## Read Your Building: Condition and Historic Assessment

Historically, people from all cultures have used similar criteria when selecting places to camp or settle. If a location looked desirable to the people building a log cabin, it probably looked desirable to the people in the area before the cabin builders arrived, and they may have left evidence of their occupation.

It can be fascinating to determine the previous uses of a site. Preservation work normally includes disturbances to sites and removing finishes and structural elements. Take advantage of these disturbances to learn about the past via archaeological investigation. If a Federal or State government agency owns a building or site, or if some or all of the funding for cabin preservation work is from Federal or State sources, such investigations are required to ensure the work you do will not adversely affect evidence of past use.

An archaeological investigation can be simple or complex, depending on the historic significance of what you find during the investigation. For Federal or State projects, contact your unit's heritage resources specialist. If no Federal or State funding is involved, you can contact a local archaeologist to conduct an archaeological investigation. Your State's historic preservation officer (SHPO) maintains a list of qualified professional archaeologists. You can find contact information for your SHPO at <http://www.ncshpo.org/shpodirectory.shtml>.

Contact the heritage resource specialist or archaeologist as soon as you begin contemplating preservation work; investigations can take a while to complete. Although the work could be as simple as a phone conversation with the specialist or archaeologist, followed by a few small test holes (dug where you need to excavate for a foundation anyway) and screening the excavated dirt (figure 30), the work can be a lot more extensive. Scheduling the investigation could take even longer than the actual excavation work, so plan ahead. If an archaeological site is clearly present or if you already know that previous residents left a historic trash dump, outhouse, or other debris, begin talks with the heritage resource specialist or archaeologist at least a year before your planned preservation work.

Figure 30—Forest Service employees constructed Longview Guard Station (Bighorn National Forest, Rocky Mountain Region) in 1909 on a site with a permanent spring nearby. The volunteer group Teacher Restoration Corps, under the direction of Bighorn National Forest East Zone Archaeologist Bill Matthews, conducted test excavations around and under the cabin foundation before beginning restoration work on the cabin. The investigation showed that the original cabin builders had scraped away all the soil containing prehistoric materials before they started construction, so the corps didn't need an extensive archaeological investigation before beginning the restoration work.

Some log cabin sites have amazing evidence of prehistoric use buried beneath historic debris. Artifacts may be more than 10,000 years old or from the early 1900s. Those who used the site in the past may have left projectile points, such as arrowheads or spearheads (figure 31), stone or metal tools, hearths or firepits, animal bone fragments, artifacts from a battle, patent medicine bottles (figure 32), crockery or china, toys, or a host of other interesting items. Specialists and archaeologists can piece this evidence together to make determinations, such as what tribe or nationality of people lived there, what occupations they had, what medicines they used, what they ate, whether they had children, and possibly even what china pattern they used (figure 33).

After looking beneath the ground surface, the next step is to conduct a condition and historic assessment of the cabin. Before planning or beginning preservation work on the cabin, you must make decisions about which portions of the cabin are historically significant and should be repaired or replaced in kind and which portions can or should be altered or removed. A condition and historic assessment will provide the information you need to make those decisions. If a Federal or State government agency owns the cabin, or if some or all of the funding for cabin preservation work is from Federal or State sources, you may need to make these decisions with input or approval from the SHPO. Check with your heritage resource specialist or archaeologist for the requirements.

If the cabin is important or you know that there is a long history of use at the site, engage a preservation specialist or historic architect to examine and evaluate the cabin's physical condition and investigate the cabin's history and design. You will need the specialist's or architect's professional expertise to properly evaluate the complex issues at the cabin. If you don't expect the issues at the cabin to be complex, an engineer, architect, experienced facilities maintenance worker, or builder may be able to perform an adequate assessment using the information provided in this section, especially with initial guidance from a preservation specialist or historic architect.

The cabin assessor must physically examine and measure the structure, photograph or make video recordings of the building's condition and distinctive features, identify and document structural and cosmetic damage and its causes, identify any previous changes or repairs, and complete architectural drawings. The more comprehensive the documentation, the better. You can refer to the assessment notes, photos, and drawings when planning your preservation work and after your work is underway. The documents will serve as historical records.

Figure 31—Forest Service archeologists uncovered this assortment of projectile points around the Hogback Cabin (Lolo National Forest, Northern Region). The site was clearly occupied long before homesteader Charles Gerhardt constructed the cabin between 1913 and 1915. The archaeologists investigated the site because of a potential mining claim on the creek behind the cabin and conducted another investigation later as part of a restoration project. The investigations uncovered arrowheads and spearheads in different locations near the cabin.

Figure 32—Forest Service archeologists uncovered this assortment of glass bottles before and during a restoration project at the Hogback Cabin (Lolo National Forest, Northern Region) from 1993 through 1995. The cabin is now available for recreation rental.

Figure 33— Forest Service archeologists recovered this glass Heinz bottle and part of an ironstone bowl during site testing at log cabins within the Questa Ranger District (Carson National Forest, Southwest Region).

