirements.

**Staples for Battens** – No 16 gauge by 7/16 inch-crown by minimum 1 1/2 inch long corrosion-resistant staples.

**Flashing** – Flashing shall be installed at wall and roof intersections, wherever there is a change in roof slope or direction and around roof openings. Where flashing is of metal, it shall be of;

0.019" Galvanized (G90)	0.019" Aluminum
16 Oz Copper	3 lb Soft Lead.

### Underlayment Materials

Single layer underlayments shall meet the minimum requirements of ASTM D226 Type II (No. 30 Felt) (ASTM D4869 Type IV), or approved equal.

## GENERAL INFORMATION

**Algae/Moss** – In certain climatic regions of the country, the development of algae and/or moss can occur on any building material. Unlike other roofing materials, the formation of these items can easily be treated and does not deteriorate the roofing tile. The growth of moss and algae form on the dirt and moisture on the surface of the tile.

**Algae** – Like the moss, the algae can be easily removed through the use of pressure washers. Often times a very dilute amount of bleach can help kill the algae and slow down the re-occurrence. Again, this should be left to the professionals to perform.

**Moss** – In most cases the use of a high pressure cleaner will remove the presence of the moss that traditionally grows in the dirt/pine needles or other debris that accumulates on the edge of the tile. Note that you may wish to contact a professional to clean your roof, since roofs can be extremely dangerous to walk on.

**Shading** – Slight variations in sand, cement, and color oxides (natural products) can cause minimal color shading. This slight variance is not detectable through standard quality control practices. In order to minimize color patterning, stair stepping, or hot-spots, tile should be selected and spread over the entire roof plane when loading the tile on the roof.

**Broken Tile Replacement** – The broken tile is first removed, if battens were used originally, existing fasteners if any, are cut, removed, underlayment repaired and the new tile is inserted. If no battens were used, a 12" x 6" by ½" plywood piece is nailed to the deck to act as a batten. As an alternative, new tiles may be inserted using roofers mastic, hooks, wires or approved adhesives to form the bond at the head of the lap area. See pages 65 and 66 (Tile Repair).

**Efflorescence** – Efflorescence is a temporary surface discoloration common to all concrete based roofing tile. It is a nuisance not only to the manufacturer, but also those involved in specification, installation, and usage. It is however, in no way detrimental to the overall quality, structural integrity, or functionality of the tile.

Efflorescence is mostly caused by the chemical nature of the cement. Manufactured cement contains free lime, and when water is added, a series of chemical reactions take place. These reactions are accompanied by the release of calcium hydroxide which can form a white chalky crystalline salt deposit on the tile surface when reacting with carbon dioxide. This reaction can appear as an overall "bloom" (overall softening of color) or in more concentrated patches.

It is difficult to predict how long the effects of efflorescence will last. It depends on the type and amount of deposit as well as the local weather conditions. The action of carbon dioxide and rain water will gradually, in most cases, remove the deposit leaving the original color of the concrete roof tile intact without further efflorescence.

**Walkability** – The inert nature of tile, its characteristics of strength over age, and its durability will contribute to a long term life expectancy. With a good installation and reasonable precautions against severe roof traffic, a tiled roof system will require very low maintenance. Walking on a roofing tile should be done with extreme caution. Place antennas and roof mounted equipment where a minimum of roof traffic will be necessary for servicing and maintenance. If necessary to walk on the tile surfaces, pressure should only be applied on the headlap of the tile units (lower 3-4 inches). This distributes the load near the bearing points of the tile. When painting or repairing adjoining walls or appurtenances, safely cover the tile surface with secured plywood to distribute traffic loads and prevent dirt, building materials, and paint/stain from damaging or discoloring the tile.

**Weather Effects On Tile** – After constant exposure to nature's elements some tile can be expected to lighten to some degree from the original color or lose some surface texture. This is due primarily to the effects of oxidation on the surface of the tile. This will not effect the structural integrity or water shedding abilities of the tile.

**Vermin Screening** – Metal, honeycomb plastic, foam fillers, mortar or equivalent should be considered to seal larger access areas. This will help minimize the access of birds and vermin infiltration.

## NEW CONSTRUCTION

See Tables IA, IB and 3 for specific code related installation requirements.

**Sheathing** – Sheathing must be structurally adequate to support the loads involved and of a material recognized in a code evaluation report or as approved by the local building official.

**Underlayment** – One layer of minimum ASTM D226 Type II (No. 30 felt) (ASTM D4869 Type IV) or approved equal, with a recognized code evaluation report, shall completely cover the decking and be lapped over hips and ridges and through valleys. Underlayment shall be lapped 6" vertical (end or side lap) and 2" horizontally (head lap).

On roof slopes below 3:12 an approved multi-ply membrane roof such as a built-up roof system, applied in accordance with Table IA, or a single-ply roof membrane assembly, or other underlayment systems approved by

the local building official, is first installed. Tile installed at less than 3:12 shall be considered decorative.

Where roof slopes fall between 3:12 and under 4:12, underlayment shall be as described in the previous paragraph, underlayments meeting ASTM D1970 (such as EPDM, Ice and Water Shield), or two layers of ASTM D226 Type II (No. 30 felt) (ASTM D4869 Type IV), installed shingle fashion, or single ply roof membrane assembly installed per code, or other approved underlayments.

In locations where the January mean temperature is 25 deg. F (-4 deg C) or less or where ice damming often occurs, the TRI/WSRCA suggests reference to the Concrete and Clay Tile Roof Design Criteria Manual for Cold and Snow Regions.

**Roof Layout** – To achieve the optimum performance and appearance, the roof area between the eave and ridge should be divided into equal tile courses, when possible. A minimum 3-inch overlap must be maintained for all tile, unless the tile design precludes. The actual layout

of the roof courses will be determined by the length of the specific tile being installed. Medium profiled tiles can be installed either straight or staggered bond.

Please consult with the individual manufacturer for additional information.

**Batten Installation** – Tiles with projecting anchor lugs that are installed on battens below 3:12 slopes shall be required to have one of the following batten systems or other methods as approved by the local building officials.

Nominal 1 inch by 2 inch, or greater, wood batten strips (See counter batten system.) installed over a counter batten system are required where slopes fall below 3:12 in order to minimize membrane penetration. Nominal 1 inch by 2 inch, or greater, wood battens are required where slopes exceed 7:12, to provide positive tile anchoring. Battens are nailed to the deck with 8D corrosion resistant box nails 24 inches on center, or No 16 gauge by 7/16 inch-crown by 1 1/2 inch long corrosion-resistant staples on 12-inch centers, allowing a 1/2" separation at the batten ends. Tile installed on roof slopes of less than 3:12

are considered decorative only and must be applied on counter battens over an approved membrane roof covering, subject to local building official approval.

Battens installed on roof slopes of 4:12 to 24:12 shall be fastened to the deck at no greater than 24 inches on center, and shall have provisions for drainage by providing 1/2-inch separation at the batten ends every 4 feet, or by shimming with a minimum 1/4" material of wood lath strips, 2-inch shims, cut from multiple layers of material, placed between the battens and deck to provide drainage beneath the battens or other methods approved by the local building official. Tile installed without projecting anchor lugs may be installed as provided above as an optional method of installation.

**Counter Batten System** – Counter battens 1/4" and larger in height will be installed vertically on the roof to provide the space between the battens, to which the tiles are attached, and the roof deck, thus facilitating air flow capability and moisture drainage.

Taking the anticipated roof loading into account, design

consideration should be given to the size and quality of the wooden battens or sheathing boards used to support the roof tile covering.

If the battens are not strong enough to support the anticipated loading, including the roof tile and snow and/or ice, the battens could deflect between the support points

causing roof tile breakage and/or other roof damage. Knots and knot holes weaken the batten. See Table 2 on page 12.

*Note: If a counter batten system is to be installed under the underlayment, caution must be used to prevent damage to the underlayment or a reinforced underlayment will be used.*

## REROOFING

Roof structure must be adequate to support the anticipated roof load of tile.

Clay and concrete roofing tiles, recognized as a Class A roof assembly passing testing according to ASTM E 108, UL 790 or recognized in accordance with IRC section R902.1, will be allowed to be installed over existing asphalt shingles, plywood or OSB.

Care will be taken to ensure both horizontal and vertical alignment on the roof.

Foreign matter will be cleaned from all interlocking areas. Cracked or broken tile must be removed from the roof.

Damaged, rusted, improper flashing will be replaced.

When reroofing wood shake/shingle roofs, existing

shakes/shingles shall be removed and solid sheathing decking, tile, and flashings installed as with new construction. One layer of ASTM D226 Type II (No. 30) (ASTM D4869 Type IV) felt or approved equal underlayment shall be installed on the roof prior to application of tile. When installed over existing spaced sheathing boards, underlayment recognized by the local building code, for this type of application with, or without battens, will be used.

In lieu of such underlayment's being provided, the building official has the discretion to determine if the existing roof covering provides the required underlayment protection.

Check with local building official for any additional requirements.

Follow installation requirements as listed for new construction, once these items listed have been addressed.

## VENTILATION GUIDELINES

The need for proper attic ventilation is required by most building code authorities, in accordance with the IBC and IRC. These codes recognize that the proper ventilation is a necessary component of any successful steep slope roof system.

