

INSTALLING A SLATE ROOF — THE BASICS

Adapted and excerpted from the Slate Roof Bible

Written for the Timberframers Quarterly

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A slate roof is a perfect roof. It's beautiful, natural, durable, recyclable, environmentally friendly, easy to maintain, and costs less than just about any other serious roof when the life of the roof is taken into consideration. Although there are many myths and misconceptions about installing slate roofs, there's really nothing mysterious about building a roof of stone. The stone is dug or quarried from the earth, brought to the surface, then hand split with a hammer and chisel into thin sheets about a quarter of an inch thick. These slate shingles are then trimmed into particular shapes, usually punched for nail holes and are then ready to be installed on a roof. They typically come from American quarries already trimmed and punched, so the roof installer only needs to know how to put them on the roof. Let's start with roof construction.

ROOF CONSTRUCTION

Standard *traditional* roof framing is sufficient to handle the weight of standard thickness slates, which are 3/16" to 1/4 inch thick. Traditional roof construction includes "stick built" or timber-framed styles with board sheathing (decking). I have seen 130 year old slate roofs in good condition built on 2x4 or 2x5 rafters. Of course, the rafters were oak, on 16" centers, with only 8' unsupported spans, and these are the sorts of things a builder needs to take into consideration when using a material like slate, which is three times as heavy as common asphalt shingles. What type of wood are you building with? How strong is it? What are the spans? What are the distances on center? If you want to build a roof that will easily last a century or two, follow the tried and proven traditional building styles. Use full framing members, such as 2x8 or 2x10 rafters, rough cut is ok, green lumber (undried) is fine. Local building materials are ideal as they stimulate the local economy, utilize local renewable resources, minimize transportation and fuel costs, and require the least amount of technology, especially when green or air dried lumber is used. Any older carpentry book will explain the spans and sizes for standard roof framing.

One consideration regarding weight: the smaller the slate size, the heavier the roof. Standard roof slate sizes range from 6"x10" to 14"x24" and everything in between. The 6x10 slates require 686 slates per square (a square is one hundred square feet of roof coverage), while the 14x24 only require 98 slates per square.

The thickness of the slates also affects the weight. Standard thickness (3/16") slates weigh 600-700 pounds per square (the smaller slates make a heavier roof). Half inch thick slates weigh *double* that. The smaller the slates, the more nails, more nailing, and more labor costs. A 6x10 slate roof will require the nailing of 686 slates to cover one hundred square feet; a 14x24 slate roof will only require the nailing of 98 slates. Obviously, the larger slates will cover a roof relatively quickly, but the smaller slates can sometimes be bought quite inexpensively, and some people like the look of smaller slates.

The steeper the roof slope the better, although a 10:12 slope (ten feet of rise in twelve feet of run) is common. Do not go below a 4:12 slope. When you do put roof slates on a lower slope, you must increase the overlap (headlap), which is discussed under "installation," below.

SHEATHING (DECKING)

Use natural boards for the roof deck. This sheathing can be one inch rough sawn lumber, green, or air dried. It can be 3/4" kiln dried lumber, preferably a softwood like spruce, pine, or fir, as kiln dried hardwoods will not take a nail very readily, or it can be inch and a half tongue in grooved lumber, also typically softwood. The inch and a half tongue in grooved lumber is more often used on larger institutional buildings such as churches. One inch thick or 3/4" thick boards are perfectly adequate for residential construction, and can be either standard or tongue in grooved. My personal preference is one inch local rough sawn lumber, either green or air dried, and not tongue in grooved. It's the most environmentally friendly roof decking, it lasts the longest, and it's the least expensive.

Do not use plywood, particle board, or any other laminated wood product for your roof deck. Plywood became popular as a roof sheathing material when asphalt shingles became popular. It didn't take many years for roofers to realize that plywood delaminates, especially along the drip edges or anywhere where it becomes exposed to moisture. Rather than go back to solid lumber roof sheathing, the roofing industry invented a contact paper to protect plywood, now known as ice and water shield. Avoid plywood and you will find that ice and water shield is not needed anywhere on a slate roof. You want to build a minimum 100 year roof when making a roof of stone, so do it right —use natural wood and leave the unnecessary roofing products on the shelf where they belong.