The condition assessment documents the current condition of each part of the structure and identifies structural problems and cosmetic deterioration or damage throughout the building, from the bottom of the foundation to the top of the chimney. The inspection includes any plumbing, electric, or heating devices and systems. Forest Service and Bureau of Land Management (BLM) employees can obtain guidance on condition assessments from the report, "So That's Why It's Always Cold in Here: A Guide for Conducting Facilities Condition Assessment Surveys," available to Forest Service and BLM employees at <http://fsweb.mtdc.wo.fs.fed.us/php/library_card.php?p_num=0473 2839>. You may also need a structural engineer's investigation and recommendations for structural repair design.

The historic assessment documents significant features and details that represent a particular historic period, style, or owner; add a finishing touch to the building; or indicate the history of the area. Such features and details may include Craftsman-style eaves, names and dates carved into or written on the building (figure 34), Victorian beadwork, porch rails made of tree branches, or flagstone porches.

The historic assessment identifies past building repairs and modifications. Repairs that match the original material and harmonious modifications that keep the building useful are important to the continued existence of a cabin. Other repairs and modifications may not be the best thing that ever happened to the cabin. For example, repairs may be falling apart or may not match the original material or appearance of the cabin (figure 35). The people who repaired the cabin may have moved doors and windows from their original location (figure 36). They may have replaced logs with a different species or size, or even with concrete (figure 37). Modifications that occurred more than 50 years ago may have "acquired significance," which means that the modifications are now old enough to be part of the building's history.

Figure 34—The initials "EB" (most likely for Ernest Betasso), made by hammering bullet casings into the end of a log, are an example of a detail that should be recorded in a historic assessment. This interesting feature was found at the Betasso Ranch Preserve "homestead cabin" near Boulder, CO.

Figure 35—Someone "repaired" the daubing on this cabin with a concrete mortar mix and an odd use of wood scraps. The "repairs" don't match the original materials or methods and probably are contributing to further decay of the logs.

Figure 36—The newer logs under the window are evidence that someone removed a door from this location and installed a window. The window originally may be from another location in the cabin. If there are similar log inserts at window height elsewhere in the cabin, they probably indicate the original location of the window.

Figure 37—When some of the lower logs of this building rotted out, someone added a concrete wall to replace the sill logs, spandrel logs, and some wall logs; added a concrete foundation; and replaced some of the wall logs with new logs. One of the new logs was roughly debarked, making it look different from the older logs. Concrete is not an appropriate "repair" for rotted logs.



### Tools for Performing an Assessment

To conduct a condition and historic assessment, use the following common tools (figure 38):

- Camera and video camera
- Paper and pencil
- Flashlight (best choice—battery-powered spotlight)
- Tape measure (also useful—6-foot folding ruler)
- Pocket knife or other small knife
- Building level, laser level, or stringline and line level
- 2- and/or 4-foot level
- Plumb bob
- Claw hammer (also useful if available—geologist's hammer)
- Pry bars and flat bars
- Pliers
- Vise grips
- Adjustable wrench
- Multibit screwdriver
- Awl
- Framing square
- Extendable mirror

Structural engineers also may use moisture meters and advanced technology, such as stress-wave timing equipment or drill resistographs, to evaluate whether wood is decayed.

