How To Use a Jack To Raise a Building

1. Raise the jack(s) ¼ inch or one-quarter turn at a time.
2. Build up the adjacent cribbing so that it is tight to the structure (you can swap thicker cribbing for several thinner boards, or vice versa) as you raise the building at ½-inch intervals.
3. Check the markerboards and adjust the jacking and cribbing if necessary.
4. Repeat until you reach the jack's limit.
5. Build up the adjacent cribbing so that it is tight to the structure.
6. Remove the jack(s).
7. Rebuild and raise the cribbing beneath the jack(s), leaving only enough clearance to reinstall the jack(s).
8. Reset the jack(s).
9. Raise the jack(s) ¼ inch or one-quarter turn at a time.
10. Build up the adjacent cribbing at ½-inch intervals so that it is tight to the structure.
11. Check the markerboards and adjust the jacking and cribbing if necessary.
12. Repeat until you raise the building as high as necessary (figure 76).

Figure 76—Preservation carpenters raised the Sage Creek Cabin (Custer National Forest, Northern Region) 18 inches during a 2-week period, using needles, jacks, and cribbing.

Foundations and Site Preparation

A building needs a solid foundation to keep it plumb and level, out of the dirt, and ventilated underneath. The foundation should have good drainage, be stable, adequately support the building and its floor loads, and keep the sill logs, spandrel logs, and floor joists a sufficient distance from the ground and moisture to deter decay and insect infestation. Log buildings with cellars are less likely to suffer foundation problems than those built on the ground or with crawl spaces, as long as the cellar remains dry and ventilated.

A good foundation extends the life of any building and is particularly important for historic buildings. Most preservation or restoration projects include foundation work. Although replacement in kind and use of matching materials are the norm for preservation work, some leeway exists for foundations. If the builders originally constructed a building without a foundation or constructed an inadequate foundation, you must build a new or better foundation for the building to survive.

Foundation changes do affect the material and visual integrity of the building, but the tradeoff is a longer life for the building. Keep in mind that the SHPO will probably need to review or approve any changes to the foundation if a Federal or State government agency owns the cabin, or if some Federal or State sources provide some or all of the funding for cabin preservation work. The SHPO usually approves beneficial changes that are in keeping with the character of the building. Check with your heritage resource specialist or archaeologist for the requirements.

People who didn't expect to stay long sometimes constructed cabins on wooden sleepers or log pilings that have rotted (figure 77) because of direct contact with the ground. You will have to lift the building to access and replace the sleepers or pilings, as explained in the Raising and Leveling section of this guide. Unless you require exact replication or the sleepers or pilings will be highly visible when the work is completed, choose the most rot-resistant logs or lumber available for the new sleepers or pilings and set them on concrete footings. Consider replacing log pilings with masonry or stone piers if that type of construction is common for other historic cabins in the surrounding area.

Figure 77—The builders constructed this small cabin on log sleepers laid directly on the ground. Despite the relatively dry climate, the sleepers have almost entirely rotted away, and the sill and spandrel logs have now begun to melt into the dirt also.

Do not replace the entire foundation if the building assessment found only minor foundation problems, such as cracked or missing mortar or loose stones. Simply fix those specific problems. Reset loose stones in their original locations if possible. Mix and apply replacement mortar to match the original mortar as closely as possible. This process may entail trying several combinations of sand, lime, and Portland cement to find a mix that matches the appearance and function of the original. Experiment with test mixes in small batches and compare them side-by-side to assess the best match (figure 78).

The masonry or cement foundations of many log buildings don't extend below the frostline and are susceptible to distortion and settlement caused by ground heaving during freeze-thaw cycles. Repair foundations that have shifted or settled and no longer properly support the building. Replace missing foundation components in kind. If the foundation is decayed, shifted, or damaged beyond repair, rebuild it. Construct new foundations using modern methods, including reinforcing rods and a footing under the stem wall (see figure 5). Ensure that the visible part of the foundation matches the historic appearance. In many cases, you must first level the building and support it on cribbing while repairs are underway, as explained in the Raising and Leveling section of this guide.

