Roofing With Slate

With the right fasteners and flashings, you'll get a roof that can last a hundred years

by Terry A. Smiley

Use good materials for a long-lasting roof. The author uses high-quality materials such as copper flashings and fasteners, bituminous membrane, 30-lb. felt and silicone caulk to ensure his roofs last as long as the slate. Wood strips run up all hips and across the ridge to provide nailing for the saddle caps applied last.

Special tools for roofing with slate. A slate ripper, on the left, is used to cut or pull nails when removing broken slates. On the right are slate hammers. They have a small striking face and a point on the opposite end for punching nail holes.

I worked on my first slate roof when I was 14 years old. The farmer whose house we were remodeling also had a huge barn, and several roof slates were missing. He asked my grandfather if we could replace the slates, and because I was the lightest and the most agile, I was recruited. Ten years later, a customer I was installing a slate floor for asked if I'd be interested in installing a slate roof. By then, I'd worked with a lot of slate and was ready to give a whole roof a try. I called the supplier from whom I'd gotten flooring slate, and he sent me a copy of *Slate Roofs,* first published by the now-defunct National Slate Association in 1926. Everything worked out fine, and since then I've put on many slate roofs from Pennsylvania to Arizona. *(Slate Roofs* has been reprinted by Vermont Structural Slate Co. Inc., P. O. Box 98, Fair Haven, Vt. 05743; 800-343-1900. The book sells for $11.95.)

Slate is the ideal roofing material. It won't corrode or burn, and for the most part it won't wear out. I'm not saying that a slate roof will never need replacement or repair. But it is important to keep in mind that a roof is a system of its materials, and a slate roof is made up of more than just pieces of sedimentary rock pulled from a quarry, split by hand and cut into rectangles. The integrity of a slate-roof system comes from all its components—the slate itself, the flashings, the fasteners and the underlayment—acting in concert, and the failure of any component can result in the failure of the whole system and leaks in the living room.

A slate roof is expensive; slate can cost between $250 and $600 per square (100 sq. ft.), and depending on the complexity of the roof, my labor costs can run as high as $450 per square. Given the high cost of the slate, it's foolish to scrimp on the quality of the other components. Using second-rate materials for any part of a slate-roof system is akin to running recapped tires on a Rolls-Royce.

I use 16-oz. copper for all flashings, copper nails, bituminous membrane at all the eaves, silicone caulk and 30-lb. felt or roll roofing under

the slate. Although some people use standard, galvanized drip edge, a metalsmith makes my drip edge for me out of 16-oz. copper. I have a standard drip-edge profile, which I adjust to fit the house and roof design. It covers at least 1½ in. of the fascia and runs up the roof a minimum of 4 in. I run it along the eaves and up all the rakes. I bend my own step flashings, but there isn't any reason why your tin knocker couldn't make these pieces for you as well.

Order your slate well ahead of time—Unless you live near a slate quarry, it's unlikely that you'll be able to go the local roofing supplier and pick up enough slate to do a roof. My regular supplier—I've been using New England Slate for 10 years (Burr Pond Road, Sudbury, Vt. 05733; 802-247-8809)—will send me a slate-availability list (along with samples) to match the specification of the job. The list includes an approximate delivery time as well as estimates of delivery costs, via tractor-trailer. My typical slate order takes anywhere from one month to three months to arrive at the job site.