Generally building codes require that a minimum net free

ventilating area for attic vents be a 1:150 ratio of the attic space being ventilated, the codes generally allow for the reduction of the ratio from 1:150 to 1:300 if the attic vents are a balanced system on a roof and/or a vapor retarder is installed on a ceiling assembly's warm side. Check with local building official for regional requirements.

**TABLE 1A**

**ROOFING TILE APPLICATION<sup>1</sup> FOR ALL TILES**

	<b>ROOF SLOPE 2 ½ UNITS VERTICAL IN 12 UNITS HORIZONTAL (21% Slope) TO LESS THAN 3 UNITS VERTICAL IN 12 UNITS</b>	<b>ROOF SLOPE 3 UNITS VERTICAL IN 12 UNITS HORIZONTAL (25% Slope) AND OVER</b>
Deck Requirements	Sheathing must be adequate to support the loads involved, but not less than nominal 1-inch thick lumber or <sup>15</sup> / <sub>32</sub> inch thick plywood or other decking material recognized in a code evaluation report or by the local building official. The use of sheathing less than <sup>15</sup> / <sub>32</sub> -inch will require supporting data.	
Underlayment In climate areas subject to wind driven snow, roof ice damming or special wind regions as shown in UBC Chapter 16, Figure 16-1 as defined by local building official.	Built-up membrane, multiple plies, three plies minimum, applied per building code requirements or code approved alternate.	Same as for other climate areas, except that extending from the eaves up the roof to a line 24" inside the exterior wall line of the building, two layers of underlayment shall be applied shingle fashion and solidly cemented together with an approved cementing material per UBC. As an option code approved self adhering membrane will be allowed.
Other Climates		Minimum one layer ASTM D226 Type II (No.30 Felt) (ASTM D4869 Type IV) head lapped 2 inches and end lapped 6 inches, or approved equal per UBC. For roof slopes of 3:12 to <4:12, two (2) layers of felt are required per IRC and IRC.
Attachment <sup>2</sup> Type of Fasteners	Fasteners shall comply with IRC section R905.3.6 and IBC section 1507.3.6 and UBC Section 1507.3. Corrosion resistant meeting ASTM A641 Class I or approved equal, number 11 gauge diameter and of sufficient length to properly penetrate <sup>3</sup> / <sub>4</sub> " into or through the thickness of the deck or batten <sup>2</sup> , whichever is less. The head of the nail used for tile fastening shall not be less than <sup>3</sup> / <sub>16</sub> inches and shall comply with ASTM F1667 for dimensional tolerances. Other fastening systems such as screws, wire, or adhesive based systems as approved by code, or local building officials will be allowed.	
Number of fasteners <sup>1,2</sup>	One fastener per tile. Flat Tile without vertical laps, two fasteners per tile. Tiles installed with projecting anchor lugs will be installed on counter battens, or other code approved methods.	Two fasteners per tile. Only one fastener on slopes of 7 units vertical in 12 units horizontal (58.3% slope) and less for tiles with installed weight exceeding 7.5 pounds per square foot, having a width no greater than 16 inches. <sup>3</sup>
Field Tile Head Lap	3 inches minimum, unless precluded by tile design	
Flashing	Flashing shall be (No. 26 galvanized sheet gage) not less than 0.019 inch corrosion-resistant metal with a minimum of 0.90 ounce zinc/sq. ft. (total for both sides) G90 sheet metal or equal.	

<sup>1</sup> For jurisdictions enforcing the:

IBC: In snow areas, a minimum of two fasteners per tile are required or battens and one fastener.

IRC: In snow areas, a minimum of two fasteners per tile are required.

UBC: In snow areas, a minimum of two fasteners per tile are required, or interlocking tiles with anchor lugs engaged on battens with one fastener.

<sup>2</sup> In areas designated by the local building official as being subject to wind velocities not in excess of 80 miles per hour "basic (fastest mile) wind speed" per the UBC; 100 miles per hour "basic (3 second gust) wind speed" per the IBC and the IRC or where mean roof height exceeds 40 feet, but not more 60 feet above grade, all tiles shall be attached as follows;

<sup>2.1</sup> The head of all tiles shall be fastened.

<sup>2.2</sup> The noses of all eave course tiles shall be fastened with clips, or other methods of attachment as approved by building code officials.

<sup>2.3</sup> All rake tiles shall be secured with two fasteners when required by IBC table 1507.3.7 and IRC section R905.3.7.

<sup>2.4</sup> The noses of all ridge, hip and rake tiles will be set in a bead of approved roofers mastic.

<sup>2.5</sup> Other methods of tile fastening will be allowed based upon submission of testing and approval of building code officials.

<sup>2.6</sup> For jurisdiction enforcing IBC and IRC, see appendix B for design considerations for high wind applications.

<sup>3</sup> On roof slopes over 24 units vertical in 12 units horizontal (200% slope), the nose end of all tiles shall be securely fastened.

**TABLE IB (Alternative option) For Roof Slopes Below 4:12 See Table IA****ROOFING TILE APPLICATION FOR INTERLOCKING CONCRETE AND CLAY TILES WITH PROJECTING ANCHOR LUGS WHEN INSTALLED ON ROOF SLOPES OF 4 UNITS VERTICAL IN 12 UNITS HORIZONTAL (33% Slope) AND GREATER**

<b>4 UNITS VERTICAL IN 12 UNITS HORIZONTAL (33% Slope) and over</b>	
Deck Requirements	Sheathing must be adequate to support the loads involved, but not less than nominal 1-inch thick lumber or <sup>15</sup> / <sub>32</sub> - inch thick plywood or other decking material recognized in a code evaluation report or by the local building official. The use of sheathing less than <sup>15</sup> / <sub>32</sub> - inch will require supporting data.
Underlayment In climate areas subject to wind driven snow, roof ice damming or wind regions as defined by local building codes	Solid sheathing one layer of ASTM D226 Type II (No. 30) (ASTM D4869 Type IV), or approved equal, lapped 2 inches horizontally and 6 inches vertically, except that extending from the eaves up the roof to a line 24 inches inside the exterior wall line of the building, two layers of the underlayment shall be applied shingle fashion and solidly cemented together with approved cemented material. As an option a code approved self adhering membrane may be used.
Underlayment for Other Climates	For spaced sheathing, approved reinforced membrane. For solid sheathing, a minimum single layer ASTM D226 Type II (No 30) (ASTM D4869 Type IV), or approved equal, felt lapped 2 inches horizontally and 6 inches vertically.
Attachment <sup>1</sup> Type of Fasteners	Fasteners shall comply with IRC section R905.3.6 and IBC section 1507.3.6 and UBC Section 1507.3 and shall comply with ASTM F1667 for tolerances. Corrosion resistant meeting ASTM A641 Class 1 or approved equal, or number 11 gauge diameter and of sufficient length to properly penetrate <sup>3</sup> / <sub>4</sub> " into or through the thickness of the deck or batten <sup>3</sup> , whichever is less. The head of the nail used for tile fastening will not be less than <sup>5</sup> / <sub>16</sub> inches and shall comply with ASTM F1667 for tolerances. Other fastening systems such as screws, wire or adhesive based systems as approved by code, or local building officials will be allowed. Horizontal battens are required on solid sheathing for slopes greater than 7 units vertical in 12 units horizontal (58.3% Slope). <sup>1, 2</sup>
Number of fasteners Spaced/Solid sheathing With Battens or spaced sheathing <sup>1, 2</sup>	5 units vertical in 12 units horizontal and below (42% slope), fasteners not required. Above 5 units vertical in 12 units horizontal (42% slope) to less than 12 units vertical in 12 units horizontal (100% slope), one fastener per tile every other row or every other tile in each course. Twelve units vertical in 12 units horizontal (100% Slope) to 24 units vertical in 12 units horizontal (200% slope), one fastener every tile <sup>4</sup> . All perimeter tiles require one fastener <sup>5</sup> . Tiles with installed weight less than 9 pounds per square foot require a minimum of one fastener per tile, regardless of roof slope. See current codeapproved evaluation report for additional installation requirement.
Solid sheathing without battens <sup>1, 2</sup>	One fastener per tile
Field Tile Head Lap	3 inches minimum unless precluded by tile design
Flashing	Flashing shall be (No. 26 galvanized sheet gage) not less than 0.019 inch corrosion-resistant metal with a minimum of 0.90 ounce zinc/sq. ft. (total for both sides) G90 sheet metal or equal.

<sup>1</sup> For jurisdictions enforcing the:

IBC: In snow areas, a minimum of two fasteners per tile are required or battens and one fastener.

IRC: In snow areas, a minimum of two fasteners per tile are required.

UBC: In snow areas, a minimum of two fasteners per tile are required, or interlocking tiles with anchor lugs engaged on battens with one fastener.