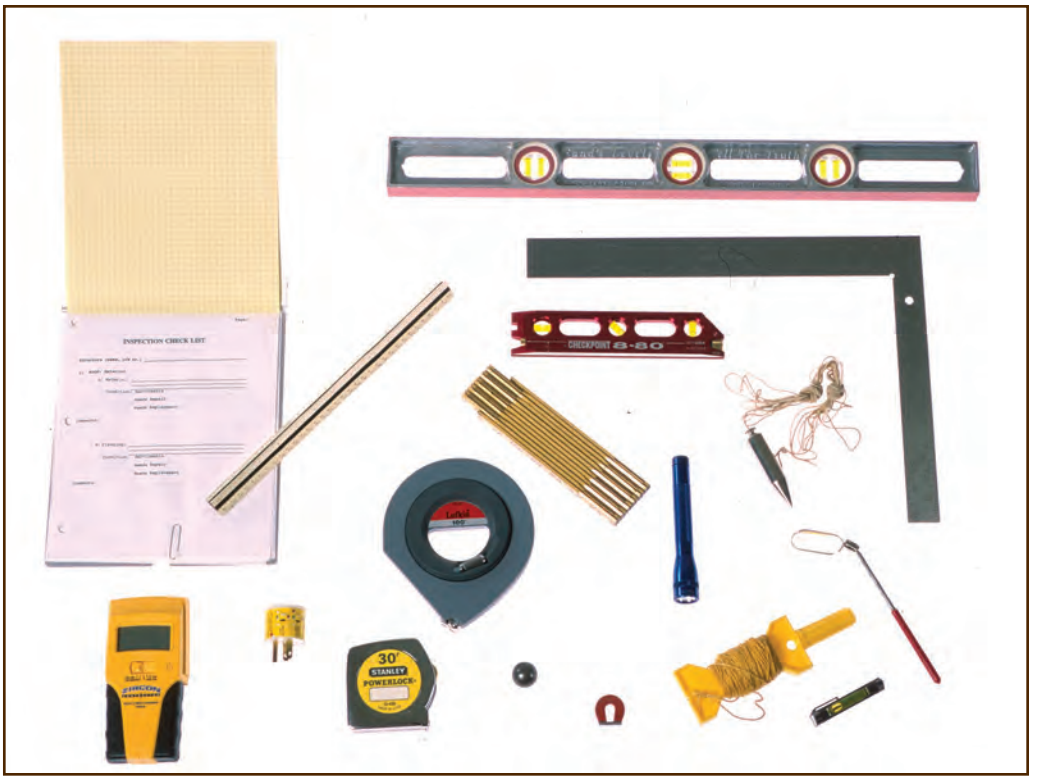


Figure 38—These tools, plus a camera, a pencil, a knife, a hammer, pry bars, pliers, vice grips, a crescent wrench, a screwdriver, and an awl are needed to perform a condition and historic assessment of a cabin.

Log cabins are more complex than they appear. The following inspection tips may help you perform a more effective condition and historical log cabin survey. If you hire someone to do the survey, the tips will help you understand and evaluate the survey report produced by the assessor.

## Foundation Inspection

The foundation is critical to the condition of a cabin because foundation-related problems can lead to problems in other parts of the building. Foundation settling is typical of log cabins. If settlement isn't severe and is no longer occurring, it isn't necessarily a problem. If settlement is active or uneven, or if it is shifting structural weight to unintended bearing points (away from the corners or unevenly distributed on the sill logs), serious wall deflections may occur. Foundations may settle because of decay, subsidence, or undermining. When frost heaves pilings, sleepers, sills, foundations, or chimneys, settlement may occur over many years as the ice melts each spring.

Water is the most common cause of deterioration and damage to any building. Check for water damage that has already occurred or that is likely to occur. At the bottom of the cabin, flowing or standing water can erode the ground beneath foundations or cause the ground to shift or sink (figure 39), making the building sag. Check the drainage around the cabin. The ground should slope away from the cabin (figure 40) so that water coming off the roof, downspouts, or adjacent higher ground won't flow toward the cabin or pool against or beneath it.

High or low spots in the floor, sloping floors, doors or windows that have gaps or that don't close or open properly, cracks or gaps in walls or at corners, or sagging or raised sections of the roof may be evidence of shifting foundations. If the building has a crawl space, root cellar, or basement, inspect the inside of the foundation as well as the exterior. Be safe. Before entering, use a flashlight or spotlight to check your intended path for animals, insects, and potentially hazardous or sharp-edged materials.

Look for evidence of repairs and renovation. New concrete, sawn lumber, and mismatched rockwork or logs are clues that someone may have performed repairs or renovation.

Figure 39—A diverted stream that overflowed and reclaimed its original streambed undermined the foundation of the Adams Ranger's House (Salmon River Ranger District, Nez Perce National Forest, Northern Region). Because the building wasn't in use and funding was unavailable, no one repaired the foundation damage for about 40 years. During that time, the lack of foundation support led to damage to sill logs and other parts of the cabin.

Figure 40—The ground should always slope away from the building, as shown in this photo of the 1931 Indian Creek Warehouse/Shop, so that runoff water is directed away from the structure. The building was moved from the Salmon River Guard Station to the Indian Creek Guard Station (both in the Boise National Forest of the Intermountain Region) in 1968.

## Floor Inspection

Check for humps, dips, and sloping floors that could indicate foundation or floor joist problems. Sections of the floor that sink or move when stepped on usually indicate failing floor joists or supports. Joists that weren't designed to support the loads currently on the floor (appliances, fixtures, furnishings, cabinetry, etc.) or rotting flooring or subflooring also are common reasons for these symptoms. Look for stains on the floor that could indicate water damage or spilled gas or oil (these stains most likely will smell like the spilled product). Inspect thoroughly in and beneath kitchens and bathrooms; water leaks commonly cause floor rot in these areas.

Look for evidence of repairs and renovation. Modern flooring materials, plugged or open holes in the floor, mismatched wood flooring, and wood flooring end joints in a straight line rather than in a staggered pattern are clues that someone may have performed repairs or renovations. "Ghosts" (materials that are aged or darkened more or less than their surroundings or have different finish coatings) may indicate the former location of a wall, cabinet, wood stove (figure 41), or stairs.

## Log and Wall Inspection

Sill, spandrel, and floor-joist logs usually are the most susceptible components to rot and damage resulting from foundation problems. These logs are crucial to the integrity of the cabin. Unfortunately, they also are closest to vegetation and the ground, both of which harbor wood-destroying moisture and insects. Rain and mud bouncing off the ground are likely to splash these components. In cold climates, winter snow buries sill and spandrel logs and melts against them in the spring. Even rot-resistant logs that are in contact with the ground probably are rotting (figure 42), or soon will rot if the contact with the ground isn't corrected. List the condition of each log in the building assessment notes and identify the probable sources of problems.