Some log buildings have stone-pier foundations (figure 79) or are supported by a row of individual pier stones. If the builders didn't lay the pier stones correctly, the foundation will fail over time.

Support all piers and foundation walls on footings that you set below the frostline. Frost depth or foundation depth usually is specified in local building codes. Building codes may not provide adequate guidance outside municipal areas. For Forest Service projects, check with the facilities engineer to determine the frost depth in the area, which varies not only with soil type and maximum extended low temperatures, but also with precipitation patterns, particularly snow cover. Civil or structural engineers or architects who are familiar with the area also may be able to provide more guidance on frost depth.

Set footings for piers at each corner, spaced along each wall and under each bearing point of the building. If the existing pier stones are undersized, locate larger stones or build new

Figure 78—A preservation crewmember shaped several mortar test mixes into patties and allowed them to cure on a plywood sheet. He compared the mixes side-by-side and moved the whole sheet near the original mortared structure to compare them with the original mortar. When you compare mixes, it is easier to see what adjustments you should make to match the original mortar.

stone piers. For best stability and durability, have a structural or geotechnical engineer design the footings and pier spacing to adequately support the building. For smaller log cabins, concrete footings that are at least 18 inches square and at least 12 inches deep generally will provide adequate support if the frost depth is shallow (figure 80).

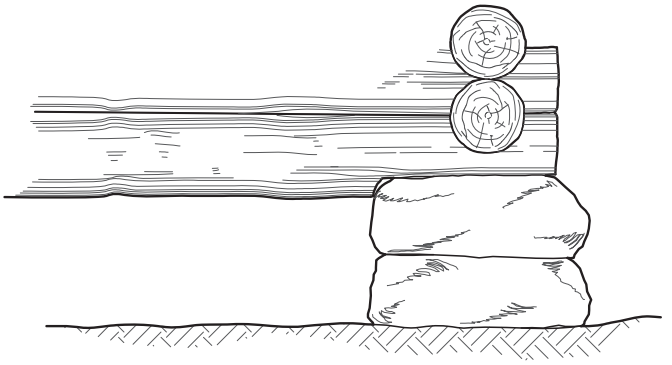

Figure 79—This drawing shows a stone pier constructed of flat rocks supported directly on the ground surface, which is typical of historic log cabins. The sill log is hewn to fit the top of the pier.

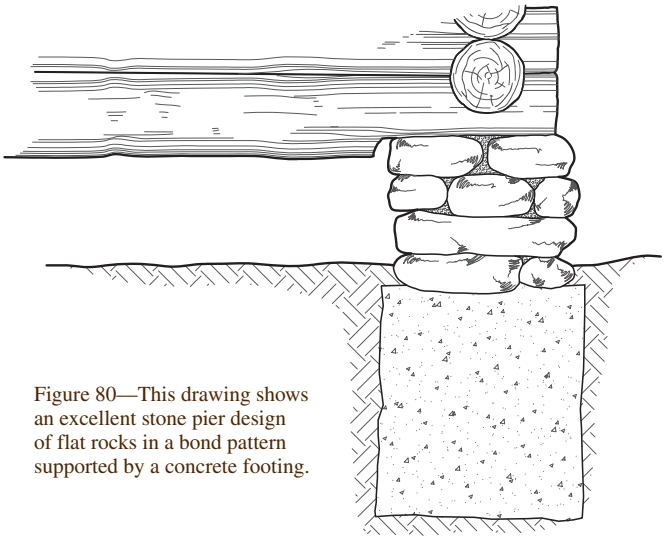

Figure 80—This drawing shows an excellent stone pier design of flat rocks in a bond pattern supported by a concrete footing.