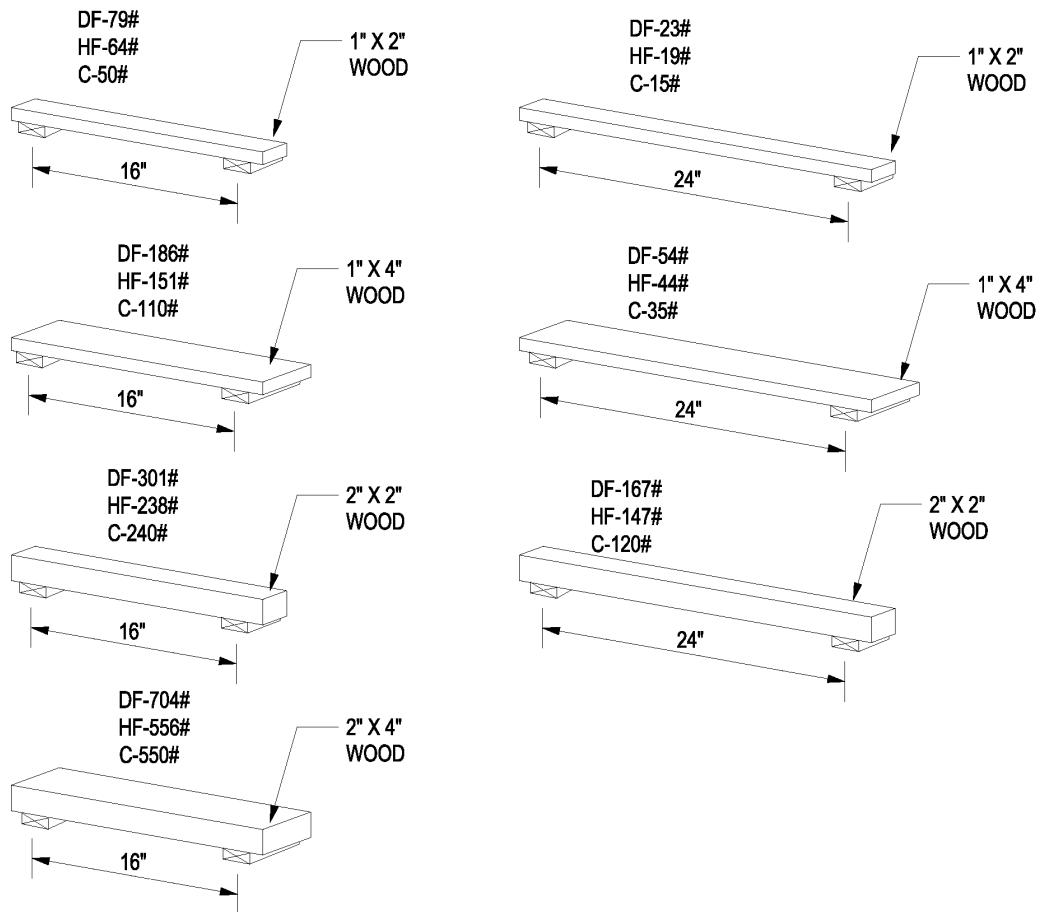
<sup>2</sup> In areas designated by the local building official as being subject to wind velocities not in excess of 80 miles per hour "basic (fastest mile) wind speed" per the UBC; 100 mile per hour "basic (3 second gust) wind speed" per the IBC and the IRC or where mean roof height exceeds 40 feet, but not more than 60 feet above grade, all tiles shall be attached as follows:<sup>2.1</sup> The heads of all tiles shall be fastened.<sup>2.2</sup> The noses of all eave course tiles shall be fastened with clips, or other methods of attachment as approved by building code officials.<sup>2.3</sup> All rake tiles shall be secured with two fasteners when required by IBC table 1507.3.7, IRC section R905.3.7 or UBC Table 15-D-2 as applicable.<sup>2.4</sup> The noses of all ridge, hip and rake tiles shall be set in a bead of approved roofers mastic.<sup>2.5</sup> Other methods of tile fastening will be allowed based upon submission of testing and approval of building code officials.<sup>2.6</sup> For jurisdictions enforcing the IBC and the IRC, see appendix B for design considerations for high wind applications.<sup>3</sup> Battens shall not be less than nominal 1-inch by 2-inch complying with IBC Chapter 23, section 2302. Provisions shall be made for drainage beneath battens by a minimum <sup>1</sup>/<sub>4</sub>-inch riser at each nail or by 4 foot long battens with at least <sup>1</sup>/<sub>2</sub>-inch separation between battens or other methods approved by local building officials. For jurisdictions enforcing the UBC, battens shall be fastened with approved fasteners spaced not more than 24" O.C. For jurisdictions enforcing the IBC horizontal battens are required for slopes over 7:12.<sup>4</sup> On roof slopes over 24 units vertical in 12 units horizontal (200% slope), the nose end of all tiles shall be securely fastened.<sup>5</sup> Perimeter fastening areas include three tile courses but not less than 36 inches from either side of hips or ridges and edges of eaves and gable rakes.

## TABLE 2 Allowable Loads (Pounds per square foot)

(See table 3 for additional batten information)

Batten and counter batten allowable loads according to species and nominal dimensions

(Allowable load includes the total combined live and dead load)



Notes: HF=Hem-Fir; DF = Douglas-Fir; C=Western Cedar (spaced at 1'0" maximum on center)

(Above values were based upon stress rated boards)

See the TRI/WSRCA Cold Weather Installation Guide for additional recommendations in cold weather applications.

Drawing shown depicts the application of all tile profiles. Unless otherwise noted it would apply to either concrete or clay tiles.



**TABLE 3  
GUIDELINES FOR BATTENS & COUNTER BATTENS**

ROOF SLOPE	STANDARD REQUIREMENTS	OPTIONAL UPGRADE(S)
2 1/2 / 12 (21%) TO LESS THAN 3/12 (25%)	<b>Counter Batten System</b> Refer to Counter Batten Systems (Page 6) & MC-05 / MC-06A	<b>Alternates:</b> Corrosive resistant metal, or other man-made material that meets the allowable loads (see Table 2), ICC-ES recognized, and/or approval of the local building official.
3/12 (25%) TO 7/12 (58.3%)	<b>Not Required</b> See below for special climatic conditions	<b>Nominal* 1" x 2" x 4' or less</b> (min 1/2" separation between battens)
		<b>Nominal* 1" x 2" x greater than 4'</b> (Provision for drainage beneath batten with min 1/4" thick decay-resistant riser at each fastener)
		<b>Counter Batten</b> Refer to Counter Batten Systems (Page 6) & MC-05 / MC-06A
<b>GREATER THAN 7/12 (58.3%)</b>	<b>Nominal* 1" x 2" x 4'</b> (min 1/2" separation between battens)	<b>Counter Batten</b> Refer to Counter Batten Systems (Page 6) & MC-05 / MC-06A
	<b>Nominal* 1" x 2" x 8'</b> (Provision for drainage beneath batten with min 1/4" thick decay-resistant riser at each fastener)	<b>Alternates:</b> Corrosive resistant metal, or other man-made material that meets the approval of the local building official and/or ICC-ES recognized batten system.

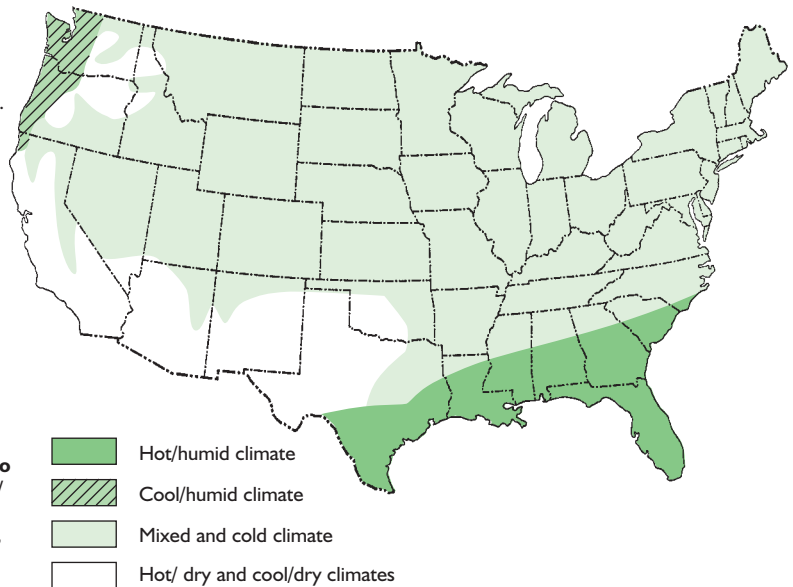
**Nominal\*:** Refer to IBC, Chapter 23 (WOOD), SECTION 2302 (DEFINITIONS).

**Allowable Loads:** When using counter battens, refer to Table 2 for additional load considerations.

**Batten Fastening:** 24" OC to the deck with 8d corrosive resistant nails.  
12" OC to the deck with No 16 gauge by 7/16-inch crown by 1 1/2-inch long corrosive-resistant staples.  
Once the batten is installed, it becomes part of the deck for fastening purposes.

**Climatic Conditions:** In dry/low humidity climates, moisture resistant battens are not required.  
Consideration should be given to lower slope roofs that are susceptible to wind driven snow and rain. Optional upgrades should be considered.