Sheath the roof deck solidly, butting the boards against each other on the sides and ends, leaving no gaps other than toe holds every few feet on steep roofs (although gaps won't hurt anything either). Almost all wood will shrink once installed on a slate roof, due to the heat and dryness. When using green or air dried lumber, you do not have to leave an airspace between the boards. Many older slate roofs were constructed of slating lath, which is simply 1x2 or 1x4 strips of wood spaced apart to allow for nailing the slates. Although this traditional system does work and conserves wood, it is inferior to a solid wood deck because it makes repair, maintenance, and restoration in the later years more difficult.

Cover the sheathing, no matter how green, with one layer of 30 lb. roofing felt paper, overlapped about three inches at the top edges, and nailed to the roof with 1"galvanized roofing nails (EG is OK here - see below). Felt paper isn't absolutely necessary for the roof to function; many slate roofs (primarily barn roofs) don't have any felt paper at all. Felt paper does, however, provide a temporary cover in the event of rain during installation, and it helps insulate and waterproof the roof, so it is recommended to use 30 lb. felt in order to do the best job.

NAILS

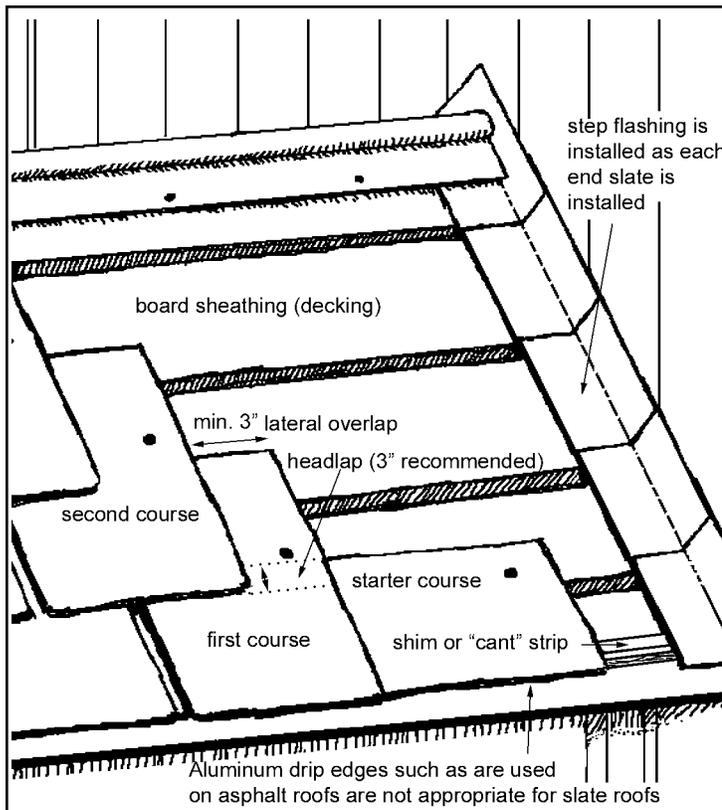
Many years ago, roof slates were hung on slating lath with a single wooden peg driven through a hole in the top center of the slate. No nails were used. Today we "hang" the slates onto the roof deck with two nails. When nailing new slates, use 1.5" copper roofing nails. When re-using old slates, a 1.5 inch hot-dipped galvanized nail will do. Make sure though, that it's "hot-dipped" and *not* electrogalvanized (EG). Do not nail the slates tightly against the deck or you will break them. It's called "overnailing." Do not "under nail" them either, or the protruding nail head will rub against the overlying slate and wear a hole in it. Nailing slates takes some practice, but it's not as difficult as it sounds. The nail holes come pre-punched and they're naturally countersunk to allow the nail head a place to hide. In Europe, it has become common to hang all slates on "slate hooks." This practice developed because the Europeans, especially the French and Germans, decided to use slates that were split very thin. The slates were so thin that a nail head could not hide in the slate, so hooks are used instead. This is another example of traditional methods being replaced for inferior, but modern (like plywood) substitutions. The best slate roof, however, is still the traditional one — nailed onto a solid wood deck.

