

HOW TO SURVEY A SLATE ROOF

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A survey on a slate roof provides critical information needed by the property owner to accurately determine existing roof conditions. This allows the pinpointing and evaluation of active roof problems and the determination of correct solutions. Yet, general roof consultants rarely have the needed expertise to thoroughly and accurately conduct an evaluation of a natural quarried slate roof. As a roof consultant who specializes in slate roofs only, I have seen existing slate roofs unnecessarily condemned by roof consultants who have provided erroneous information, leading to costly and avoidable litigation.

A slate roof in Florida, only a few months old, is condemned by a roof consultant from the northeast. He was hired by the wealthy owner to investigate leaks in the roof. The consultant walked all over the 6:12 roof in hard-soled boots holding a wrecking bar in one hand and a video camera in the other. Every so often he would rip some slates off with the tool and then exclaim, "Yep! Wrong nails!" His camera zoomed in on a copper smooth-shank inch and a half roofing nail that he had pried out of a standard-thickness slate.

The problem is that these weren't the wrong nails; they were the correct nails to use in this situation. Nevertheless, the consultant convinced that owner that the roof had to be entirely removed and replaced due to a perceived faulty installation with incorrect nails. The owner then had the roof completely torn off and reslated! This was a 25 million dollar house with a new Vermont gray-black slate roof installed with the correct copper nails! I got involved when the situation had become mired in millions of dollars of litigation and the roofer's insurance company requested my forensic expertise in the matter. I was deposed three times under oath before the matter eventually settled out of court. During these depositions, the owner's aggressive attorney hammered me with questions about the nails, insisting that ring-shank nails are the correct nails to use when installing slate. They are not.

In fact, smooth-shank nails have always been used for attaching slate to the roof substrate. This is because they can be removed somewhat easily when being pulled out by a slate ripper when repairing the roof. Ring-shank nails break off and leave a nub in the substrate that prevents the replacement slates from sliding back into place, which can be very frustrating when one is trying to repair a roof. Ring-shank nails may be used when nailing metal flashing on a slate roof, but their use as slating nails is strongly discouraged. This has been codified in the Slate Roofing Contractors Association (SRCA) General Installation Guidelines for Natural Quarried Roofing Slate, published in June of 2012 and available free online at SlateRoofers.org:

3.2 Nails

A. Nails shall be solid copper, smooth-shank roofing nails, minimum 11 gauge, minimum 1.25" length. Copper nails 2.5" or longer shall be minimum 10 gauge. Alternatively, Type 304 smooth-shank stainless steel roofing nails can be used, not less than 1.25" long.

B. Hot-dipped galvanized smooth-shank roofing nails may be utilized when specified.

C. Nail length is to be approximately twice the thickness of the slates plus one inch. Nails are to fully embed into the roof decking material without more than 1/4" nail length being exposed on the underside of the roof decking. When the underside of the roof decking is exposed, such as at overhanging eaves, the nails shall be long enough to penetrate the roof decking, but not so long that they may be visibly driven through.

D. Recommended nail lengths are as follows when 1" or thicker roof deck is utilized:

1. 3/16"-1/4" thick slates are to be fastened with 1.5" nails.
2. 3/8" thick slates are to be fastened with 1.75" nails.
3. 1/2" thick slates are to be fastened with 2" nails.
4. 3/4" thick slates are to be fastened with 2.5" nails.
5. 1" thick slates are to be fastened with 3" nails.

Note that electrogalvanized nails are not mentioned. They have no place on a slate roof except to nail down felt paper underlayment.

From what I could see from the evidence in the Florida case, the slate roof had not leaked at all. In fact, it was only the copper built-in gutters that leaked. They had been incorrectly soldered and the lap joints had no rivets. There were no expansion joints either, despite long gutter runs, and expansion and contraction caused the solder joints to pop open, allowing water into the building. You could slip a credit card between the gutter sections at the solder joints where they popped. The obvious solution to this problem was to install expansion joints retroactively and correctly rivet and re-solder the existing lap joints. A more experienced roof consultant would have helped here. Instead, it turned into a disaster.

At a church on the east coast, a similar situation occurred. A newly installed Pennsylvania black slate roof leaked at the copper ridge. A local professional roof consultant was called in and he recommended that the entire roof be removed and re-slatted. This roof was only months old. In his opinion, the copper ridge joints should have been soldered together, but weren't, and this was causing the leaks. He recommended that the ridge be removed, self-adhesive underlayment be installed under-

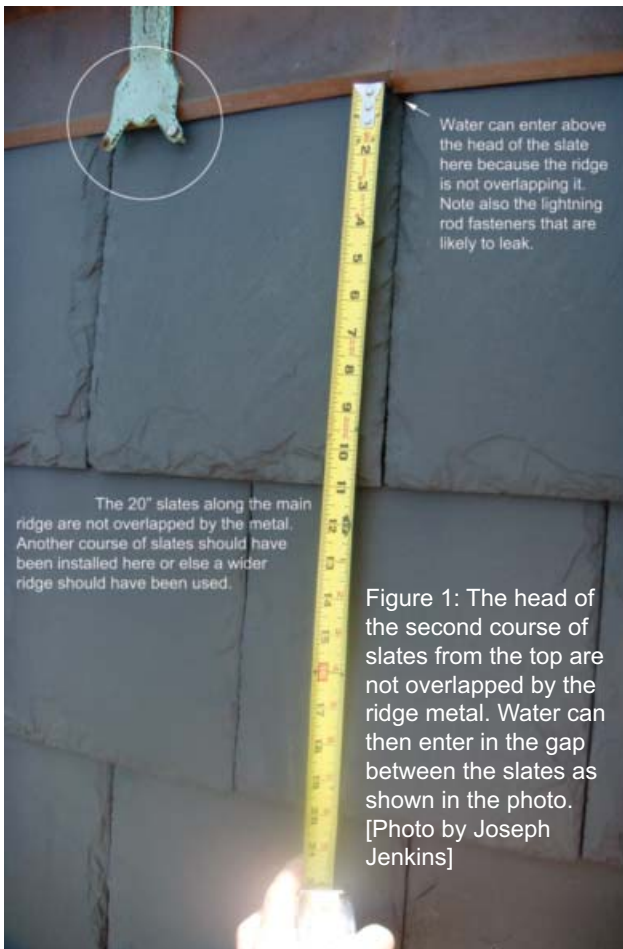




Figure 3: The old copper ridge was removed and wider, new copper ridge was installed, leaving a generous 5" headlap on the second course of slates where there was no headlap before. [Photos by Chris Short]



