

SLATE ROOFS

WHY LEARN THE HARD WAY?

By Joseph C. Jenkins

All roofing contractors do it at some point in time, don't they? They bite off more than they can chew by diving into a project while lacking the necessary experience. It's called "learning the hard way." Since my area of expertise is in slate roofing and I only provide consulting services for such projects, I have had a golden opportunity to observe and document the mistakes, big and small, that contractors make when installing slate roofs. Many of today's contractors are inexperienced in this age-old traditional roofing system, and even slate specialists make mistakes. I know this for a fact, as I have probably made many of them myself over the past four decades, and I confess to having jumped into jobs not knowing what I needed to know beforehand.

By documenting and illustrating some of the mistakes I have seen in the field, I hope to help others avoid making the same mistakes as well as to assist consultants in recognizing a correctly installed slate roof. Slate roofs are a wonderful architectural phenomenon, but poor installations can hurt the reputation of this excellent system.

Three Basic Components

Slate is a type of stone that readily splits like a deck of cards, thereby allowing for the fashioning of flat, long-lasting, and beautiful stone shingles. In the United States, slate shingles are typically fastened to decks using roofing nails. Most roof decks are made of wood, although a rare few are made of nailable concrete. The basic components of a slate roof, therefore, consist of three elements: the slate shingles, the deck (typically wood), and the fasteners (typically

roofing nails, but sometimes slate hooks) that attach the slates to the deck. Nothing else is needed for a successful, watertight slate roof installation – nothing. This fact has been thoroughly proven in the field by 150 years of demonstration in the United States and even longer in the United Kingdom.

In fact, my region of the United States, northwestern Pennsylvania, has more rainfall than either Portland, Oregon, or Seattle, Washington, not to mention annual temperatures ranging from -30° F to 103° F, and lots of sleet, snow, and ice during the winter months. Despite these conditions, we often do restoration work on 120-year-old slate roofs, still chugging away watertight. These consist of nothing more than the basic three elements. There is no functional underlayment on these roofs. *Figure 1* provides an example of the longevity of slate roofs still operating after more than a century, still watertight and consisting of only stone, wood, and fasteners. Incidentally, the fasteners are almost all hot-dipped galvanized nails.

Granted, a fourth element is commonly required: sheet metal flashings. Flashings seal the joints and penetrations in slate roofs, but if no joints or penetrations exist, no flashing is needed. Ridges and hips can be made

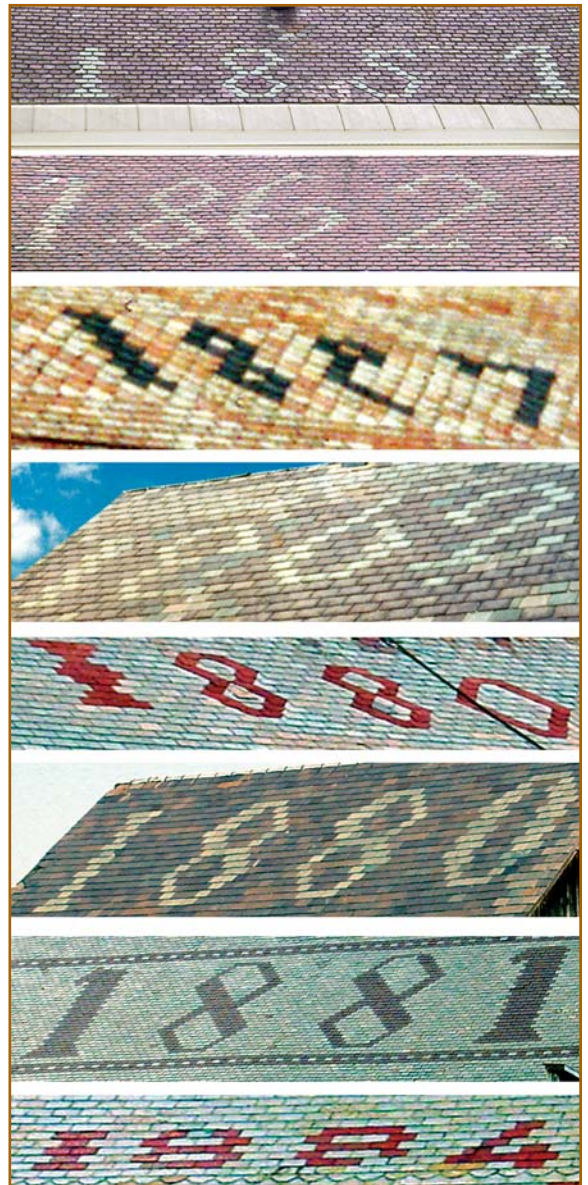


Figure 1 – These photos of existing slate roofs attest to the durability, beauty, and longevity of this natural roofing system.

of slate alone. So can valleys. Nevertheless, flashings tend to be an important component of most slate roof systems and are often a source of problems when installed incorrectly.

Most American slate shingles should have an expected longevity of somewhere between 75 and 150+ years, depending on the type of slate. Therefore, the three roof components should also have a similar longevity. If the slate is going to last 150 years, the deck and fasteners should also last that long. The best slate roofs use a good quality slate of known origin and proven performance, which is fastened with corrosive-resistant fasteners such as copper, stainless steel, or hot-dipped galvanized nails, to decks of solid wood at least 3/4-in thick. Pretty simple. So what goes wrong?