TOOLS

Many people think that it's difficult to work with slate. Wrong. Slate is a very nice material to work with, especially old roofing slates. It cuts readily, you can punch a hole in it easily, and you don't need electrical tools, only simple hand tools. A good slate cutter looks somewhat like a paper cutter and will cut straight cuts, and even convex and concave curves. A slate hammer not only nails slates, but will punch holes in them, and even cut them. A slate ripper is a long sword-like tool that removes a slate from the roof without having to remove overlying slates even after the slate has been nailed in place. A ladder hook attaches to a ladder section and hooks over the ridge of the roof to allow for a way to get up and down on a steep roof. Roof jacks nail to the roof deck to create a platform to work from. You should have all of these tools, plus a nail belt, chalk line, utility knife, and a collection of ladders.

INSTALLATION

When laying out a roof in preparation for slating it, chalk lines across the entire roof area marking the top edge of every row of slate. No aluminum drip edges (as are commonly used on asphalt shingle roofs) are needed on slate roofs. When measuring for the starter slate and the first row, allow for the slate to hang beyond the drip edge of the fascia (or trim moulding) one and a half inches. The starter slates are usually made of the same size slates as those on the main roof, turned sideways and upside down (back facing out), and usually 1/4 of the length of the first one is trimmed off to allow the joints to be properly staggered in relation to the overlapping row. *The rule*



of thumb is that all butt joints between slates should have a minimum of three inches of lateral clearance in relation to the butt joints of overlapping slates. On many old roofs the starter slates are not laid side-ways, but are simply the same slates as the rest of the roof — cut short — and again the joints are staggered. In all cases, the starter slate must be laid over a shim or cant strip about 1/2 inch thick, which cants the slate at an angle comparable to the angle of the slates on the rest of the roof.

The slates that run up the side of the roof should extend beyond the gable ends one full inch. Run a string up the edges of the roof to give yourself a straight edge to follow when laying the slate (tie the string to temporary nails), or chalk lines up the roof edge to align the inside edge of the slate in order to leave a one inch overhang on the outside.

When you reach the top of the roof, the top rows of slates must be cut shorter in length to fit the roof. Frequently the top row, the “cap” slates, must be shimmed underneath so they’ll remain flat when the ridge iron or copper is installed; otherwise they’ll cock crookedly and look bad. They can be shimmed with pieces of slate, usually the pieces that are cut off the top rows when the slate is laid.

Headlap is critical. Every slate overlaps TWO rows beneath it. The only exception is the starter row and the first row. The overlap on the second row beneath the slate is called the “headlap,” and it is typically three inches. If you do not allow for sufficient headlap you may as well not put the roof on. On lower slopes such as 4:12, you must increase the headlap to four inches. On very steep roofs (12:12 or greater) a two inch headlap may be sufficient. Rule of thumb — don’t put slate on low slopes and do use a three inch headlap when installing on steep slopes.

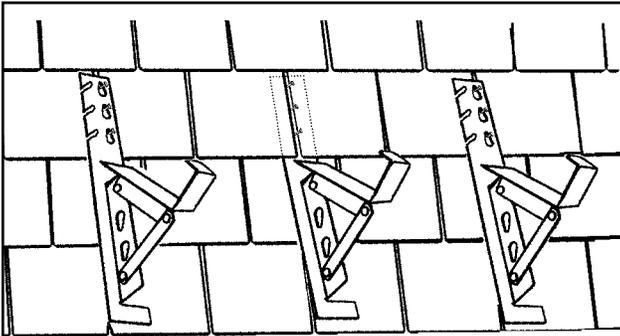
NEVER walk on slate during the installation, or any other time. This is very important. Run the rows of slate up the roof at an angle and work from the side. Slate is not asphalt — it cannot be walked on. Don’t sit on it either. Hook ladders will keep your weight off the slate. Also, roof jacks and planks with ladders sitting on them lying on the roof are a good way to go. The ladders CAN lie on the slate.

VALLEYS

Be sure to use a non-corrodable metal in the valley. Twenty ounce copper or terne coated stainless steel are recommended. Valley metal flashing is installed over the felted sheathing before any slating begins. The felt paper need not overlap the valley flashing (the valley metal can be laid right on top of the felt). Remember that the felt is only a temporary covering which will become full of holes when you install the slate. It’s the SLATE that makes the roof waterproof, NOT the felt underlayment! This is why it’s ridiculous to rely on ice and water shield to waterproof a slate roof.