Figure 4: The new copper ridge was installed with 40 ounce copper straps one inch wide, nailed to the roof, folded over and riveted to the copper along the edge of the ridge. [Photos by Chris Short]

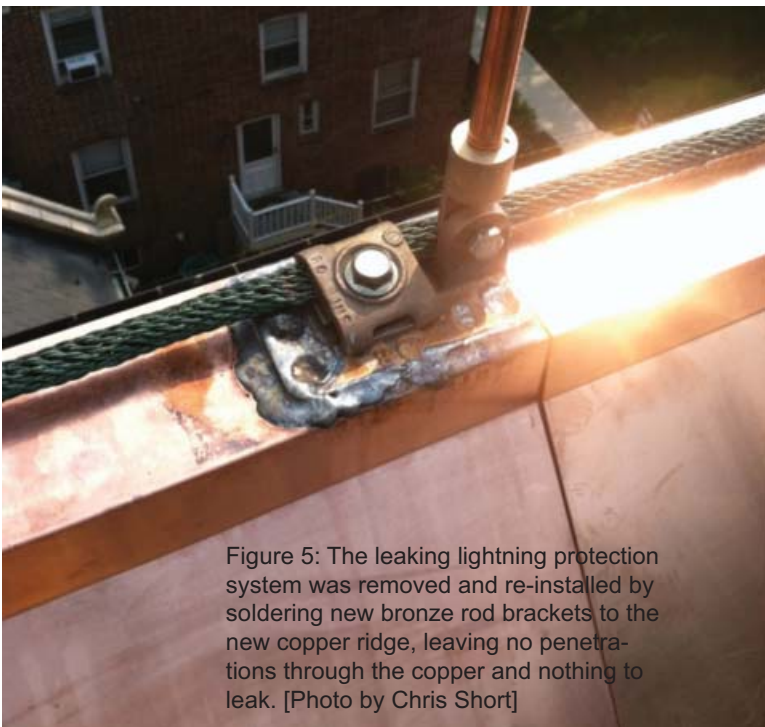


Figure 5: The leaking lightning protection system was removed and re-installed by soldering new bronze rod brackets to the new copper ridge, leaving no penetrations through the copper and nothing to leak. [Photo by Chris Short]

neath the ridge slates, and then the ridge metal be re-installed with soldered joints. His rationale for replacing the rest of the roof was based on the fact that the slates had been installed with only two inches of headlap.

In reality, the ridge copper did not overlap the top courses of slates adequately (Figure 1). It was also punctured with many holes by a lightning rod and cable installation (Figure 2) and these two conditions caused the leaks. The correct solution was to remove the ridge metal, fabricate new ridge that was wide

enough to adequately cover the slates (Figure 3), and then install the ridge without exposed fasteners by using 40 ounce copper straps (Figure 4). The lightning protection system was then attached to the copper ridge with soldered fasteners (Figure 5). This corrected the ridge installation and stopped the leakage. The consultant's opinion that the ridge joints should have been soldered together was mistaken because ridge metal is typically only overlapped, not soldered. This allows for expansion and contraction of the metal. The use of self-adhesive underlayment is a temporary band-aid solution often resorted to by persons who want to stop a leak, but aren't sure what's causing it. For more information about cleating copper ridge to a roof, see my article in Traditional Roofing #8 at TraditionalRoofing.com.

The advice that the entire roof should be replaced due to the 2 inch headlap had some merit. The slopes on the church roof included 6:12, 9:12, 12:12 and 16:12 sections. Two inches of headlap is in-

adequate for a 6:12 or a 9:12 slope but is marginally acceptable for a 12:12 slope and passable for a 16:12 slope. Therefore, the lower slope roofs should be replaced, but the steep slope roofs, which constituted the bulk of the roof area, could remain. Headlap recommendations related to roof slope and slate size are outlined in the SRCA slate roofing installation guidelines available at SlateRoofers.org and are listed below.

A courthouse in the midwest was having serious problems with its slate roof. Again, this was a fairly new roof, only 15 years old, and slates were broken, cracked or falling off left and right. No less than seven experts had been called in to evaluate the situation, including engineers, roof consultants, roofing contractors and construction personnel. Not one of them determined that the slates were of foreign origin, despite the fact that foreign slates are made to metric standards and measure in centimeters, not inches, which is immediately apparent when measuring the slates.

The consensus of most of the experts was that the slates were falling off due to weather damage and that the entire roof should be replaced at the expense of an insurance company. It was the insurance company, by the way, who called me in to look at the roof. In my report, I point out that “[Expert #1] describes the slates as 9”X18” with a 2” headlap and stated that they were installed too tightly. [Expert #2] stated that the slate was a 12”X20” Vermont slate with a 3” headlap and that the “loose, cracked and broken shingles” amounted to over 50% of the total number of roofing slates. [Expert #3] stated that the slate was 12”X22” Vermont non-fading gray slate installed with a 9” exposure and a 4” headlap and that 30-40% of the roof was damaged. [Expert #4] stated that hail damage was evident on 5-10% of the roof surface. [Expert #5] stated that the slate roof had been installed correctly, whereas both [Expert #6] and [Expert #7] indicated installation deficiencies.” Wow -- and to think that the County paid all of these people for these opinions. I can only imagine their frustration.

My survey revealed black Spanish slates, 50 cm X 30 cm, installed with an average 2.67 inches of headlap on a 6:12 sloped roof. Four inches of headlap is recommended for this slope. The damage to the slates was caused by poor quality slates, faulty installation procedures such as over-nailing (driving nails right through the slates), foot traffic (common on lower sloped slate roofs when installed by inexperienced roofers), and ice damage at the bottoms of the valleys where ice piled up in the built-in gutters. I reported that the roughly 300 damaged slates should be repaired and that the inadequate headlap was an installation deficiency that was not the responsibility of the insurance company. The County was going to have to live with this until such time as the roof is replaced. Unfortunately, the County should have had an experienced consultant overlooking the installation. Now that the SRCA has published slate roof installation guidelines, it should be much easier for property owners and roof consultants to acquire correct specifications for slate roof installations.

KNOW YOUR SLATE

Roofing slates are made from natural stone and are currently quarried in Pennsylvania, Vermont, Virginia, New York, and Canada, although there are many existing older roofs with slate from Maine and from scores of quarries that are no longer operating. It pays to take some time to try to know what slate comes from where. There is a forum at SlateRoofCentral.com where anyone can post questions and include photos. If you want your slate identified, this is a good opportunity. This is also a good place to ask general questions about any slate roof. There are often professional slaters on the site willing to provide information, links and advice.