Throughout the structure, persistent dampness leads to rot in logs, lumber, paper, and many other building materials. Moss, mold, and mildew indicate excess moisture, but may not indicate structural damage. Conversely, some deteriorated materials don't show these indicators. For instance, multiple coats of paint on a window sill may hide dry, crumbling wood. The

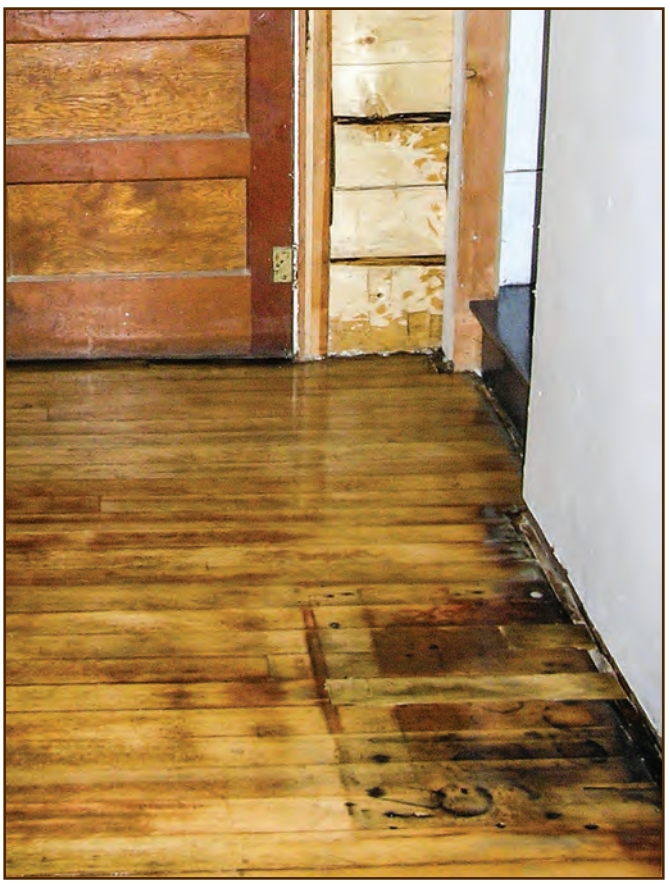

Figure 41—This section of floor at the Adams Ranger's House (Salmon River Ranger District, Nez Perce National Forest, Northern Region) shows evidence of the former location of a stove and also a piece of flooring that someone replaced.

Figure 42—Constant contact with the ground has seriously decayed the sill log of this building.



logs around windowsills and doorsills, corner notches, crown ends, and any other areas that are regularly saturated by rain runoff or backsplash are likely to deteriorate.

Crown ends that extend beyond the drip line of the roof edge are particularly vulnerable to saturation from roof runoff and are a likely spot for rot (figure 43). Flat notching is especially susceptible to rot because the top surface of the log is cut and provides a flat or cupped surface that can hold moisture.

If the site is irrigated, check the sprinkler spray patterns and adjust the sprinkler heads as necessary to ensure that water doesn't hit the building. Outside face rot commonly occurs when vegetation or snow holds moisture against the outside of a cabin or a sprinkler waters the cabin logs regularly.

Vegetation growing beside or on a building may hold moisture against the wood and cause rot (figure 44). Tendrils of climbing vines erode chinking, daubing, and mortar. Specifically designed sod or "green" roofs or walls won't damage a building, but other plants growing on or against buildings eventually will cause damage.

If historic exterior siding covers the cabin, do not rip it apart to test the logs. Generally, don't disturb historic siding unless you see obvious signs of settling or deterioration, or you have reason to believe that the logs behind the siding may be deteriorating. You usually can conduct an inspection where siding is missing, loose, rotting, or damaged, which is exactly where the logs beneath are most likely to have problems. If you must remove pieces of siding to inspect logs, remove them carefully, label them, and save them to reinstall or as samples for choosing or crafting replacement siding.

To detect decay, thoroughly inspect outside, inside, and even beneath the building if it has a crawl space or basement. Carefully probe the logs for rot. If possible, avoid damaging the wood during your investigation because repair techniques can sometimes save even badly deteriorated logs that are mostly intact. Use an awl or narrow knife blade to poke the logs. If you can poke the awl or blade into the log fairly easily, the log is rotten directly beneath the surface. Probe soft areas to determine the depth of decay. Experienced inspectors can reliably detect hollow-sounding areas of possible interior decay by gently tapping up and down the lengths of the logs at regular intervals with a smooth-faced hammer or an awl