Before the valley metal is installed, strike a chalk line up the edge of one side of the valley, on the felt paper, to indicate where the edge of the metal valley flashing should be. In most situations, a valley that is overlapped by 5” of slate will suffice, providing there is enough slope and the roof planes are roughly equal in size and slope. Therefore, a standard 6” exposed valley will require 16” valley flashing material. Wider material can be used, although you’ll find that you just nail holes in the outer edges anyway, which is a waste of material. Larger roofs that drain more water, such as on churches, should have wider exposed valleys (like 8”) with wider valley material. There are, of course many variations in valley styles, from open valleys to closed valleys to rounded valleys, creased valleys, inverted V-groove valleys, etc. The inverted V-grooves are necessary when two unequal roof planes are draining into each other.

The metal is then nailed in place with a nail of a compatible material (i.e. copper flashing with copper or brass nails, etc.), and the nails are kept to within one inch of the edge of the valley metal. The valley metal is then carefully forced into the valley with the pressure of a knee as the other side is nailed (or pre-break a line down the center of the valley for especially steep roofs). Some schools insist on folding the outer edges of valleys and cleat-



ROOF JACKS NAIL IN THE SLOT OVER STANDARD THICKNESS SLATES WITH 16P COMMON NAILS, AND UNDER THICK SLATES (AS SHOWN IN THE CENTER) TO HOLD A 2X10 PLANK. A LADDER CAN BE SET ON THE PLANK AND LAID ON THE ROOF. ALTERNATIVELY, REMOVE A SLATE AND NAIL THE ROOF JACK BETWEEN THE TWO UNDERLYING SLATES.

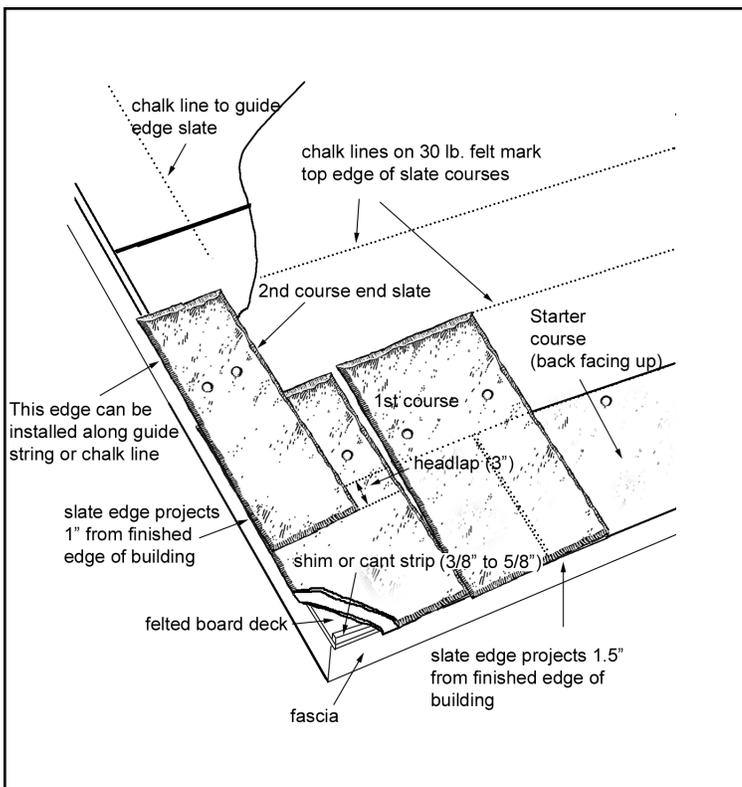
ing them into place rather than nailing them directly to the roof sheathing. Having replaced literally miles of old leaking valleys myself, both nailed and cleated, I have never seen an instance of a nailed valley leaking because it was nailed. Cleated valleys leak for the same reason as nailed valleys — corroded metal. Cleating is a practice recommended when solder joints are used in the flashing to prevent strain on the joint. Valleys sections do not need to be soldered; they are instead overlapped by 6 inches — therefore cleating is an unnecessary step that can be readily avoided.