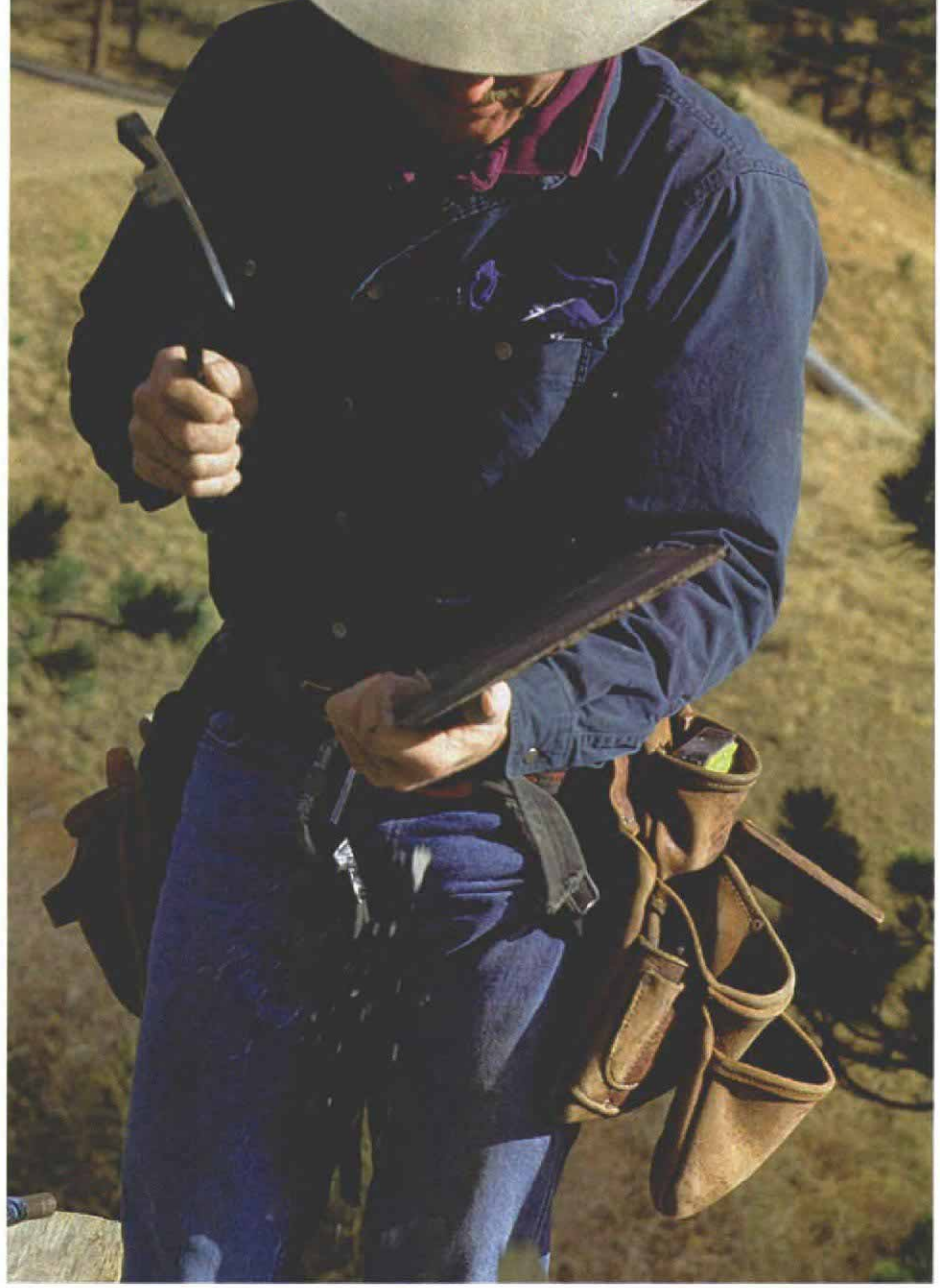
Pipe staging holds a lot of weight—Because slate is so heavy, loading it on a roof can be a precarious operation. And it seems that no matter how carefully I try to plan things, if I load the roof with more than a couple of days' worth of slate, I spend a lot of time moving the darn stuff around. So I prefer not to stock the whole roof at once. I think it's safer to keep roof surfaces open and free of clutter. And it makes layout easier if the roof isn't full of roofing materials.

It goes without saying that slate is heavy. You need a strong staging on which to stock materials. I like to use steel-pipe scaffolding. It's quick and easy to set up, and although you can rent pipe staging, three months of rental fees about equal the purchase price. If possible, I have a scaffold at all the eaves. I also wear a safety harness when I'm working on a roof (sidebar p. 74).