**Standard 4' battens fastened direct to the deck are not allowed in the Cool/Humid climate zone. Batten systems that provide drainage/air-flow (shims, counter battens or other approved systems) are required.**



**TABLE 4**

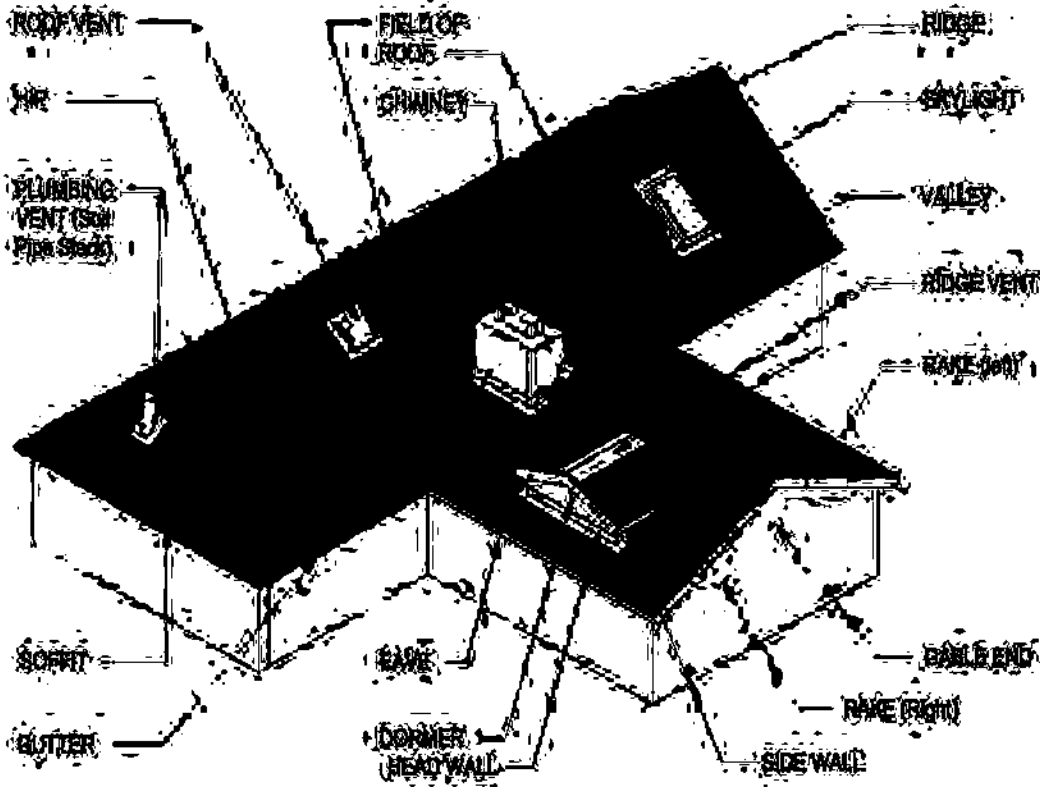
<b>ROOF SLOPE CONVERSION</b>			
<b>Slope/Pitch</b>	<b>Slope %</b>	<b>Ratio</b>	<b>Angle (deg.)</b>
4:12	33	1:3	18.4
5:12	42	1:2.4	22.6
6:12	50	1:2	26.6
7:12	58	1:1.7	30.3
8:12	67	1:1.5	33.7
9:12	75	1:1.13	36.9
10:12	83	1:1.2	39.8
12:12	100	1:1	45.0
14:12	117	1.2:1	50.2
15:12	125	1.25:1	51.3
16:12	133	1.3:1	52.4
18:12	150	1.5:1	56.3
20:12	167	1.7:1	59.5
24:12	200	2:1	63.4
28:12	233	2.3:1	66.5
32:12	267	2.7:1	69.7
36:12	300	3:1	71.6
40:12	333	3.3:1	73.1
44:12	367	3.7:1	74.9
48:12	400	4:1	76.0

**TABLE 5**

<b>METRIC CONVERSION</b>	
1 inch	25.4 mm
1 foot	304.8 mm
1 sq. inch	645.2 mm <sup>2</sup>
1 sq. foot	0.0929 m <sup>2</sup>
1 pound (mass)	0.453 kg
1 pound/ft.	14.594 N/m
1 pound/sq. in.	6894 Pascals (1 pa-N/m <sup>2</sup> )
1 pound/sq. ft.	47.88 Pascals
°Fahrenheit	1.8 x °C + 32
1 pound (mass)/sq. ft.	4.88 kg/m <sup>2</sup>
1 yd <sup>3</sup>	0.765 m <sup>3</sup>
1 inch of water	248.8 Pa
1 inch of mercury	3377 Pa
1 mph	1.61 km/h
1 gallon	3.785 liters
1 square (100 sq. ft.)	9.28 m <sup>2</sup>

## IDENTIFICATION OF ROOF AREAS

MC-01



**CHIMNEY:** A penetration constructed of stone, masonry, precast concrete, or a wood frame base, containing one or more flues projecting through and above the roof.

**CORNER:** A frame projection through the sloping plane of a roof.

**EAVE:** A projecting edge of a roof that extends beyond the supporting wall.

**FIELD OF ROOF:** The central or main portion of a roof, excluding the perimeter and flashings.

**GABLE:** A triangular portion of the end wall of a building directly under the sloping roof and the eave line.

**GUTTER:** A channel component installed along the slope edge perimeter of a roof to the main leader or downspout.

**HIP:** The inclined external angle formed by the intersection of two sloping roof planes.

**HEAD WALL:** Flashing installed at a horizontal roof to wall.

**RAKE:** The sloped edge of a roof or of adjacent to the first rafter of a gable.

**RIDGE:** The highest point of a roof, represented by a horizontal line where two roof areas intersect, running the length of the area.

**ROOF VENT:** A penetration through the roof to allow ventilation.

**SKYLIGHT:** A roof accessory set over an opening in the roof, designed to admit light, normally transparent, and mounted on a raised frame curb.

**SCOFF:** The underside of any eave or overhanging section of the roof eave.

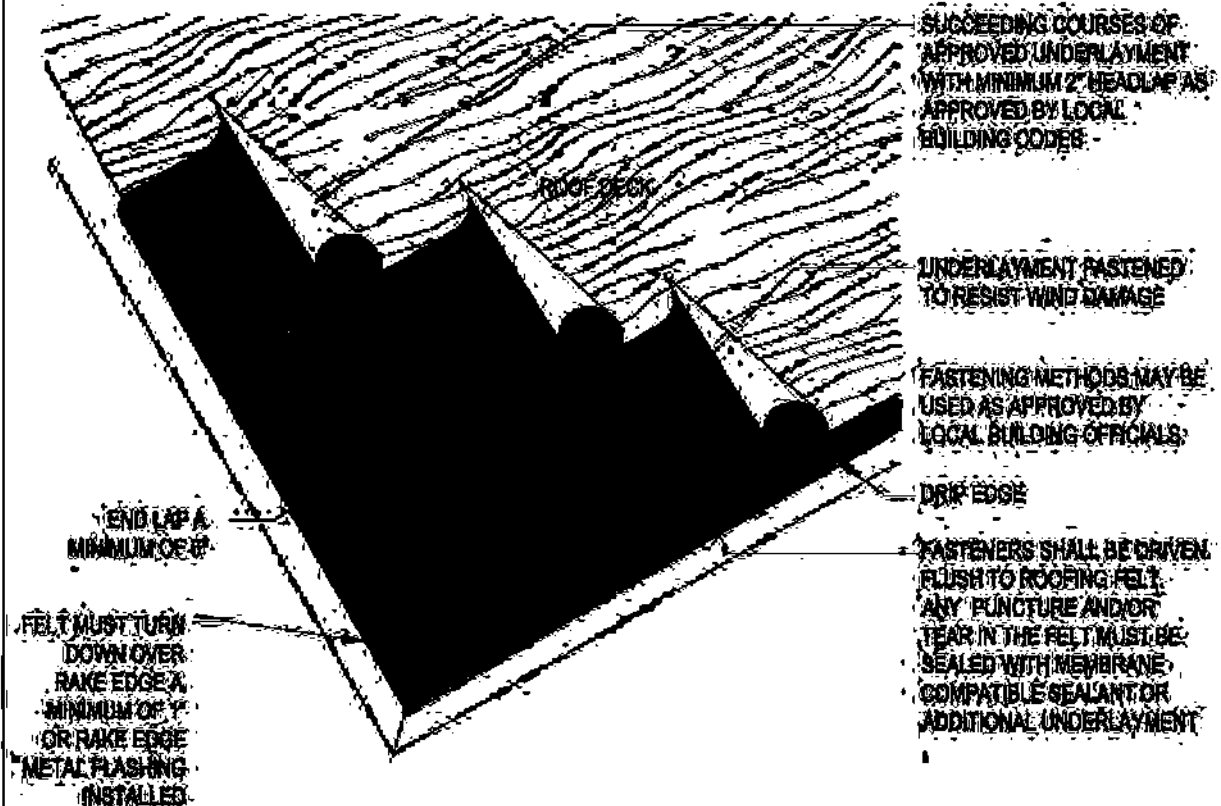
**SOIL PIPE STACK:** A ventilation pipe that penetrates the roof, used to vent plumbing fixtures.

**VALLEY:** The internal angle formed by the intersection of two sloping roof planes.

Drawings do not depict the application of all the products. Users should consult the manufacturer for other details or any limitations.