Slate Selection

Well, let's start with the size of slate selected for the project. The smaller the shingles, the more that are required to cover 100 square feet of roof – a “square.” For example, the largest standard size, 14 in x 24 in, requires 98 shingles per square. The smallest standard size, 6 in x 12 in, requires 533 shingles per square. Since each shingle is attached to the roof deck with two nails, use of smaller slate will require much more labor during installation. If a contractor is not aware of this fact, he may choose to purchase small slates simply because they tend to be considerably less expensive. In one case, this proved to be a dire error – the contractor bought 6 in x 12 in slates for a reroof on a 12-story building in Kansas, probably trying to save money on materials; then he went bankrupt halfway through the job, no doubt because his labor costs were sky-high.

The type of slate is also very important. Ideally, the slate selected for a project is a tried-and-proven material with many decades of outstanding performance in the field and is manufactured by a company that takes pride in its product. Most American and Canadian slates fall into this category. However, there are many foreign slates entering the American market these days with little or no history of performance. In one recent case, a very large two-year-old roof installed with Chinese black



Figure 2 – This Spanish black slate leached rust stains down the new slate roof. This photo shows the slate after only one year on the roof.

slates faded or changed color dramatically to create a splotchy, unpleasant black and white appearance. This entire roof had to be removed and reslated at great cost. This is not to suggest that all Chinese black slates will do this, but obviously some will. Selecting the correct slates can be very tricky when the slates come from another continent and you can't trace their origin back to any particular hole in the ground.

Some Spanish black slates are known for their pyrite content, which will bleed red rust stains down the roof. *Figure 2* shows such a slate, taken from a residence in

Florida after only one year on the roof. This large residential roof had to be completely reslated at great expense. The owner of the residence selected this slate because he liked the shade of black on a new sample piece and did not understand that some slates will change in appearance with exposure to weather. When selecting Spanish slates, it is important to know whether those being considered are pyrite-bearing, a condition that may or may not be obvious by visual inspection. In a recent case on the east coast, an entire church roof had to be reslated because the new, Spanish black slates were bleeding rust down the roof, and the church people did not like the way it looked. Again, this is not to be construed as a condemnation of all Spanish black slates, as some are quite good.

In another case, Spanish black slates were ordered for a large roof, but they were not all of the same origin. Although they looked the same sitting in the pallets on the ground, once they were installed on the roof, they created a slightly mottled look that was unacceptable to the property owner. It's hard to say who was to blame for this mistake – the supplier, who should have known he was not sending the same material to the job site, or the contractor, who did not reject the slates due to obviously different pallet markings that suggested slates of different origins. The con-



Figure 3 – Even domestic slates can rust. These Vermont slates on a high-rise apartment were poor in quality and should have been screened for pyrite inclusions.

tractor also could have prevented the unsightly, patchy mottling of the roof by thoroughly blending or shuffling the slates before installing them. This would have allowed for a uniformly mottled effect that is pleasing to the eye.

Even if the slate is from the same source, different pallets can contain different shades of slates, due to the location of the rock strata and/or other factors related to the quarrying of the material. Therefore, when the slate is delivered to the site, all of the pallets should be opened from the outset and slates should be taken from each pallet in order to

blend the entire inventory and create a pleasant appearance on the roof. It is a mistake to start with one pallet, install those slates, then open another pallet, install those slates, etc.

Poor-quality slates occasionally originate from the United States. This may be due to the manufacturer's not culling out rejects, for example. Shoddy quality control can lead to rusting pyrites on even the best American slates. *Figure 3* shows Vermont slates badly rusting down an apartment building roof. This is very unusual and indicates a commercial source of roofing slate that should have been avoided or a bargain slate that wasn't worth the money combined with a contractor who should have culled the defective slates out but didn't know what a bad slate looked like.

Follow Traditional Methodologies

There are other factors related to the manufacture of roofing slates that can affect quality and longevity. Direction of grain and nail hole placement are two examples. A good manufacturer will be aware of these nuances and strive to produce top-quality slate. It pays to buy from such a slate source.

Once the correct slate has been selected and delivered to the job site, it's time to begin installation. Styles and methods of installation can vary greatly, but one impor-



Figure 4 - Traditional slate roofing systems, despite their incredibly successful performance, are being largely abandoned in favor of plywood roofs with peel-and-stick underlayments.

known methods and materials that have proven longevity. A solid, nonlaminated wood roof deck, with the emphasis on correct slate and flashing installation and not on underlayment, has proven to provide exceptional longevity. Such traditional methods and materials can easily be replicated today, yielding the same degree of success.

Modern asphalt roof installations rely on plywood decks and self-adhered modified bitumen or other heavy underlayment, creating a roof deck system that strays widely from traditional slate roofing systems. Traditional systems made of board

decks and slater's felt (30-lb felt) allow for the transpiration of air through the roof deck, which enables the roof to "breathe,"