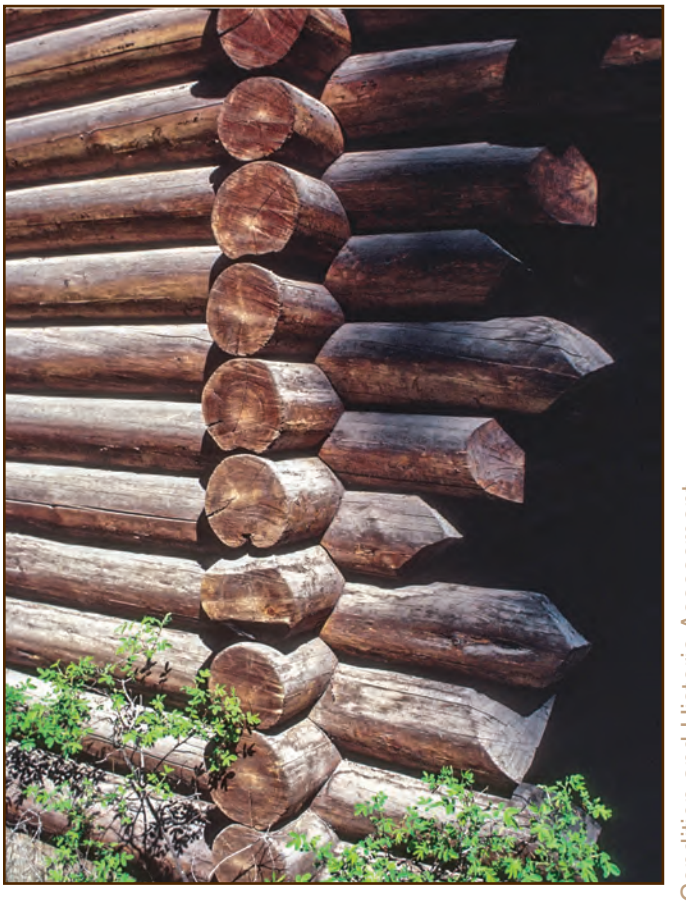

Figure 43—The crown ends to the left of center in this photo originally extended beyond the drip edge of the roof. When they began to rot, someone used a chain saw to trim off the rotted ends. They originally looked like the crown ends to the right of center in the photo. Trimming with a chain saw is **not** a recommended "repair" method because it destroys the defining visual characteristics of the building.

Figure 44—Plants that grow on or against buildings, including vines like these, are picturesque, but contribute to log rot because they hold water against the wood.

or knife handle. If you find or suspect rot near the center of a log, you may need to have a structural engineer investigate more thoroughly using stress-wave timing equipment or a drill resistograph.

Long cracks that run with the wood grain (called "checks") aren't signs of rot. They occur naturally as the logs dry out and age. Moisture and fungal decay can get inside a log through a check, however, especially if it is on the log's upper surface. Probe checks to determine whether decay is underway inside the log.

Insect infestation is common in wood construction in many parts of the country. Insects, such as termites, carpenter ants, and powderpost beetles, are more likely to infest logs or other wood that touches the ground or is less than 8 inches above the ground because they can get at it easily and because it is likely to be damp. Look for telltale signs of insect activity, such as mud tunnels, exit holes, or "frass," a sawdust-like powder. Hire a professionally licensed exterminator to treat insect infestations because most of the chemicals that kill wood-destroying insects and deter reinfestation are toxic. For information on wood-destroying insects, see the University of Florida's web page about wood-destroying insects at <http://www.edis.ifas.ufl.edu/IN035>.

Rodents search aggressively for food and dry places to nest. They particularly like to get into uninhabited buildings, and they can wiggle though tiny holes to do so. Evidence of rodent infestation includes their droppings, chewed food containers and fabrics, and nesting sites. Because rodents can carry hantavirus, take proper precautions as identified in the Safety First section of this guide. Keep rodents out by closing up all possible entry holes—which means any opening that a ¼-inch diameter sphere could slip through. For more information about hantavirus and keeping rodents out of buildings, see the Forest Service Facilities Toolbox section on hantavirus at <http://www.fs.fed.us/eng/toolbox/haz/hanta.htm>.

Check for plumb walls using a plumb bob hung on a string attached at the head end of a long nail driven lightly near the top of the wall. If the distance between the wall and string is about the same from top to bottom (allowing for the roundness of the logs), the wall probably is close to plumb. If the plumb bob rests against the wall, it may mean the wall is plumb but the nail is too short, or it may mean the wall is leaning away from you. Try it again on the other side of the wall to confirm. If the plumb bob hangs away from the wall at the bottom (figure 45), the top of the wall is leaning toward you. Check several locations along the length of each wall.

While inspecting the walls, check for loose or missing chinking and daubing, poorly fitting additions, sagging porches, failed or failing connections or notching at the corners, etc. Keep in mind that foundation problems may result in wall deflections and broken connections.

Check the doors and windows to see if the frames are plumb and level and if they open and close correctly.

Look for evidence of repairs and renovation. Joints in the middle of logs (see figure 36), modern dimensioned lumber (figure 46), logs shaped with powertools, inconsistent log species or sizes, corner styles that don't match, and mismatched or modern-looking windows (figure 47), doors, and daubing are clues that someone performed a repair or renovation.