After the concrete footing cures, lay the original pier stones again or construct new piers (figure 81). Construct new piers from the same type of masonry as the original historic piers, whether the masonry is bricks, stones, split rock with mortar, or even concrete blocks. Build the piers as tall as the originals, but at least tall enough so that they provide a minimum of 8 inches of space between the ground and the sill log (figure 82).

You may be able to repair continuous foundations of masonry or concrete if they have only partially failed. Completely replace severely deteriorated foundations (figure 83). Support the building on jacks, bars, and needles (figure 84) and remove all the damaged or failed sections. If the foundation is constructed of masonry, be careful when removing the individual stones or bricks. Salvage and carefully store materials that are undamaged for reuse in the reconstructed foundation.

Continuous foundations usually are composed of a footing and a stem wall, with vents spaced along the wall. If the original foundation was only a stem wall without a footing, add a footing when you reconstruct the foundation. The footing won't change the building's appearance, but it will add stability to the foundation and extend the life of the building. As with pier foundations, have a structural engineer design the footings and stem wall to ensure adequate stability and support for the building. Footings must be below the frostline.

Build the new foundation as tall as the original, but at least tall enough to provide a minimum of 8 inches of space between the ground and sill log. Use materials and workmanship that are similar to the general appearance of the original foundation. Unlike with modern log home construction, do not put foam sill sealer between the foundation and the sill and spandrel logs because in historic log buildings the sealer is more likely to trap moisture against the logs than prevent moisture from wicking into the logs. You may lay a sill plate of treated lumber between the foundation and the sill and spandrel logs to raise them off the foundation and prevent the logs from wicking moisture. If you add a treated lumber sill plate, set it back 1 inch or so from the outer edge of the foundation. For a more historically appropriate appearance, conceal the sill plate by applying daubing over its exterior surface. Use daubing that matches the daubing used between the cabin logs. See the Chinking and Daubing section of this guide for more information.

Figure 81—Preservation crewmembers constructed a new footing and stone pier at the Judith Guard Station of the Lewis and Clark National Forest, Northern Region. The footing is under a corner of the cabin where the wall meets the porch.

Figure 82— A preservation crewmember constructed a new footing and sturdy flat stone pier at the Badger Cabin within the Lewis and Clark National Forest, Northern Region.

Figure 83—This foundation corner is cracked and leans out, but it's more intact than the rest of the foundation under the Bull River Guard Station of the Kootenai National Forest, Northern Region. The forming details in the concrete are important to the appearance of the building.

Figure 84—Preservation crewmembers removed part of the foundation to allow placement of a jack (center) and a timber needle (far right) to support the cabin during foundation removal and log replacement. The crewmembers replaced these temporary supports with steel needles on cribbing before forming the new foundation.

If you've supported the building on needles, construct the new foundation around the needles (figure 85). When the building rests on the new foundation and you remove the needles, transform the gaps in the foundation that you left around the needles into foundation vents (figure 86) or fill them in with the same material as the rest of the foundation. Be sure to provide foundation vents with sufficient open area so that moisture isn't trapped beneath the building. Have an engineer or architect determine the necessary vent square footage. The needle gaps alone may not provide enough venting. Be sure to screen the vents so that rodents and insects can't get under the cabin. Use a layer of insect screen behind a layer of ¼-inch metal hardware cloth. Apply the screening on the inside of the foundation where it won't be noticeable.

Use hardware cloth inside the foundation to keep rodents out if you construct the foundation wall using unmortared rubble, split stone, or cobblestone (figure 87). Before building the aboveground portion of the new foundation wall, measure the height of the gap between the ground and the sill and spandrel logs and add about 1 foot. Cut the hardware cloth to this width. Tack the edge of the hardware cloth to the underside of the sill and spandrel logs all around the foundation so that most of the cloth hangs to the inside of the foundation. Run the cloth down about 6 inches below the ground inside the foundation. Bury the cloth belowground inside the foundation wall. If you cannot excavate to bury the cloth, fold the extra length along the inside of the building and weigh it down flat against the soil with plenty of heavy rocks, then finish building the foundation wall.