Thirty-lb. felt and bituminous membrane dry-in the roof—Putting on a slate roof is slow (but satisfying) work. A typical job takes me about three months after the time the slate arrives from the supplier. One huge job I did—170 squares, laid in a graduated, textural pattern—took me a year to complete. Because so much time passes from start to finish and because it's likely that the other trades are finishing off the interior of the house while I'm working, I take special care to dry-in the roof.

Roof dry-in starts with the application of Ice and Water Shield at all eaves (W. R. Grace & Co., P. 0. Box 620009, Atlanta, Ga. 30362; 404-448-5880). This bituminous membrane is designed to stop water from backing up under the slate with the formation of ice dams, a problem in northern climates for all roofing materials, not just slate. Ice and Water Shield is a self-adhesive flexible membrane, 40mm thick. It's made of polyethylene film and rubberized asphalt. On the back it has a release paper that is peeled off when the membrane is applied to the roof deck.

I lay a 1-ft. wide strip of membrane on the roof deck starting at the fascia. Over this first piece I



A slate hammer pokes a small hole in the back of a slate and makes a beveled hole in the face. A sharp blow with the point of the slate hammer punches a small hole in the back of the slate about 2 in. from the outside edge. The hammer's point pokes a small hole (the size of the hammer point) through the first couple of layers of the slate, and the percussion of the hit blows out the rest of the layers, leaving a conical hole. Ideally, the larger hole on the slate's face makes a countersink for the nail head.

install the copper drip edge. The top 3 in. of the drip edge then are covered by a 3-ft. wide sheet of membrane. Another sheet goes above this one, lapping the first 3-ft. sheet by 3 in. Two 3-ft. sheets of membrane give me almost 6 ft. of protection from ice damming.

After the second row of bituminous membrane is on the roof, I complete the dry-in with rows of roll roofing or of 30-lb. felt. Fifteen-lb. felt is the standard weight for most roofing materials' underlayment. But the additional cost of the heavier materials I use is offset by the fact that they hold up longer without repair.

Roofing nails will hold the paper securely, but I like to use special nails called cap, or button, nails. These nails have a small square of stiff plastic pushed onto the shaft right below the head. The large head of the cap nail holds the larger piece of plastic securely against the felt, effectively resisting the forces of wind and rain.

Two special tools are all you'll need to get started—For around $100 you can get all the special tools needed to put on a slate roof: a slate hammer and a slate cutter. Both are available from New England Slate.

A slate hammer is essential to good slate work. Most slate hammers are lightweight, about 14 oz., and they have a small striking face, usually ¾ in. across. Slate hammers have a long, tapered 6-in. point on the back of the head (right photo, p. 70). The hammers' point is used for punching nail holes in slate.

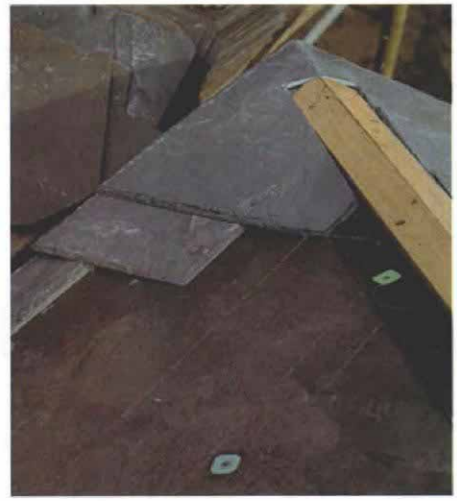
Most slate will come from the supplier with a hole punched in each top corner, but there are a lot of times, such as when you cut a large piece of slate into smaller pieces, when you'll have to punch your own holes. It's not hard to do, but like a lot of simple procedures, punching holes takes a little practice.

Because I'm right-handed, I hold the piece of slate face down in my left hand and then give the back of the slate a sharp blow with the point of the slate hammer. The face, or the exposed side of the slate, is the side with the beveled edges. When the slate is cut at the quarry, the shearing action of the cutter leaves a beveled edge on one side and a smooth edge on the back. I try to punch the hole about 2 in. from the side edges of the slate and 1 in. more than the exposure line from the bottom. Just the right hit will poke a small hole in the back of the slate (top photo, p. 71).