# SINGLE-LAYER UNDERLAYMENT

MC-01A



**Note:**  
 Roof slopes below 3:12 shall have an approved half-ply roof membrane, applied in accordance with Table 1A, or a single-ply roof membrane system, or other multi-ply underlayment system(s) approved by the local building official.

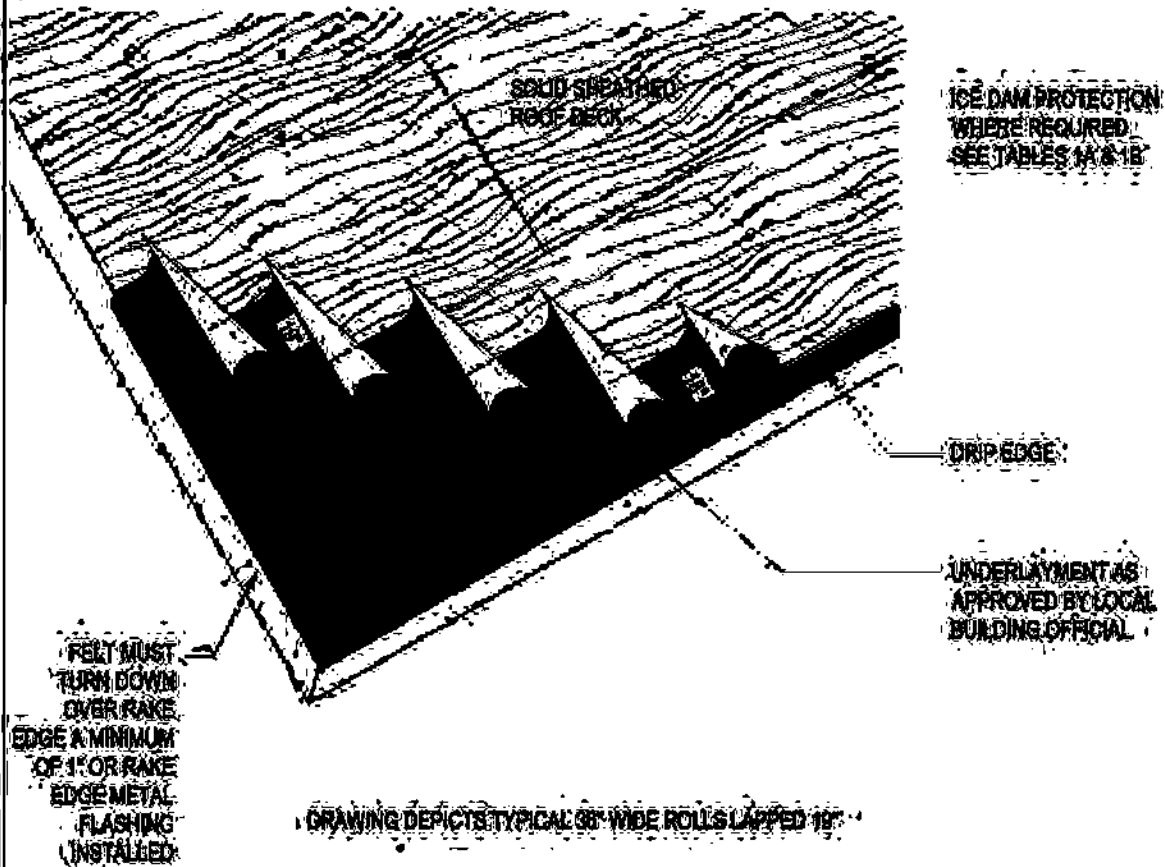
ICE DAM PROTECTION WHERE REQUIRED: SEE TABLES 1A & 1B

- Notes:**
1. Ensure that the roof deck is properly fastened, clean and smooth before underlayment and roof tiles are applied.
  2. Verify that the roof deck has no significant delamination, warpage, etc. Check for roof deck decay or damage.
  3. Make sure repairs are made to the roof deck as necessary to meet local building codes.
  4. Most problems with water-shedding roof installations occur from water that migrates through improper flashing of the tile, wind-driven rain or ice damming. Because of this possibility, the underlayment is critical to the success of the roof system.
  5. For recommended underlayment and fastening requirements, see Table 1A and 1B.
  6. Underlayment should extend a minimum of 4" up vertical wood blocking or wall. Lap should be a minimum of 6" endlap (vertical lap) and 2" headlap (horizontal lap).

Cladding shown depicts the application of all tile profiles. Unless otherwise noted it would apply to other concrete or clay tiles.

**DOUBLE LAYER UNDERLAYMENT**

(Required for 3:12 ≤ Roof Slope &lt; 4:12, Optional Upgrade 4:12 And Above)

**MC-01B**

FELT MUST  
TURN DOWN  
OVER RAKE  
EDGE A MINIMUM  
OF 1" OR RAKE  
EDGE METAL  
FLASHING  
INSTALLED

DRAWING DEPICTS TYPICAL 36" WIDE ROLLS LAPPED 10"

**Notes:**

1. Ensure that the roof deck is properly fastened, clean and smooth before underlayment and roof tiles are applied.
2. Verify that the roof deck has no significant deterioration, warpage, etc. Check for roof deck rot or damage.
3. Make sure repairs are made to the roof deck as necessary to meet local building codes.
4. Apply a half sheet parallel to eave. Fasten underlayment sufficient to hold the felt in place.
5. Completely cover the starter sheet with a full-width sheet.
6. Most problems with water-shedding roof installations occur from water that migrates through improper fastening of the tile, wind-driven rain or ice damming. Because of this possibility, the underlayment is critical to the success of the roof system.
7. Underlayment shall extend a minimum of 4" up vertical wood blocking or wall.
8. Lap succeeding sheets to ensure double layers over entire roof. End laps (vertical laps) shall be a minimum of 6".

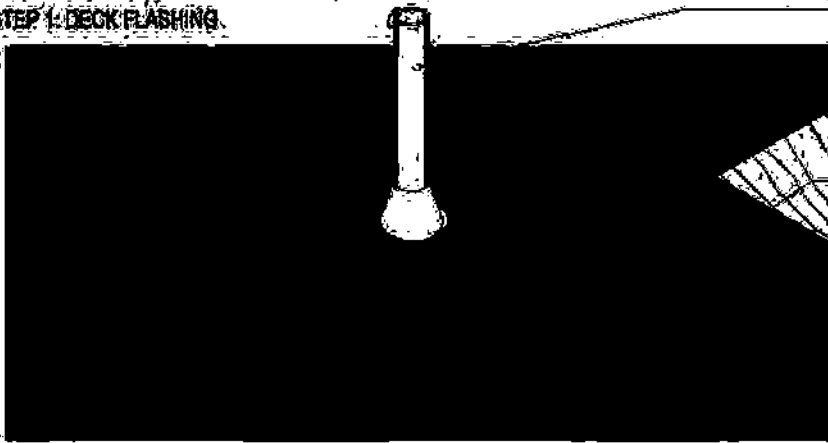
Drawing shown depicts the application of all the profiles. Unless otherwise noted it would apply to either concrete or clay tiles.

# TILE PENETRATION FLASHING

(Shows Required Two-Step Deck And Tile Flashing)

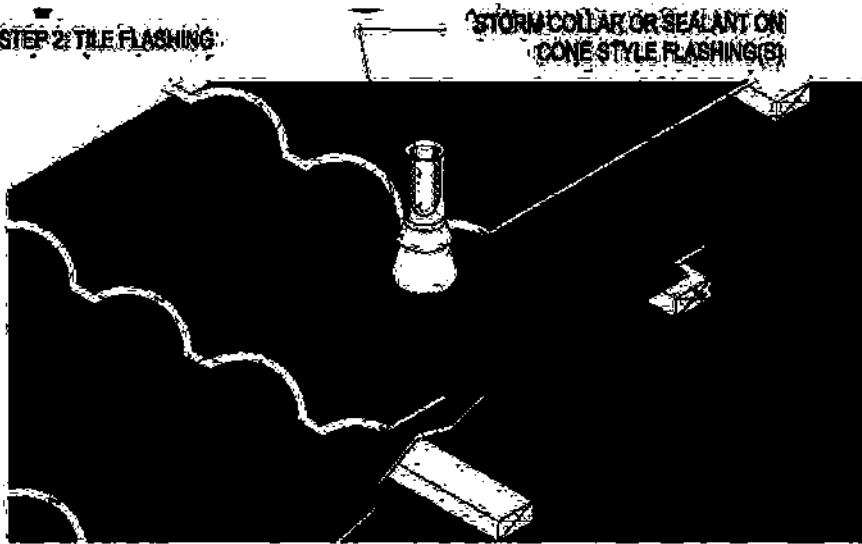
MC-02

STEP 1: DECK FLASHING



PENETRATION  
 UNDERLAYMENT  
 PREFORMED FLASHING INTEGRATED INTO UNDERLAYMENT (INSTALLED TO PREVENT MOISTURE FROM PENETRATING ROOF DECK. OPTIONAL STRIPPING, THREE COURSE WITH ASPHALT ROOF CEMENT AND REINFORCING FABRIC FOR INSTALLATION OF DECK FLASHING WHEN PERMITTED BY THE BUILDING OFFICIAL.)