Slates are also currently quarried in India, China, France, Germany, Italy, Wales, England, Brazil and South Africa and were once quarried in Ireland and other countries as well. Slates of overseas origin are cut in metric dimensions as mentioned earlier, so slap a tape on them; they will not measure exactly in inches. Some foreign slates are good; a lot are bad and will fail prematurely. Regarding the quality of slates, the SRCA states:

Part 2 — Roofing Slate

2.1 Procurement

A. Procure new roofing slates from known sources so that additional matching supplies can be obtained if needed. A single quarry source is recommended.

B. Slates shall be supplied by manufacturers that are experienced in the production of roofing slate and that quarry or mine high-quality rock specifically selected for roofing grade applications. Provide manufacturer's warranty in writing. Substitution of slates with slates from other sources shall not be permitted without written approval from the Owner or architect.

C. Slates shall be identified and labeled according to the quarry source and location. For example, foreign slates shall not be misrepresented as domestic slates.

2.2 Quality Control

A. Slates shall conform to ASTM C 406 and shall be Grade S1 (minimum 575 lbf breaking load¹, maximum 0.25% absorption², and maximum 0.002 inches depth of softening³).

[¹ASTM C120, Test Methods of Flexure Testing of Slate (Breaking Load, Modulus of Rupture, Modulus of Elasticity); ²ASTM C 121, Test Method for Water Absorption of Slate; ³ASTM C 217, Test Method for Weather Resistance of Slate]

B. All slate shall be hard, dense, sound rock of natural cleft with chamfered (beveled) edges. No broken or cracked slate shall be used, although broken slates may be cut into smaller, unbroken pieces.

C. Slates up to 3/8" in thickness shall be punched for nail holes; slates over 3/8" in thickness may be drilled and countersunk, for a minimum of two nail holes each. The holes punched in the slates shall be the correct diameter to provide a snug fit for the shank of the roofing nails. Slates shall be punched back to front (except starter slates, which are punched front to back). Slates shall be punched on the thinner end if there is a variation in the thickness along the length of the slate.

D. Rectangular slates with broken corners on the exposed end shall be rejected if a corner is broken off greater than 1.5 inches in either direction, although such slates may be used for cutting into smaller pieces.

E. Curvature of slates shall not exceed 1/8 inch over a distance of 12 inches. Curved slates shall be trimmed and punched to permit them to be laid with the convex side facing up.

F. Defects in slates such as "knuckles," "knots," "knurls" and "cramps" which protrude above the surface of the slates shall be positioned such that they remain on the exposed top surface of the slate after installation. Knots, knurls and cramps shall not be permitted on the back or covered portions of the slates unless removed by grinding beforehand. A slate shall be rejected if a surface defect adversely affects the proper laying of the slate.

G. Slates shall be free of pyrite inclusions that can visibly leach rust stains onto the roof.

H. Slates shall not have carbon-bearing bands known as "ribbons" as these are considered defects that undermine the longevity of the slate.

I. Nail holes are to be positioned no more than 1.5" in from the side edges of the slate. Nail holes must be positioned approximately 2/3 the distance from the bottom of the slate when using standard 3" headlap. The top of the underlying slate shall not be penetrated by the slating nails.

Roofing slates come in various thicknesses, widths, lengths, and colors. Again, the SRCA has spelled this out for us so we don't need to reinvent the wheel:

5.3 Slate Thicknesses, Sizes and Colors

A. Thicknesses

- 1. Standards; Nominal 3/16 inch (5 mm) to 1/4 inch (7 mm)*
- 2. Quarters; Nominal 1/4 inch (7 mm) to 3/8 inch (10 mm)*
- 3. Heavies; Nominal 3/8 inch (10 mm) to 1/2 inch (13 mm)*
- 4. Extra Heavies; Nominal 1/2 inch (13 mm) to 3/4 inch (19 mm)*

B. Standard Slate Sizes

- 1. 24"L X 14"W (610 mm X 356mm)*
- 2. 24"L X 12"W (610 mm X 305 mm)*
- 3. 22"L X 12"W (559 mm X 305 mm)*
- 4. 22"L X 11"W (559 mm X 279 mm)*
- 5. 20"L X 14"W (508 mm X 356 mm)*
- 6. 20"L X 12"W (508 mm X 305 mm)*
- 7. 20"L X 11"W (508 mm X 279 mm)*
- 8. 20"L X 10"W (508 mm X 254 mm)*
- 9. 18"L X 14"W (457 mm X 356 mm)*
- 10. 18"L X 12"W (457 mm X 305 mm)*
- 11. 18"L X 11"W (457 mm X 279 mm)*
- 12. 18"L X 10"W (457 mm X 254 mm)*
- 13. 18"L X 9"W (457 mm X 229 mm)*
- 14. 16"L X 14"W (406 mm X 356 mm)*
- 15. 16"L X 12"W (406 mm X 305 mm)*
- 16. 16"L X 11"W (406 mm X 279 mm)*
- 17. 16"L X 10"W (406 mm X 254 mm)*
- 18. 16"L X 9"W (406 mm X 229 mm)*
- 19. 16"L X 8"W (406 mm X 203 mm)*
- 20. 14"L X 10" W (356 mm X 254 mm)*
- 21. 14"L X 9"W (356 mm X 229 mm)*
- 22. 14"L X 8"W (356 mm X 203 mm)*
- 23. 14"L X 7"W (356 mm X 178 mm)*
- 24. 12"L X 10"W (305 mm X 254 mm)*
- 25. 12"L X 9"W (305 mm X 229 mm)*
- 26. 12"L X 8"W (305 mm X 203 mm)*
- 27. 12"L X 7"W (305 mm X 178 mm)*
- 28. 12"L X 6"W (305 mm X 152 mm)*

C. North American Roofing Slate Colors

- 1. Unfading Black*
- 2. Semi-Weathering Gray/Black*
- 3. Unfading Gray*
- 4. Semi-Weathering Gray*
- 5. Unfading Purple*

6. Semi-Weathering Purple
7. Unfading Mottled Green and Purple
8. Unfading Green
9. Semi-Weathering Green (Sea Green, Gray/Green)
10. Unfading Red

5.4. Slate Exposures and Headlaps

When Using 3" and 4" Headlaps (showing number of slates needed per square)