Valleys should be laid in sections not to exceed twelve feet in length, although a ten foot *maximum* length is recommended due to the adverse effect of expansion and contraction that can cause long pieces of metal to buckle and develop a leak over time. The valley sections should simply be overlapped by six inches — no soldering is necessary or recommended, as it's the old solder joints on the old valleys that tend to leak, once again, due to expansion and contraction. Do not use roof cement or other adhesives along the edges of a valley (except

as an emergency seal in the event of rain during installation), as adhesives make later repairs of the roof unpleasant and difficult while adding no advantage to the functioning of the roof.

Valleys are typically laid “open,” with approximately six inches of metal exposed. The overall width of the valley metal can vary from 14” to 20”, although a minimum of 16” is recommended for a 6” exposure (providing no nails penetrate the valley more than an inch or so from the edge of the metal when the roof is slated). Open valleys typically have parallel sides running from bottom to top, although some roofers prefer open valleys that gradually widen toward the bottom. When laying slate into a valley, chalk a line the length of the valley on both sides to indicate the edges of the slate, then draw over the chalk lines with a permanent ink felt-tipped pen, as the chalk lines will wear off the metal almost immediately. When nailing slate over the valley metal, be careful to nail only along the edge of the metal, and not anywhere near the center. If a small, triangular piece of slate cannot be nailed over the valley at the end of a slate row without nailing too close to the center of the valley, eliminate that piece of slate — you won't need it.

RIDGES



Ridges, like valleys, are typically made of metal, but are often slate, and sometimes ceramic tile. When finishing slating along a ridge, it's important that the roof sheathing does not have any appreciable gap at the peak. If a gap exists (as is typically left when a carpenter sheaths a roof for ventilated ridge) the slates may not lay properly, and ridge metal will not have a sufficient base in which to nail. Ridge ventilation became common on houses as more and more people had problems with plywood delaminating and walls sweating moisture. Slate roofs, when properly built, naturally breathe. The gaps between the sheathing boards and between the slates allow for some air flow. This is contrary to asphalt shingle roofs with plywood decks, which do not breathe and must be ventilated. If you want to ventilate your slate roof, ventilate out the gable ends, or through roof top vents. If you insist on venting through your ridge, buy or build a ridge vent system specially designed for a slate roof — do not use the cheap aluminum vented ridge sold for asphalt shingle roofs.

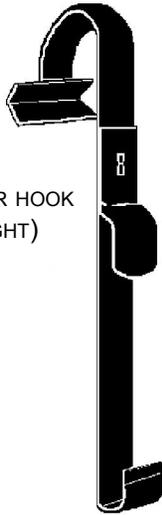
DO NOT

1. Do not use laminated wood roof decking — use solid lumber.
2. Do not use insufficient headlap — use three inches of headlap — more on lower slopes.
3. Do not walk on the slates or sit on them during installation — if possible, work from the side or from hook ladders or roof ladders on planks.
4. Do not use “electrogalvanized” nails — use hot dipped galvanized nails on recycled roofs and copper or stainless steel nails on new slate.
5. Do not rely on the underlayment (felt or ice and water shield) to waterproof the roof — you will puncture it profusely when you install the slate. A properly installed slate roof will not leak, underlayment or no underlayment. Ice and water shield is a product designed to protect plywood from delamination — you will not need it on a slate roof.
6. Do not use aluminum drip edges — they’re made for asphalt shingle roofs.
7. Do not use ventilated ridges unless they’re specifically designed for slate roofs — ventilate through gable ends or through individual roof vents.