An unsupported slab foundation basically is a sheet of concrete laid on the ground that directly supports the log walls. Unsupported slabs don't have a stem wall or thickened edge that extends below the frostline. Do not construct an unsupported slab beneath a log building (or any other building) in an area with expansive soils or a climate that experiences ground frost. The slab will crack and heave. If your cabin rests on a failed, unsupported slab, jack the building up, remove the old slab, and build a new continuous foundation that extends below the frostline to good bearing soil. In some cases, you may be able to remove only the outer edge of the slab and replace it with a proper foundation to support the log walls. You can leave the remainder of the slab in place as a floor. Replacing the slab is an enormous amount of work, but will save the building.

Figure 85—Preservation crewmembers replaced deteriorated logs and constructed forming for the new foundation around the steel beam needles that support this cabin.

Figure 86—The completed replacement foundation matches the appearance of the original foundation, including the forming details on the corners. Preservation crewmembers created foundation vents out of the gaps in the foundation through which the steel beam needles extended.

Figure 87—Preservation crewmembers constructed a new cobblestone foundation under the Cooper's Flat Cabin in the Bitterroot National Forest, Northern Region.

Log Replacement

Because the steps for repairing and replacing logs are more interwoven than sequential, and many choices and options exist, it is difficult to present the information in logical order. This section will first explain how to select and prepare logs, then how to remove and replace logs, how to shape logs, and finally, how to repair logs.

Selecting and Preparing Logs

People usually think of historic cabin logs as being round, but they actually were often sawn or hewn (figure 88), especially where larger logs were available. Builders normally constructed a cabin with only one log shape, but sometimes incorporated a different log shape for additions or other changes to the building.

Although builders frequently constructed log cabins using only a felling axe, a broadaxe, and a saw, nowadays builders commonly use a large kit of handtools and powertools.

Basic Toolkit for Log Work

- **Measuring tools—**Calipers (figure 89) and tape measures (figure 90).
- **Moving and carrying tools—**Timber tongs, hooks, and big mallets (sometimes called commanders, commandettes, beetle mallets, or persuaders) (figure 91).
- **Debarking tools—**Bark spuds (figure 92), spokeshaves, and drawknives (figure 93), and sometimes shovels.
- **Holding tools—**Log dogs, log staples, and log cleats (figure 94).
- **Log shaping and working tools—**Chain saws; axes and hatchets (figure 95); broadaxes (figure 96); adzes (figure 97); smooth-faced hammers; chisels, slicks, and gouges (figures 98 and 99); crosscut saws and handsaws (figure 100); and circular saws, worm drive saws, and reciprocating saws (figure 101).

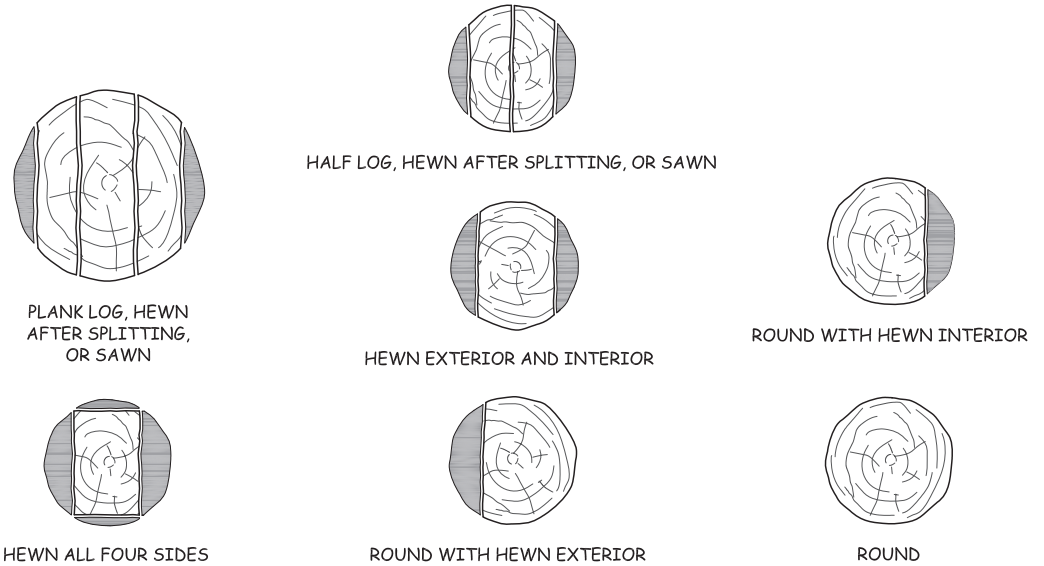

Figure 88—This drawing shows the various shapes used for cabin logs. Logs that are hewn or sawn flat on only one or two sides are called "cants." The sections of log that are sliced or split from the outside of hewn logs sometimes are called "slabs."

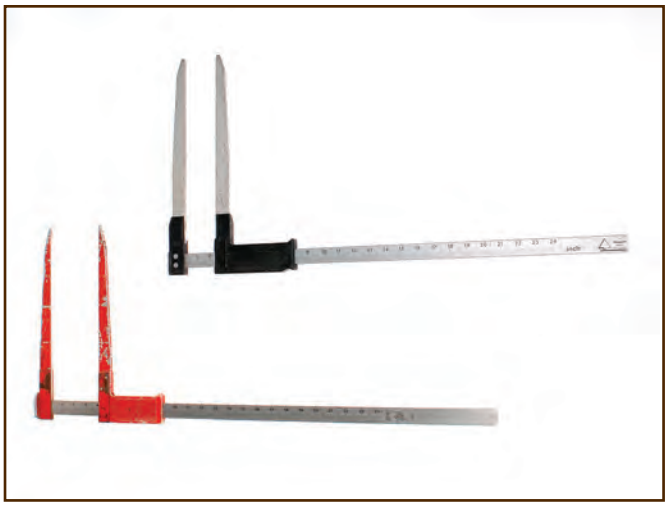

Figure 89—The Northern Region Historic Preservation Team uses an assortment of log calipers.

Figure 92—From left to right, these tools are a hardwood bark spud specially made in a shop, a Snow & Nealley bark spud, and a Dixie cedar bark spud.

Figure 90—It's handy to have an assortment of measuring sticks and tapes available for use during log cabin restoration projects.

Figure 93—You can find drawknives and spokeshaves in various configurations and sizes. This photo shows two spokeshaves (at the bottom) and a variety of drawknives. Both drawknives and spokeshaves smooth wood as the operator pulls them across the wood surface.

Figure 91—From top to bottom, these useful log handling tools are timber tongs on a carrying bar (sometimes called a Swede hook), an old style cant hook, a peavey, a short-handled cant hook, railroad tie tongs (to the right), a hookaroon, a pickaroon, a hickory-head commander mallet with iron bands (to the right), and a homemade Osage orange-head commander mallet.

