

SLATE ROOFS

by Joseph Jenkins

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Not many people know a whole lot about slate roofs, but there is one group that has a reputation for being particularly inaccurate in their knowledge. When a property owner reveals that a “home inspector” has passed judgement on their slate roof, professional slaters can be pretty sure the assessment is incorrect and probably way off base. This article aims to help fix that problem.

A slate roof is a very specialized roofing system that dates back hundreds of years. Many existing slate roofs in the United States are over a century old and still in use. All but one of the photos of the dates written into slate roofs shown in Figure 1 were taken by the author (the 2003 date was installed by the author). These are roofs that are still functioning well, some even after 150 years or more.

A standard slate roof installation is a model of simplicity. It is comprised of thin, flat, usually rectangular slabs of stone overlapping in such a manner as to be water tight and to stay water tight for a century or two. The stones, or *slates*, are fastened to a wood roof deck with nails. Those three components: stone, wood and fasteners, are all that are needed for a successful slate roof system that will keep a structure dry for centuries. Of course, there are many variations of slating styles: side-lapped slate, graduated slate, diamond pattern, random widths, staggered butts — but let’s stick with the standard pattern, which encompasses the vast majority of slate roofs in the United States.

In a standard slating pattern, each slate is the same length and width (although shapes may vary). Each slate is fastened to the roof along a chalk line that marks the top edge of the slate course with two nails. It is very important to understand that each slate overlaps *two* courses below it. This is called the “headlap” because the top of the slate, or the “head,” is being overlapped by the slates two courses above (see Figure 2). This headlap is usually three inches, but can range from 2” to 4” depending on roof slope or other factors. The headlap is one element of a slate roof that is critically important, because without it the roof would leak like a sieve. Slate sizes, widths, lengths, colors, shapes, and thicknesses can all vary, but a proper headlap must be maintained. A minimum three-inch headlap is standard, but greater headlap is acceptable. Less headlap can

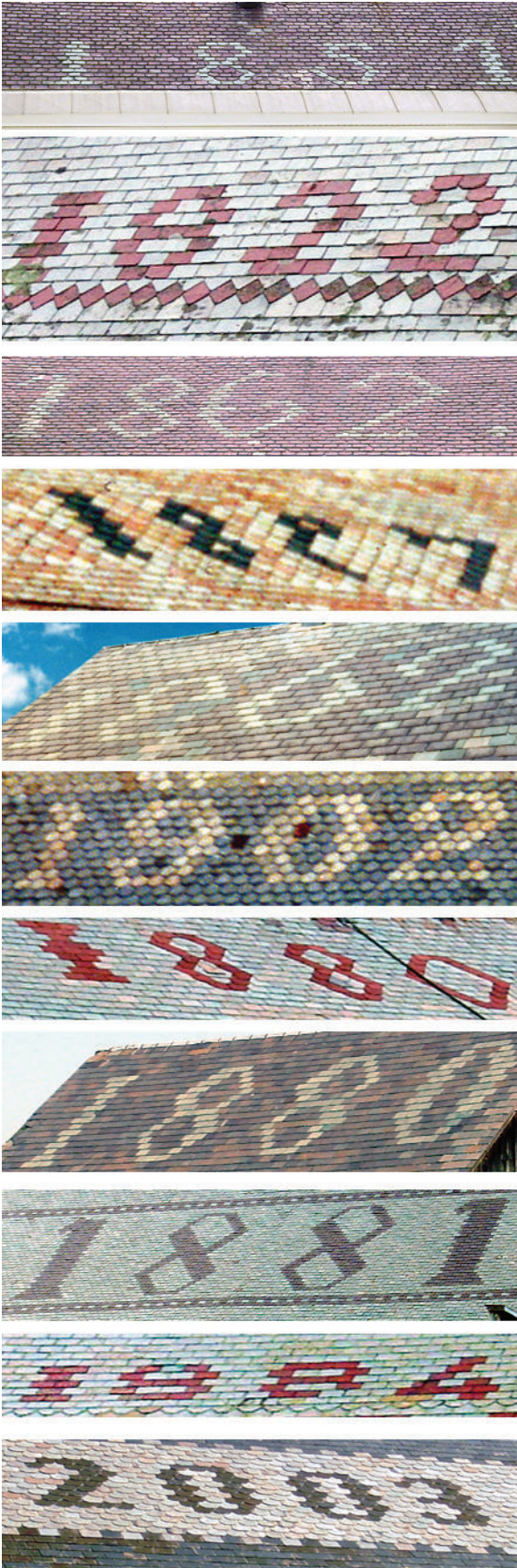


Figure 1: Dates inscribed on existing house and barn slate roofs. All photos by author except 1822 roof, which was taken by Steve Taran Jr.

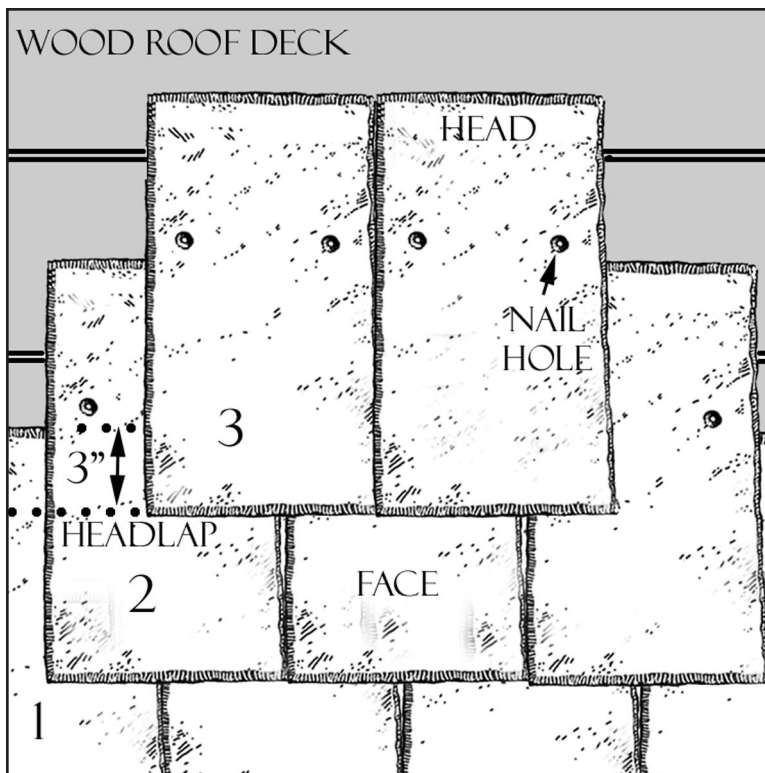


Figure 2: Standard slate installation pattern, showing overlap, headlap, placement of nail holes, “face” and “head” of the slate. Course #3 overlaps course #1 by three inches. This is called the “headlap.”

lead to leakage, depending on the slope of the roof, however two inch headlap is not uncommon on older roofs with adequate slope.

What typically goes wrong with slate roofs? Well, for one thing, slate is stone. It is wrestled from the earth in heavy slabs and worked into individual shingles largely by hand. The fact that slate roofs are rock roofs is the main reason why they last so long. However, stone is a natural material and may have invisible fractures or other imperfections that are not noticeable when the roof is installed. These can cause slates to eventually break and come off the roof.

People walking on slate roofs also damage them. This includes the roofing contractors who install or repair the slate. A “Bigfoot” roofing contractor tramping on your roof in clodhopper boots will definitely crack slates which can later, after a freeze/thaw cycle or other environmental pressure, break apart. This is a big problem today with new slate roof installations performed by inexperienced roofers. Dozens and even hundreds of slates can break off the roof within the first five years after installation due to careless foot traffic during the installation. Broken slates can routinely be replaced, however, as we will discuss below.

Some slate varieties are softer than others and do not last as long as the harder types (“S1” slates). Softer, “S2” or “S3” slates will become flaky and crumbly when they reach the end of their effective lives, which could be as soon as 55 years, but more likely around 80-100 years. These “soft slate” roofs cannot be saved or restored, but can be replaced with new or salvaged slates. Harder slates, such as most Vermont slates, the Peach Bottom slates, Buckingham slates, Monson slates, and others, could conceivably last centuries on a properly maintained roof.

Flashings eventually wear out. These are the metal joints around chimneys, in valleys, alongside dormers, around pipes that protrude through the roof, etc. They are also routinely replaced by experienced slate roofing professionals.

Finally, bad workmanship, such as improper repairwork, plague many an old slate roof. This is visible as tar splotches on roofs, mis-matched slates, metal patchwork, coated roofs, and other mistakes. Once again, these errors can usually be removed and properly replaced by someone who knows what he is doing. Applying coatings to slate roofs creates a problem that cannot be easily reversed, however, and such a practice should be avoided.

ALL SLATE IS NOT THE SAME

It is imperative that people who own, inspect, or work on slate roofs know of the different types of roofing slate, their origins, longevities, characteristics, and qualities, and be able to identify the slate on the roof in question. If sight identification is not possible, then they must be able to send a slate sample or photo to someone who knows slate in order to have it identified. Presently, in the U.S., roofing slate is still being quarried in Virginia, Pennsylvania, New York, and Vermont. However, a century ago there were hundreds more American slate quarries than there are today, including in Maine and Georgia. The differences in appearance and quality between the slates from the various quarry areas are sometimes striking, so a knowledge of the history of slate quarries is also important for people who work with traditional slate roofs. Older homes in the U.S. are likely to have one or more of the following types of slate on them: Vermont “sea green,” VT unfading green, VT mottled green and purple, VT gray/black, VT purple, New York red, Pennsylvania Bangor black, PA Chapman black, var-



Figure 3: This new slate roof, installed by the author, shows a variety of slate types, including salvaged New York red, Vermont unfading green (the lightest ones), new Vermont sea green (the medium gray ones), salvaged Vermont sea green (the tan ones), Vermont unfading purple (solid purple) and mottled green and purple (purple with green spots, flecks or streaks), Virginia black (the dark gray ones), and Vermont salvaged, polluted sea green slate (the dark ones with the light spots, darkened by air pollution over a century).

ious other PA black slates from the Lehigh-Northampton slate region, PA/Maryland Peach Bottom black, Georgia gray/black, Maine black, and Virginia black slate.

Figure 3 shows a new slate roof installed by the author and made with a variety of new and salvaged slates, clearly illustrating the striking contrasts in color and shade between common types of roofing slate. What you can't see is the longevity of each type of slate. Half of the slates on that roof are already 100 years old. The other half are brand new. It is very likely that this roof will last a century — well into 2100.

WHEN FLASHINGS FAIL

Even if a slate roof is made of very long lasting slate, the metal flashings can wear out and leak before the slate wears out. These flashings are sheet metal joints that are installed between the various planes of the roof in order to prevent water entry, such as in the valleys, along dormer walls, and around roof penetrations such as chimneys. The most common older flashings were made from terne coated steel, which is steel coated with a lead/tin combination, also erroneously (but commonly) called "tin." Terne coated steel must be painted regularly to avoid corrosion. Copper flashings (either plain copper or lead coated) were used primarily on institutions and upscale residences; sometimes sheet lead flashings were used on older buildings, especially around plumbing vent pipes. The "tin" flashings could last 90 years or longer if they were kept painted. Copper flashings, ironically, because they are typically not painted, will begin to corrode, pit, and leak in about 60 to 70 years in areas of high wear, such as valleys. For this reason, older copper flashings should be painted in order to extend their effective lives.

When flashings begin to fail on a slate roof that is made of sound, hard slates, only the flashings should be replaced, not the entire roof. This is routine work for slate roof restoration professionals. One of the extraordinary characteristics of slate roofs is that they are designed to be taken apart and put back together. Broken slates, worn flashings, rotted sheathing boards, or any element of the roof can be removed and replaced without the need to replace the entire roof. Because of this unusual maintenance characteristic, slate roofs can be made to last as long as the slate itself will last, which could be hundreds of years.



Figure 4: This bell tower on a church built in the late 1800s displays the typical deteriorated flashing and poor maintenance common on slate roofs in the United States today. However, one slater with a helper removed the tarred mess and replaced it with new copper and matching slates in a single work day. Such revitalization of old slate roofs is routine work for experienced slate roofing professionals.

When repairing or restoring a slate roof, individual slates are removed from the roof in order to expose the existing flashings, which can then be removed and replaced. The removed slates are then put back into their original positions and the repaired roof will look much the same as it did before the repair, except with new flashings. The sign of a good repair is one that is invisible to the layperson.

Figure 4, left photo, shows a bell tower on a church that has been poorly repaired with roof cement, unfortunately a common sight on old slate roofs. The photo on the right shows how a mess like that can be cleaned up and restored with new copper in one day by a professional slater and helper. Figure 5 illustrates a similar situation — valleys that were tarred repeatedly by Neanderthals until the roof looked beyond hope (and, of course, still leaked). However, one day's work by a professional slater working alone cleaned up the roof and gave it an almost miraculous new lease on life. Such is the art of slate roof restoration.