Slate Size (in.)	Exposure (3" H.L.) (Slates/Square)	Exp. (4" Headlap) (Slates/Square)
6x10	3 1/2"	800
7x10	3 1/2"	686
8x10	3 1/2"	600
6x12	4 1/2"	600
7x12	4 1/2"	515
8x12	4 1/2"	450
9x12	4 1/2"	400
10x12	4 1/2"	360
7x14	5 1/2"	412
8x14	5 1/2"	360
9x14	5 1/2"	320
10x14	5 1/2"	288
12x14	5 1/2"	240
8x16	6 1/2"	300
9x16	6 1/2"	256
10x16	6 1/2"	230
12x16	6 1/2"	192
9x18	7 1/2"	221
10x18	7 1/2"	199
11x18	7 1/2"	187
12x18	7 1/2"	171
10x20	8 1/2"	180
11x20	8 1/2"	164
12x20	8 1/2"	150
14x20	8 1/2"	129
11x22	9 1/2"	146
12x22	9 1/2"	134
14x22	9 1/2"	115
12x24	10 1/2"	120
14x24	10 1/2"	103

Consultants should know that roofing slates have fronts and backs, tops and bottoms. The front, which shows beveled or chamfered edges, faces away from the roof. The back, which has flat, straight edges, faces the roof. The top is what's covered by the overlying slates and is also called the "head" of the slate. The bottom is what you see on the roof, also called the "face."

Roofing slates are laid back side down to the roof, except the starter course, which is laid front side down to the roof. The starter course is underneath the first course along the eaves and you can't

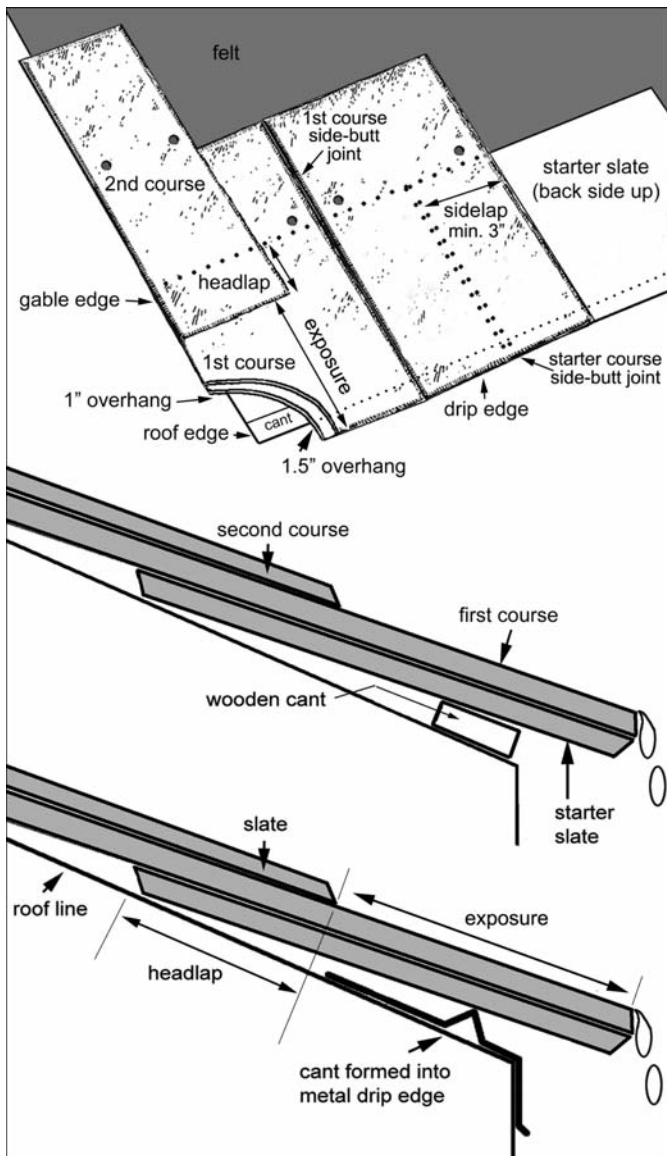


Figure 6: These diagrams from the Slate Roofing Contractors Association show the starter course, first course, second course, wood cant, metal cant, sidelap, exposure, headlap and butt joints.

installations, every slate should overlap two courses below it by a specified number of inches. Remember the head of the slate? It's overlapped by two courses of slate above it. Standard headlap is three inches, but it can increase to as much as five inches as the slope lessens and decrease to as little as two inches as the slope increases. I have seen quite a few large and very expensive roofs with no headlap at all or even "negative headlap," which means gaps between the slates directly into the substrate underneath. I've seen this on college dormitories, reroofed historical structures, mansions and churches. Both zero and negative headlap should produce a sickening feeling in a competent consultant as there is no cure for this roof malady other than to remove and reslate the roof. A more detailed discussion of headlap is available in an illustrated article I wrote for the Traditional Roofing Magazine #6, titled "Wrapping Your Head Around Headlap," available for free download at TraditionalRoofing.com. The Slate Roofing Contractors Association headlap guidelines state:

4.2 Headlap

A. All standard field slates shall be installed with a minimum 3" head lap when

really see it; only the bottom edge is exposed. But here is a good place to determine how much experience a roofer has with slate. As you climb the ladder or examine the roof on a lift, the first place you reach is the eaves. Is the starter course laid back-side-up as it should be? If not, you can expect to see errors on the remaining roof caused by inexperience. The SRCA has a handy diagram in its guidelines showing these details (Figure 6).

You won't have to go far to see additional errors. Keep looking at the starter course. Is there a cant strip underneath it? There should be. The cant tilts the starter at an angle so it is sloped the same as the field slates. It can be a wood strip, or it can be built into a metal drip edge. It can even be the fascia, slightly raised to prop up the starter course. An inexperienced roofer will fail to install any cant.

Keep looking. Are the starter slate side butt joints offset by the overlying slate side butt joints? There should be a minimum of three inches of lateral overlap. Often, there is none. Is there any headlap on the starter course? The second course of slates should be overlapping the starter by at least three inches. Figure 7 illustrates some of these issues. Again, I authored a detailed, illustrated article about starter courses in Traditional Roofing Magazine #5.

UNDERSTAND HEADLAP

One of the most grievous errors on slate roofs is inadequate headlap, which can condemn an entire roof no matter how new or how nice the slates are (see Figure 8). In standard American slate roof

the roof slope is 8:12 up to 20:12.