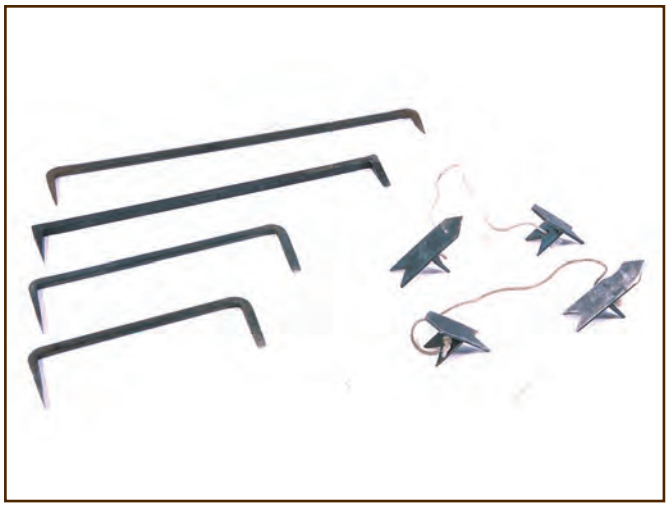

Figure 94—You can find log dogs (on the left, sometimes called log staples) in various sizes with either chisel or pointed ends. The most effective chisel end log dogs are constructed with the flat side on one end perpendicular to the flat side on the other end. Log cleats (on the right) come in pairs connected by ropes.

Figure 95—You can find axes and hatchets in a variety of configurations and sizes. This assortment includes, from left to right, a True Temper 5-pound single bit miner's pattern axe with a 28-inch handle, a True Temper 3½-pound single bit Jersey pattern axe with a 32-inch handle, a Hy-Test 6-pound single bit Australian pattern axe with a 32-inch handle, a Bluegrass 3½-pound double bit western pattern axe with a 32-inch handle, a 2½-pound double bit axe with a 24-inch handle, a 2½-pound single bit boy's axe with a 20-inch plumb handle, and a Gränsfors Bruks 1½-pound carpenter's hatchet with an 18-inch handle.

Figure 96—From top to bottom, these three tools are a Gränsfors Bruks 4-pound, 1700 pattern Swedish broad axe with a 17-inch handle; a Beatty 9-pound Pennsylvania pattern broad axe with a 20-inch single bit handle; and a Douglas 8-pound New Orleans pattern broad axe with a 20-inch dog leg (sideways bend) handle.

Figure 97—From left to right are a Douglas carpenter's adz, an Austrian hatchet adz, an enxó hand adz from Portugal, and a Cheney adz-claw hammer.

Figure 98—You can safely transport assorted chisels and gouges in handmade leather tool rolls such as these. You will need a few handy mallets to operate the chisels and gouges.

Figure 99—From left to right, these tools are two antique 3½-inch slick chisels, a Barr 3½-inch scarf slick chisel, a Barr 2½-inch gouge, and an antique swan neck chisel.

Figure 100—From top to bottom, these saws are a one-man crosscut saw with Great American tooth pattern and its wooden sheath, a Disston champion tooth pattern pruning saw with its leather sheath, and a 4-foot Royal Chinook lance tooth pattern convertible one-man/two-man crosscut saw with its fire hose sheath.

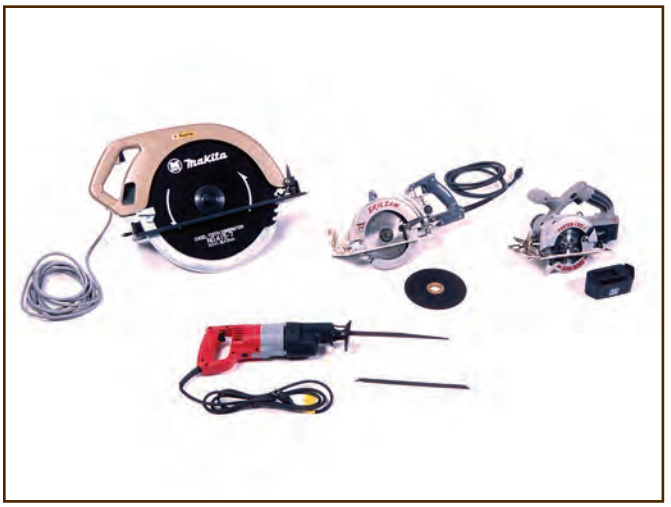

Figure 101—The powertools in the top row are a 16¼-inch diameter Makita circular saw, a 7¼-inch diameter Skilsaw worm drive circular saw, and a 6-inch diameter Porter-Cable cordless circular saw with an extra battery and battery charger. Below the three circular saws is a Milwaukee Sawzall reciprocating saw with blades for cutting wood and metal.

Additional Tools for Log Repair and Replacement Work

- Hand planes (figure 102) and power planes.
- Power drills, bits, and hole saws (figure 103), hand drills, and augers.
- Squares and short lengths of steel bands (figure 104) or asphalt building paper strips.
- Scribes (figure 105).
- Levels, plumb bobs, and stringlines (figure 106).
- Sanders, routers, power planers, and grinders (figure 107).
- Graphite or blue lead pencils and blue chalk. ONLY use pencils or blue chalk; felt-tip markers or red chalk won't wear off and will bleed through paint and stain (figure 108).
- Epoxies (figure 109).
- A generator for powertools if electricity isn't available onsite.

The brand names mentioned in the figure captions are for identification purposes only and are not a recommendation or endorsement of those products. See Appendix F—Acquiring Tools and Materials for more information about where to obtain tools.

Figure 102—The planes in the left column of this photo are,from top to bottom: an old Stanley #5 corrugated blade jack plane with a plane angle guide, a Lie-Nielsen scrub plane, and a large Veritas low-angle rabbet block plane. On the right, from top to bottom, the planes are: an old Stanley #3 finish plane, a Stanley #78 rabbet plane, and a Lie-Nielsen rabbet block plane.

Figure 103—These three tools are, from top to bottom, a Milwaukee Hole Hog with a 24-inch-long, ¾-inch bit and a 24-inch bit extension; a Porter-Cable 19.2-volt, ½-inch chuck cordless drill with a ¼-inch Irwin bit; and a Milwaukee ½-inch hammer drill with a "D" handle and a 1¼-inch diamond masonry bit. Also shown are a 2½-inch carbide spur cutter bit and a Milwaukee hole saw kit.

Figure 104—At the top of this photo is a steel band for marking round logs. Other layout and measuring tools on the left are, from top to bottom: a large framing square, a small framing square, a large wood handled tri square, and a sliding "T" bevel. On the right are, from top to bottom: a caliper made from two small squares, a protractor with an extension arm, and an angle divider. A sliding "T" bevel is an adjustable gauge for setting and transferring angles. An angle divider divides the miter angle of inside or outside corners so that trim or other components can be cut properly to fit into odd angles.

Figure 105—This assortment of scribes includes, counter-clockwise from the left: a Veritas transfer scribe, a Starrett transfer scribe with a separate angled pencil attachment, two old divider scribes, and two different Gränsfors Bruks forged log scribe models.

Figure 106—This photo shows some older model plumb bobs and levels, but the newer versions are very similar, although with more plastic parts. Shown are, from top to bottom: a 24-inch-long Stanley wooden level, a wooden torpedo level, a stringline level, a small square with a clamp-on level attached to it, a brass plumb bob, and an iron plumb bob.

Figure 107—This group of planers, sanders, and grinders includes a 3¼-horsepower, 5-speed Porter-Cable plunge router (top left), a 4-inch Makita belt sander with dust bag (lower left), a 6⅛-inch Makita planer (upper right), a 3¼-inch Makita planer (middle right), and a Bosch 4½-inch disc grinder with a wood planing disc and a 4½-inch carbide metal wood rasp disc (bottom right).

Figure 108—Use pencils and blue chalk (as shown in this photo) on logs, not markers or red chalk. Marker ink and red chalk will not wear off and will bleed through paint and stain. The pencils in the upper right of the photo are blue ink pencils—when you spray the pencil line with water, the line turns blue. Blue lines are easier to see on logs than are graphite lines.

Figure 109—Epoxies such as these are essential for repairing logs.

Finding a replacement log isn't the same as finding a log to build a new cabin. Replacement logs must closely resemble the appearance, shapes, and dimensions of the rotted logs. Each replacement log should be the same species as the rotted log, with a similar crown (the natural curve of the log) and matching diameter at both ends. If you will hew the log, the new log diameter should be 2 to 3 inches larger than the rotted log. If you have to, you can always take wood off a log, but you can't add it on.

Log replacement work is one area where planning ahead really pays off: cut replacement logs at least a year in advance of the project if possible. Cut straight, healthy trees or find straight, standing, recently dead trees, such as those left from a wildland fire. If you purchase replacement logs for a cabin with debarked logs, ensure that the replacement logs are already peeled and cured or are freshly cut so you can peel them relatively easily.

After you select and cut the log, move it to the worksite (figure 110). Remove the bark within a week of cutting a green log if the log will replace a debarked log. It's a lot easier to remove bark when the log is still green—the longer the log sits, the harder it is to remove the bark. Set it on sawbucks or saw horses so you can peel it without ruining your back (figure 111). Use log dogs to prevent the log from rolling.

Block green logs off the ground and let them cure for a year or two. Green logs take a long time to cure—sometimes as long as a year per inch of thickness. Most of the shrinkage, twisting, and warping occurs in the first or second year of curing, though. If you can allow the logs to cure longer, do so. Recently dead trees (less than 2 years dead) are already cured, but it is harder to get the remaining bark off standing dead trees than green trees.

If possible, arrange enough time for the initial curing before using the logs in the cabin. If necessary, you can cut a tree, shape it into a replacement log, and use it in a building in a day, but a green log shrinks 2 to 3 inches and may warp or twist as it dries. This shrinkage puts a lot of stress on the rest of the building. It may cause the structural members to separate or cause weak points, such as notching, to fail. Chinking and daubing won't survive the curing process and you will have to replace them after the logs cure.

Figure 110—This eight-person crew can safely and easily move a large log.

Figure 111—This crew used drawknives, shovels, and a bark spud to remove the bark from a replacement log for the cabin at Badger Station of the Lewis and Clark National Forest, Northern Region.

Round Logs

Round logs are the easiest building logs because they are simply cut and delimbed trees. Historically, people peeled most round cabin logs, but you can find unpeeled logs on small, rough, quickly constructed buildings, such as miner's cabins, and on some high-style rustic buildings. People shaped round logs with axes, saws, planes, and chisels (figure 112).

Some people coped round logs (sometimes called "Swedish coping") before setting them in place. A coped log has a U- or V-shaped trough cut down the length of its underside, mimicking the round shape of the log below it. To create a cope, secure the log top side down on low cradles if you're using an adz, or on sawhorses or sawbucks if you're using an axe. Use a stringline to mark the two edges of the area you will cope. Use the axe (figure 113) or adz to hollow out a depression on the inverted log, forming a curve that approximately matches the curve of the top of the log on which the coped log will rest when it's set in place. Use a curved adz (figure 114) to more easily create this arched shape.

To speed the coping process, people sometimes create the basic V-shape using a chain saw and add the curve with the axe or adz. Controlling the chain saw so that it carves out only the desired section is very tricky—do not attempt it unless you are an experienced sawyer. Carving out a little extra volume with the axe or adz helps accommodate the naturally lumpy shape of the log on which you will rest the coped log, but removing too much extra volume makes the joint leaky.

The purpose of coping is to create a log wall with no gaps between the logs. As you set each successive log in place, the edges of the cope crush slightly, so each log sits tight atop the log below it. If you cope expertly, chinking and daubing is unnecessary, although you may want to fill the space inside the cope with chinking to improve air tightness.

Figure 112—The author uses a chisel to shape the end of a log for the cabin at Badger Station of the Lewis and Clark National Forest, Northern Region.

Figure 113—This photo from the early 20th century shows a man using an axe to cope the logs for the Magee Ranger Station within what is now the Idaho Panhandle National Forest. He apparently had excellent balance and was an expert axeman. Safety wasn't a big consideration in those days. Swinging an axe without proper footing on the ground or on a solid platform is not safe—don't do it!

Figure 114—Secure the log upside down on the ground when you use an adz to create a cope.