STEP 2: TILE FLASHING



FIELD TILE  
 PROFILE TILE FLASHING (CONFORM SHEET LEAD OR OTHER MALLEABLE METAL FLASHING TO PROFILE OF TILE) TO MAINTAIN DRAINAGE TO TOP OF TILE  
 BATTEN (WHERE REQUIRED)

ALL PENETRATIONS SHOULD BE LOCATED IN SUCH A MANNER AS TO NOT IMPEDE FLASHINGS AT ROOF TRANSITION.

**Notes:**

1. For recommended underlayment and fastening requirement, see Table 1A and 1B.
2. All penetrations require a deck flashing and tile flashing.
3. The flashings shall extend into the tile a minimum of 4" on flat tile and a minimum of 1" past the crown of a profiled tile.
4. Dimensions shown are minimums and are intended to be approximate to allow for reasonable tolerances due to field conditions.
5. For flat tile, rigid flashing materials may be used.

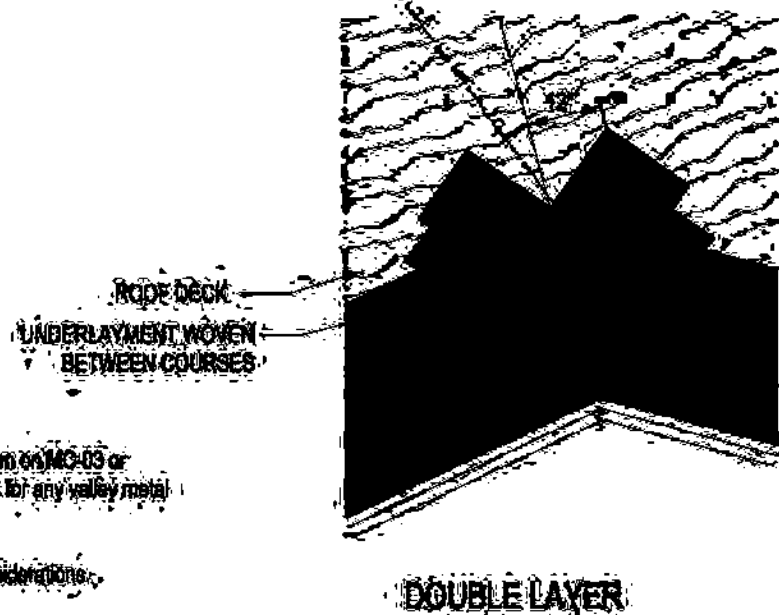
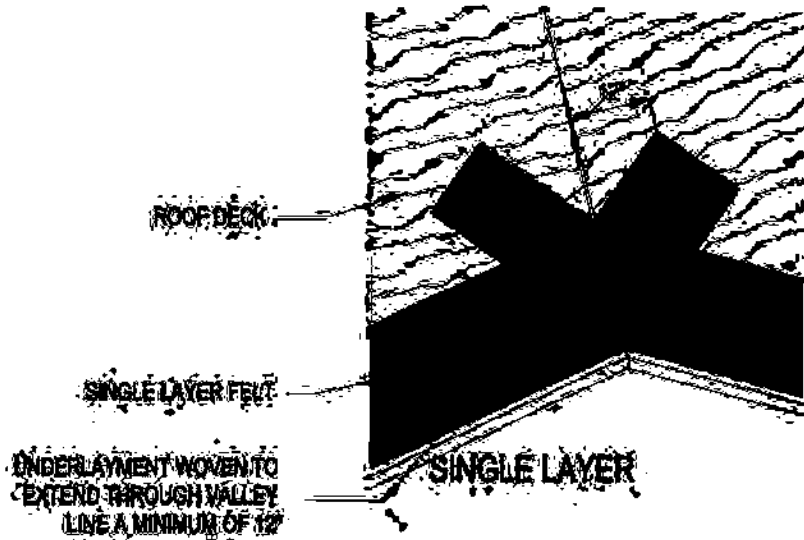
Drawing shown depicts the application of all tile profiles. Unless otherwise noted, it would apply to either concrete or clay tiles.

Appendix A

# VALLEY UNDERLAYMENTS

## WOVEN UNDERLAYMENT (Metal Flashing Not Shown)

MC-03



**Note:**  
 The underlayment options shown on MC-03 or MC-03A are acceptable options for any valley metal configuration.

See MC12-0 for additional considerations.

**Note:**  
 For recommended underlayment and fastening requirements, see Table 1A and 1B.

Drawing shown depicts the application of all the profiles. Unless otherwise noted, it would apply to either concrete or clay tiles.

Appendix A

# VALLEY UNDERLAYMENTS

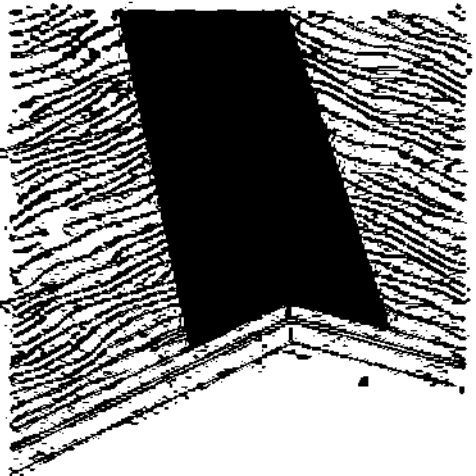
MC-03A

## OVERLAPPING UNDERLAYMENT

THIS METHOD NOT TO BE USED WITH STANDING HEM VALLEY METAL

36" SWEAT / BLEEDER SHEET

ROOF DECK



UNDERLAYMENT TO LAP OVER VALLEY METAL A MINIMUM OF 2"

Note:  
 The underlayment options shown in MC-03 or MC-03A are acceptable options for any code approved metal.  
 See MC-12B for additional considerations.

ROOF DECK

VALLEY FLASHING

OPTIONAL: SELF-ADHERING POLYMER MODIFIED ASPHALT MEMBRANE ON EACH SIDE TO COVER FLASHING FLANGE

CUT TOP CORNER OF UNDERLAYMENT TO INSURE PROPER DIVERSION OF WATER INTO THE VALLEY METAL

ROOF UNDERLAYMENT

VALLEY FLASHING

EXTEND ENTIRE WIDTH OF VALLEY METAL BEYOND ROOF EDGE



Note:  
 For recommended underlayment and fastening requirements, see Table 1A and 1B.

Drawing shows depicts the application of all the profiles. Unless otherwise noted it would apply to either concrete or clay tiles.

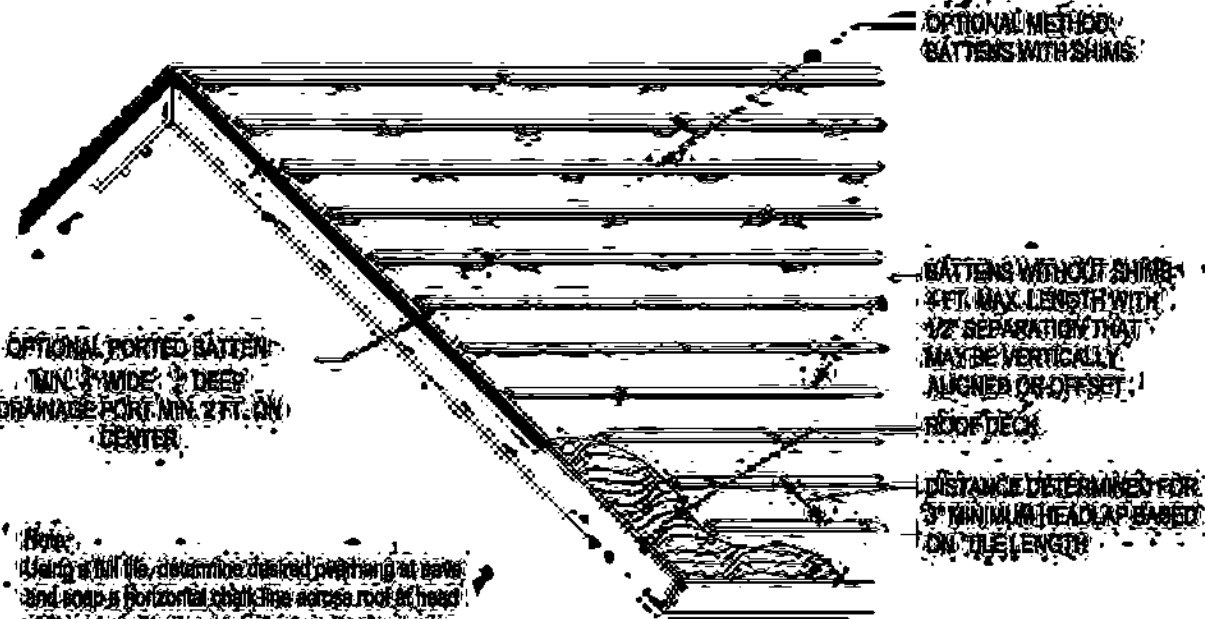
Appendix A



# BATTEN LAYOUT OPTIONS

(FOR TILES WITH LONGITUDINAL ANCHOR LINES)

MC-04



**Note:**  
Using a full tile, determine desired overhang at eave and snap a horizontal chalk line across roof at head of the eave of batten. Use of girth pulley and safety closures should be considered in determining the overhang.