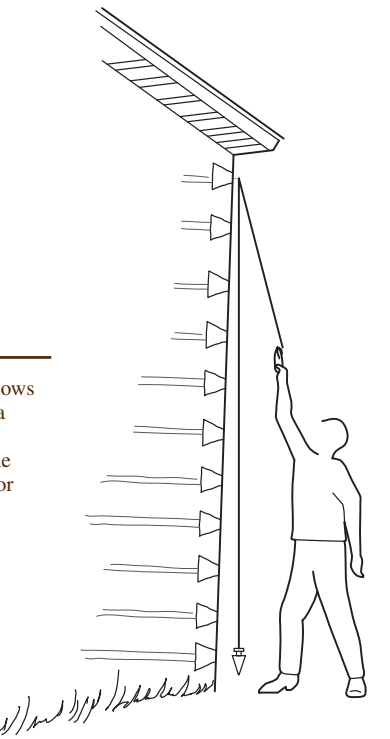

Figure 45—This drawing shows how to use a plumb bob on a string hung from a nail near the top of a wall to determine whether the wall is vertical or leaning.

Figure 46—This building shows evidence of several inappropriate "repairs." The piers supporting the building are of different types of brick and were constructed using at least three different construction methods. Someone used modern dimensioned lumber to replace the sill and spandrel logs. The door may originally have been located where a log "patch" is placed under what is now a shuttered window. People used at least two different styles and materials for the daubing. Someone also used daubing material to "patch" deteriorated areas on the ends of some of the logs.

Figure 47—The single-hung windows in this cabin are newer than the rest of the cabin. Telltale evidence includes the window manufacturing style and the double log trim above the windows. Someone probably used the double trim to mask the gap between the shorter new windows and the logs that were cut for the taller original windows. These changes are typical of evidence that you may find in a structure that is relatively well cared for.

## Roof Inspection

Roofs are crucial to the integrity of any building because the roof's primary function is to keep moisture out of the building. Sometimes preservation projects take several years because of the timing or availability of funding or a lack of skilled people to do the work. When beginning such a preservation project, first ensure that the roof isn't leaking. You can temporarily use a tarp to cover a leaking roof if you must complete other work, such as leveling the building, before you can start permanent roof repairs. Remember that a tarp is only a temporary solution. Tarps don't let rain in, but they also don't let water from damp materials out. They can trap water against the structure, which can cause more rot and decay.

### Roof Anatomy

From top to bottom, the roof system consists of:

- **Roofing—**Usually wood shingles or shakes, asphalt rolled roofing, or metal sheets.
  - For some cabins: asphalt building paper and metal flashing.
- **Solid sheathing, skip sheathing, or roof lath strips—**For rafter or truss roofs.
- **Framing structure—**Rafters, purlins, trusses, and beams.
- **The top wall log—**Sometimes referred to as the "roof plate" or "rafter plate."
- **Gutters and downspouts—**For some cabins.

Check from both the exterior and interior of the cabin for leaks and damage. Thoroughly check around changes in roof pitch, valleys, ridges, eaves, vents, chimneys, and flues; these areas are especially prone to leaking and deterioration. Check for rot, ridge damage, sagging rafters, broken rafter or collar ties and braces, and framing members that have been dislodged from their sockets in the roof plate or that are cracked. Decay is common on rafter and purlin ends, especially those that extend beyond the roof dripline, as is frequent on rustic-style cabins (figure 48).

Details are important, especially on roofs, because they have such a large affect on the appearance of a cabin. For instance, if historic cedar shingles still are in place, remove several of them and measure their size, shape, exposure length, butt thickness, taper, and any special features. Measure the unweathered portions of the shingles for better accuracy. If someone replaced the original shingles, look for old photos or patterns on the sheathing that might provide evidence about the historic shingles. Peel up a corner of the existing roof covering and check for nail patterns and remnants of the original roof. Examine the original shingles to determine the tree species, such as white oak, cypress, eastern white pine, or western red cedar. Determine whether the shingles are sawn, handsplit, dressed, or beveled. Note any distinctive shaping. Record the materials and layering of the hips, ridges, valleys, and dormers. Photograph and describe any decorative elements, such as trimmed butts, patterns, colored stains or paints, and exposed nails. Note whether shingle lath, skip sheathing, continuous sheathing, or purlins support the shingles. Also note the ridge cap style and whether it appears to be original to the building.

Figure 48—The awl stuck into this rafter tail shows how deeply the rot has penetrated. Rot is very common on rafter tails like these that extend beyond the edge of the roof.

The builders may have used lead as flashing around chimneys or vents in the roof. Although lead is an excellent flashing material that builders still use today, it can be absorbed through the skin and cause serious health problems. Information on how to work safely with lead is available in the Forest Service Facilities Toolbox section on lead roofing and flashing at <http://www.fs.fed.us/eng/toolbox/haz/haz22.htm>.

Few people constructed cabins with gutters, but they sometimes added gutters later. If the cabin has gutters, check whether they are leaking, clogged, or have pulled away from the fascia. Check whether the downspouts leak, are securely fastened to the side of the building, and have returns at the bottoms that direct water away from the foundation.