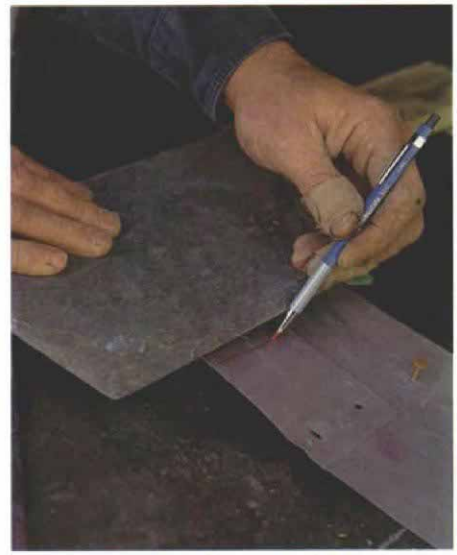
When you turn the piece over, you'll see that the percussion of the blow has blown out a larger hole on the slate's face. The point of the hammer pokes a small hole (the size of the hammer point) through the first couple of layers of the slate (bottom left photo, p. 71), and the percussion of the hit blows out the rest of the layers, leaving a conical hole. Ideally, the larger hole on the slate's face makes a countersink for the nail head (bottom right photo, p. 71).

For small pieces of slate, say the little pieces of a hip's cap, which a hammer blow might break, I lay the slate face down on a board and punch the hole with the hammer's striking face and a nail set. The less violent blow to the slate sometimes can keep it from breaking.

A slate cutter looks like a paper cutter. The author holds the finish-side down and uses short, chopping strokes to munch through the piece of slate. The cutter give a clean cut on the back of the slate and a beveled cut on the face or finish side.



The first course is made of three layers of slate. The first and second layers of slate, cut to 4 in. and **10½** in. respectively, are bedded with silicone and nailed even with the drip edge. The third layer is full-length slates. For a hip roof, the full-length slate is notched around the wood strips that provide nailing for the saddle caps.



Layout tools. The author uses a wax pencil for laying out courses on a sheet-metal story pole. The red wax shows up equally well on slate, sheet metal and felt paper.

Several other features also are incorporated into most slate hammers. These features include a nail puller and a slate-cutting edge that is forged into the metal shaft between the handle and the hammerhead.

Some people use the hammer's slate-cutting edge for trimming pieces of slate. I prefer to use a slate cutter, which is similar in design to a paper cutter. The cutting edge is anywhere from 4 in. to 16 in. long.

Slate cutting is a process of shearing, or nibbling, through the slate, rather than a guillotine action. You put the slate in the cutter face-side down. You hold the slate with one hand, and with the other hand you force the cutting edge through the slate in short strokes to nibble away at the stone (photo top left). Slate cutting is surprisingly easy, and with practice any intricate shape can be cut.

The slate cutter forces the layers of slate away from the exposed face, and when the stone is turned over, the cut edge is beveled away from the cut. Occasionally, if I am using thick slate or if I am working on a special detail where a square, nonbeveled edge is required, I'll use a wet saw with a diamond blade to make my cuts. For the most part, however, a slate cutter is faster, if not more convenient.

Sheet-metal story poles speed layout—Roofing slates are available in different lengths, and the slates' length establishes the weather exposure of the courses on the roof. Longer slates are laid with longer courses. The slates used for the photos in this article are 18 in. long. Other standard lengths are 12 in. and 24 in.

Slate is laid on a roof so that a part of each slates' length is covered by the next two courses above. Because of this overlap, the roof is always three slate layers thick. Slate is laid with a 3-in. head lap. This construction means that the top of each course is covered not only by the next course above but also by the first 3 in. of the second course above. The 3-in. head-lap rule is the basis for figuring the course height of a certain length of slate. To figure out the course height, you take the total length of the slate, subtract 3 in. and divide the difference by 2.

For instance, an 18-in. slate minus 3 in. equals 15 in. Dividing that in half leaves a 7½-in. course for an 18-in. slate. Course height can vary by ¾ in. short or ¼ in. long. In order to run an even course up to a ridge or to ensure a course meets, say, the bottom of a skylight, you could run 18-in. slates in courses from 6¾ in. to 7¾ in.