When Starting to Slate a Roof — Ten Quick-Reference Steps

- 1) Make sure that the fascia is completely installed beforehand and that the ends of the sheathing boards are firmly nailed.
- 2) Felt over the board sheathing with 30 lb. roofing felt, lapped at least three inches at the top and sides.
- 3) Nail a wooden starter shim at the bottom edge of the lowest sheathing board - it should be about 1/2” thick, and at least an inch wide (eight foot lengths are convenient). Cedar or redwood is ideal (cedar shim shingles will work), but the same local lumber as the sheathing will do just fine.
- 4) Chalk a horizontal line on the felt paper for the starter slates, measuring the width of the slate up the roof from the bottom edge of the wood shim, deducting 1+1/2 inches for the slate overhang. Next, chalk a line for the first full row, now measuring up the roof the length of the slate and deducting an inch and a half for the overhang.
- 5) Now measure up the remainder of the roof equal distances equivalent to the exposure of the slate, and chalk lines accordingly. But first, make sure your second full row of slates will overlap the starter row by three inches based on your measurements — if not, drop that second row down an inch or so to where you need it to be, then chalk the rest of the roof with the exposure measurement. [Exposure is determined by subtracting the headlap from the total length of the slate, then dividing the remainder in half. For example, a 20” slate with a 3” headlap will have a 8.5” exposure ($20 - 3 = 17$, divided in half = 8.5).]
- 6) Do not bed the starter slates or any slates in roof cement or caulk, except for very small pieces on edges in unusual circumstances. Adhesives make it very difficult to repair the roof in the future. Instead, two 1+1/2” hot dipped galvanized or copper nails per slate is a good rule of thumb which will ensure the secure attachment of all slates to the roof. Don’t nail the slates too tightly, let them hang on the roof. Do make sure the nailheads are set into the slate however, as nails that stick up will eventually wear a hole in the overlying slate, and cause a leak.
- 7) Tap a couple of temporary nails into the side of the fascia on the gable end, one at the top and one at the bottom, and run a string up the edge of the roof positioned one inch out from the fascia. Use the string as a guide to align the edge of the slate as you nail them into place. Remove the string when you’re done. Or chalk vertical lines on the roof for edge slate alignment.
- 8) Make sure the slots between the slates on the first full row are staggered at least 3” laterally from the butted ends of the starter slates. If not, reinforce the joint by sliding a piece of flashing over the starter slate and under the first row at the joint.
- 9) You can work the first half dozen rows from a ground ladder or ground scaffold, then nail roof jacks and planks along the bottom of the roof and work up from there. Use more jacks, planks and roof ladders as needed.
- 10) Have fun!

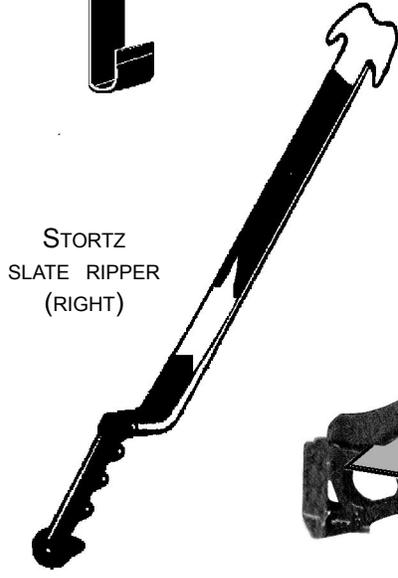
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LADDER HOOK
(RIGHT)



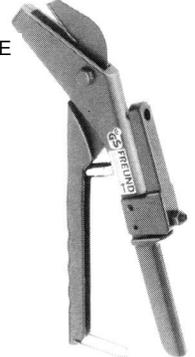
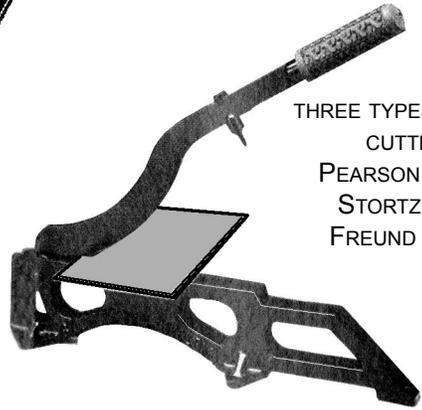
MISCELLANEOUS
SLATE HAMMERS
(LEFT)



STORTZ
SLATE RIPPER
(RIGHT)



THREE TYPES OF SLATE
CUTTERS:
PEARSON (ABOVE)
STORTZ (LEFT)
FREUND (RIGHT)



SLATE ROOFING — TOOLS OF THE TRADE