

What Roof Consultants Need To Know About Slate Roofs

By Joseph Jenkins

Slate roofs are roofs made of rock mined or quarried from holes in the ground, pits, tunnels, and deep shafts. It is hand worked into manageable sizes then split into roofing shingles with hammers and chisels. The finished shingles are punched for nail holes, and the thin slabs of stone are fastened to the roof deck with nails. A good slate roof will last a century and maybe two. Commercial roof slate quarrying began in the U.S. around the mid 1800s.

There are two general categories of slate roofs upon which a roof consultant will be called to provide consultation services. They are 1) older slate roofs and 2) new slate roofs. By far the most common slate roof in the U.S. and in the world is an older slate roof, which can easily last a century or more in good working order. Therefore, the bulk of this article will focus on older slate roofs. However, roof consultants are also called upon to provide advice when replacing or installing a slate roof. This matter is addressed later in this article.

OLDER SLATE ROOFS

Traditional slate roofing is a fabulously successful system that can easily function as a waterproof covering for 100 years, and, if properly constructed, for 150 years or even 200 years. Some slate roofs in Europe are still in good functioning condition after 400 years. Their longevity, however, is not their only attribute. Slate roofs are made of natural materials – primarily stone (slate) and wood (boards or lath/battens) with metal fasteners (nails). They are simple roofing systems, and they're beautiful to look at. When they do need to be replaced, they can be discarded as clean fill. As

such, they are roofs that are sought after by those who have ecological concerns.

Slate roofs are arguably the least expensive roofs money can buy when the entire life of the roof is taken into consideration. A 120-year-old slate roof on a cathedral in Arkansas cost \$765 for the labor and \$1,166.50 for the materials in 1881 to install the 117-square, ornate roof, including a 220-foot spire. Adjusted for inflation, it should be obvious that this was money well spent, averaging about \$16 per year over the life of the roof (See Photo 1).

Why Older Slate Roofs Fail

There are two main reasons why older slate roofs fail: 1) type of slate used: and 2) flashing failure.

Type of Slate

The primary reason older slate roofs fail is because of the type of slate; some types wear out sooner than others. There are many types of roofing slate and they each have their own particular qualities. On the 120-year-old cathedral roof mentioned above, for example, the slate was installed with an ornate pattern of

Photo1: Cathedral of St. Andrew, Little Rock, Arkansas, showing two types of slate: PA black and VT unfading green.