Look for evidence of repairs, renovation, and former framing, sheathing, or roof materials. Sometimes the top layer hides several layers of previous roof materials. The owner may have raised the roof when adding a second story or made structural changes when constructing an addition. A builder may have framed the roof using material recycled from other buildings, or reused material from an original section of the cabin on an addition. Someone may have repaired the roof after a storm or fire damage.

## The Rest of the Cabin

Although most serious structural damage is likely to be in the foundation, floor, perimeter walls, and roof, you may find serious problems elsewhere in the cabin. People often made repairs and renovations to the interior of the cabin as well. Inspect chimneys, fireplaces, stoves, vents, porches, interior walls, trim, plumbing, wiring, fixtures, and finishes for past changes or damage.

Deterioration may simply be the natural result of aging materials. For instance, Bakelite, an early plastic invented in 1909, becomes brittle as it ages and may crumble without ever being damaged. Other deterioration may be the result of poor construction methods or may be because of problems that are telegraphed from other parts of the cabin. Deformed or misshapen window trim may result from a sag or twist in the cabin due to a failed sill log, for example.

If the cabin has painted surfaces (figure 49), the paint may contain lead. Lead was a common ingredient in paint before 1978. If the paint is intact and the cabin won't be used as housing or by children, the lead paint may not be a problem. If you intend to remove, sand, drill, or cut the painted material as part of the renovation, follow the specific requirements for working with lead-based paint that were enacted to protect the health of workers and building occupants. See the Safety First section of this guide for more information about lead-based paint and the requirements for working with buildings that contain lead-based paint.

When inspecting interior trims, paints, and finishes, you may have to gently peel and sand through several layers of paint, flooring, or wallpaper to find the original color or materials. Do so in an inconspicuous place, such as a closet, behind an electrical outlet plate, behind door or window trim, or under a doorsill.

As with the cabin exterior, moisture damage can cause serious decay inside a cabin. If the building contains plumbing, check for pipe, fixture, and faucet leaks. Look for old drainpipes, fixtures, and soldered plumbing joints made of or containing lead. More information on lead and working with lead plumbing is available in the lead and copper plumbing section of the Forest Service Facilities Toolbox at <http://www.fs.fed.us/eng/toolbox/haz/haz30.htm>.

Check for damaged or deteriorated wiring, gas tubing, fixtures, and appliances. Look for fixtures or appliances that don't work, leaking or kinked tubing, tubing in contact with the ground, wiring with brittle plastic or fabric insulation, loose wiring or tubing connections, exposed wires, and broken switches, outlets, valves, switch plates, and outlet covers.

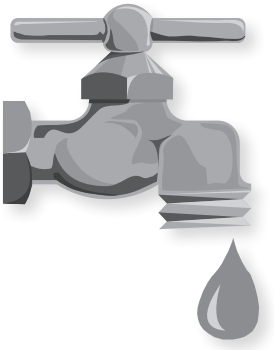

Figure 49—Someone painted the interior of this cabin to provide a brighter and more finished appearance. Test old cabin paint for the presence of lead if you will remove, sand, drill, or cut it during the renovation. If the paint contains lead, you must follow Occupational Safety and Health Administration requirements. *Photo © Andrew Gulliford; used with permission.*

Asbestos was a common component of many building materials from about 1905 to about 1980. Materials containing asbestos may be present in log cabins built or modified during this time period. If you haven't already inspected your building and it contains ceiling tiles, composition flooring, plumbing or boiler insulation, asbestos cement siding, vermiculite insulation, heat-resistant panels or fabrics, caulk, mortar, or adhesives that were installed between 1905 and 1980, hire an accredited asbestos inspector to sample and test the material. Exposure to asbestos fibers or dust can have serious long-term health consequences. For information about materials containing asbestos in buildings, see the Safety First section of this guide. If the inspection report identifies materials containing asbestos or you suspect that the cabin may contain asbestos, do not disturb it. Arrange for properly trained and certified personnel or contractors to perform abatement work on asbestos-containing materials.

## Decisions, Decisions: Deciding What To Do to the Cabin

After you have thoroughly inspected the cabin, you must determine what preservation work you should do. When making decisions, consider the historic value of the components. You should repair or replace portions of the cabin that are historically significant with in-kind materials. Portions that aren't significant are better candidates for removal or alteration than historically significant components.

Concerns about obvious structural problems often cause line officers to initiate preservation projects, but many other repairs usually are needed. Now, you must prioritize repairs and decide how far your budget will take you.

It can be tempting to first do those repairs that will make the cabin more attractive. Don't give in to temptation. First, complete the practical repairs that will protect the building from further deterioration—it will be cheaper in the long run. If the inspection reveals any components in danger of imminent collapse, shore them up. If there are problems in the foundation or the roof (figure 50), fix them. Next, close the gaps where weather or animals can enter the cabin. Closing gaps can be a temporary fix, such as putting plywood over a broken windowpane, if time or the budget won't allow permanent fixes right away. Then, concentrate on other structural repairs, such as sill logs, floor joists, walls, ceilings, windows, and doors. You must often perform electrical, plumbing, and heating system repairs in coordination with wall, ceiling, and floor work. Finally, make the cosmetic repairs—paint, floor refinishing, curtains, appliances, fixtures, and so on.