I like to lay out all my slate courses for the whole roof before I nail on the first piece. Establishing my course layout ahead of time prevents confusion when I start laying slate. I lay out my courses on story poles made of 24-ga. galvanized sheet metal that I rip to 2 in. (photo bottom left). I pop rivet the strips together in lengths equal to the eaves-to-ridge length of the roof.

To make a matching set of story poles (one for each end of the roof), I nail two strips next to each other at the ridge, letting them hang down the roof to the eaves. With the two strips hanging next to each other, I can mark my course lines on both strips at once. I like to use a mechanical

Duct tape and string help to align the saddle caps. The pieces of the ridge cap or hip cap (shown here) are bedded in silicone and fastened with two nails each into the wood strips the author attaches to all hips and ridges. To keep the caps straight, he sights along a string that runs from the eaves to the peak. Strips of duct tape hold the two pieces of the caps together while the silicone dries.

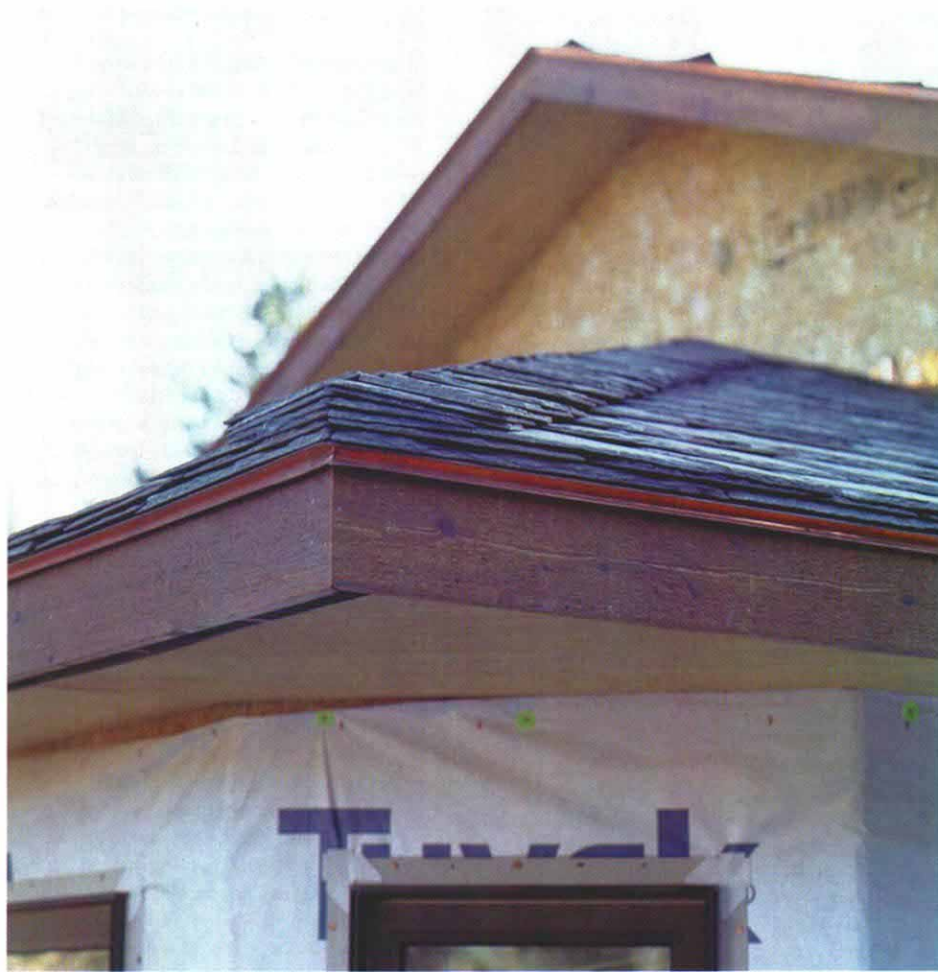
red-wax pencil for marking the story poles (bottom photo, facing page). I also use the wax pencil to mark on slate.