OPTIONAL METHOD: BATTENS WITH SUMMS

BATTENS WITHOUT SUMMS  
4 FT. MAX. LENGTH WITH  
1/2" SEPARATION THAT  
MAY BE VERTICALLY  
ALIGNED OR OFFSET

DISTANCE DETERMINED FOR  
3" MINIMUM HEAD LAP BASED  
ON TILE LENGTH

OPTIONAL METHOD: BATTENS WITH SUMMS SEE NOTE B

OPTIONAL PORTED BATTEN  
MIN. 3" WIDE, 3" DEEP  
DRAINAGE PORT MIN. 2 FT. ON CENTER

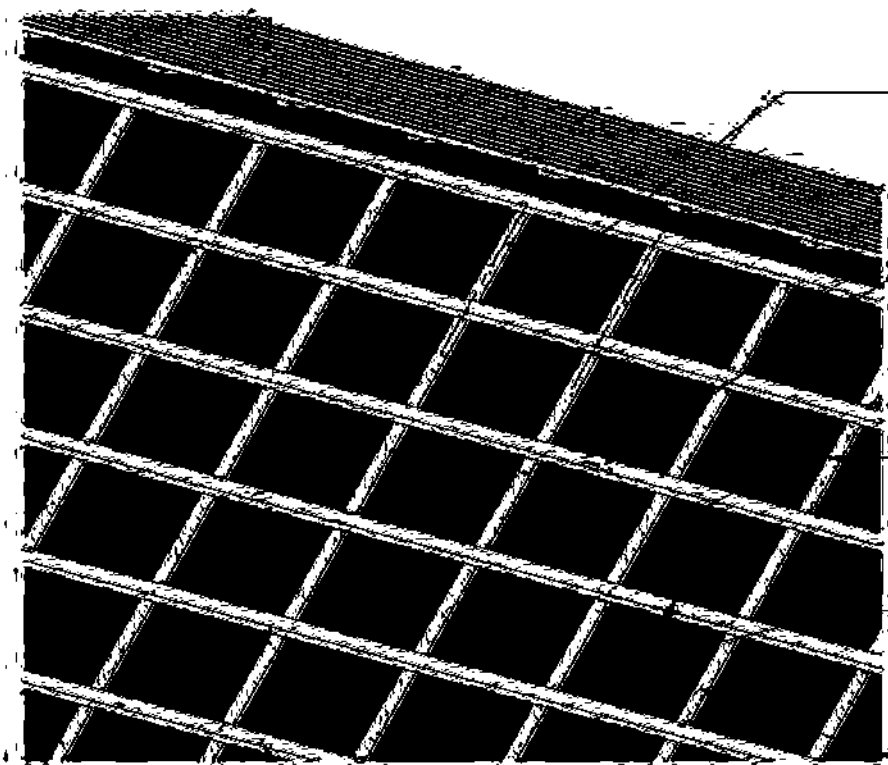
- Notes:**
1. For recommended underlayment and fastening requirements see Table 1A and 1B.
  2. Battens shall not be less than nominal 1" x 2" or other code approved products.
  3. Battens shall be no longer than 4ft and be separated with 1/2" minimum gaps at eave to allow drainage. An alternate method permits use of longer batten with a minimum 1/4" thick decay resistant material (e.g. asphalt shingle, wood shingle or tarp sheet) at each fastener to provide drainage. Both methods approved by local building officials.
  4. Battens for tiles with protruding anchor legs are optional for slopes between 2:12 and 7:12. Direct fastening attachment of tile will be per local building code.
  5. Consideration should be given to climate and roof orientation to determine if it is beneficial to specify vertical battens over underlayment with horizontal battens applied over the vertical battens.
  6. See Table 2 and Table 3 for additional batten considerations.

Drawing shown depicts the application of all tile profiles. Unless otherwise noted it could apply to other concrete or clay tiles.

# COUNTERBATTEN INSTALLATION SYSTEM

MC-05

**Note:**  
 Consideration should be given to climate and roof orientation to determine if it is beneficial to specify/use vertical battens over underlayment, with horizontal battens secured over the vertical battens.



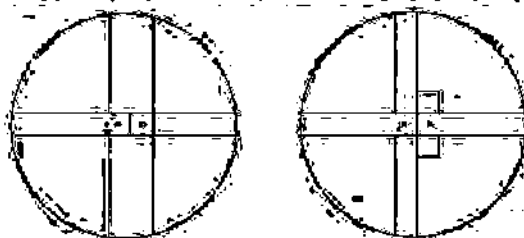
SEE TABLE 2 FOR SIZE AND SPACING OF VERTICAL BATTENS (24" MAX SPACING BETWEEN VERTICAL BATTENS)

HORIZONTAL BATTENS

VERTICAL BATTENS: MINIMUM 1/4" THICKNESS

DISTANCE DETERMINED FOR 3" MIN HEADLAP BASED ON TILE LENGTH

WHERE FASTENING TO FRAMING MEMBERS IS DESIRED, MARK RAFTER LOCATION AS FELT IS BEING APPLIED



SEE TABLE 3  
 BATTEN TERMINATION (OPTIONAL)

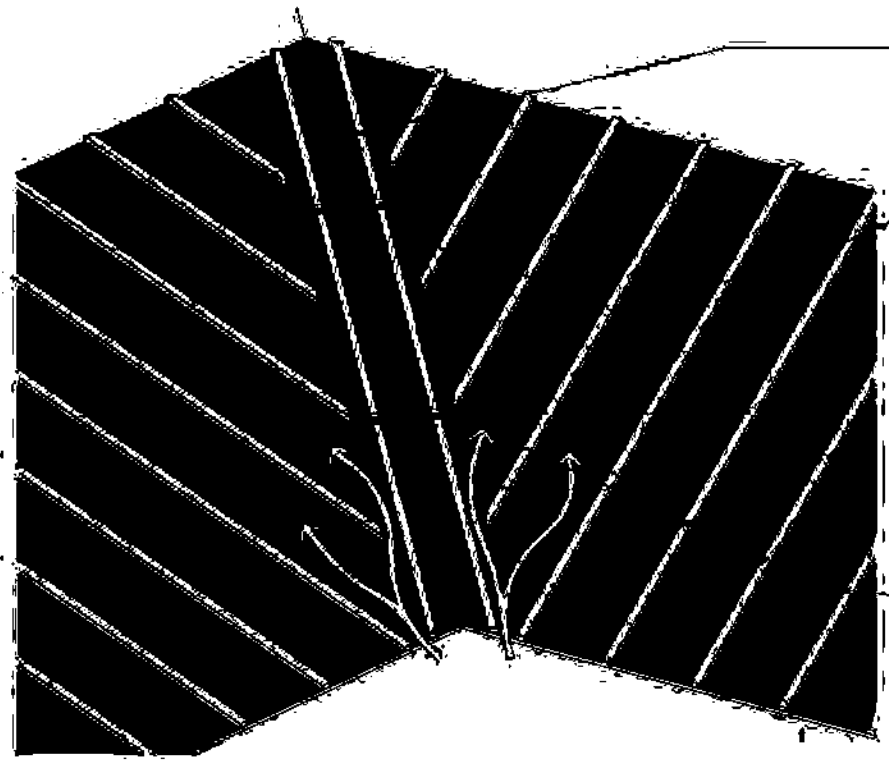
- Notes:**
1. For recommended underlayment and fastening requirements, see Table 1A and 1B.
  2. Horizontal batten shall be sufficient thickness to fully engage protruding anchor lips of the tile.
  3. See Table 2 and 3 for additional information.
  4. Fasten battens a minimum of 24" on center with minimum 8d corrosion-resistant nails penetrating through decking or into structural framing. Batten attachment is 12" on center with staples a minimum of 1-1/2" long 7/16" crown, No. 18 gauge corrosion-resistant allowing for 3/4" penetration into foot deck or provide min. 1/4" through the sheathing which ever is less or on 24" centers if fastened directly to structural framing.

Drawing shown depicts the application of all tile profiles. Unless otherwise noted, it would apply to either concrete or clay tiles.

# VERTICAL BATTENS - FOR DEEP TROUGH VALLEY

MC-063

ANY VALLEY FLASHING WITH OUTSIDE EDGES RAISED TO THE HEIGHT OF THE VERTICAL OR HORIZONTAL BATTENS



EDGE STRIP

VERTICAL BATTEN

PROVIDE 2" MIN CLEARANCE FOR AIRFLOW AND DRAINAGE



DEEP TROUGH VALLEY

REFER TO MC-06 FOR WOVEN UNDERLAYMENT  
REFER TO MC-17 FOR FINISH DETAIL  
REFER TO MC-179 FOR DEEP TROUGH DETAIL

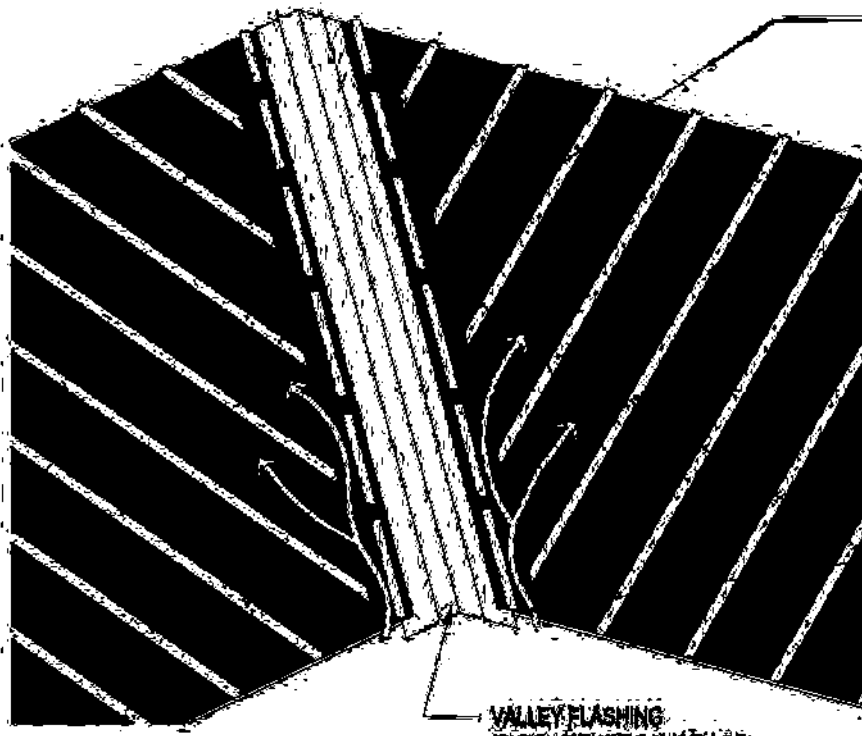
### Notes:

1. For recommended underlayment and fastening requirements, see Table 1A and 1B.
2. Consideration should be given to climate and roof orientation to determine if it is beneficial to specify use vertical battens over underlayment, with horizontal battens secured over the vertical battens. See table 3 for additional considerations.

Drawing shows details the application of all its profiles. Unless otherwise noted it would apply to either concrete or clay tiles.

**VERTICAL BATTENS - FOR STANDARD VALLEY AND HIPS**

**MC-06A**



BATTENS WITH MIN. 2" GAPS FOR AIRFLOW AND DRAINAGE AT MIN. 48" O.C.

VERTICAL BATTEN

PROVIDE MINIMUM 2" GAP FOR AIRFLOW AND DRAINAGE

VALLEY FLASHING (EXTEND ENTIRE WIDTH OF VALLEY METAL BEYOND ROOF EDGE)

REFER TO MC-06A FOR OVERLAPPING UNDERLAYMENT REFER TO MC-17B FOR FINISH DETAIL

**Notes:**

1. For recommended underlayment and fastening requirements see Table 1A and 1B.
2. Horizontal battens shall not be less than nominal 1" x 2" or code approved equal.
3. Consideration should be given to climate and roof orientation to determine if it is beneficial to specify use vertical battens over underlayment, with horizontal battens secured over the vertical battens.
4. See Table 2 and Table 3 for additional considerations.

Drawing shown depicts the application of all tile profiles. Unless otherwise noted it would apply to either concrete or clay tiles.

Appendix A

# ESTABLISHING VERTICAL ALIGNMENT

MC-07



Example above is based on roof tile that has an exposed width of 14 1/2" individually or 34 1/2" for three tiles.

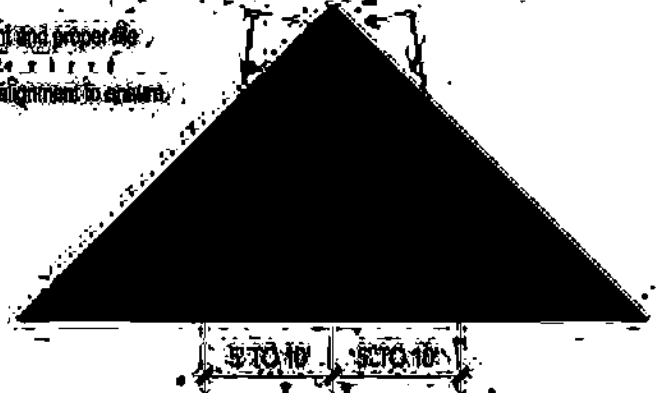
Vertical alignment on this roofing tile is, for the most part, controlled by the natural seat of the interlocking channels of the adjacent tiles. It is important however to establish a true vertical alignment prior to application of field tiles to assure a symmetrical installation. Proper roof layout greatly enhances the appearance and performance of the installed roof and serves to simplify and speed the application of the tile. A few minutes devoted to layout at the beginning of the job can result in significant savings of time and effort as the job progresses.

On a gable roof installation, the first vertical guideline is established by installing the first three tiles of the eave course and measuring the distance from the leading edge of the third tile back to the rake edge. This increment is then marked at the eave course and a chalk line is snapped to delineate the vertical guide.

The exposed width dimension of the tile is then determined and measured from the vertical guide as frequently as needed to maintain proper alignment. Note that this measurement is marked in three tile increments. Vertical lines must be perpendicular to the eave.

Marking above at the eave line as close to the center of the hip section as possible. Measure a path away from either side of the center point (2'-10" if possible) marking sure that both marks are the same distance from the center line. Using a tape measure or job of exactly the same length. Swing an arc away from each mark in inward as high on the hip as possible. The intersection point of this arc represent the high point of the vertical line above the peak made near the center of the eave line. A chalk line may be snapped to provide vertical reference. Incremental measurements may then be taken in either direction from this corner line to provide guidelines for vertical alignment.

On small hip sections, careful attention to horizontal alignment and proper placement is usually adequate to maintain vertical alignment. On larger roof sections, it is helpful to establish strict vertical alignment to ensure uniform appearance and ease of application.



Drawing shown depicts the application of all the products. Unless otherwise noted it would apply to either present or clay tiles.

# ROOF LAYOUT

## USING SPECIALLY MARKED MEASURING TAPE



To achieve maximum beauty, the area between the eave and ridge should be divided into equal tile courses, when possible. Minimum 2" overhang must be maintained for all tile unless design of the product. (See MC-04 for hidden applications)



(TOP COURSE MARK AT 1/2" FROM CENTER OF RIDGE)

MARK FIRST COURSE FOR DESIRED OVERHANG.

NOTE:  
ADDITIONAL CONSIDERATIONS MAY BE REQUIRED FOR VENTING

CONSIDER SIZE AND PLACEMENT OF CUTTER WHEN SETTING FIRST COURSE OVERHANG.

- Notes:**
- Using a full tile, determine desired overhang above and snap horizontal chalk line across roof at head end of tile. Use of rain gutters and eave closures should be considered in determining the overhang.
  - Snap a horizontal chalk line at the top of the roof, 1/2" from the center of the ridge. (Adjust for slight overhang)
  - With measuring tape, marked for maximum "exposed length" of tile being installed, measure vertically from the course nearest the ridge at either end of the roof. (e.g. 34" for a 13" length tile)
  - If a mark on your tape does not fit evenly upon roof trim, move the tape to the left or right until the next mark fits upon the line.
  - Mark the deck at every mark on the tape.
  - Repeat this process at other end of roof.
  - Snap lines between marks on the deck. All courses will be equal with minimum recommended overhang maintained.
  - Repeat above steps for all roof planes.
  - Half up of battens or tiles at each horizontal line.

## ROOF LAYOUT FOR CLAY DIAGONAL CUT ONE-PIECE TILE

- Horizontal Lay Out:**
- Using a full tile, determine desired overhang at eave and snap a horizontal chalk line across roof at head end of tile. Use of rain gutters and eave closures shall be considered in determining the overhang.
  - At the top of the roof deck, mark a reference point by measuring 1/2" from the center of the ridge, plus the distance of one full course. (i.e. 34" for a 13" length tile)
  - Measure up the roof slope to the reference point and divide by the manufacturer's maximum exposure in an effort to determine if the roof section will terminate with a full tile. Mark roof deck for each course of tile and snap chalk lines over entire section.
  - If roof section does not terminate with a full tile at the ridge, decrease the course exposure in small increments (perhaps 1/4") in order to finish with a full tile at the ridge (see note below).
  - If the top course does not terminate with a full tile, cut a diamond, as required and finish with mechanical fastener or other approved fastening method.

- Vertical Lay Out:**
- To assure proper vertical alignment, determine the manufacturer's rated maximum on-center spacing requirements and snap chalk lines as a reference point. (Specify the inside of the tile)
  - For gable end roof sections, determine the proper distance from the left and right eaves and mark the eave and ridge section to align the edge of the tile.
  - Measure between the two marks and divide by manufacturer's rated maximum on-center spacing. If required, decrease the on-center spacing, slightly in an effort to terminate with a full tile at gable ends. Ensure that the installed tile are within the manufacturer's minimum maximum on-center spacing requirements.

**Note:** Tiles are allowed by ASTM C1157C-14R2 for a variation in tile size from the manufacturer's stated "nominal dimensions" if the manufacturer is responsible to verify the delivered roof tile dimensions prior to commencing with roof layout and to ensure that the tile is installed within the manufacturer's on-center spacing requirements. Most diagonal-cut tiles will allow slight course exposure adjustments typically 1/4" per tile.

Drawing shown depicts the application of all the profiles. Unless otherwise noted, this will apply to other profiles of clay tiles.

Appendix A