B. Less than an 8:12 slope down to 4:12, the slates shall be installed with a minimum 4" headlap.

C. Installing roofing slates on slopes less than 4:12 is not recommended.

D. On slopes 20:12 or greater, slates may be installed with a 2" headlap.

E. Headlaps may be increased at ice-dam prone or poor drainage areas.

The best way to determine headlap on a slate roof is to measure vertically the distance of 10 course exposures, then divide by ten to get an average exposure. When doing a roof survey, you should do this measurement on all roof surfaces if you can, and repeat in various locations on large roof surfaces. Exposure and headlap can vary from place to place on the roof when installed by inexperienced roofers. If you measure 90 inches over ten courses for example, then you have an average exposure of nine inches. If you double the exposure and subtract that from the length of the slate, you have calculated the headlap. For example, if the slate is 20 inches long and there is a nine inch exposure, you have a two inch average headlap. In other words, $\text{headlap} = (\text{length of slate}) - 2X(\text{exposure})$.

Bear in mind that most slate roofs with slopes 10:12 or over will function with only a two inch headlap, as evidence in the field shows on old roofs. However, under heavy snow conditions or driving rains, this amount of headlap is considered deficient and is not recommended. Stick to the SRCA standards for best results.



Figure 7: Common mistakes made when installing starter courses include orienting the starter slate face side up, installing no cant, inadequate headlap, and insufficient side-laps. [Photo by Joseph Jenkins]

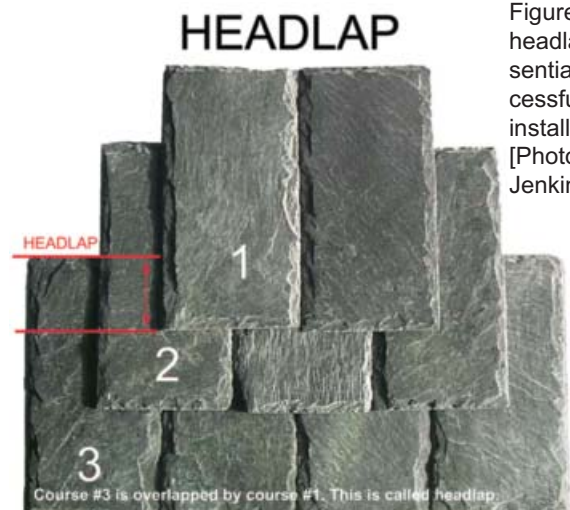
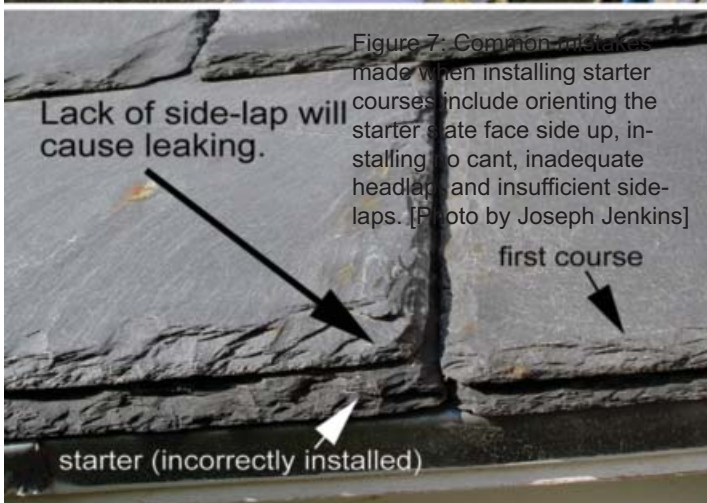


Figure 8: Correct headlap is essential for a successful slate roof installation. [Photo by Joseph Jenkins]



HOW LONG WILL THE ROOF LAST?

OK. So you've looked at the eaves, checked the starter course, measured the headlaps, examined the slating nails, and determined the type of slate. What about the age of the slate? Different slate types have different longevities; some wear out much sooner than others; some last 75 years, some last 200 years or more. The longevity is determined primarily by the chemical makeup of the stone, which can vary according stone type, location in the quarry, even depth in the rock formation. For example, I have seen Vermont "sea green," aka "semi-weathering gray-green" slates, completely worn out at 115 years of age. You could put your finger right through them. I have also seen many sea green roofs at 120 or 130 years in great condition, very hard and with many decades of life left in them. Vermont sea green slates, in my opinion, have a general life expectancy of about 150 years. Pennsylvania black slates last from 60 to 150 years, depending mostly on quarry location, although about 80-90 years is average. Some PA black slates are legendary, such as the Peach Bottom variety, which can last 200 years or more. Buckingham, Virginia slates are also very long lasting and it's not unusual to see them at 120 years of age in perfect condition. I examined a roof in Scotland that was 215 years old and the slates were perfect – not a bit of deterioration on them.

Here's a rule of thumb that every roof consultant should know: if the slate is still good, the roof probably does not need to be replaced, no matter how old. The 215-year-old slate roof in Scotland did have to be removed and re-installed because the fasteners had worn out over that time, but the slates were renailed to the original one inch rough-sawn pine board roof deck. No plywood or peel and stick were used and the renailed roof may last another century or two.

Other factors that reduce the life of slate roofs include abuse by roofing contractors who walk on the roofs, tar them, paint them, coat them, repair them incorrectly and ruin them. I have seen a number of roofs condemned at an early age, as young as one year, because the slates came from a foreign source and bled red rust down the roof (Spanish) or turned white and fell apart (Chinese). There are excellent slates coming out of both Spain and China, but it may take some work to find them.

In the United States, most of the older roofs fall into the 100-130 year age bracket. Nails tend to be well-preserved underneath hard slates on older roofs. Figure 9, for example, shows a slating nail that is 132 years old removed from a Buckingham slate roof on a church in Virginia. Note that it shows virtually no deterioration despite the age. You will often hear people insist that an older slate roof must be replaced because of nail failure. This is rarely true and is only likely to happen when the slate itself has turned soft and is allowing moisture through into the nails. It's also possible on barn roofs where the underside of the nail is exposed to the interior where it protrudes through the roof deck. Condensation over a long period of time will rust the nail from the bottom up. Otherwise, nails do not deteriorate underneath hard slates unless water or moisture can get to them.