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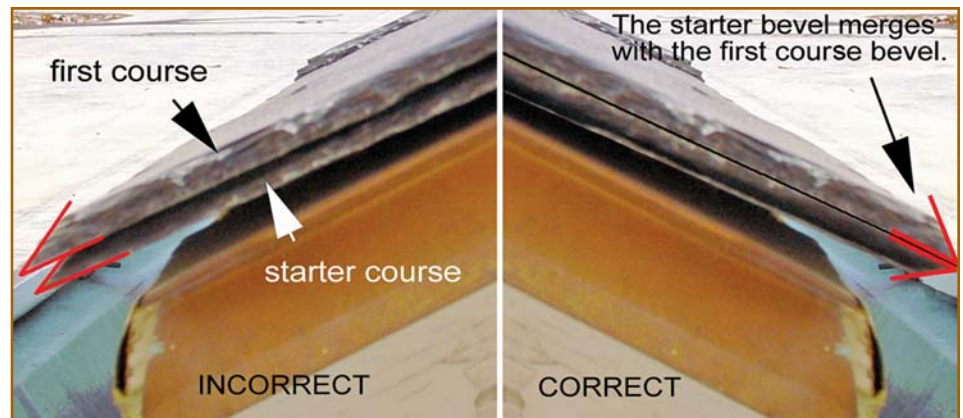
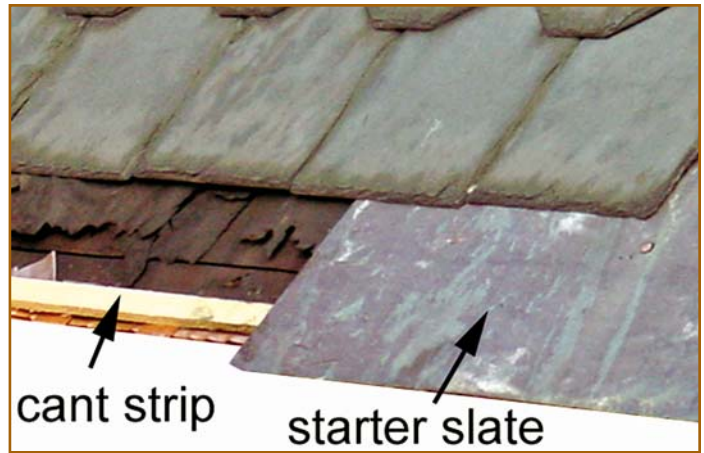


Figure 5 - The starter course should be flipped over and laid upside down as shown on the right in this illustration. This creates a clean drip edge and allows for correct nail countersinking.



Figure 6 - No slate lies flat on a slate roof. Every slate is angled, which is why it should not be walked upon and why the starter course requires a cant.

Figure 7 – Note that the starter slate is laid backside up and is propped up by a cant strip.



allowing it to dry out should water ever penetrate the roof covering. The boards won't wick moisture through wide areas as laminated decks will, so that if the roof deck becomes water damaged, it can be repaired easily. The thin, temporary felt underlayment on a traditional slate roof will slowly disintegrate over time, allowing for the free use of the slate-ripping tool, which slides under the slate and is so essential to the repair and maintenance of the roof. Heavy underlayments can dry up and crack underneath the slate, impeding the use of the slate ripper, making repair and long-term maintenance a nightmare.

Figure 4 shows a 150-year-old slate roof being replaced in Boston. Although the roof was still functioning at the time of replacement and the existing roof system – made of slate, 1-in boards, 30-lb felt, and nails – had demonstrated a 150-year performance, the contractors who replaced the roof completely abandoned the existing system and replaced it with one that had no proven longevity, emphasizing underlayment and completely eliminating any chance of air transpiration. The original 1-in roof board deck, still sound, was covered with ½-in plywood, then self-adhered modified bitumen, then 30-lb felt, and then slate. Will this new roof system last 150 years? Time will tell, but why reinvent the wheel? A chain is only as strong as its weakest link. Traditional, 3-link slate roofing systems have already proven themselves, are less expensive, are more environmentally friendly, and take less time to install. If one wants to guarantee that a slate roof will last a century or two, traditional methodologies should be followed.

Common Installer Errors

Let's look at how traditional slate roofs are correctly installed, and let's identify where contractors go astray, beginning with the starter course. The starter course is the very first row of slates to be installed. Starter slates are invisible once the roof is completed, because they're hidden underneath the first course of slate.

There are several common mistakes made when installing starter courses. For one, the starter course slate should be installed face down, unlike all the other slates on the roof, which are installed face up. Technically, this is not a significant functional mistake because the roof will still perform correctly whether the starter slate is face up or face down. However, nail holes on starter course slates are punched at the

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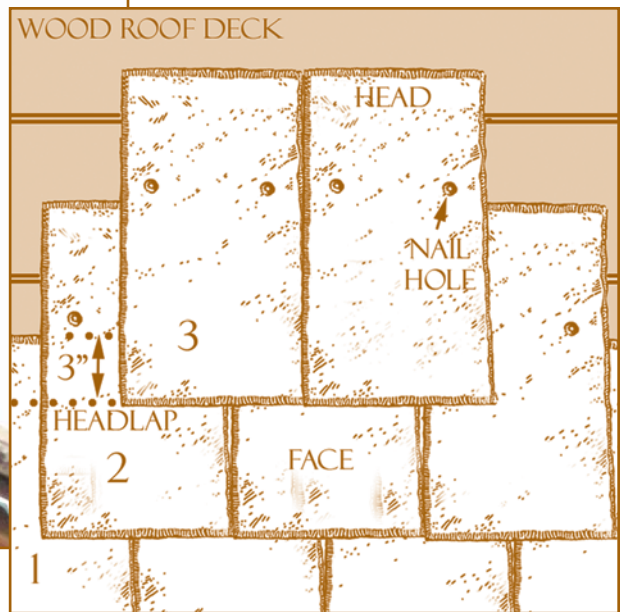
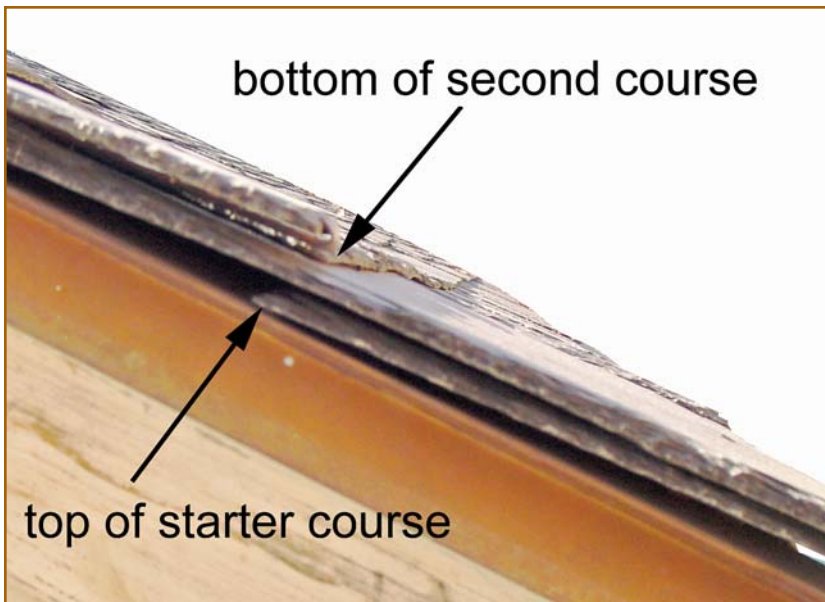