Once I have the courses set up on the story poles, I nail one at each edge of the roof and then snap lines, usually six courses at a time. I then roll the story poles to the ridge, where they are out of the way. I first used this system on a complex roof that had seven different slate lengths and different course heights, and since then, I realized that it saves time on even the simplest layout.

Slate nails act as hangers—Slate nails are a critical part of a slate roof's life expectancy. The best nail for slate work, combining long life and a wide range of sizes, is copper. Standard copper slating nails are available in sizes from ½ in. to 3 in. To figure nail length, double the thickness of the slate and add ¾ in. for deck penetration. For this roof I used ⅜-in. slate and 1½ in. nails

Nailing is the most important skill required for good slate work. A nail must be driven far enough below the surface of the slate (into the countersunk hole made by the hammer) so that the slate above won't rest on the head of the nail and provide a stress-inducing high spot. Conversely, the nail must not pull down so hard on the slate as to break it. The best way to nail a slate is to hold it down snug with one hand and then sneak the nails in just below the surface. Experience will teach you when you've nailed wrong, but only at a price.

Slate nails act more like hangers than fasteners. They are holding the slates on the roof, not holding them to it. If you could pick up a proper-



A capped hip is six layers thick at the eaves. A three-layer first course is capped by a three-layer saddle cap for a total of six layers of slate.

ly nailed slate roof and give it a good shake, the slates would be loose enough to rattle.

Triple-layer first course is bedded in silicone—In roofing with slate, the first course, starting at the eaves, is three layers thick (center photo, p. 72). I cut the slate of the first layer to a length of 4 in. I punch holes in these small slates and nail them even with the bottom of the copper drip edge. Before nailing, I bed the slates in two walnut-size blobs of clear silicone caulk. I bed all my small slates—starter courses, ridge caps, small pieces running up a hip—in silicone.

The silicone provides long-term shock protection against things such as someone leaning a ladder against the eaves or walking up a hip. The silicone also provides additional resistance to the unsightly slippage that can sometimes happen with smaller pieces of slate. Few things look worse from the ground than a slate that has slipped below the others in an otherwise straight course on a roof.

The length of the second layer in the first course is determined by adding 3 in. to the full-size course height. If I'm using 18-in. slate and if the exposure of the courses is 7½ in., then the second layer is 10½ in. long.

The second layer is also bedded in silicone, and it is laid over the 4-in. first layer, even with the drip edge. Next comes my first full-length layer of slate. It covers the first two layers of the starter course and is laid with its bottom edge even with the drip edge. From here, standard coursing, following the lines I've snapped with my story pole, continues to the ridge.

Along with a 3-in. head lap, I lay slate with at least a 3-in. side lap. This layout means that joints between slates in one course should be offset by at least 3 in. from the joints in the course below.

Use wood strips for the ridge and hip saddles—I cap all ridges and hips with slate saddles. Each saddle is made of two pieces of 12-in. by 6-in. slate that butt together and extend 6 in. down each side of a ridge or hip. I use a 3-in. head lap for the saddle. Following the same formula used to determine course exposure for the full-length slates gives me a saddle exposure of 4½ in. (12-3=9; 9/2=4½.)

As a base for the saddles, I rip pieces of wood 2 in. wide and as thick as the three overlapping layers of slate that result from the slate course running up the roof. The wood provides a solid base to nail the slate saddle caps to. I nail the pieces of wood along all of the ridges and down all of the hips (left photo, p. 70), stopping 6 in. from the eave end of the hips and 6 in. from the rakes or gable. If the saddle base pieces went all the way to the eaves, they would be visible from the ground.

Running slate up a hip roof is not difficult, but it does require some careful slate cutting. I make a three-layer first course similar to the straight-eaves first course described earlier. The only real difference is that the pieces have a 45° cut along the edge of the hip and a notch cut in the second and third pieces where they go around the wood saddle base pieces (center photo, p. 72). After the starter course is run, finishing the hip is a matter of filling in pieces of slate where they meet the solid-wood strips.

At the eaves, a hip is six layers thick—For a hip roof, I start laying the saddle caps at the eaves. Like all first courses, the first course of saddle caps has three layers. The three-layer hip and the three-layer saddle make a total of six layers of slate at the eave end of the hip (bottom photo, p. 73). I punch two nail holes in the upper left-hand or right-hand corners of each saddle piece, depending on which side of the hip they will go on. The holes have to be close together so that the nails will go into the 2-in. wood strip instead of through the slates below (top photo, p. 73).

As I run the saddle caps up a hip or across a ridge, I bed each piece of cap in silicone. I run a bead of caulk between the two pieces of slate where they meet at the ridge. I stop the bead 4½ in. from the bottom edge so that the caulking won't be visible. Triple coverage of the slates keeps things watertight. Even though every cap is held in place by the two nails in each piece, I use duct tape to hold the saddle slates in place until the silicone dries (top photo, p. 73). I run a string down the center of a hip or ridge. Aligning the joint where the pieces of each saddle cap meet with the string gives me a straight course.

A slate ripper removes broken slates—I always give my customers a limited lifetime guarantee on their slate roofs, but all they have to do to void the guarantee is walk on the roof. Slate is brittle, and it will break easily. If a slate roof is never walked on, the most maintenance you may need to do is replace a couple of slates that inevitably get broken when the roof is installed. When I'm installing a slate roof, I always walk on it gingerly, watching where I step.

Replacing a slate is accomplished using a special tool, a slate ripper. A slate ripper is an 18-in. to 30-in. long piece of flat ⅛-in. by 2-in. forged steel attached to a round, offset handle (right photo, p. 70). A hook is forged on either side of the flat end of the ripper.

To replace a slate, I slide the ripper under the broken slate and use the flat end to locate and then hook over the nails holding the slate in place. Once the nail is hooked, I smack the offset handle of the ripper with a sharp blow from a 2-lb. sledgehammer. A single sharp blow causes less stress to the surrounding slates than repeated light blows.

Once the nails are pulled or cut, the pieces of the broken slate should slide out. A new slate of similar size is bedded in silicone and slid into place. To fasten the new slate, I snip both sides of a nail head to make it T-shaped. I punch a hole in the replaced slate at the upper end of the slot between the slates in the course above. Then I drive the T-headed nail between the slot and through the slate.

Next I fashion a piece of copper to cover the nail in the slot between the slates above. The copper is 3 in. wide and long enough to hook over the top of the replaced slate and cover the T-nail by 3 in. I hem, or bend over, the top ¾ in. of the copper. Then I slip the copper, hemmed-side down, onto the flat end of the ripper and shove the ripper between the replaced slate and the slates above. The hemmed end should snap down past the top of the replaced slate and hook onto the edge. Like all slate-roofing techniques, all this one takes is a little practice. □

Terry A. Smiley runs TAS Construction in Woodland Park, Colo. Photos by Jefferson Kolle.

Fall Prevention

I think of scaffolding as a way to get materials to the roof, not necessarily as something that keeps me from falling off. To keep from falling, I rely on gear similar to what mountain climbers use (photo above). I wear a harness that has a sling around each leg and a belt around my waist. A carabiner, which is a big clip kind of like a giant safety pin, attaches to both leg slings and to the belt. I run a series of screw eyes into a rafter every 12 ft. along the roof ridge. A climbing rope is tied to another carabiner and hooked to the screw eye. A smaller rope runs from my harness to the climbing rope. A simple slipknot, the barrel knot, connects the smaller rope to the climbing rope. The barrel knot allows me to move up and down and across the roof while keeping a taut line between me and the ridge.

You'd be surprised how fast you'll get used to wearing the harness and using the ropes. For me the climbing gear is much more comfortable and infinitely more adjustable than other construction safety belts I have seen. Clerks at a mountaineering store can set you up with everything you need, and they can show you how to use the equipment.

I've been a firm advocate of a rope and climbing harness ever since I was on a job where a man fell 8 ft., a man who is now a paraplegic.—*T. S.*