Figure 9: Just because the roof is old doesn't mean the nails have gone bad. This steel slating nail was pulled off a Buckingham slate roof on an 1879 church in Virginia in 2011. [Photo by Joseph Jenkins]

Another common refrain from “experts” is that the roof must be replaced because the underlayment has worn out. One engineer informed me that slate roofs should be removed every 60 years and reslated with new underlayment. In reality, the underlayment is used as a cheap, fast, temporary roof to keep the water out of the building until the real roof is installed. Thousands of slate roofs have been installed with no underlayment whatsoever and function well a century later. Standard underlayment for slate roofs is 30 lb felt, which will dry up and disintegrate underneath the slates over time. The non-functioning underlayment does not reduce the life of the roof.

The most common problem with older slate roofs, other than broken or missing slates, is flashing deterioration. Valley metal wears thin and eventually leaks. So do chimney flashings, step flashings, pipe flashings and the like. One nice characteristic of slate roofs is that they can be taken apart and put back together and therefore repaired much like a car. If your car needs a new fuel pump, you take out the old one and replace it. If the slate roof needs new chimney flashing you remove the old flashing and replace it. This is routine work for slate roof restoration professionals. Granted, such professionals may be hard to find at times, but they’re out there. The SRCA lists potential slate roofing contractors on its website and provides resource materials to its members, including videos and some training opportunities.

When surveying a slate roof, a close look at the flashings is necessary. It helps to actually get on the roof and look at the metal up close because tiny pin holes can leak buckets, especially in valleys. Looking at the roof or at flashings through a pair of binoculars is helpful, but one cannot do a comprehensive survey that way.

How do you get on a slate roof? First, wear soft-soled shoes such as tennis shoes. Do not wear hard-soled work boots. Avoid walking on the roof. If you have to move about on the slates, crawl around on all fours keeping your distributed weight on the open faces of the slates. You can usually walk upright in the valleys, hips and ridges without worrying about damaging them, so these are the preferred walkways. Hook ladders (Figure 10) are essential at times when you just can’t get at a roof area any other way.

Many of the roof surveys I do don’t require even ladders. Of the hundreds of roof surveys I have done I have required a hoist only a few times. Trap doors on the roofs of institutional buildings come in real handy. Climbing up hips, down valleys and along ridges can allow access to an entire roof using nothing but climbing agility and fearlessness. Exiting an open window and moving along a built-in-gutter is another strategy. This is not work for those who fear heights or who lack agility. Having

climbed on slate roofs since 1968, despite my age of 60 at this time, I still find it possible to access most slate roofs with the minimum of gear. But what about OSHA, fall protection, ropes, lanyards, scaffolds, hoists and all else one thinks of when steep and high roofs are considered? Roof inspections are exempt from OSHA fall protection requirements. That fact is about all I remember from the 10 hour OSHA safety course I took years ago.

This could be one main reason why many roof consultants do not accurately assess the conditions on a slate roof. Because it can be high and steep and the consultant cannot achieve close enough access to get a good look at the details. Surveying such roofs is a specialty skill, but with the proper tools and guidance, it can be done successfully.

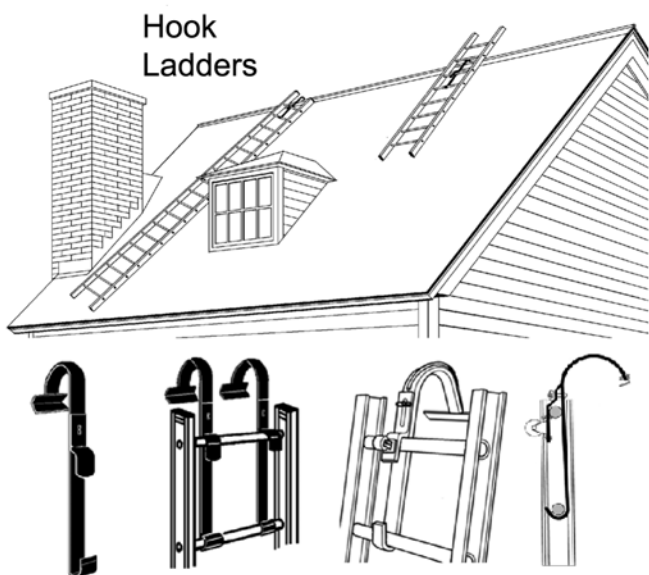


Figure 10: Hook ladders come in handy when accessing steep roofs.

TOOLS

Slate Rippers



Figure 11: The slate ripper is an essential tool for slate roofing contractors. It is used to pull out the nails that hold a slate in place, thereby allowing the slate to be slid out.

Tape Measure: You will need to measure the size of the slates, the exposures, headlaps, possibly roof surfaces, valley lengths, etc. On the other hand, you can usually buy an aerial roof report from a service such as SkyTekImaging.com. These reports can be ordered over the internet for a reasonable fee and they will provide estimates of roof slopes, surfaces and dimensions, including ridge, hip and valley lengths. I highly recommend the use of such imaging services. Nevertheless, you will have to verify the report's accuracy by taking some measurements on your own.

Slope Finder: A slope finding tool such as a Johnson Pitch and Angle Locator, available at Lowes, is handy for determining roof pitch and it will fit in your pocket.

Camera: If the survey is non-destructive and the roof is not being opened, then that's about all you need other than a pen and paper to write down your notes, and of course a small but good digital camera to record your observations. I keep my camera clipped to my belt alongside my tape measure so my hands are free for climbing. A good digital

still camera will also take video footage. Make sure you have enough memory and battery life; I always keep a spare battery in my pocket. Video footage is great for taking verbal notes because you can record your voice and your comments for later review.



Slate Hammers

Figure 12: Slate hammers come in a variety of shapes and styles. They all have a pointed pick end that is used to punch nail holes in slates.