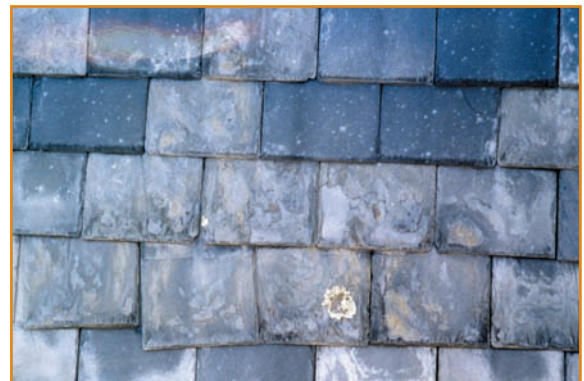
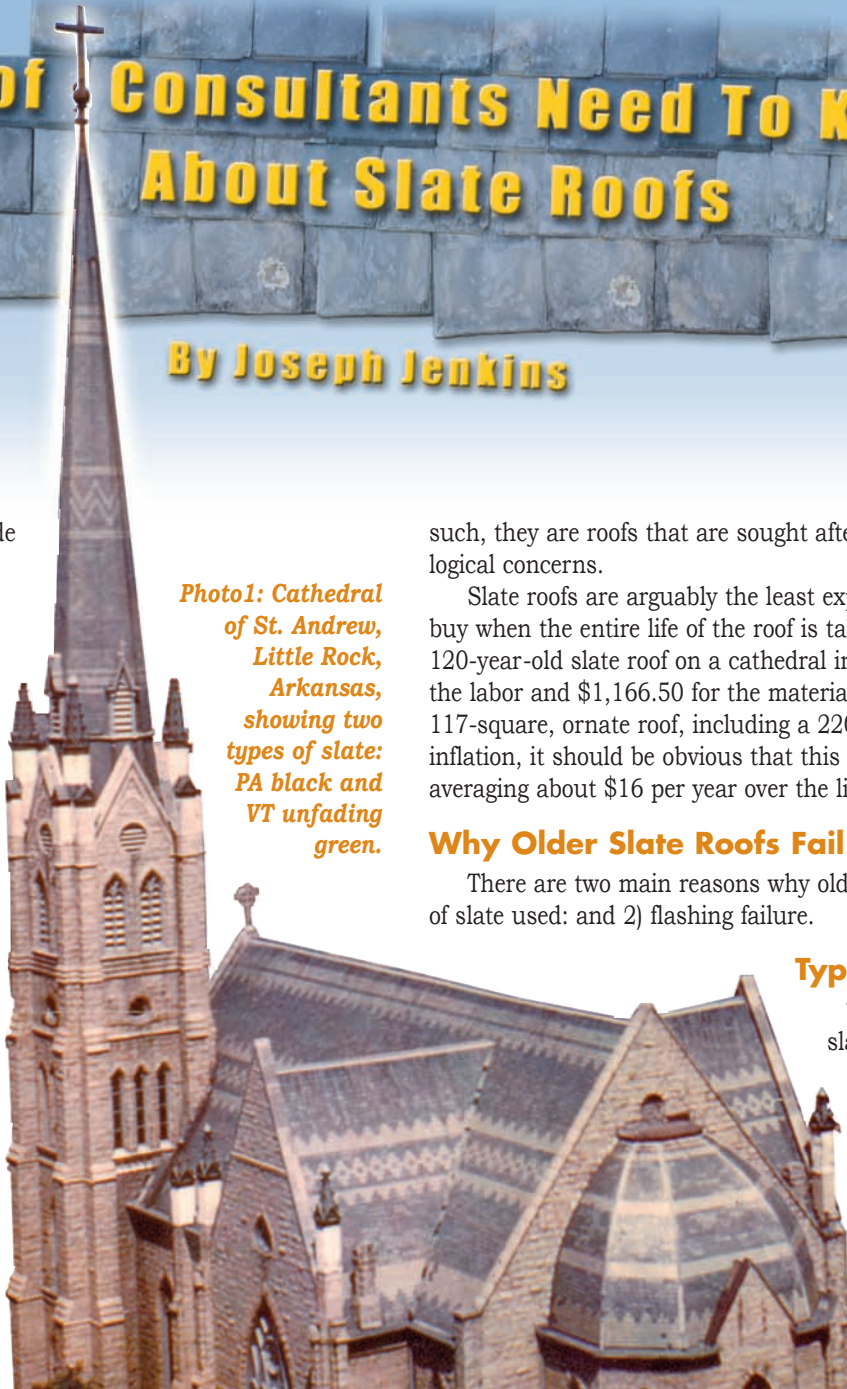


Photo 2: Softer Pennsylvania black slate, 120 years old, on cathedral in Little Rock.



Photo 3: Pennsylvania black and Vermont unfading green slate, 120 years old, on St. Andrews Cathedral. Black is worn out; green is still good.

black and green slate. The green slate originated in Vermont, while the black slate originated in Pennsylvania (Photo 2). The black slate had a life expectancy of about 120 years and was showing a lot of delamination and crumbling. The slates had served their useful life and were now failing. The green slates, on the other hand, showed no deterioration after 120 years (Photo 3). It's anyone's guess how much

longer they would last. If the entire roof had been installed with the green slate, it would not have needed to be replaced at this time.

It is imperative that roof consultants know the different types of slate, their origins, longevities, characteristics, and qualities and to be able to identify them by sight. If sight identification is not possible, then they must be able to send a slate sample somewhere to have it identified. Presently, in the US, roof slate is still being quarried in Virginia, Pennsylvania, New York, and Vermont. A century ago, not only were there hundreds more quarries, but they were also located in Maine, Georgia, and Maryland. The differences between the slates from the various quarries were sometimes phenomenal; therefore, some knowledge of the history of slate quarries is also important for roof consultants who work with older slate roofs.

It must be pointed out that roof slate has been quarried and mined in Europe for centuries. While Wales has perhaps some of the oldest slate quarries in the world, Spain is now the largest producer of roofing slate in the world, and China has entered the market in a big way. Slate is also produced in South Africa, India, central Europe, Italy, and elsewhere throughout the world. These foreign slates are now entering the American market and being used on new roofs.

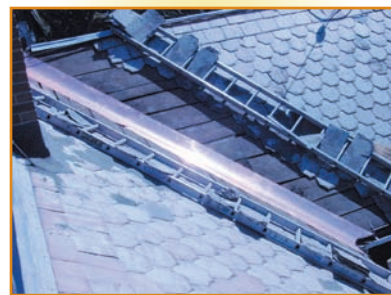
Flashing Failures

If a roof is composed of very long-lasting slate material, the metal flashings will wear out and leak before the slate wears out. These flashings are metal joints that are installed between the various planes of the roof in order to prevent water entry. They are also installed around roof penetrations such as chimneys. The older flashings were usually made from terne-coated steel (steel coated with a combination of tin and lead, known colloquially as "tin") that had to be painted regularly to avoid corrosion. Copper flashings were also used, primarily on institutions and upper-scale residences. The terne 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 service lives.

When flashings begin to fail on a roof that is made of sound slates, only the flashings should be replaced, not the entire roof. This is routine work for slate roof restoration professionals (Photos 4, 5, and 6). One of the extraordinary characteristics of slate roofs is that they can be taken apart and put back together. Broken slates, worn flashings, rotted sheathing boards, or any element 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.

When repairing or restoring a slate roof, individual slates are removed to expose the existing flashings, which can then be removed and replaced. The removed slates can then be put back into their original positions, and the repaired roof will look much the same as it did before the repair. Faulty slates are also removed in order to be replaced, and matching slates must be used whenever possible. The tool required for removing slates from a roof is the slate ripper (Figure 7), a sword-like object that slides under the slate to be removed and pulls out the two nails that hold it in place. Rippers do not cut the nails as many



Photos 4, 5, and 6: Typical flashing repair – before, during, and after: valley replacement on badly abused residential slate roof.

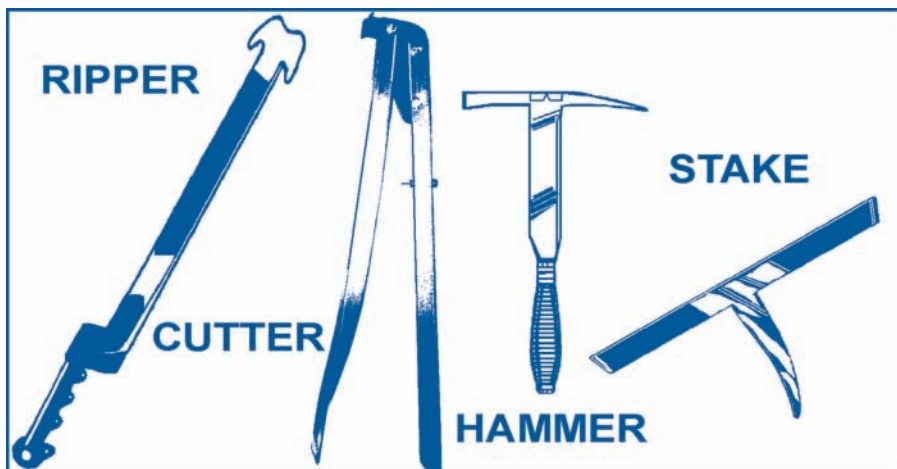


Figure 7



Figure 8

people believe, as cut nails leave a nub under the slate that makes it difficult to slide a replacement slate into place.

A slate hammer has a hole punch at one end, used to punch holes in slates for nailing. Slate hammers also often have shanks designed to cut slates, which is done by a chopping motion against a straight edge such as a slater's stake. Slates readily punch without breaking, leaving a clean hole with a "counter-sunk" characteristic into which the nail head sits. Slates are also readily cut with a simple hand-held device, a slate cutter. Slate roofing contractors work on slate roofs using hook ladders (Figure 8), intended to keep their weight off the slate while giving them a safe work platform to cling to. It is improper to work on slate roofs by walking on them using ropes. It is also improper to tar the surfaces of slate roofs. Slate is an excellent material to work with, having extraordinary physical characteristics. It does not shatter like glass, as many people believe.

Additional Assessment Considerations

There are additional nuances involved with older slate roofs, such as types of nails, underlayment, roof sheathing or battens, slope, and previous maintenance. These factors will influence the longevity of a slate roof.

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 accessible. These repairs tend to be done poorly; the roof will still leak, resulting in more traffic, 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. 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 rarely the case. 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 installed, and 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 and peg combination was then hung over a horizontal lath on the roof - no nails were used (see Figure 9). The weight of the slates overlapping each other held the roofing in place.

In the U.S., slates are secured in place with two nails situated about a third of the way down the slate, along the outside

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Photo 9: Barn roof showing lath roof decking. 100-year-old white oak lath is still in good condition despite the totally deteriorated valley flashing.

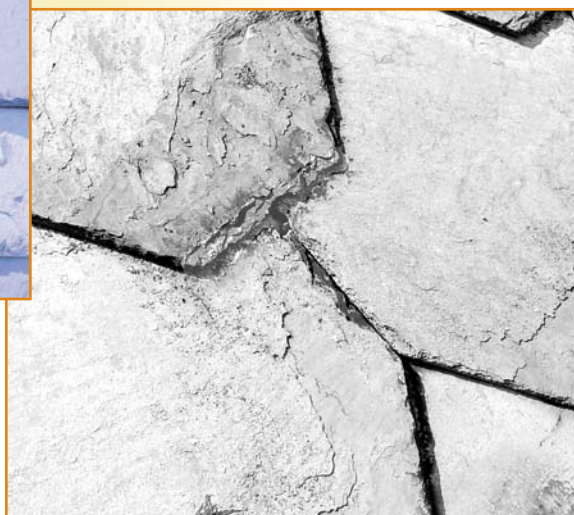
edges. The slates are nailed into boards (roof sheathing – usually one inch thick) or into horizontal wooden strips (slating lath or battens, usually one by twos or threes), depending on the preference of the installer. Lath roofs are common in Wales, England and Europe, so immigrants from those countries may have chosen to copy 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. Most of the older slate roofs in the U.S. are nailed with hot-dipped galvanized roofing nails, although most institutional and upper-scale residential roofs are nailed with copper nails. Some older slate roofs are nailed with square-cut iron nails. Many a hot-dipped nail that has been on a slate roof for 100 years 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.

The need for felt underlayment on slate roofs is another “urban myth,” so to speak. The most common underlayment on older slate roofs is 30-pound felt. It is used in order to prevent leaking during installation. After about 75 years, the felt deteriorates almost to a powder under 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. The felt underlayment is only essential during installation on a structure where rainwater 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, although this sort of advice is often given by roofing contractors or consultants who haven’t the slightest idea what they’re talking about.

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Finally, one of the most common causes of leaks in older slate roofs is, unfortunately, improper repairs (*Photos 10, 11, and 12*). Bad repairs will still leak, they look ugly, and they can be very costly because the owner usually has to pay to correct them. These combined factors 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. In addition, roofing contractors, as well as consultants, who have little or no expertise in slate roofs,

will advise an owner to replace a slate roof that may have many decades of life remaining. A client will listen to bad advice when it is the only advice that can be found. (See *Figure 13*.)



Photos 10, 11, and 12: Typical bad repairs. 10: wrong type and shape of replacement slate, face-nailed through overlying slates; ugly and a sure leak. 11: Nail in slot to fasten replacement slate, then caulked – another sure leak (should have used a bib flashing). 12: Nail in slot without caulk or bib flashing becomes a “hidden leak” because the hole is almost invisible.



Figure 13: Standard methods for replacing slates in the field of the roof include the nail-in-slot and bib method (left) and the slate hood method (center). The exposed strap method (right) is to be avoided).

New Slate Roofs

Roof consultants will be called upon to advise on the installation of new slate roofs. This is where the tar will hit the fan in some modern roofing circles. There exists today such a wide gap between natural, traditional roofing techniques and modern, chemically-based roofing techniques, that most roofing contractors and architects are experienced only in the latter. They therefore specify slate roofs as if they are just a variation of an asphalt shingle roof, which they are not. Slate roofs are expected to last a century or two, and the materials used in conjunction with the slate should have that degree of longevity, at least. Asphalt and chemically-derived roofing has an average life expectancy that doesn't begin to approach that of slate.



Photo 14: A fully sheathed board roof deck with a temporary 30-lb. felt underlayment is a very successful tried and proven roofing system used with slate roofs and should be used with all new slate roofs for best results. The felt is optional. No underlayment is needed for the proper functioning of the roof. The valley replacement on a 104-year-old church shown above reveals the 1" hemlock board decking and the complete absence of underlayment. The slate is PA black, still in good condition. No water can penetrate the slate/copper roof system, which is why the underlayment is optional.

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Therefore, asphalt roofing systems should never be used as a pattern for slate roof installation.

The common steep-slope asphalt roof system of today employs a plywood or other laminated or glued wood product deck, often covered with a self-adhesive underlayment. A properly installed slate roof, however, will avoid any laminated or glued wood product for decking, as these materials have no record of the longevity required for a slate roofing system. Self-adhesive underlayment is a product designed to prolong the life of laminated wood decking, and therefore has no real purpose on a properly constructed slate roof (*Photo 14*).

A proper slate roof, built according to traditional American techniques, will have a board roof deck – either one-inch thick, rough-sawn lumber, or 3/4" planed, kiln-dried lumber, or 1-1/2" planed, kiln-dried lumber (more common on institutions). Tongue-and-groove lumber is also used. The nails used on new slate roofs should be either copper or stainless steel, although hot-dipped, galvanized nails can last a century or longer. Aluminum nails and electro-galvanized nails should be avoided.

It should go without saying that the design of the roof itself adds much to its effectiveness and longevity. Low slope slate roofs, for example, should be avoided. For best results, slate roofs should be designed so they're too steep to walk on. Also, non-corrosive flashings should be used, such as terne-coated stainless steel or copper. The flashing can be eliminated altogether, in some cases, by designing the roof with rounded (slated) valleys and slate hips and ridges, as is more common in Europe.

Roof ventilation is a big issue today in the roofing industry, as it should be. Asphalt roofing shingles nailed or stapled onto plywood decks are roof systems that will not breathe – they suffocate the roof, and proper ventilation is imperative. Otherwise the plywood can delaminate, and the roof may fall apart. Slate roofs attached to board decking, on the other hand, are breathable roof systems. They are not air-tight, they're watertight. Ventilation may be necessary to prevent condensation under the roof sheathing from warm inside air leaking into the attic space. This is easily achieved with gable vents or roof vents, air spaces between the insulation and the sheathing, and ventilated soffits. However, most older residential slate roofs had no particular ventilation systems associated with them. After a century, most are still in good working order. Such is the advantage of a roof that can breathe on its own.

When these older slate roofs are retrofitted with insulation, care must be made to ensure that warm air will not come in contact with cold roof sheathing. Aluminum ridge vents should be avoided on slate roofs. Such vents are designed to be used with asphalt shingles; they do not fit the ridge of a slate roof well, and they interfere with the normal maintenance of the roof.

New slate roofs are only as good as their installation.

Contractors who are skilled at asphalt roofing are not necessarily qualified to install slate. For example, many new slate roofs today are having serious problems such as scores of slates falling out within the first ten years after installation. This is caused by the installers walking on the slates during installation – a common practice among asphalt shinglers on asphalt roofs, but a mistake on a slate roof. Slates will crack under the weight of the roofer's foot and the cracked slates will fall apart later after a couple of freeze/thaw cycles, or even in high winds.

Furthermore, roofing slates are overlapped in such a manner that each course overlaps two courses below. This arrangement is called the headlap, and three inches is standard. If a proper headlap is not used, the roof can have serious problems later. Over-nailing and under-nailing of the slates can also be a problem. Over-nailed slates are driven too tightly and the nail can break through the slate, or the slate can crack under the stress. Under-nailed slates are not driven tightly enough and the nail-head will rub against the overlying slate, eventually wearing a hole through it.

Poorly installed slate roofs are unfortunately and unfairly beginning to give slate a bad name. The installation of slate roofs is an art in itself, and when mastered, it creates a roof to be proud of – a work of practical beauty that can benefit many generations. It is imperative, therefore, that roof consultants require prospective contractors to have experience and a record of competency regarding slate installation.

One major concern today is the inadvertent selection of bad slates for roofing material, often from foreign sources. There are bad slates available on the market – slates that will fail within as little as ten years. The best way to determine the quality of a certain type of slate is to do an historical analysis.

Purple Vermont slates, for example, have been historically proven to last 150 years (*Photo 15*). PA black slates often last 100 or more years. Chinese or Spanish slates of an unknown origin are a gamble, some failing in as little as one year. Any roof consultant who specifies or encourages the use of a slate material of unknown origin is asking for a nightmare.

Some Slate Roof Consulting Highlights

An inspection in 1998 of the slate roof at Ford's Theater in downtown Washington, DC (the site where Abraham Lincoln was assassinated) revealed a roof that was leaking badly in one spot and not so badly in another. The National Park Service, responsible for the maintenance of the building, was considering replacing the roof.

There was good access to the roof from an adjacent building, which had a flat roof (*Photo 16*). One could stand immediately beside the slate roof with the drip edge at waist height. The slates looked old, and in fact, they were the original 1865 Buckingham, Virginia slates, installed just prior to Lincoln's death (he visited



Photo 15: Camara Slate Quarry, Vermont.



**Photo 16: Ford Theater,
Washington, DC.**

the theater shortly after it had been constructed). Surely this 133-year old roof was a candidate for a re-roofing project.

After inspecting the entire roof, it became obvious that it had already been replaced. The original slates had been removed about 25 years earlier, but the good original slates

had been salvaged and re-installed with copper nails only on the visible side of the roof. The old slates now covered an area that comprised about 1/5 of the total roof. The entire remainder of the roof had been re-slatted with new Buckingham, Virginia slates. Essentially, Ford's Theater already had a new roof, a fact not visible from the flat roof below.

A solder seam on a copper coping of one parapet wall had split right where water pooled on the parapet. This was the cause of the primary leak. A metal flashing on the flat roof next door to the theater had pulled away from the building, causing the secondary leak. The slate roof did not leak at all! No one then at the National Park Service had been employed there longer than 20 years, so no one remembered when the roof had been replaced, and there were no records. This single consultation saved the federal government a few hundred thousand dollars.

In 2000, an upscale estate in the New York City suburbs was in need of a roof consultation (*Photos 17 and 18*). Some slates had been found on the ground alongside the mansion after the winter ice had thawed, and the owners were concerned. A slate roofing "expert," a "third generation slater," was called in to inspect the roof. He subsequently advised that the entire slate roof needed to be replaced – to the tune of \$450,000. This seemed odd, especially considering that the slate roof in question was only 12 years old! An independent examination by a professional consultant revealed that the snowguards – the metal fixtures on the eaves that hook under the slates and protrude up off the roof surface to prevent snow and ice avalanches – had pulled out under the weight of an excessive snow load. When the snowguards let loose, they pulled some slates off with them, and it all ended up on the ground. The snow guards failed



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because there were not enough of them for the size and steepness of the roof. This had been a particularly bad winter for ice and snow, and the sparse snow guards couldn't hold the load.

The entire problem was repairable by replacing the missing slates and doubling the number of snow guards or leaving them off completely. And it was all covered by homeowner's insurance! The lesson to be learned here is that just because someone calls himself an "expert" on slate, that doesn't mean he is. Always get a second opinion in a situation of this magnitude. In this case, it saved the prudent owners nearly half a million dollars!

It is very common to run into situations where perfectly good slate roofs have been condemned as "beyond repair" by either roofing contractors or roof consultants (never RCI member consultants, of course!). However, a properly informed, honest roof consultant can save a client a lot of money as well as preserve one of America's most overlooked treasures – slate roofs. ■

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ABOUT THE AUTHOR

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