Figure 8 – The starter course should be overlapped by the second course by at least three inches. In this case, it is not overlapped at all. This is a serious but common mistake. Note also that the starter slate is incorrectly laid backside down. This is an indication that the installer was inexperienced in laying slate.

Figure 9 – Headlap is a critical detail on a slate roof. Lack of headlap will cause an entire roof to be condemned.

quarry with the intention that the slates are to be installed face down. This allows for a clean edge where the starter slate meets the first course (Figure 5). The reason it's important to know this information is because the orientation of the starter course is an indi-

cation of whether the slate installer has had much experience. Inexperienced installers often put the starter course face up.

Often, the cant or shim strip is missing underneath the starter course. Starter slates must be angled on the roof in order to

match the angle of all the other slates in the field of the roof. No slate lies flat on the roof because every slate is overlapping other slates, as shown in Figure 6. Since the starter course does not have a course of slate underneath it, something else must



Figure 10 – This is an example of inadequate headlap on a shopping center roof in Louisiana.

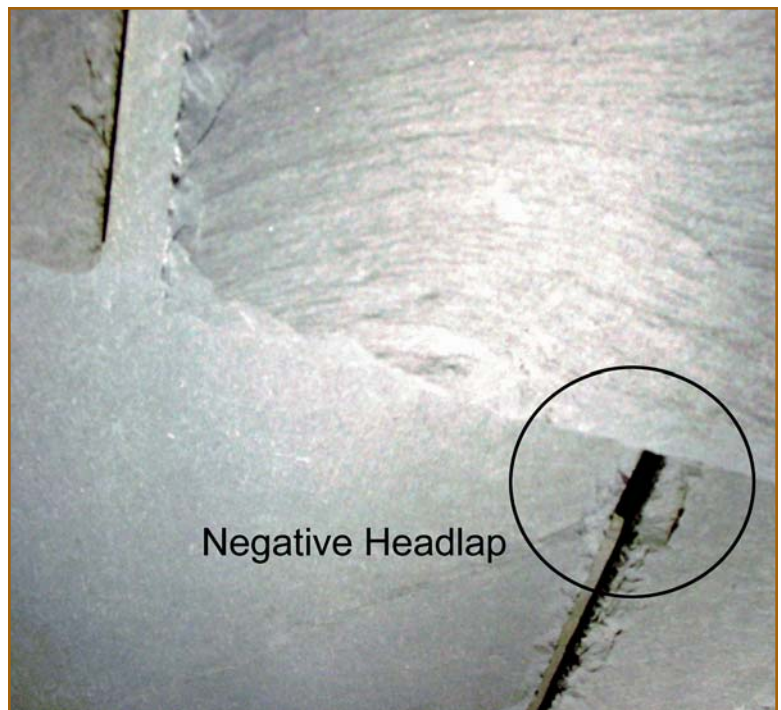


Figure 11 – When the slate courses are spread too far apart vertically, negative headlap can result. Although this requires fewer slates to cover the roof, it also creates holes all through the roof. There is no remedy for an egregious error such as this other than to remove the entire roof and start over.

Figure 12 – “Sidelap,” or lateral overlap, should be a minimum of 3 in. Here we see no lateral overlap at all. This entire roof had to be removed and reslated, as it also had no headlap.

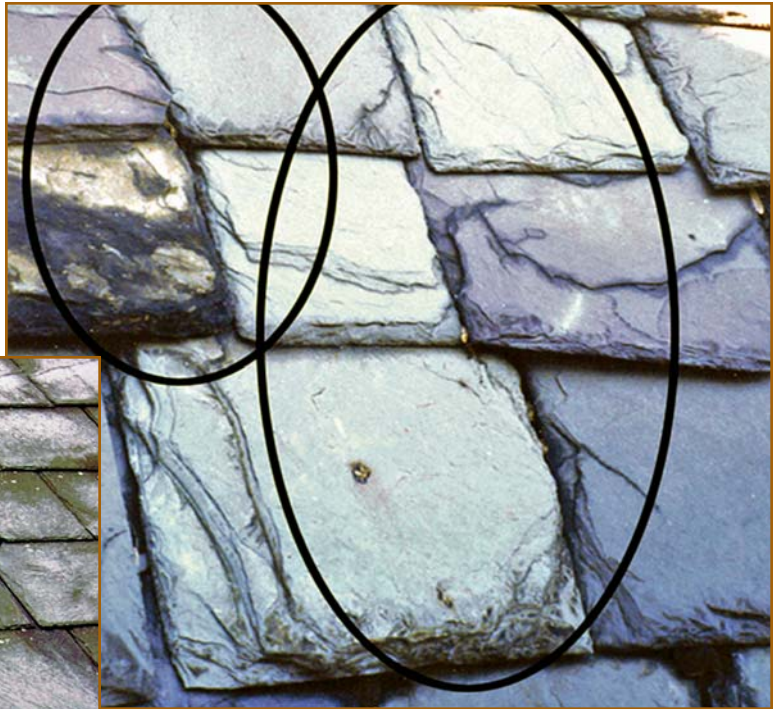


Figure 13 – Each slate side-butt should be staggered so as to break the course below down the center. Instead, these slates were butted directly over the underlying slating nails, ensuring leakage.



installed under it to create the proper angle. Typically, this is done by installing a wood strip (*Figure 7*), but it can also be achieved by using a metal drip edge with a cant formed into the metal, or even by raising the fascia.

Another very common mistake on starter courses is a lack of headlap, especially when the field slates are turned side-

ways and used for starter slates. The second slate course must overlap the starter course by a minimum of 3 in. Inexperienced slaters often overlook this important detail. Since the bottom of the roof has more water running over it than virtually any other part of the roof, it is imperative that the headlap on the bottom courses of slate be correct. An example of a starter course lacking headlap is shown in *Figure 8*.

Speaking of headlap, this is one of the first details that a roof consultant should look for on a new slate roof installation. If the headlap is missing or inadequate, the roof is probably going to be condemned. Headlap is the overlap on each course of slate by the second course above it (*Figure 9*). This overlap is what prevents the roof from leaking. Three inches is standard, but headlap can vary according to the slope of the roof. *Figure 10* shows a newly installed shopping center roof in Louisiana with about an inch of headlap on the field slates. The overlap should be 3 in. There is no fix for this inadequacy other than to rip off the entire roof and start over. *Figure 11* shows a university building roof in Pennsylvania with a new slate roof – and, incredibly, negative headlap. This is the same as having holes all through the roof. It’s hard to believe that roofing contractors can make

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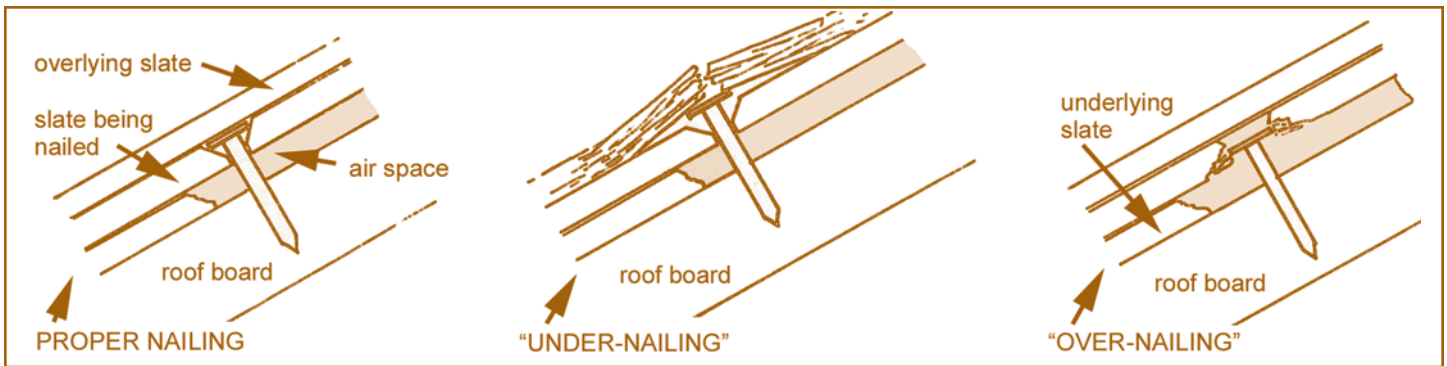


Figure 14 – A good slater has no problem nailing slates correctly. When properly nailed, the nailhead just sits down inside the slate. When undernailed, the protruding nailhead, over time, can damage the overlying slate. When overnailed, the slate being nailed will crack, break, or cock awkwardly on the roof.

such drastic mistakes, especially on institutional buildings, but seeing is believing.

Lateral overlaps or sidelaps should also be 3 inches minimum. However, don't be surprised to see slates with no lateral overlap at all, as shown on an historic building in Georgia (Figure 12). Incorrectly placed sidelaps can leave the butt joint directly over the slating nails, as shown on an historic Pennsylvania State Park building in Figure 13. This will allow direct water entry through the nail holes.

Another common installation mistake is the overnailing and undernailing of the slates. Slate nail holes are meant to be crater shaped to allow the nail head to sit down inside the slate (Figure 14). Otherwise, the nail head will protrude and rub against the overlying shingle, eventually creating a hole (Figure 15). When the nail is not driven far enough, this is known as undernailing. Overnailing, on the other hand, is when the nail is driven too far and breaks through the slate. This leaves the slate hanging on one nail or sliding out altogether (Figure 16).

Nail length is an issue that is commonly off the radar screen of the average roofing contractor. The slating nails should barely penetrate the roof deck boards. If the nails are too long, they break through the back of the boards and splinter out of the wood, reducing the board thickness where the nail is located and undermining the effective holding power of the nail (Figure 17).

A very common error with new slate roof installations is what I call the Bigfoot Syndrome – roofers walking on the slates during installation, as shown in Figure 18 on a new bank building in Kansas. An experienced slating crew will make every effort to keep off the slates during installation by staging the roof correctly (Figure 19). When Bigfoot walks all over the slates, the shin-

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Figure 15 – A protruding nailhead can eventually wear a hole in the overlying slate.

Figure 16 – This slate was nailed so tightly that the nails broke through the slate and the slate is now sliding out of place.