A layperson or a home inspector may look at either of the situations shown in these photos and be immediately convinced that the roof is shot and must be replaced. When a slate roof professional looks at the tarred mess, he sees a common sight that can be routinely repaired. Remember, any part of a slate roof can be removed and replaced. If a section of a roof has been severely damaged by Cro-Magnon Man, it can be repaired, or as a last resort, selectively removed and reslated. Box gutter linings, or “built-in” gutters, are another common problem on old slate roofs because the metal deteriorates and leaks. They, like valleys and any other flashings on any slate roof, can be replaced without removing and replacing the entire roof.

The general rule is, “If the slate is still good, the roof should be repaired or restored.” The slate is still good if the exposed surface is smooth, free of delamination, flaking or other signs of obvious deterioration, no matter how old. If in doubt about the quality of the slate, get an expert opinion, or go to slateroofcentral.com

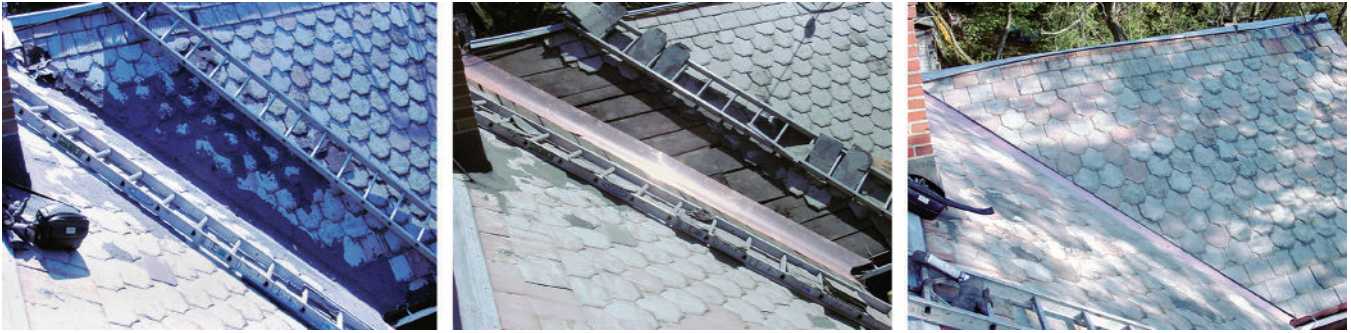


Figure 5: A valley on a late 1800s residence has been repeatedly tarred, walked on, and abused by the Cro-Magnon Roofing Company (left). However, it is restored by a professional slater, working alone, in one work day. The old valley and all tarred slates are removed and new 20 ounce copper valley flashing is installed (center photo). The valley is then reslated with matching salvaged Vermont “sea green” slates (right photo). When the job is done, the house roof is almost as good as new, but untrained eyes would likely have condemned this roof at first sight.

and post a query on the public message board there. The slating professionals who frequent that message board seem more than willing to render a free opinion to a total stranger.

WHEN SLATES ARE BROKEN OR MISSING

It is not uncommon for a century old slate roof to have 50 or more slates fail from simple attrition. Slate is a natural stone and some may contain faults or hairline cracks and may eventually break here and there on the roof. A typical 20 square roof (2,000 square feet), with a typical 10”X20” slate, will include about 3,400 slates. If fifty of them fail after a century, then the failure rate of the roof is 1.5% per 100 years — phenomenally small. Yet, one missing slate is all it takes to create a leak, which in turn may cause someone to shout, “tear the roof off and replace it!” More often than not, many people unknowingly lose a good slate roof when they could easily have repaired or restored it.

Faulty slates should simply be removed and replaced. Replacement slates matching in size, shape, and color must be used whenever possible. Replacement slates must never be fastened in place with visible straps or exposed nails (known as “face-nails”). Instead, there are two generally accepted methods of fastening replacement slates into place: the *nail and bib method*, or the *slate hook* (see Figure 6).

The nail and bib method is perhaps the most widely used. This involves removing the broken slate with a slate ripper, then nailing the replacement slate with a nail in the slot between the overlying slates and then sliding a “bib” flashing under the overlying slates and over the nail head. The bib is often bent slightly in order to fit into place by friction. It can be composed of aluminum, copper, or other non-corrodible metal, but it should not be shiny and reflective like stainless steel as it may then be visible from the ground on a sunny day. Instead, copper or brown painted aluminum (coilstock) blend nicely into the roof and are preferred. A

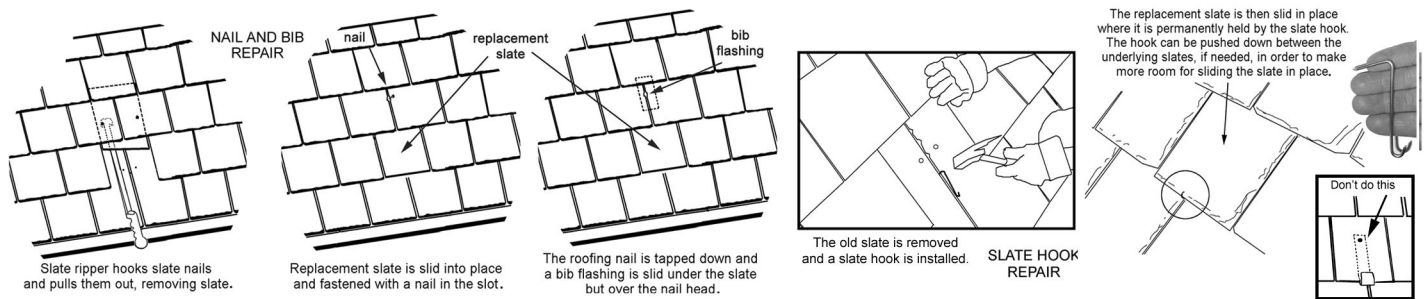


Figure 6: Individual slates can easily be removed and replaced on a slate roof. A “slate ripper” is used to remove the broken slate by pulling out (not cutting) the nails that hold the slate. A matching replacement slate is slid into place, then fastened in one of two ways: with a nail in the overlying slot covered by a “bib flashing,” or with a slate hook. Exposed strap hangers should be avoided because they are unsightly and will open up under pressure of snow sliding off a roof.

common size bib is 4”X7”.

A slate hook is a hard wire hook made of galvanized steel, copper, or stainless steel, approximately three inches long. A small exposed loop hooks the replacement slate in place. This is one instance when an exposed repair device is acceptable because the tiny hook is almost invisible from the ground. Stainless steel hooks are stronger than copper hooks. Slate hooks are preferable to the nail and bib on new slate roofs, especially for repairs in the field of the roof. Exposed strap hangers used for repairs are to be avoided because they’re unsightly and they deface the roof.

The tool required for removing slates from a roof is the *slate ripper* — a sword-like object that slides up under the slate and yanks out the two nails that hold it in place. It does not *cut* the nails — it pulls them out, bending them in the process. You never not want to cut the nail because that will leave a piece of nail under the slate which will interfere with sliding the replacement slate into place.

A *slate hammer*, another important slate roofing tool, has a hole punch at one end used to punch nail holes in slates. Some slate hammers also have shanks designed to cut slates, which is done by a chopping motion against a straight edge, typically a *slater’s stake*. Salvaged slates readily punch without breaking, leaving a clean hole with a "countersunk" characteristic into which the nail head sits. New slates can be hard and brittle and require some practice for easy punching with a slate hammer. Standard thickness slates (3/16” to 1/4”) are readily cut with a simple hand-held device, a *slate cutter* (see Figure 7).

Experienced slaters work on slate roofs using *hook ladders*, which keep their weight off the slate while giving them a safe work platform to cling to. It is not proper to work on slate roofs by walking on them using ropes, as walking on slate roofs breaks the slates; this is the primary reason why low-slope slate roofs fail prematurely. Murphy’s Law of slate roofing states: “If it *can* be walked on, it *will* be walked on,” so the best slate roofs are those that are too steep to walk on. Slate roofs *can*, in some circumstances, be carefully walked on by a qualified slate roofer, and that means a slater who will repair any slates he may break during his moving about, which is usually done carefully and on all fours.

It is improper to tar or coat the surfaces of slate roofs, or to use surface tar for repairs. Not only is this unsightly, but it doesn’t stop leaks permanently and it ruins the slates.

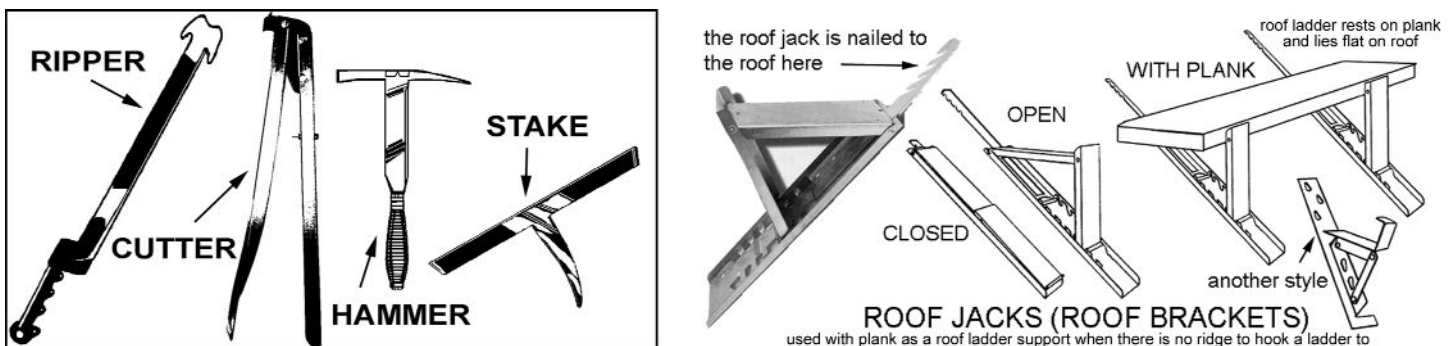


Figure 7: Basic tools of the trade include the slate ripper, for pulling out old slates; the slate cutter, for cutting and trimming slates; the slate hammer, for punching holes in slates (some styles also cut slate); and the slater’s stake, used as a backing when cutting slates with a slate hammer. Roof jacks, also called roof brackets, provide a quick, relatively safe way to access a slate roof when there is no ridge for hooking a ladder. The roof jacks are nailed in the slot between the slates and when removed, a bib flashing is slid in the slot to cover the nail holes. Alternatively, a slate can be pulled out in order to allow a roof jack to be nailed to the roof without penetrating any slates.

ABUSE, BAD REPAIRS, AMATEUR WORK AND NEGLECT

One of the most serious problems facing older slate roofs today, and a cause of many leaks, is not natural attrition, flashing failures, broken slates, or global slate failures. It is, put plainly, bad work. There are many unqualified persons attempting to repair slate roofs who don’t know what they’re doing. In my own slate roof restoration business, fully half of the work we do is the removal and replacement of faulty repairwork. Slate roof owners pay good money to have their roofs abused, then they have to pay good money again to

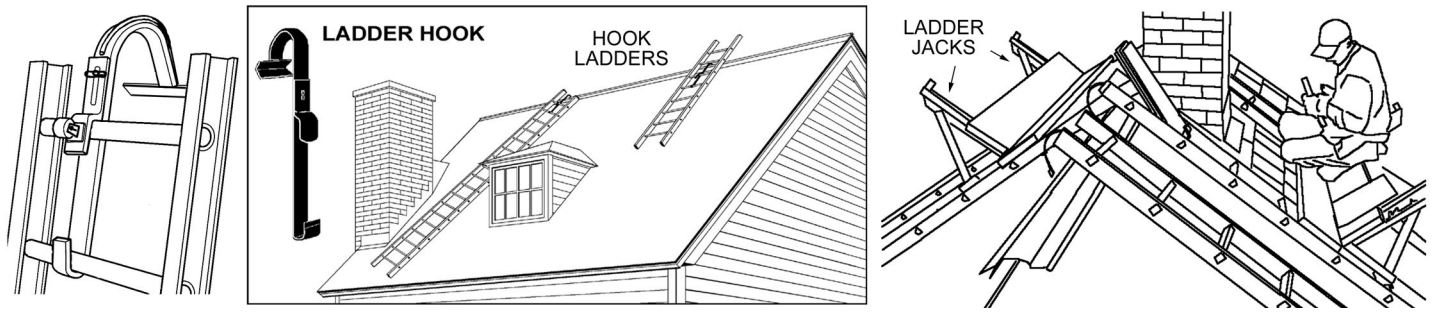


Figure 8: Professional slaters do not routinely walk on slate roofs because foot traffic on slate roof damages the slates. Instead, if there is a ridge to hook onto, hook ladders are used. Hook ladders allow safe access to slate roofs without breakage of the slates. “Ladder jacks” can quickly attach to hook ladders to create a safe work platform or roof scaffold by providing a framework to support wooden planks. Professional slaters may use a combination of hook ladders, ladder jacks and “roof jacks” (Figure 7) when accessing slate roofs.

have it repaired correctly. Abused roofs include the ones that are walked on by “Bigfoot,” the ones that are face-nailed, tarred, repaired with non-matching slates, coated, or reflashed incorrectly (see Figure 10).

Furthermore, roofing contractors who have little or no expertise in slate roofs will advise a roof owner to replace a slate roof which may have many decades of life still remaining. A roof owner will listen to bad advice when it is the only advice that can be found. All these factors combined can make a roof owner, in frustration, want to forever remove her slate roof no matter how much longer it will last if properly repaired.

However, there is no longer any excuse for roofing contractors, home inspectors, or home owners to remain ignorant about slate roofs. A simple search on Google will yield an abundance of information about slate roofs, including how-to information, message boards, source lists, contractors, consulting services, organizations, books and periodicals. Furthermore, new trade organizations have sprung up in recent years in order to promote and advance the slate roofing industry and the slate roof contracting trade including the National Slate Association (slateassociation.org) and the Slate Roofing Contractors Association of North America (slateroofers.org).

MYTHS, RUMORS, MISCONCEPTIONS

Low slope slate roofs will fail prematurely because people will walk on them over the years and break the slates. The resultant leaks are often repaired by non-professionals because the roofs are low in slope and therefore easily accessible. These repairs tend to be done poorly; the roof will still leak, resulting in more traffic on the roof, and a downward spiral of deterioration begins, ending with the demise of the slate roof. The lowest slope advisable for a slate roof is 4:12 (four feet of rise in twelve feet of run). However, the slope should be too steep to walk on in order for the roof to last a long time. That would bring the slope up to about 8:12 or steeper.

Nails are often said to be the cause of slate roof failure, however this is often not the case at all. It is true that nails will corrode on an older slate roof, but this is most likely under two general conditions: 1) the nails were of poor quality when initially installed, and/or 2) the slate has reached the end of its life and moisture is now penetrating the roof, thereby corroding the nails. Originally, in Wales, slate roofs were installed with wooden pegs driven through a hole in the top center of the slate. The slate/peg combination was then hung over a horizontal lath on the roof — no nails were used. The weight of the slates overlapping each other held the roofing in place.

In the U.S., field slates are nailed in place with two nails situated about a third of the way down from the top of the slate, along the outside edges. The slates are nailed into the roof boards, also called roof “sheathing,” which is often one inch thick lumber. Slate can also be nailed into horizontal wooden strips called “slating lath” or “battens,” usually 1x2 or 1x3 lumber. Lath roofs are common in Wales, England and Europe, so immigrants from those countries often copied their traditional styles of slate installation once they arrived here in the U.S. at the turn of the last century. Traditional Scottish roofs use solid boarding, as is more common in the U.S.



Figure 9: All slate is not the same. The above sampling of slate roofs includes, 1) a 70-year-old Vermont unfading green slate; 2) 110-year-old Pennsylvania black slate (a harder variety); 3) 90-year-old Vermont purple slate; 4) 100-year-old Buckingham, Virginia slate; 5) a mix of sea green slate (also known as semi-weathering green), Buckingham, and NY red slate; 6) Chapman (PA) slate with its characteristic diagonal striations. To see more examples of slate roofs, or to help determine their expected longevities, go to slateroofcentral.com and click on “how to identify your roof.”



Figure 10: Bad repairs can be found on almost any old slate roof. Some constitute “hidden leaks,” such as #1 above, where a nail has been driven into the top of the slot, caulked, then the caulk has worn off leaving an almost invisible hole in the roof. A bib flashing would have prevented this problem and will still solve the problem if inserted at this time. #2 illustrates the same problem, this time with roof cement rather than caulk. #3 shows “face nails” that have been tarred over — these are guaranteed leaks. #4 illustrates two obvious errors: wrong type of replacement slate and exposed roof cement. #5 is another example of a multiple error — face nails, wrong type of slate and wrong shape of slate. All of the above can be removed and the roof properly repaired.

Most of the older slate roofs in America are nailed with hot-dipped galvanized roofing nails, although many institutional and upscale residential roofs are nailed with copper slating nails. Some older slate roofs are nailed with square-cut iron nails. I have seen many a hot-dipped or cut-steel nail that has been on a slate roof for 100 years and is still in quite serviceable condition. The exceptions are as mentioned above: poor nails to begin with (not hot-dipped), or a roof on its last legs due to slate deterioration. It should be added that slates are not nailed tight to the roof. They are loosely nailed to the roof deck, or some say “hung” on the roof. This is to prevent strain by the nails against the slates themselves and to prevent damage to the slates when hammering them in place.

The need for felt underlayment on slate roofs is a myth. The most common underlayment on older slate roofs is a single layer of 30 pound felt. It is used to prevent the roof from leaking during installation. Once the slate is installed, if you could magically yank the felt paper out from under it, it wouldn’t make any difference — the felt is a temporary covering and is severely punctured and obsolete once the slates are in place. After about 75 years, the felt deteriorates almost to a powder underneath the slates. This is not a cause for concern. Many slate roofs in the U.S. have been installed with no felt underlayment whatsoever and they do not leak, even after a century. This is true for virtually all barn roofs, where leaking during installation was not a concern so no felt was used when the roof was installed. These roofs do not leak — felt or no felt. The felt underlayment is only essential during installation on a structure where rain water can damage the interior.

It is very bad advice to tell someone that they must replace their slate roof because the felt has worn out.

Fake “slates” should be avoided. They do not function like natural stone and will not have the longevity, although they can still be as pricey as natural slate. How can you tell the difference? It’s obvious to slate professionals, but to an untrained eye some fake slate may look like the real thing. However, no two natural slates are exactly alike. Manufactured artificial substitutes, on the other hand, will show a lot of uniformity from piece to piece.

Another myth about slate roofs is that slate is too heavy for the average building. Yet, the average slate roof weighs less than three of the cheapest asphalt shingle roofs. Roofing contractors will agree that just about any structure will hold three asphalt shingle roofs and the roofers’ rule of thumb is that after three asphalt shingle layers have been installed on a structure, it’s time to remove it all, create a huge pile of garbage, then start all over with new asphalt shingles. Better to stick with slate. At least when the slate is replaced a century or two later, what can’t be recycled onto another roof can be used as clean fill, not garbage. In short, if a roof can hold three asphalt shingle roofs, it can hold slate.

FIVE TIPS FOR HOME INSPECTORS

1) Identify the slate (see Figure 9). You can’t do this with binoculars on a rainy day. Wet slate does not look the same as dry slate. The single most important detail of a slate roof inspection is the *type of slate*. Until you determine the type of slate, you can’t do much else. Find out how old it is while you’re at it. Most slate roofs were installed when the building was erected. In any case, if the slate is still good, the roof is repairable. There is a “how to identify your slate” page at slateroofcentral.com.

2) Look at the flashings, including the chimney flashings, valleys, ridges, hip metal, plumbing vent pipes, step flashings on dormers, and any other flashings — are they tarred over? If so, they were probably leaking and likely still are. Are they pitted? They need replaced. If they’re just rusty, a good coat of paint may cure them — for now. If the slate is still good, faulty flashings can and should be maintained, repaired or replaced.

3) Look for any bad, old repairs. They will almost certainly be there. They will look like tar patches, metal patches, slates of the wrong color, shape, size or type, face nails, and exposed straps. These can all be erased and the roof put back in order, if the slate is still good.

4) If you have to get on the roof, don’t walk on it. Use a hook ladder or other appropriate means of access.

5) If in doubt, do additional research: read the Slate Roof Bible, search the web, or get an opinion directly from a slate roof professional.

In summary, just because a roof is old that doesn’t mean its time is up. Slate roofs are peculiar in this sense. Even though an American slate roof is 120 years old already, that doesn’t mean it won’t live to see its 200th birthday. That is, if roofing contractors and home inspectors, leave it alone. On the other hand, well informed home inspectors can help our communities as well as the slate roofing industry by protecting and preserving one of our nation’s most overlooked architectural treasures — slate roofs.

Author bio:

Joseph Jenkins has been in the preservation trades since 1968 and directs a corporation in northwestern Pennsylvania that provides national slate roof consulting services, slate and tile roof contracting services, slate roofing publications and slate roofing tools and supplies. He has personally worked on over a thousand slate roofs, many with an average age of one century. Jenkins authored and self-published The Slate Roof Bible, which has been recognized in four national book award competitions and presented with the National Roofing Contractors Association Gold Circle Award. He has been a presenter on the topic of slate roofs at the past eight annual International Preservation Trades Workshops and has conducted slate roofing presentations at the Natural Building Colloquium, the Roof Consultants Institute, the Restoration and Renovation Trade



Show, the Traditional Building Exhibition and Conference, and many other venues. Jenkins is on the Board of Directors of the National Slate Association (slateassociation.org) and has recently founded the Slate Roofing Contractors Association of North America (slateroofers.org). His web site at slateroofcentral.com provides information on slate roof installation, slate and tile roof repair, industry contacts, sources of materials, slate roofing tools and a message board on slate, tile and asbestos roofing. His website at joseph-jenkins.com provides information about his other books and publications.