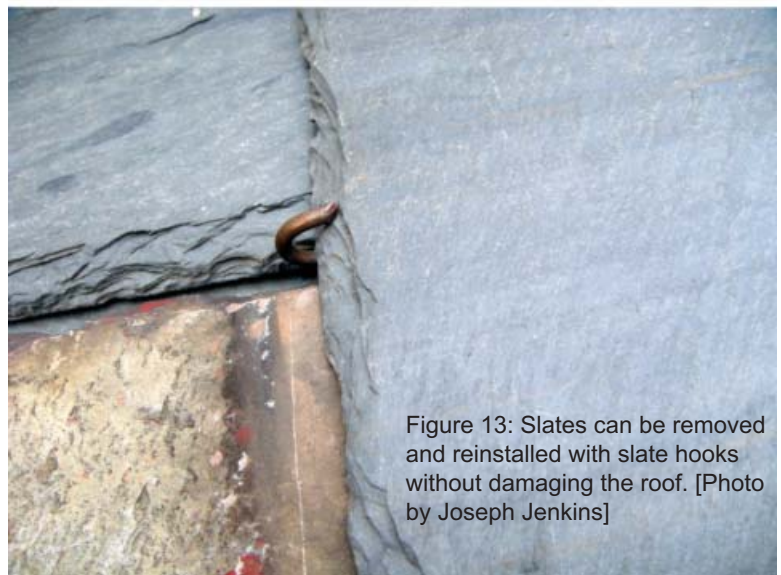
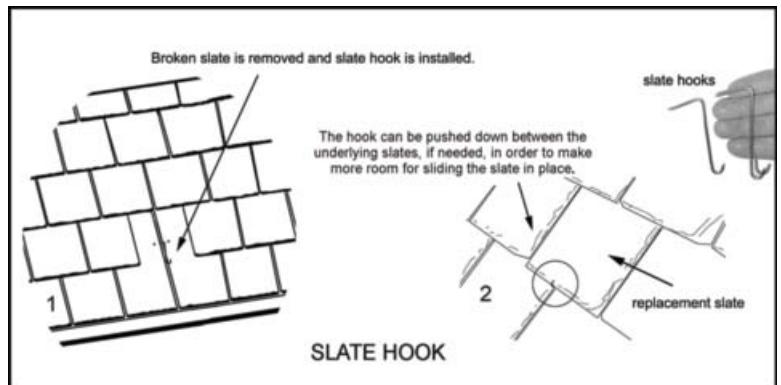


Figure 13: Slates can be removed and reinstalled with slate hooks without damaging the roof. [Photo by Joseph Jenkins]

But how do you look at nails, for example, if you don't remove slates? Simply find a place where a slate is missing and you will find an exposed nail (that's how I got the nail in Figure 9). You can usually pry a nail out with just about anything, even a car key. Not ring-shank nails though – they won't come out without a hammer and even then they may break off.

Rippers, Hammers, Hooks: If you need to take the roof apart, you will need a few more tools, including a slate ripper for pulling out the slating nails that hold the slate in place (Figure 11). Unfortunately, we can no longer take tools in our carry-on baggage so you will have to check a separate tool bag if you're flying to the site. A ripper is long enough that you will need a full size suitcase just to fit it in diagonally. Then you'll need a slate hammer for beating on the ripper (Figure 12). Once the slate is out, you can put it back using a slate hook (Figure 13) and the roof will be no worse for the wear. Pulling slates out allows you to determine what the underlayment is and what the roof deck is made of when there is no access to the underside of the roof. It's important to know whether the roof deck is made of solid boards (the tree species should also be determined, if possible), slating lath (strips of wood spaced evenly, also called skip sheathing), plywood, OSB, or even gypsum or nailable concrete. Different substrates affect the amount of time and effort it will take to repair the roof. Cheap substrates such as 1/2" plywood or OSB should not be on slate roofs at all. According to the SRCA:

3.7 Roof Decking

A. The roof deck shall be a minimum of 3/4" thick wood. Solid, glue-free wood is recommended.

B. Nailable concrete and gypsum concrete may also be suitable roof decking materials.

C. Minimum 3/4" glue-free slating lath or skip sheathing can be spaced on rafters as a nailing substrate.

D. Minimum 3/4" glue-free boards, slating lath or skip sheathing can be installed over glued or laminated roof decks to provide a suitable nailing substrate.

E. Surfaces to which the roof slates are to be applied shall be in a suitable condition or shall be repaired to a condition satisfactory for slating. All surfaces to be slated shall be swept clean of any debris.

Of course, if you're driving to a site and have a truck with ladders, you should have all the tools you need, including hook ladders and roof brackets. Roof brackets, also called roof jacks, nail into a roof and provide a support for planks, thereby creating a roof scaffold. You can nail them right through the slates in the space between the shingles, then remove them and slide a metal flashing under the slates but over the holes. Alternatively, you can remove a slate and then nail the bracket between the underlying slates. Then you simply remove the bracket and replace the slate with a slate hook. You can stand on these roof scaffolds or place single section ladders on them by laying the ladder flat on the roof with the feet on the plank. These techniques will enable you to reach almost any place. Figure 14 shows roof jacks, planks, a roof ladder and a hook ladder utilized to reach the peak of a church roof behind the bell tower. There was no other easy way to reach the top of this 16:12 peak. I should add that there are quite a few slate roofing videos on YouTube, especially at the channel jenkins01. You can see the roof brackets being removed and the bib flashing being installed on this church there, for example.

The only time you'll be out of luck is when the eaves are so high they can't be reached by ladders. This is when scaffolding, hoists, or the aforementioned hatch door are needed.

Other things to look for on slate roofs are "over-nailing" and "under-nailing" of the slates. Over-nailing is when the person who is driving the nails hits the nail too hard and it punches into the slate. This tends to break out the nail hole and leave the slate fastened only with one nail. You will see slates hanging sideways when this happens. Under-nailing is when the installer doesn't drive the nail

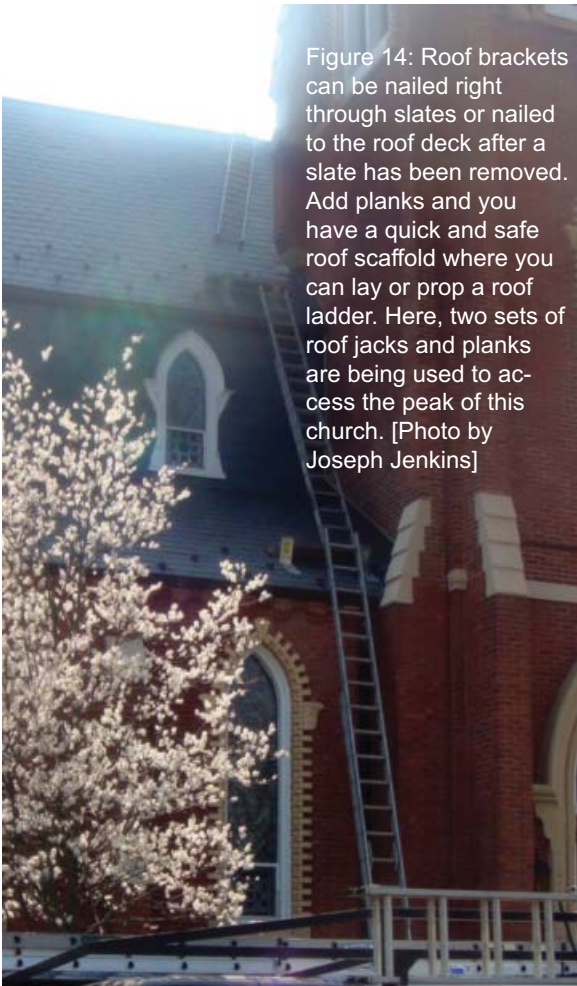


Figure 14: Roof brackets can be nailed right through slates or nailed to the roof deck after a slate has been removed. Add planks and you have a quick and safe roof scaffold where you can lay or prop a roof ladder. Here, two sets of roof jacks and planks are being used to access the peak of this church. [Photo by Joseph Jenkins]

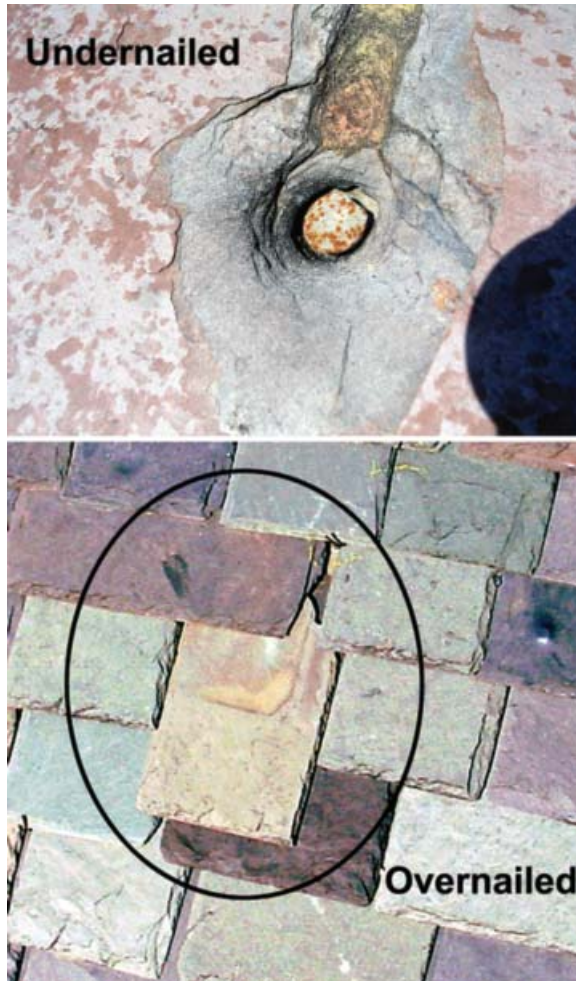


Figure 15: Under-nailed slates aren't driven in far enough, leaving a protruding nail head to rub against the overlying slate, eventually to wear a hole in it. Over-nailed slates become broken when the nail is driven through the slate. [Photos by Joseph Jenkins]

far enough and the head sticks above the slate. The result is a nail head rubbing against the overlying slate, eventually wearing a hole in it (see Figure 15).

Often, consultants are called on to determine if weather events have damaged a roof. The two primary types of damage are from hail and wind. When a slate is punctured, the back of the hole blows out, forming a crater on the side opposite the impact.



Figure 16: External punctures, such as from large hail stones, leave holes with sharp edges, as shown here. The crater is always opposite the impact side. [Photo by Joseph Jenkins]

Therefore, if you are seeing holes in slates that show craters, you can be sure that the holes originated from internal pressure, such as a nail head underneath (as shown in Figure 15). Large hail stones can puncture slates, but you will not see the crater on the face of the slate (Figure 16). In the February, 2008 issue of RCI Interface, I authored an article called "What the Hail," which explains this in greater detail. It can also be downloaded at TraditionalRoofing.com.

Wind damage is easy to spot. Slates are blown off, flashings are blown loose, or a flying object like a garbage can lid impacted the roof and broke slates. Some experts insist that high winds cause "chatter," meaning the slates flap around a bit. They say that this condition not only exists, but warrants the replacement of entire roofs after wind events. This is pure fantasy. In order for a slate to pull loose and chatter, the nails holding it would have to pull out too. But the nails cannot

push themselves back in and would be left slightly protruding out of the deck. The overlying slates would then be slightly sticking up in the air resting on the protruding nail heads. The idea that slates can flap around, chattering in the wind, then settle back down flat, nails and all, is incorrect.

There is, of course, a lot more to slate roofs than what can be covered in this article. Due to space constraints, I will have to limit the information here to a general overview of the subject. More information is available in the Slate Roof Bible, Traditional Roofing Magazine, the SRCA website SlateRoofers.org, and at SlateRoofCentral.com, including free instructional videos, free downloads, and a public forum.

Captions for Illustrations:

Figure 1: The head of the second course of slates from the top are not overlapped by the ridge metal. Water can then enter in the gap between the slates as shown in the photo. [Photo by Joseph Jenkins]

Figure 2: Exposed, loose fasteners are common sources of leakage. [Photo by Joseph Jenkins]

Figure 3: The old copper ridge was removed and wider, new copper ridge was installed, leaving a generous 5" headlap on the second course of slates where there was no headlap before. [Photos by Chris Short]

Figure 4: The new copper ridge was installed with 40 ounce copper straps one inch wide, nailed to the roof, folded over and riveted to the copper along the edge of the ridge. [Photos by Chris Short]

Figure 5: The leaking lightning protection system was removed and re-installed by soldering new bronze rod brackets to the new copper ridge, leaving no penetrations through the copper and nothing to leak. [Photo by Chris Short]

Figure 6: These diagrams from the Slate Roofing Contractors Association show the starter course, first course, second course, wood cant, metal cant, sidelap, exposure, headlap and butt joints.

Figure 7: Common mistakes made when installing starter courses include orienting the starter slate face side up, installing no cant, inadequate headlap, and insufficient sidelaps. [Photo by Joseph Jenkins]

Figure 8: Correct headlap is essential for a successful slate roof installation. [Photo by Joseph Jenkins]

Figure 9: Just because the roof is old doesn't mean the nails have gone bad. This steel slating nail was pulled off a Buckingham slate roof on an 1879 church in Virginia in 2011. [Photo by Joseph Jenkins]

Figure 10: Hook ladders come in handy when accessing steep roofs.

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