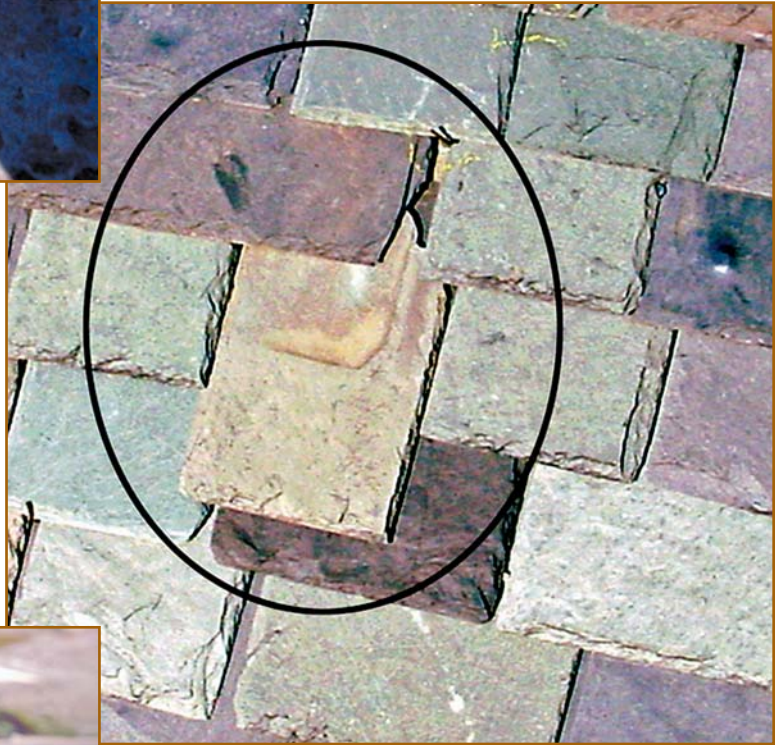


Figure 17 – When the slating nails are too long, the back of the roof decking breaks out. This reduces the effective holding power of the nail. A longer nail, therefore, does not mean more holding power. The best nail length just barely penetrates the roof deck.



Figure 18 – It is a mistake to walk on a slate roof during installation.

Figure 19 – A correctly staged slate roof will enable roofers to install the slate without needing to walk on the shingles.

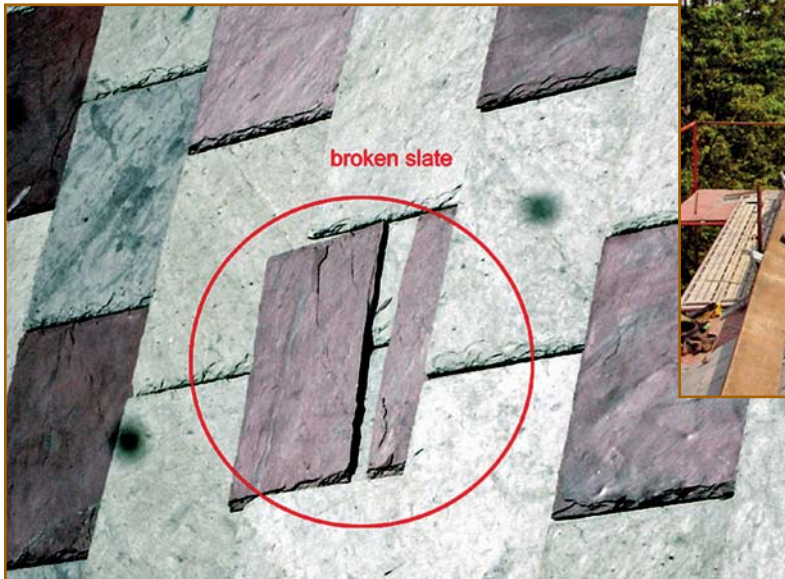


Figure 20 (left) – Slate roofs that are walked on during installation will shed slates after the roof has been installed, perhaps for years.

order to prevent leakage through the corner. If a corner isn't folded or soldered, as shown in *Figure 22*, then the only thing keeping it from leaking is caulk or sealant, which do not have adequate longevity. An incorrectly folded chimney corner is illustrated in *Figure 23*. This is a leak waiting to happen. Dormers also often have corners that need to be flashed. Without folded or soldered corners, a dormer can be left wide open and waiting for the first good rainstorm (*Figure 24*).

Figure 21 – Uphill flashing should always lap on top of downhill flashing. Negative overlap, as shown, will leak.

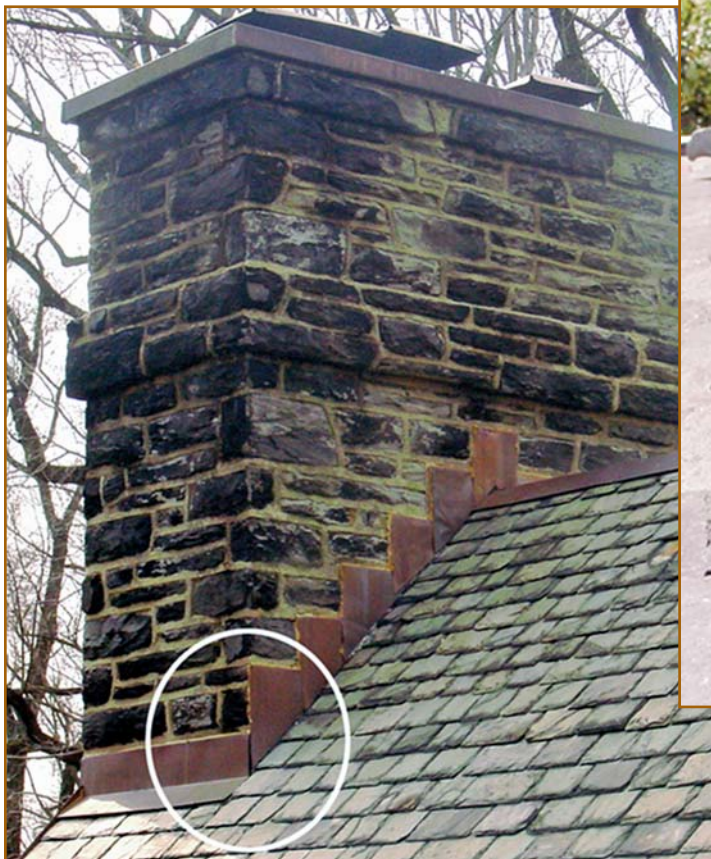
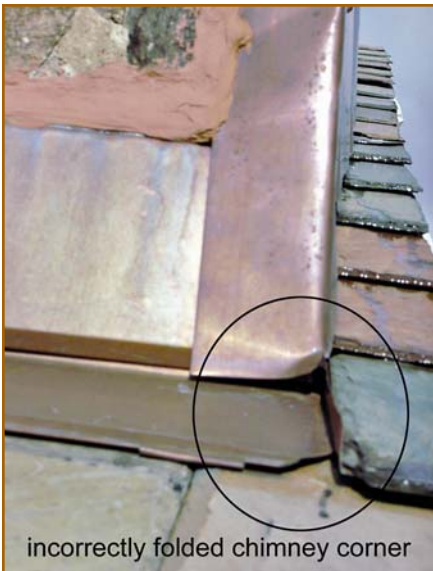
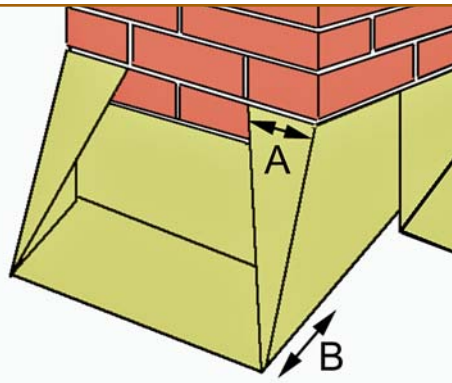


Figure 22 (left) – Chimney corner flashings should be either folded or soldered. If neither is evident, then the corner is either sealed with sealant or not at all. In either case, this is a leak waiting to happen.



incorrectly folded chimney corner



A correctly folded chimney corner will ensure that A) water running down the chimney will not enter the corner, and B) water running down the roof will not enter the corner.

Figure 24 - This is a case in which the corner flashing is neither folded nor soldered, leaving a large hole in the roof and clearly showing how corners need special attention in order to prevent leakage.

Figure 23 - This chimney corner flashing (left), although folded, was installed incorrectly and will surely leak. A properly folded corner flashing must account for the water that runs down the chimney as well as the water that runs down the roof. In effect, the flashing should create a "mini-roof" over each corner.

Common on many slate roofs are built-in gutter systems. "Box gutters" require expansion joints, but they're often installed without any allowance for expansion whatsoever. This becomes evident by the failure of the solder joints (Figure 25), which are then often roof-cemented after they start leaking in order



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Figure 25 – This is a perfect example of a new built-in gutter showing failed solder joints because not a single expansion joint was installed in the gutter system.

to alleviate the water penetration (Figure 26). Expansion joints (Figure 27) can be added after the gutters are installed, but it's a lot easier to install the gutters correctly in the first place.

A common sight on new slate roof installations is incompatible metals, often steel and copper used together (Figure 28). The copper will “eat” the steel, causing steel fasteners to degrade at an accelerated rate.

Another incompatible metal error involves copper rivets. Many roofing supply outlets sell copper rivets with copper-plated steel mandrels. When the rivet is installed, the steel mandrel breaks off inside the rivet, lurking inside to eventually rust and create a hole in the flashing. These rivets look like they're made of copper, but they aren't. Check them with a magnet to be sure. Copper is not magnetic, but steel will stick to a magnet like glue, so if your rivets are magnetic, don't use them with copper. Copper rivets should have non-magnetic brass mandrels, not steel.



Figure 27 – Expansion joints allow built-in gutters to move when expanding and contracting, thereby relieving the stress on the solder joints and prolonging the life of the gutter.



Figure 26 (above) – Box gutters require expansion joints; otherwise, the solder joints will crack under pressure. This is evidenced by solder joints that have been covered by roof cement, a common sight on box gutters, both new and old.



Figure 28 – Metal fasteners should always be compatible with the metal they are fastening. Steel fasteners on copper, as shown, will deteriorate.

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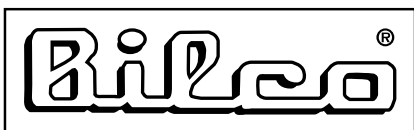
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Top of gutter should clear plane of roof.



Figure 29 – Ideally, the outer edge of external rain gutters should be hung below the plane of the roof to prevent damage to the gutters from sliding ice and snow.

Open-flame torches should never be used to solder flashings, so if you see a worker on a roof soldering a box gutter with an open-flame plumber's torch, say something. The flame is too hot and will ignite the substrate, be it felt paper or rosin sheet, which will then smolder underneath the metal, perhaps unnoticed until it's too late.

If the smoldering is noticed, panic will ensue because there is no way to get to the fire without first ripping out the flashing. The correct tool for a soldering job is a closed-flame soldering device or a heavy-duty electric soldering iron. Open-flame devices can be used on external copper gutters, however, when the metal is not in con-



Figure 30 – This gutter is just waiting for a snow avalanche to knock it off.

Figure 31 – Snowguards must be installed in adequate quantities, or they will get knocked off in the first bad ice storm, damaging the roof in the process.





Figure 32 – Diamond blades cut a square edge on slates, making them stick out like a sore thumb.

tact with the roof.

Speaking of gutters, they're often hung too high. The outer edge of external gutters should be below the plane of the roof (Figure 29) if the gutters are in locations where snow or ice could slide down the roof and knock them off. The gutter in Figure 30, for example, will not last long.

Snow retention systems are another source of problems when they're installed incorrectly. One of the tricks for a proper snowguard installation is to use enough of them. Otherwise, they won't be able to hold the weight of the ice and snow and will rip out, taking slates with them. A poor snowguard installation is shown in Figure 31. Insufficient snowguards on this large roof

caused many of the devices to rip out during an icy winter. Follow the manufacturer's guidelines when installing these important slate roof elements.

Incorrect tools can be the downfall of many a would-be slater. Slate roofing has its own unique set of tools and equipment. For example, slates should be cut with – you guessed it – “slate cutters.” A slate cutter will leave a beveled edge on the shingle, thereby allowing it to match all the other shingles on the roof, all of which have beveled edges. If a diamond blade is used to cut the slates, a square edge remains, which can stick out like a sore thumb and get a roofer into big trouble if the property owner doesn't like the look of it. Figure 32 is



Figure 33 – Slate roofing requires the correct tools to do the job right. There is no excuse for the sort of work shown here.

BUILDING ENVELOPE KNOWLEDGE ASSESSMENT

Test your knowledge of building envelope consulting with the following questions developed by Donald E. Bush, Sr., RRC, FRCI, PE, chairman of RCI's RRC Examination Development Subcommittee.

1. What is the definition of a monomer?
2. What is a micron?
3. What is a Newton (N)?
4. What is olefin?
5. What is the formula for determining the percent of water by volume in a sample?
6. What is the formula for determining the percent of water by weight?
7. Steel deck design requires special attention to which four items?
8. What are the three basic wind-speed determinants?
9. Which four basic variables are identified as crucial to the final design wind-uplift pressures?

Answers on page 30


BUILDING ENVELOPE KNOWLEDGE ASSESSMENT

Answers to questions from page 29:

1. A simple molecule that is capable of combining with a number of like or unlike molecules to form a polymer.
2. A unit of measurement equal to 10^{-6} m (0.000001 m) or 10,000 Angstrom.
3. The SI unit of measure for force.
4. An unsaturated, open-chain hydrocarbon containing at least one double bond: ethylene or propylene.
5. $\frac{\text{Volume of water in sample}}{\text{Volume of sample}} \times 100$
6. $\frac{\text{Sample weight wet} - \text{sample weight dry}}{\text{Sample weight dry}} \times 100$
7. Side-lap fastening, end-lap detail, span, and thickness.
8. Geographic location, local topography, and elevation.
9. Wind velocity and building size, shape, and wall openings.

Reference: *Manual of Low Slope Roof Systems*, Edition 4. Glossary (Questions 1-6), Chapter 4 (Question 7), and Chapter 7 (Questions 8 and 9).

a perfect example of square edges exposed at the wrong place on a slate roof. These square edges could be dressed with a slate hammer and stake to give them the proper appearance, but one first must have these tools in the toolbox. When the proper cutter is not on hand, a roofer may resort to drastic measures to try to cut slates, as shown in *Figure 33*, where it looks like the slates were chewed off. This brand new roof, by the way, also had to be completely removed and reslated, causing the property owner much expense and grief.

Hopefully, you've gained some knowledge from this little sampling of slate roof mistakes. Slate roofing is not rocket science, and any reasonably intelligent person who takes the time to become informed about the topic will be able to successfully install a roof sure to last for many generations. There are plenty of slate roof resource materials available, both in print and on the Internet. A couple hours of research can save a roof installer a lot of problems, including ulcers and litigation. Slate professionals long for the day when every slate roof is installed free of major defects. In the meantime, they won't be holding their breath waiting. 

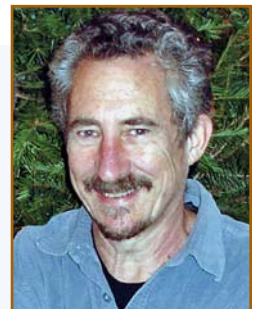
Resources

- Joseph Jenkins, *Slate Roof Bible*, 2nd edition. Available from joseph-jenkins.com, amazon.com, rci-online.org, or via any major bookseller.
- *Traditional Roofing Magazine* – a free magazine supported by advertisers and focusing on slate roofing but also including other traditional roofing systems. All articles are posted at www.traditionalroofing.com after the print version has been circulated. Sign up for a free subscription at traditionalroofing.com.
- Slateroofcentral.com – Source lists, contractors, tools, materials, supplies, public message board, instructions, illustrations, and more.
- Slateroofers.org – the official Web site of the nonprofit Slate Roofing Contractors Association of North America.
- Josephjenkins.com - source of tools, materials, supplies, and equipment related to the slate roofing trade.

All photos by Joseph Jenkins.

Joseph C. Jenkins

Joseph Jenkins, president of Joseph Jenkins, Inc., near Grove City, PA, has been involved in the slate roofing trade since 1968. His company provides slate roof consulting services nationwide, slate and tile roof contracting in northwest Pennsylvania, and slate roofing publications, tools, and supplies internationally. Jenkins also speaks on the topic of slate roofs in the U.S. and abroad. During his career as a contractor, Jenkins has personally installed and restored over 1,000 slate roofs. He authored and self-published the award-winning *Slate Roof Bible* in 1997, now in its second edition, and edits and publishes the *Traditional Roofing Magazine*. He founded the Slate Roofing Contractors Association of North America, Inc. in 2005 and is a member of RCI.



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