You must decide what methods to use to accomplish the necessary repairs. For instance, if only a portion of a log is rotten, should you replace the entire log, or will a Dutchman splice on the end suffice? Should you repair deteriorated windows or will you need to replace them? See the individual building component sections for information you must consider when making these decisions.

Sustainability is a big concern these days. Although sustainability improvements aren't required for existing Forest Service buildings that are less than 10,000 square feet,

Figure 50—Roofing replacement often is the first renovation chore on a log cabin. These National Park Service preservation workers are replacing the shingle roof on the Jessie Elliott Ranger Station of the Custer National Forest. It's not a log building—it's the only stone ranger station in the Northern Region. The builders constructed it around 1913 and installed wood shingles in the same manner as on log buildings of the same vintage. Full scaffolding with railings all around the roof provided fall protection on this project.

preserving a historic building and keeping it in good repair contributes toward the agency's overall sustainability. Preserving a building for continued use is the ultimate recycling project. Excellent information about historic buildings and sustainability is available from the Whole Building Design Guide web page <http://www.wbdg.org/resources/sustainable_hp.php>, from the National Trust for Historic Preservation website <http://www.preservationnation.org/information-center/sustainable-communities/>, and from the Forest Service Facilities Toolbox section on historic facilities <http://www.fs.fed.us/eng/toolbox/his/susbuildings.htm>, so it's not repeated here.

The first Guiding Principle for Historic Preservation is to retain as much historic and existing fabric as possible. Stabilizing and repairing parts of the building that are only partially damaged by decay or insects are always preferable to replacing these parts. Repairing rather than replacing preserves more of the building's integrity, including historic tool marks. Integrity includes keeping the original components or replacing them with new components that are the same size, configuration, and material as the originals. It isn't always easy to assess how much of the historic fabric you can save without compromising the strength or security of the structure. Generally, if more than half of a log is rotted, replace it. When in doubt, consult a specialist, such as an experienced preservation carpenter, an architectural historian experienced in preservation, or a structural engineer with experience working on historic buildings.

General guidance on repair and replacement decisions is available through the U.S. Department of the Interior, National Park Service's Technical Preservation Services website <http://www.nps.gov/tps/index.htm>, including pamphlets, books, videos, web pages, technical consultation, and education on preserving, restoring, and rehabilitating historic buildings. The National Park Service's Preservation Briefs <http://www.nps.gov/tps/how-to-preserve/briefs.htm> provide information about many historic building materials.

After carefully considering all the factors, outline a preservation strategy that includes the methods you will use in each repair and the order in which you will make repairs.

### Negotiating Conflicting Requirements

Sometimes it seems as though there's no way to reconcile preservation requirements with accessibility requirements and building codes. Although historic preservation standards tend to trump other considerations for buildings that have a primary purpose of displaying and interpreting historic resources, most Forest Service log cabins have a primary purpose as an office, residence, or recreation accommodation. There often is a juggling act between accomplishing the primary service provided by the building and maintaining the historic fabric of the building. Building codes, fire codes, accessibility regulations, and historic preservation standards and guidelines all recognize this.

Accessibility requirements for historic buildings differ between residential, commercial, and public buildings and depend on whether the building is being altered or repaired. Be sure to check the historic building accessibility standards available at <http://www.access-board.gov/guidelines-and-standards/buildings-and-sites>. You usually can provide accessibility without impacting the main façade of a cabin. See the Accessibility section of the National Park Service's introduction to the historic standards and guidelines <http://www.nps.gov/tps/standards/rehabilitation/guidelines/introduction.htm> and the Forest Service Facilities Toolbox section on historic facilities <http://www.fs.fed.us/eng/toolbox/his/index.htm> for more information on how to accomplish both accessibility and preservation.

Building codes and fire codes also vary depending on building age, type, and use. International Code Council standards are available at <http://www.iccsafe.org/content/pages/freeresources.aspx>. National Fire Protection Association (NFPA) standards are available at <http://www.nfpa.org/freeaccess>. See the Accommodate Life Safety and Security Needs section of the Whole Building Design Guide <http://www.wbdg.org/design/accommodate_needs.php> for more information about safety and historic preservation.

## An Ounce of Prevention: Project Planning

After you've thoroughly inspected the cabin and determined the scope of the preservation work, you can begin planning your project.

As you plan, remember that the most important rule is to **always work safely.** See the Safety First section of this guide.

The following three rules of thumb can have significant consequences for your project:

1. Preservation projects usually take twice as long and cost twice as much as you thought. Even old buildings that are thoroughly inspected tend to conceal surprises that are discovered during the preservation work.
2. Since at least the mid-1800s, people have used the adage "if anything can go wrong, it will." To avoid the consequences of this adage, be thoroughly prepared for all the problems you can imagine and have a backup plan in case something happens that you didn't imagine could occur.
3. Measure twice and cut once. