Slate Roofs

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Slate roofing is considered a high-quality, durable, and aesthetically pleasing material which receives considerable focus in both the sale of properties and in the evaluation of building condition. Like many building topics, opinions run heavier than actual data. The abandonment of good slate roofs which should have been repaired is a financial shame and the destruction of a valued asset. At the same time, careless optimism about a bad slate roof which is at the end of its life risks an angry inspection client. This article reviews types of slate, common defects, inspection topics, and some repair tips.

Every slate roof looks terriffic when it's wet - unless you're seeing leaks inside. There are, fortunately, some better ways to look at and think about this material. Slate roof failures result from breakdown of the material itself, from poor installation, or from poor maintenance. Evaluation of the condition of slate roofing, and estimating its remaining life considers at least these factors:

- type of slate - durability of the material itself
- age and condition of the slates - where are we in the expected life of the material and what damage is visible
- installation quality, fasteners used
- evidence of repair history, quality of maintenance work
- leaks - a telltale which could point to any or all of the above

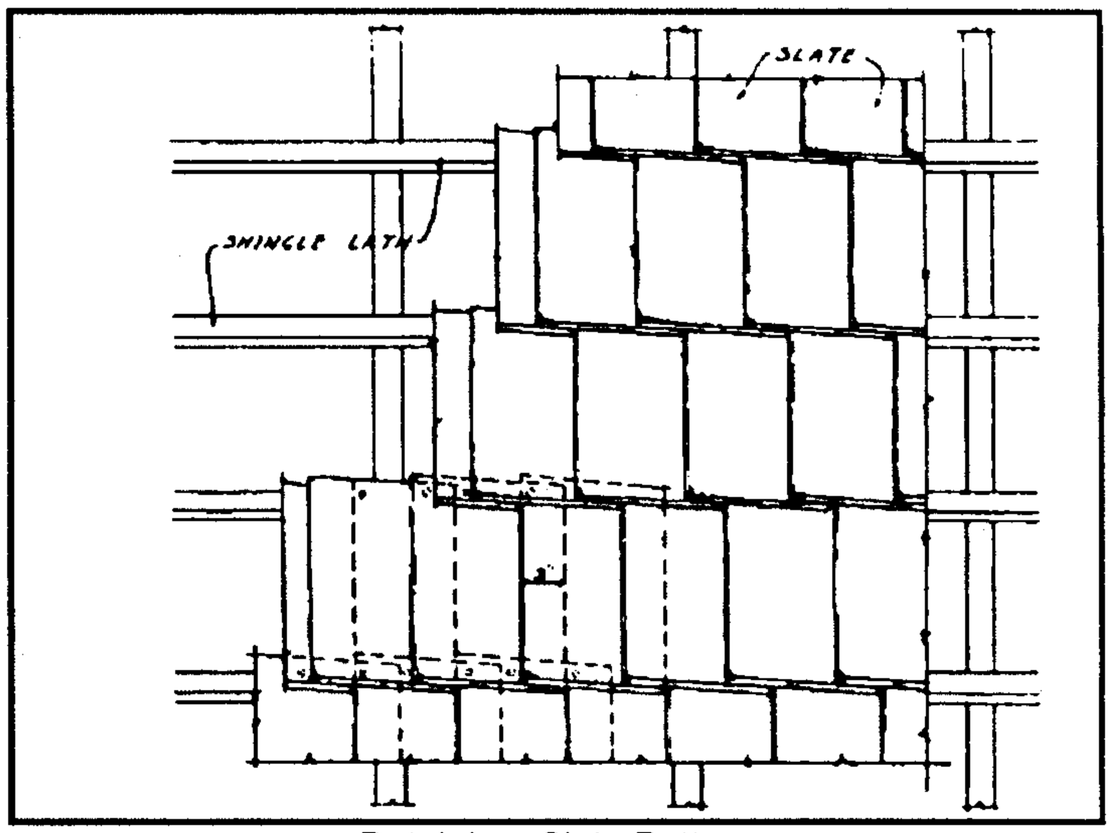
This article discusses these concerns. Other very important factors in evaluating the condition of a building roof such as the condition of roof decking or sheathing, and roof structure and framing, and condition of valleys and other flashings [1] are not considered in this discussion but must indeed be evaluated by the inspector.

Types of slate

Variations occur in color, thickness, surface texture, graduated sizes and varying widths. Standard slate roofs use slates 3/16" to 1/4" thick of one uniform length and width with square tails laid to a line in a conventional shingling pattern.

Textural style roofs use rough-textured slates with uneven butts and varied thickness. Different colors and varying sizes are often used. The resulting roof has a very rustic look.

Graduated slate roofs use slates which vary in size and often in thickness, with larger slates at the eaves, smaller and with less shingle exposure[2] at the ridge. Original work graduated roofs show smooth transition among the sizes from larger to smaller as each course of slates approaches the ridge line. Where lots of repair work was done this effect may have been lost. This roof style makes the roof and building look larger and taller than it actually is.



Dutch Lap Slate Pattern

In addition to color, graduated and textural patterns, slates are placed in a variety of shingling patterns, of which several are illustrated in sketches throughout this paper, such as French, Dutch-lap, and open-lap patterns. The

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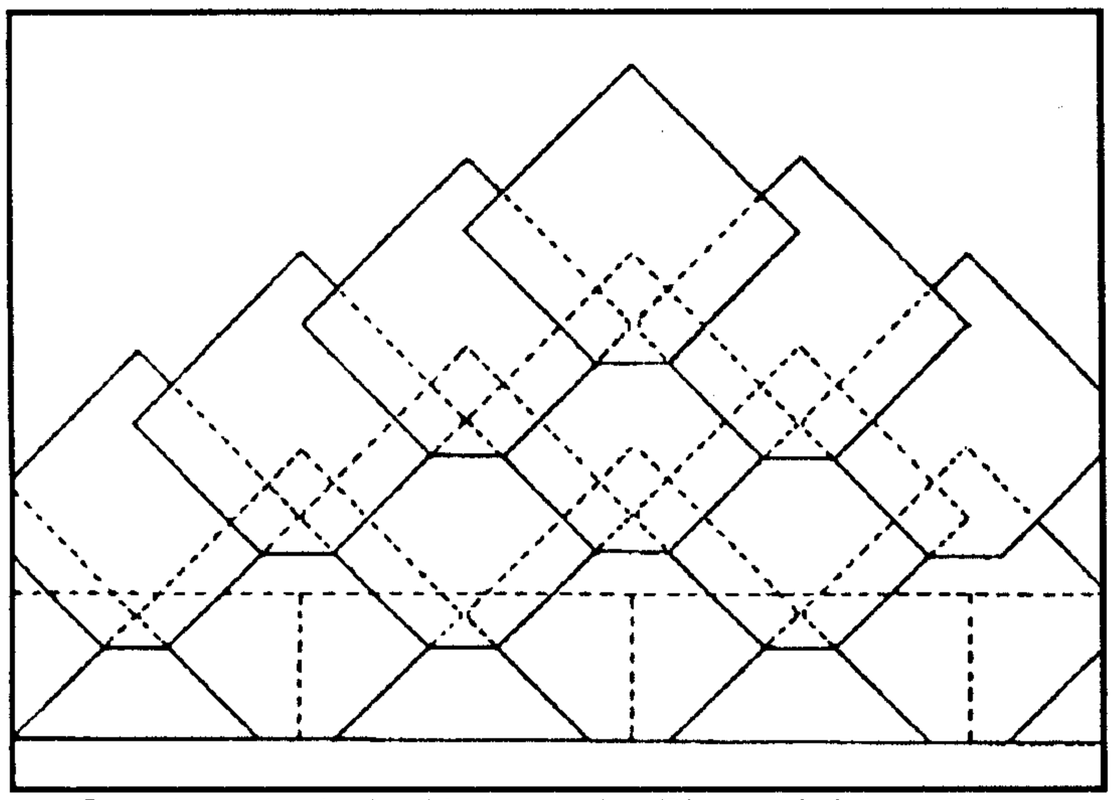
1 Inspectors should be cautious in evaluating roof condition to avoid failing the roof material itself when leaks are confined to flashing areas. We've found good Vermont slate roofs which have been "roofed over" with asphalt (and ruined) when the leaks were located in and only in metal valleys. Metal flashings may be deteriorating from slate particles washing off of the roof. We read repair suggestions in the Old-House Journal involving use of roofing cement and felt for temporary purposes, as well as the preferable soldered or replacement repairs. We've found severe corrosion, particularly on copper, when asphalt roof cement has been used for temporary repairs. In our opinion this is a poor short-term repair which causes increased damage. On an historic restoration project involving slate roofs with copper flashings the worst corrosion we found on the copper was where roof cement had been used to patch leaks. Other patches and materials over similar leaks caused much less apparent damage.

2 Shingle exposure is the portion of the shingle which you can see from outside, or the portion left exposed to the weather. In most shingle roofing systems the exposed portion of the shingle is considerably less than the total shingle length.

Dutch lap uses a 3" side overlap and a vertical exposure of all but 3" of the slate. The result is essentially a single layer of roofing with only 3" of overlap at the top and side. The open joints are all on one side or the other along any given row or course of slates. This system is extra vulnerable to wind-driven rain.

The French method slate pattern also offers essentially a single layer of roofing with three inches around the perimeter of each shingle.



French method, also Hexagonal or Diagonal slate patterns

Finally, slates have a natural "grain" in the material. Normally the slates are cut so that the grain runs the length of the slates. If the slate is quarried improperly, the nail holes create a perforated effect on the slate and it will break in half at the nail holes *after* the installation. Watch for this interesting defect.

Colors

According to the National Slate Association slate is a stone material which has an indefinite life. [1] Because the actual composition of slate affects its durability (and cost), the identification of the source of existing slates is useful in evaluating the condition and future life of a roof. Common sources of roofing slates used in the US and Canada are Pennsylvania, Virginia, and Vermont. California, Georgia, Michigan, New York and Maine also have or had slate quarries. In 1924 the remaining active slate quarrying areas were Maine, Vermont-New York, Pennsylvania, and Virginia. Common slate names have British origins. Maine's Bangor recalls Bangor blue mined in North Wales.

Identification of the slate source by visual inspection is difficult by other than experienced slate handlers or laboratories. However as the slate source has such a dramatic effect on the expected life of the material, any anecdotal, historical, or visual clues are useful. Readers are cautioned not to assume that slates in their area necessarily came only from the nearest slate quarry. Though that's a reasonable bet in many cases, one might find Virginia slate or Maine slate on roofs as distant from the quarries as British Columbia! Vermont Structural Slate Co. will identify slates if you mail them a 1.5"x1.5" triangular sample.

Basic slate colors are black, blue-black, grey, blue-grey, purple, mottled purple and green, green, and red. These color names should be preceded by designations of "unfading" or "weathering" (discussed later). Color is determined by variations in chemical and mineral composition.

The mineral composition of the shale from which slates are cut varies significantly among quarrries and from state to state in the US. The primary constituents are white and black mica. [2]

Virginia slate is blue-grey in color, tough, durable, and considered a top quality material by most slate sources. This slate is notable for a pecular luster giving attractive lights and shadows on roofs.

Vermont slate is typically green with purple, black, and red available. Vermont green slate is the most abundant, with well developed cleavage (easy to split into roofing slates), with good "fissibility" (relatively easy to work), making it the most common variety used. Slate from Vermont is lower in lime content than the Pennsylvania variety. Chemical composition of slates varies of course by quarry as does slate color. Slates are available in both fading and non-fading varieties. In Vermont slate fading color is not considered an indication of deterioration. Rather it's an aesthetic factor.

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1 Slate Roofs, reprinted by the Vermont Structural Slate Co. We caution readers that while this is absolutely the best reference we've found on slate roofing, the language on durability is a bit enthusiastic. You'll have to look closely at the footnotes to identify the less durable materials.

2 See later details in this article. A detailed procedure for analysis of slates was documented in US Geological Survey Bulletin #700, "The Analysis of Silicate and Carbonate Rocks", by Dr. W.F. Hillebrand.

Blue-grey Pennsylvania slate is possibly the best known and most widely distributed of the comon slate colors. Some architects and roofers call these slates Pennsylvania black. But as "Black-Bed" slates, a less durable material, might be confused with the better quality Pennsylvania material, the blue-grey name should be used.

Unfading Pennsylvania grey, which weathers or fades less than "weathering" varieties, has soft grey tones and may have additional strength or durability. Unfading Pennsylvania black, heavier than other slates, has a rougher appearance and does not, as its name claims, fade significantly. [Fading may be taken to mean a general "lightening" across the slate.] Blue-black "hard-vein" Pennsylvania slates are hard material which grows darker on exposure to weather.

Grey and Grey-Black slates are quarried in Vermont and parts of New York. The grey is lighter than the Pennsylvania blue-gray. You may find it mixed with purple. Grey-black is quarried in both light and dark greys, some with a mottled effect. Unfading green, weathering green, unfading purple, unfading mottled purple and green, variegated purple have been quarried in Vermont and New York.

Unfading red is quarried only in Washington County, New York.

If you find slate which is not one of these colors it's a "freak". It would be rare to find a freak which was quarried thinner than 1/4", usually in greater thicknesses up to 2". Some are not true slates in every quality and may not be salvageable when worn or on roofs in poor condition.

We did not find references listing sources of ribbon slate other than Pennsylvania's Lehigh-Northampton district quarries. Ribbon slate is identified by diagonal "stripes" visible in the shingles. Ribbons may be in the entire shingle or in some applications, may be in the upper or covered portion of the slates. Slates which contain no ribbons are referred to as "clear" slates.

Aging and durability

Darker grey "Buckingham" slates from Virginia are considered a durable high-quality material which, properly maintained, can have a near indefinite life. Average life of these slates is 175 years.[1]

Vermont slate roofs, with proper maintenance, can last indefinitely.[2] By other sources, Vermont slates have life expectancy of 100-200 years.[3] Such roofs should be maintained, not replaced. With proper maintenance such an asset may be continued for an indefinite period. Inspectors who do not know the composition and source of slates would not want to condemn, except in the worst of circumstances, a Vermont slate roof.

Typical life for Pennsylvania slate roofs is 40-50 years. These life expectancies are general experience with the *material* and do not consider installation or environmental factors which vary from one building to the next.

Earlier British experimentation on slate durability and composition emphasized that variations in the tendency of slates to absorb water may be the principal cause of deterioration seen by modern inspectors. Slates which are soft, delaminating, and thus at or near end of their useful life may have been damaged by frost. "That sort of slate", said Dr. Watson, the bishop of Llandaff, "other circumstances being the same, is esteemed the best, which imbibes the least water; for the imbibed water not only increases the weight of the covering, but, in frosty weather, being converted into ice, it swells and shivers the slate."[4] Watson continued to suggest that slates, being less porous than clay roofing tiles of the day, were more durable.

Watson's opinion that slates are more durable than clay tiles is arguable as both materials are found with considerable variation in composition. Indeed unglazed clay absorbs more water (up to 10%) than slate (usually 1%) but tiles are not necessarily damaged by these freeze-thaw conditions. Watson's comments pertain to use of slate in Britain.

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1 The Old House Journal, April, 1983 p. 57

2 The Old House Journal, April 1983, p.58, and Slate Roofs, National Slate Association, p. 71.

3 Steven Trapasso, *personal communication.* Also the Old House Journal April 1983 rates Vermont slates as having a 175 year life.

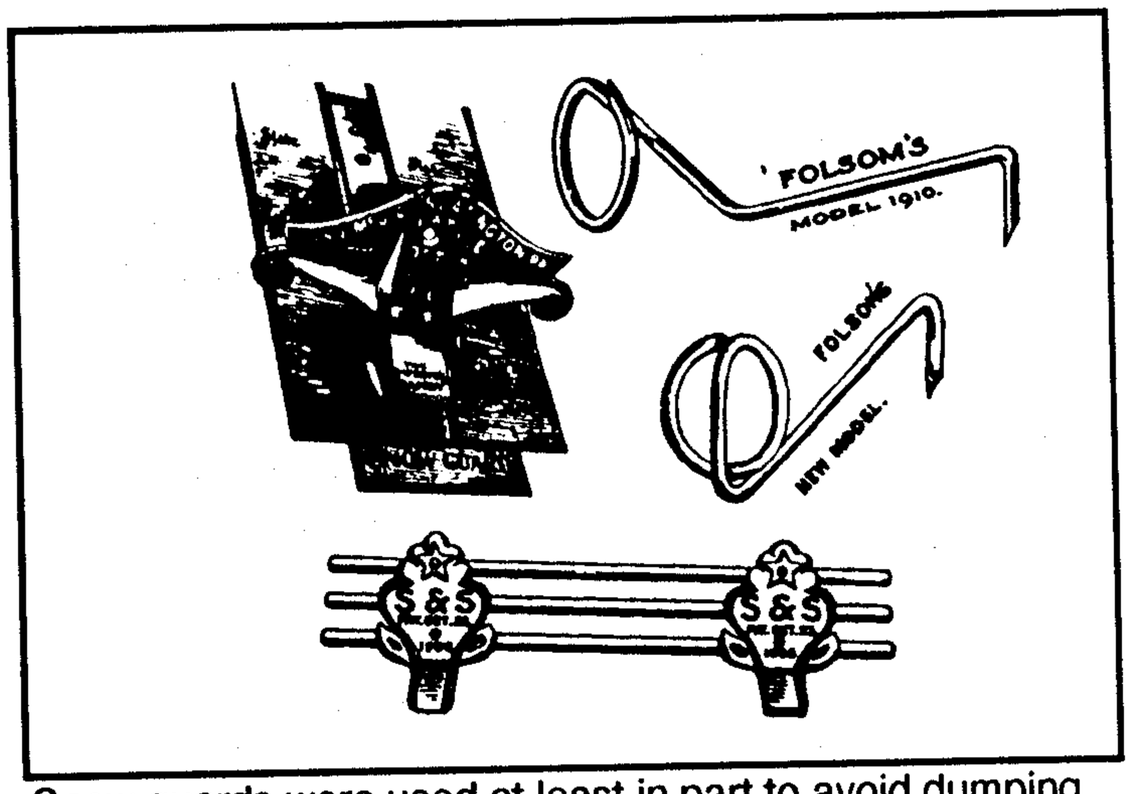
4 The New Practical Builder and Workman's Companion, Peter Nicholson, 1823, reissued 1861, republished with companion modern opinions in Handbook of Building Crafts in Conservation, 1981.

The extent of color change in Pennsylvania [and possibly other] slates often indicates the extent of deterioration. More white, more effloresence probably means more deteriorated.

However we were warned by an experienced slate roofer that determination of slate condition other than by direct up-close inspection is highly unreliable. Slates may look fine from the ground, but be found soft and at end of life on close inspection.[1] By direct inspection we mean looking at slates from a few inches, either from a ladder or some other point of view such as an attic window. We strongly advise inspectors not to walk on slate roofs. Risks include falling - very slippery, and extensive damage to the slates.

The rate of deterioration depends on the source quarry and the depth from which the slates were cut. These determine the density and composition of the slate. Site conditions, such as the roof pitch, exposure to sun, building moisture and ventilation and exposure to mechanical damage also affect slate life. It is interesting to note that several references indicate that slates actually harden after being quarried and exposed. We'd presume that observation pertains to the early or initial state of use of the slates, and we found no reference which claimed some chemical or molecular process of permanent or continuing hardening over life.

Deteriorating Pennsylvania slate shows a mottled appearance, with white faded patches resulting from exposure to sunlight and moisture. The white areas generally begin at the three exposed sides of a slate, growing towards the center of the slate as a function of time and exposure. The white visible in Pennsylvania slate is evidence of efloresence - lime deposited on the slate surface. If the whole slate is white in color and scaling you should consider the slate to be at the end of its life. However as long as the slates are physically intact the roof is serviceable. If a roofer recommends tearing off the whole roof you should ask to be shown examples of failed slates.



Snow guards were used at least in part to avoid dumping snow off of roofs at entrances or where gutters could be damaged by slides.

It is important for an inspector to distinguish between the mottled edges-in whitening (efflorescence) and fading. By contrast to the effloresence process, fading slates generally fade monotonically[2] across the slate rather than from edges in. Faded slates will not show an obvious whitish powder of surface deposited mineral salts as thick as that left by efloresence. All slates will fade from weather exposure. Those which have only minimal color change are classed as "permanent" or "unfading". Those which change more markedly are classed as "weathering".

We've heard several explanations for the mechanism by which Pennsylvania slates deteriorate, of which the most interesting was the opinion that lime in the slates in the presence of moisture reacts to break down organic components in the slate. For slates higher in carbon or car-

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1 Trapasso, *personal communication.*

2 Monotonically means that the color change is even across the material rather than showing up as a splotch, or a ring of white around darker color, or in other variations. It's a nice word, not recommended for inspection reports.

bonaceous materials this may be indeed the most accurate explanation. Pennsylvania "Black Bed" quarried slates were high in carbonaceous impurities and were recommended by the Slate Association only for temporary buildings or for chalkboards. By the 1920's this slate was recognized as not as durable; you'd not expect to find it surviving on a building in 1991. [1] The National Slate Association reference does not detail the mechanism of slate deterioration. It does point out that the slate roof on the Saxon Chapel at Stratford-on-Avon was built 1100 years ago - still in good condition. [2]

Examining quantitative analysis of slates from nineteen quarries[3] we observe that while oxides of silica (SIO_2) and aluminum oxide (AL_2O_3) are the dominant components of slates, almost all have measurable levels of calcium oxide (CaO) and other carbonates and oxides. [4] There are dramatically higher levels of these materials in Pennsylvania slates (3%) than in slates from Vermont (.3%-.7%). Clearly there is more material available to form calcium carbonates and effloresence in the shorter lived materials.

The brown color of some slate may be from oxidizing iron content in the slate which is following a similar reactive path. We did not find references to brown in Virginia slates.

The known chronological age of slates may be available from an owner or other documentation. As with all materials, experienced inspectors rate the *apparent wear age* of the roof, not the actual age.

Ribbon Slates

"Slate is of medium hardness, very fine grained of low porosity, great strength and consists essentially of insoluble and stable minerals that will withstand weathering for hundreds of years. Some slate in Pennsylvania contains ribbons which consist of narrow original beds usually containing carbon, and darker in color than in the body. There is tendency for some ribbons to contain an excessive amount of the less resistant minerals, and they should not appear on exposed surfaces."[5]

Ribbon slates are easily identified from the ground. The stripes are accentuated because the ribbon portion absorbs more water than the rest of the slate. Usually the ribbons are darker, often multi-colored browns and reds. An Albany NY slate roofer[6] suggests that ribbons were desirable for a pattern effect, and that they were equally durable with other slates from Pennsylvania.

Some roofers consider ribbon slates as less durable material.[7] We suspect that the durability of ribbon slates depends on the particular minerals which make up the visual diagonals. If the diagonals are comprised of minerals softer than the surrounding slate, early wear is likely. In at least some cases, ribbon slates are less durable than other Pennsylvania slates.

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1 By Mr. Trapasso's account the decomposition of Pennsylvania slate may be understood as a process similar to decomposition of wood. The lime which was in the slate, when the slate was mined, had not caused deterioration because the slates were protected from sunlight. When the slate is split, cut, punched for use, the lime is in an inactive or dormant state. Following application on a roof surface the slate material is exposed to ultraviolet rays (sunlight) and moisture. These components cause the lime to break down the organic materials in the slate (shale), making the slate increasingly porous and causing the white effloresence. Lime and other mineral salts are dissolved and deposited on the surface of the slate when moisture evaporates.

2 Slate Roofs, National Slate Association, p.71-76.

3 Slate Roofs p. 73

4 Carbon, which would be broken down in the process described by Trapasso, occurs in slates from only a few quarries, and then in usually small amounts of less than 1%. This would seem to argue against the "slate rots" explanation of deterioration.

5 Dr. Oliver Bowles, Mineral Technologist of the US Bureau of Mines, in *"The Characteristics of Slate"*, June 1923 paper delivered to the American Society for Testing Materials. ASTM.

6 Capital Region ASHI chapter education seminar, fall 1990

7 Trapasso, *personal communication.*

If these slates were actually shorter-lived than clear cut materials, why were they used? In the 1940's one square (100 sq. ft.) of Pennsylvania slate cost about $6.00, or about $15.00 installed. Because of these attractively low prices and low anticipated replacement cost *[boy were they wrong!]* ribbon slates were very popular and were used extensively. As slate and roofing costs rose and as ribbon slates were less expensive than clear slates, some clever roofers used slates which were cut so that the ribbons were only in the upper half of the slate. As the ribbons were covered by the next course, these roofs were more durable.

An inspector may spot this interesting material from attic view[1] or from outside if a slate has fallen out of position, exposing the upper half of its predecessor course. The cost of installing a modern slate roof makes the choice of poor materials illogical.

Installation quality, fasteners used

The following may all be indications that the roof is failing from the condition of the slate nails:

- many loose slates sliding down and often, pieces of slate on the ground around the building
- numerous repairs showing old slates re-secured in place (could also indicate other problems)
- improper tar and flashing materials used to secure loose slates[2]

Inspecting from the attic interior may also give clues to fastener age, type, and condition if some nails are visible. You may see tips of nails, depending on the length of fasteners used.

Proper installations use copper, stainless, or hot-dipped galvanized nails for fastening slates. Very early slate roofs were secured using wood pegs. Later ones used tie-wires in some applications. Slaters' nails have a thinner head than conventional roofing nails, avoiding damage to the covering slates. We've found many slate roofs installed with steel nails in the Northeast. We've also found lots of roofs in that area which are losing good slates from nail failures.

When a slate is punched (usually at the quarry) the hole is driven from the back of the slate, leaving a ragged pit at the front (exposed) surface of the slate so that the nail head can be countersunk flush with the top of the slate. This avoids damage to the next course of slates which overlay the nail heads and which may crack under load.

Because most roofs have at least some custom slate fitting (for example at valleys), some slates are hand-punched and may be fractured around the nail hole. Usually only two holes are punched, 1.25" to 2" from either side and about a quarter of the length of the slate down from the top. More holes and more nails may be used to hang thicker heavier slates.

Where battens or spaced roof sheathing are used the spacing of the battens will affect where the holes are punched in the slates. Slates punched too close to their centers or too low in the slate are more likely to leak when water seeps down in a fan-shaped pattern from the vertical abutment of the sides of the slates in the next course up the roof. If you are inspecting a roof which frequently leaks following prolonged rains, and if the slates and flashings look pretty good, and if leaks are everywhere, you might look for improper punching or nailing errors. Don't rush to condemn the roof - how often and how badly does it leak? Under what conditions? What is being damaged? Where is water going?

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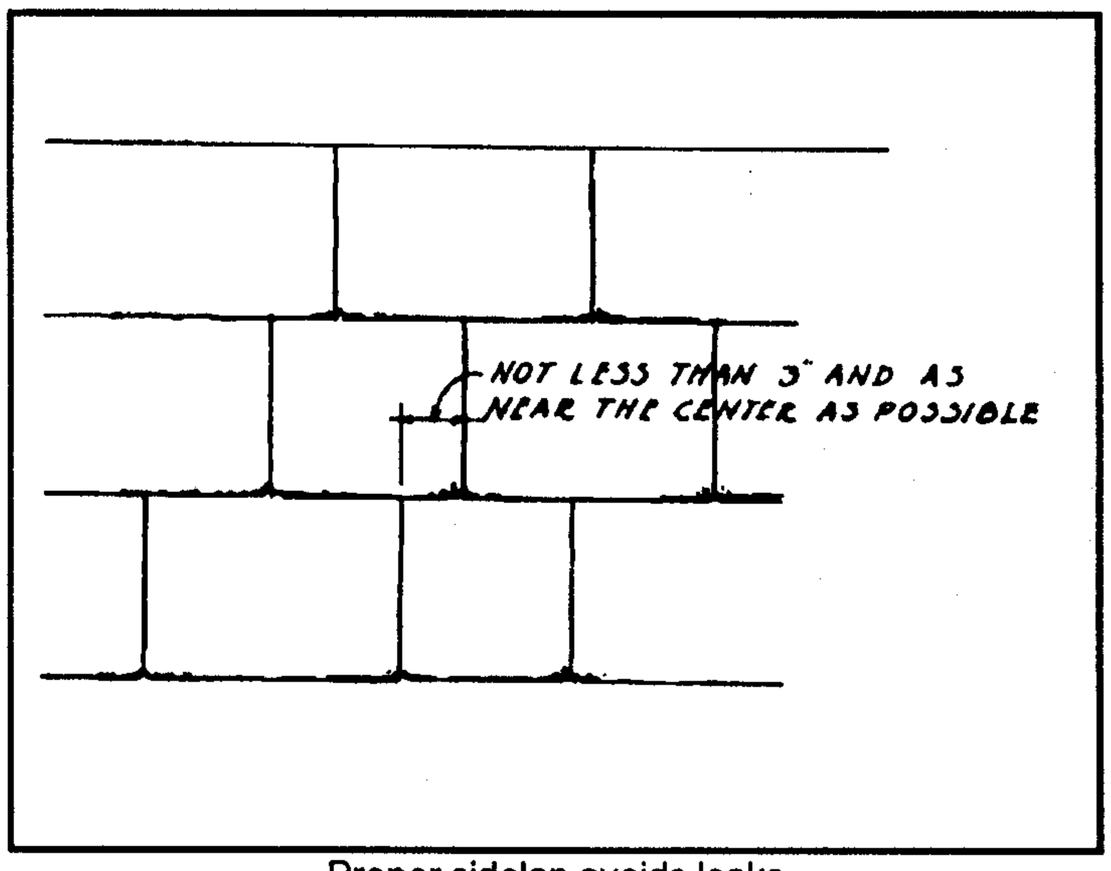
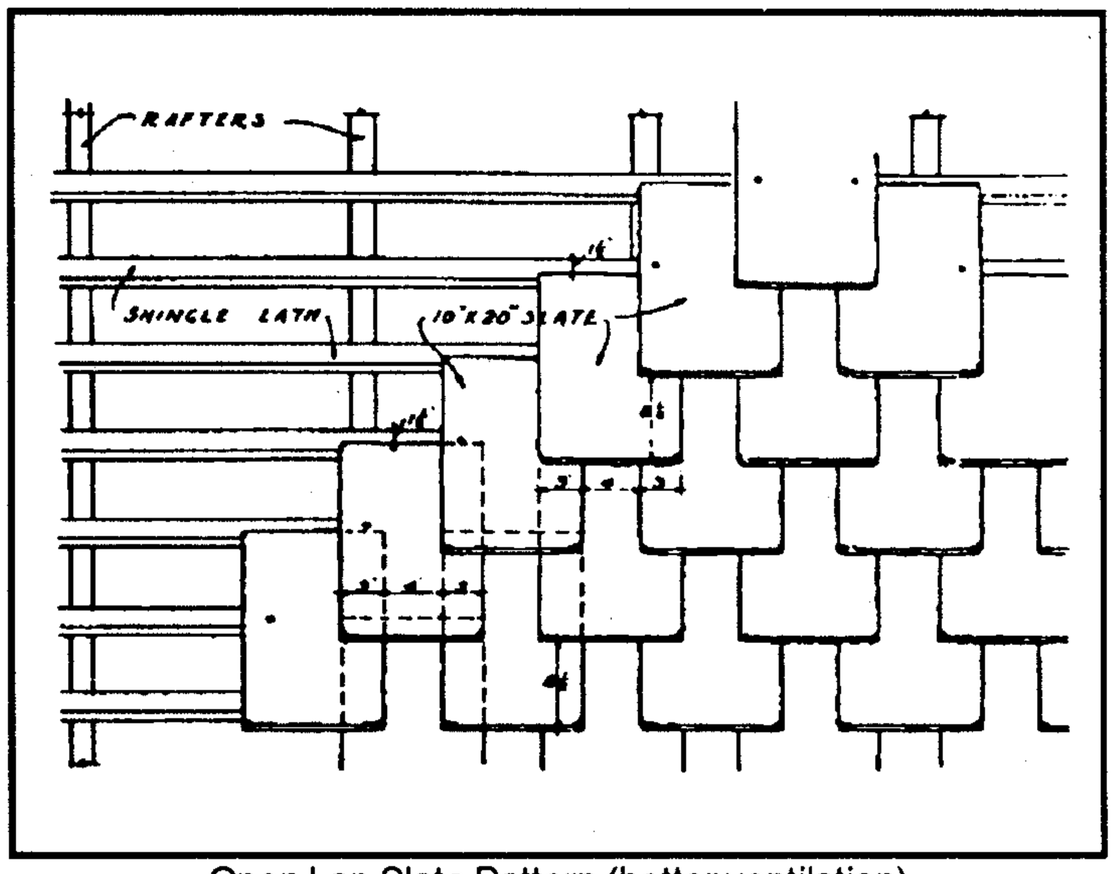
1 Attic view means inspecting the underside of the roof surface from inside the building. If open or spaced sheathing was used as nailing base for the slates you'll be able to see the backs of the slate material, or in some cases, you'll see roofing felt, usually damaged or soft, which may provide openings to see the slates. Where closely-spaced board sheathing was used you'll not see slates except perhaps through a knot hole or damaged board.

2 In our opinion, galvanized flashings are a mistake on slate roofs. The flashing is very likely to wear, rust, and fail before the slates. While replacing flashings is quite possible and appropriate, it's often expensive and if not done by an experienced slate roofer, there is risk of costly damage to the roof. We had a client this year whose slate roof was damaged by the mason working on the chimney. He accepted a low-bidder for roof repairs. We found asphalt shingles nailed over and around the area of damaged slates. To say that the roof leaked was the least aggravating observation concerning this work.



Proper sidelap avoids leaks



Open Lap Slate Pattern (better ventilation)

Slates should hang loosely on the nail. Nails too tight may break the slate as they're pulled through it as wood shrinks. Nails not driven fully are likely to break the slate above.

Other signs of poor installation include inadequate side laps. [1]

Other factors in roof condition

Roof slope, as with all roof systems, is a big factor in shingle wear. The steeper the slope, the more durable the roof. Slates have been used even on flat roofs, as ballast, and slates were used to line the reflecting pool at the US Capitol in Washington DC.

Condensation in attic interiors can be a problem. All slate roofs need ventilation to equalize the temperature between inside and outside the roof surface. Elimination of unwanted moisture in winter and heat in summer will both extend roof life. Serious damage from interior moisture is likely to be to roof sheathing and framing, but high interior moisture will shorten the life of most roof coverings as well. The open lap slate pattern shown above was probably intended for use on buildings with high interior moisture - perhaps a cow barn.

Most normal slate roof installations, as originally built, may have had adequate ventilation. In our opinion, serious moisture problems may begin when modern renovations insulate between rafers and add interior finishes in attics. For those designs special provisions may be needed to cool and dry the roof cavity.

Mineral deposits found on the interior surface (attic view) of slates, when none are visible outside, are a sign of possible attic moisture problems. Where no outside staining or effloresence match inside findings, the inspector may suspect that sun exposure is drying the outer surface leaving longer moist conditions inside. If these conditions are not consistent on all roof surfaces you may find the most mineral deposits on the north or shaded roof surfaces.

Moss on slates should be considered as damaging as on any other type of shingle. The moss retains moisture against the slate and its roots may actually penetrate and damage the material. On older roofs with heavy moss the growth can actually lift and separate the shingles. Chemical treatments may help with moss as it does on wood roofs. Extreme care should be used in working with chemicals.

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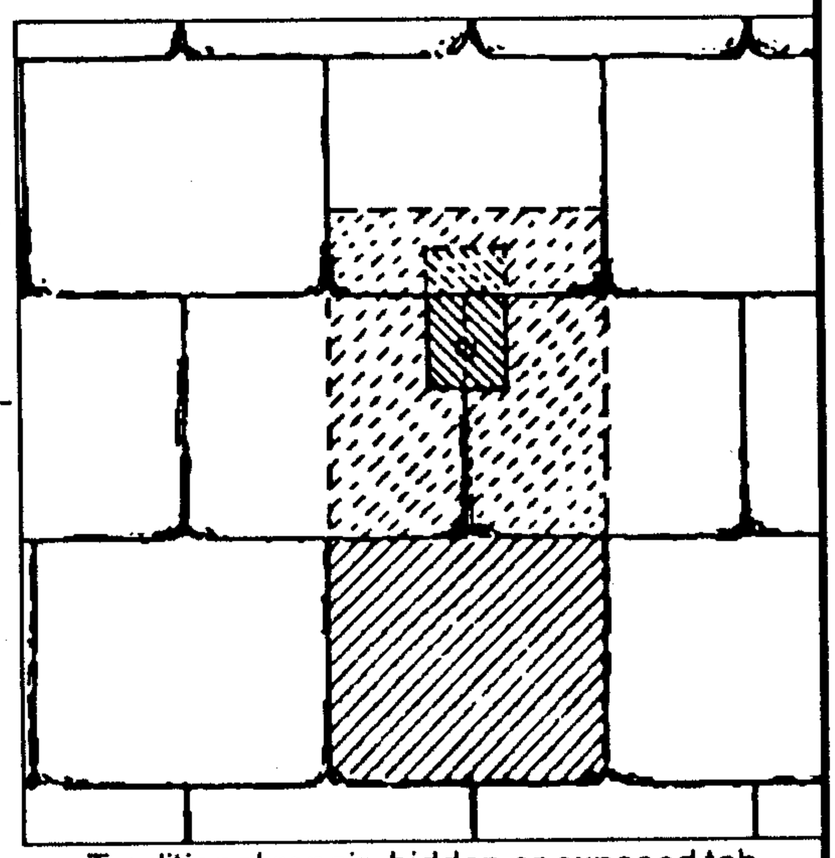
1 Side laps should be not less than 3" and each side-joint should be as near as possible to the center of the slate below. Particularly where improper repairs have been done you may find violations of this rule. Inadequate side laps risk leaks as a result of wind-driven rain. Inadequate side laps might be suspected on roofs which use varying-width or graduated width shingles. However some experienced roofers and inspectors commented that graduated, random-width, graduated width slate roofs were more costly than other slate systems and were often installed by more skilled roofers. Do not mistake graduated or random slate sizes for necessarily improper application.

Repairing slates

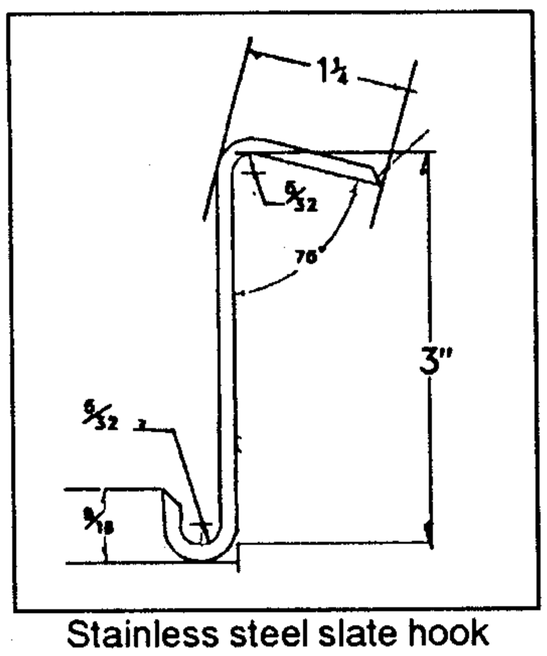
A proper slate repair involves several steps:

- cut the concealed nails, holding the damaged slate in place. There are usually two nails.
- acquire the properly sized replacement slate. If the exposure is ten inches the slates should be twenty-three inches long. A proper slate application uses slates which are twice the exposure plus a three-inch allowance for head lap.
- slide the slate into place, use the gap between the sides of the above-course of slates to mark the location of a single holding nail.
- the nail hole is punched into the slate from the back, so that the ragged part of the hole is on the front or face of the slate. This will allow the nail to sit flush in the hole. It's a crude form of counter-sinking.
- nail the replacement slate into place with a copper nail. Sometimes the edges of the nail head have to be cut off to pass between the sides of the two slates in the covering upper course.

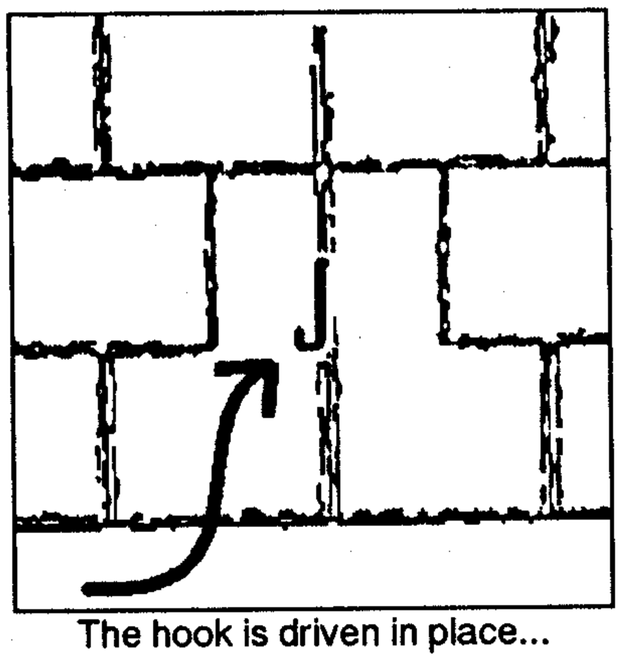


Traditional repair, hidden or exposed tab.

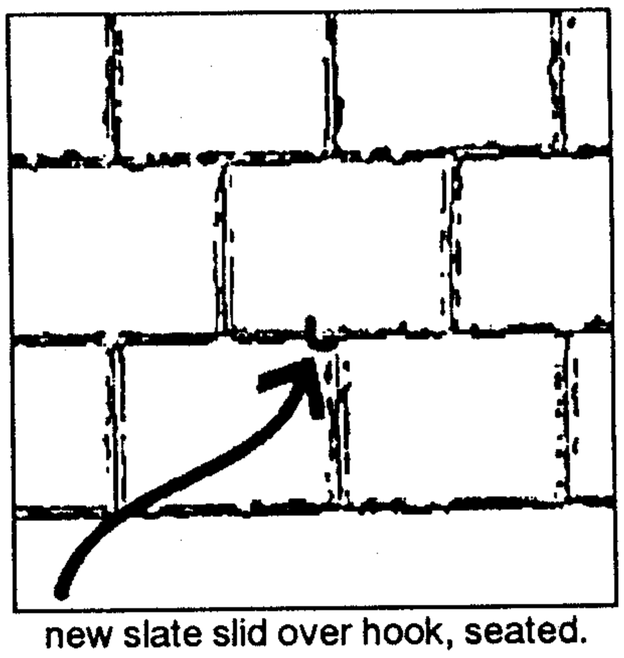
- cover the new nail with a copper "bib" which is slid up under the covering or overlaying slates to cover the nail hole and to extend up below the next upper covering slate whose bottom edge covers the upper portion of the gap through which the nail was placed. the copper bib should have its edges burred, or should be bent slightly so that it will not slide out. The top of the bib should extend well above the nail and under the slate above. Some roofers slide the bib up under all three of the slates above the repair slate making the copper totally hidden. The bib is bent slightly arched and burred to stay in place.
- An alternative procedure uses 3" stainless steel slate hooks distributed by Vermont Structural Slate (and possibly other companies). The fastener end of the hook is nailed roughly 3" up from what will be the lower edge of the replacement slate. The slate is slid up over the hook and seated.



Stainless steel slate hook



The hook is driven in place...



new slate slid over hook, seated.

Roof framing for slate roofs is often stronger than similar framing for houses of the same age for which lighter roof materials were used. A slate roof can weigh as little as 700 pounds per square[1] up to 8000 pounds where 2" thick slates were used on a graduated slate roof. On a residential building the maximum weight per square you'd probably find would be 2500 pounds. The addition of slate to a house not framed for this purpose will require an analysis of the roof framing system.

Clues about the quality of a slater's work may be found in hip and ridge design. This topic is not discussed here.[2] Flashing details, valley flashing methods, weather exposure, mechanical damage from falling limbs, foot traffic or improper workmanship, are examples of other factors which affect roof life. They are not discussed here.

Repair history

Tar is normally an indication of improper maintenance. It should be considered a temporary, unreliable repair. Tar or roofing cement should not be found at chimneys, sidewall flashings, plumbing vents, or elsewhere. The tar itself usually remains effective as a sealant only for a year or so. While in place, tar traps moisture within the slates, causing the slate itself to deteriorate. When flashings leak on a roof they should be repaired or replaced as necessary, without using roof cement.

Watch for numerous copper tabs at the center of replacement shingles. These indicate that repairs have been made and they may be a clue about the overall condition of the fasteners. In a first-class slate repair you should not be able to see the copper tabs. The Old-House Journal April 1984 roofing issue describes an alternative method for securing slates which will leave a copper tab exposed. Expert roofers have a less visible method of fastening the replacement slate. *[See sidebar.]*

Using asphalt over slates is surprisingly common "re-roof" procedure as it avoids labor and disposal costs for the slate material. *[In some areas of the Northeast it also represents the popularity of lower-cost asphalt and the dearth of experienced slaters who might have repaired the slate roof.]* When nailing the asphalt shingles it is common to find only a poor bond of new nails to original roof decking. The slates below tend to chip and bulge the new material resulting in a "peanut brittle" or "popcorn" effect. Since the comparatively large thermal mass of the slates retains heat, the asphalt shingles are "cooked" from their backside as well as from their front when exposed to sunlight. The life of such shingles is estimated by some to be half the normal span.

Leaks

All slate roofs probably have at least some flashing, slate, or other damage or mechanical installation errors. Some conditions such as a side lap error, damaged slate, or even flashing error may leak only in certain weather conditions such as windy rain storms from a particular direction, water backup behind ice dams, or prolonged rains. Where slates are missing near valleys the adjoining slates may be damaged as well. Openings may cause leaks or water to pass below the valley flashing even if the flashing looks intact. Where there were previous repairs it's common for the felt underlayment to be torn as well. If there are porous slates or openings above the tears in the felt, water may leak through.

Ice dams at roof eaves can be a serious leak source on slate as most other roof systems. Traditionally 30# felt was used at eaves as "insurance" against this problem. Some slate suppliers recommend this heavier felt for all underlayment, not just at the eaves. However two components conspire to reduce the effectiveness of felt as ice-dam protection: every nail at the eaves punctures the felt, and with age felts often dry and disintegrate before the slates have worn out.[3]

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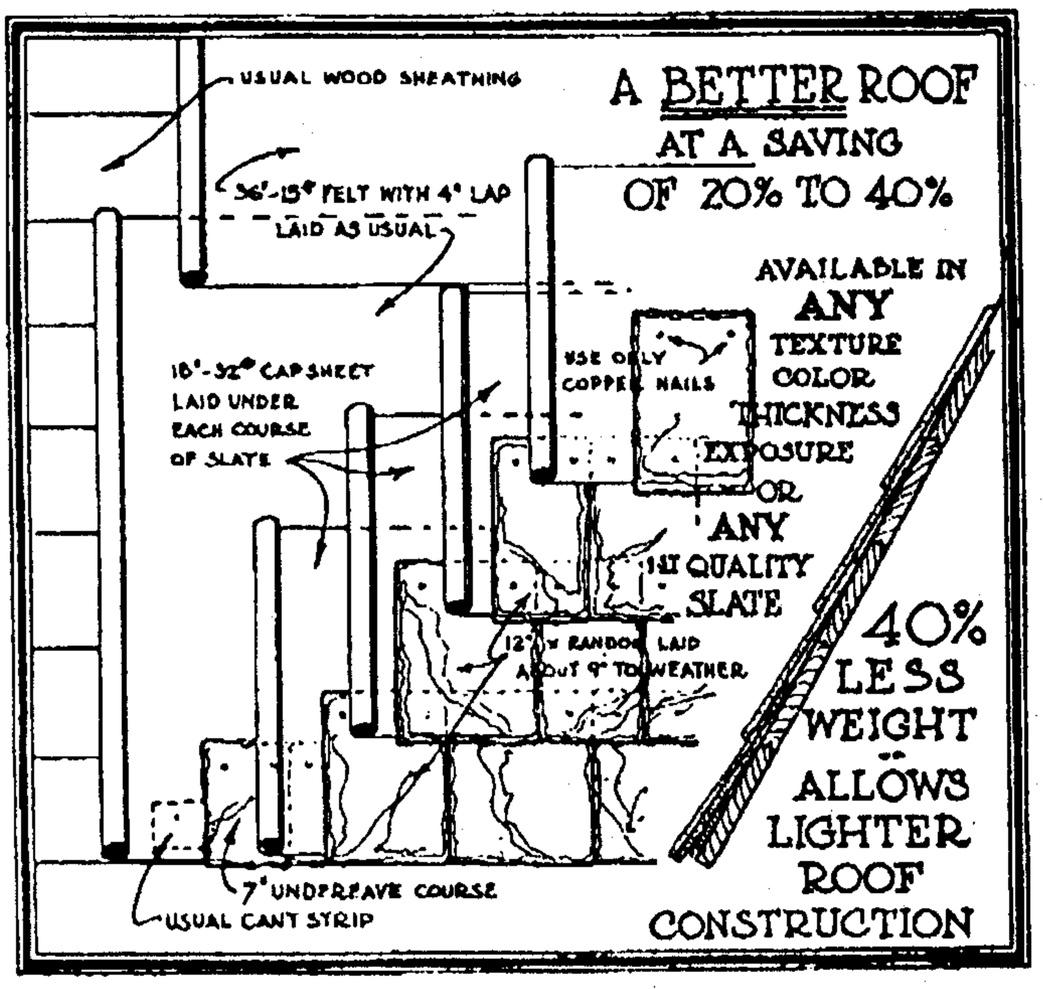
1 one roofing square is 100 sq. ft.

2 See Alan Carson's *"Slate Roof"* presentation notes used at several ASHI Seminars.

3 Ice dam protection is improved in new or re-roof applications using the newer sticky membranes such as WR Grace's Ice and Water Shield™. However the preferred solution to this problem is proper attic ventilation. Good venting avoids the ice-dam problem and adds reductions in winter moisture and summer heat problems. Old houses whose attics have been converted to living space, particularly with unvented ceilings following the underside of fully-insulated roofs are likely to be serious moisture and heat traps.

In conventional roofing design slates are used on roofs with a slope of at least 4" of rise in 12" of run, that is, on 4 in 12 roofs. A 3" head lap is used, often 4" when the slope is less than 8 in 12. So a 20" long slate, with a 3" head lap, would have an exposure of 8.5". For 18" slates the exposure is 7.5", and for 16" slates, 6.5". Roofs with less head lap or more exposure may be more leak-prone.



Some slate companies advertised *A slate roof that cannot leak, yet [was] inexpensive, easy to apply, beautiful..., durable as time,"* using a design which was soon found to be a disaster: 12" slates were placed with 9" exposure, leaving 3" for headlap and 6" which was backed only by a cap sheet of 32# felt interlaced with the slates. Roofs were also installed following this poor design, using 14" slates with 10"-11" exposure. Felt is not functional as a permanent roofing material: even where it is not exposed directly to sunlight, as the organics dry out the felt cracks, disintegrates, and leaks. We have reports[1] that inspectors have been the subject of legal actions following their failure to identify this defect in slate roofs. See the illustration above.

Holding actions for older roofs

If a client cannot afford to replace a slate roof a wiser course may be to do nothing, to trap small leaks in an attic, or to tar leaky areas.[2] Although these steps are not preferred, they are often better than abandoning what may be a valuable roof of predominantly durable slates.

Where the slates are good but fasteners are failing, some roofers may be willing to remove, salvage, and reinstall slates. Slates which are less than 1/4" thick should be discarded. The increase in labor costs for this procedure makes this "re-roofing" process expensive. Some slate companies suggest[3] that this procedure might be selected as a continuing repair/maintenance process so that over a decade of maintenance the roof has been totally replaced. It's likely that the total labor bill for a drawn-out project will be larger than the costs of an all-at-once repair. However this approach permits spreading out a large investment over a longer and less painful period.

ASHI ethical guidelines require inspectors to have no financial connection with work performed on buildings they inspect. But where further evaluation and/or repair advice is needed it is perfectly proper, and in our opinion advisable, to refer clients to experienced, qualified slate roofers just as you would to an expert in another field for other concerns.

For slate roofs, refer clients only to roofers who have experience with slate materials. While we'd prefer to refer a client to three reputable experts, if we could locate only one in our area, by our opinion of what's most sensible, we'd refer to that one. Contractors who are not familiar with slate and confronted by a leak in a valley or in an area of limited mechanical damage, may sell a complete re-roofing job to an anxious owner.

Similarly, improper repairs or traffic on a roof with fragile fasteners or slates, may cause much more new damage than was present before.

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1 Personal communication, Doug Sheldon, Vermont Structural Slate, December 1990.

2 Tarring leak areas is a very unpleasant and ugly holding action. However if a roof may be salvaged by deferring a proper repair for a short time we'd probably tolerate this step. Advising clients that the only option is to complete a very expensive slate repair immediately is likely to result in an asphalt roof-over which may, in the long run, be a worse crime. This is clearly a matter of opinion.

3 Personal communication, Vermont Structural Slate, December 1990

Alan Carson and Dan Friedman are ASHI Members, home inspectors, educators and writers in Toronto and Poughkeepsie respectively. Information in this article is taken from the references shown below, from inspection experience, from opinions shared at ASHI and other education seminars, from the authors' personal, limited experience repairing and rebuilding of slate roofs, and from very helpful Bill Markcrow and Doug Sheldon at Vermont Structural Slate Co. We also paraphrased from a presentation to NY Metro ASHI Members by Mr. Steven Trapasso in October, 1990. Mr. Trapasso has 40 years experience in working with slate, and has a clear love affair with the material, particularly when it comes from Vermont.

References

Slate Roofs, National Slate Association, 1926, reprinted 1977 by Vermont Structural Slate Co., Inc., Fair Haven, VT 05743, 802-265-4933/34.

Slate Roofs, Steven Trapasso, presentation to NY Metro ASHI, Inc. chapter seminar, November 1990.

The Old-House Journal, *Special Roof Issue*, April 1983, The Old-House Journal, PO Box 50214, Boulder, CO 80321-0214

Handbook of Building Crafts in Conservation, Jack Bower, Ed., Van Nostrand Reinhold Company, NY 1981 ISBN 0-442-2135-3 Library of Congress Catalog Card Nr. 81-50643.

Slate Sources

- Vermont Structural Slate Co., PO Box 98 Fair Haven, VT 05743 802/265-4933 802/265-3865 FAX (Green, purple, unfading red, and Spanish imported black.)
- Rising & Nelson Slate Co., West Pawlet, VT 05775; 802/645-0150 (all VT colors plus Buckingham Grey from VA and blacks from PA.)
- Evergreen Slate Co., 68 Potter Ave., Granville, NY 12832; 518/642-2530. Vermont slates in 10 colors.
- Hilltop Slate Co., Middle Granville, NY 12849; 518/642-2270 (all VT colors plus imported Spanish Black)
- Structural Slate Co., Pen Argyl, PA 18072; 215/863-4145 (PA black)
- Buckingham Slate Co., 4110 Fitzhugh Ave., Richmond, VA 23230; 805/355-4351 (VA Buckingham Grey)

In addition to these slate sources there are several slate look-alike substitutes. While the application techniques, flashing and nailing concerns are similar, the wear characteristics of these materials may be quite different and were not evaluated for this paper. This paper is not an endorsement, nor a critique of any of these materials.

- Eternit, Inc., rigid fiber reinforced cement roofing slates (and board products. Village Center Drive, Reading, PA 19607 800/233-3155
- BritSlate™ are made from 100% quarried slate particles combined with an adhesive (epoxy?) and no fillers with no questionable side effects according to the manufacturer. According to the manufacturer, they can be cut, drilled, etc. and come with a 50-year guarantee. They're less prone to breakage than slate, fireproof, and do not absorb water (like natural slate), and do not encourage organic growth (moss and lichens) because they are not porous. BritSlate North America, Inc., 647 West Boylston St., Worcester, MA 01606 508/852-4888 508/852-7224 FAX 2/90.
- Reinforced-cement shingles which "look like slate but are lighter and one-third the cost" are available from Atlas International Building Products, 5600 Hochelaga St., Montreal, Quebec, Canada H1N 1W1. [$180/square loose or $400./sq. installed, 30-year guarantee.]
- Supra-Slate "looks like slate and is manufactured in colors of real quarry slate." Tegusol is a double interlocking clay roof tile. Available from: Supradur Manufacturing Corporation, PO Box 908, Rye, NY 10580 800/223-1948 or 914/967-8230. or 122 East 42nd St., NY, NY 10168 212/697-1160
- Lifetile® Boral Concrete Porducts, Inc., produces high density extruded concrete roofing tiles meeting Class "A" requirements. Dallas, TX 214/544-2227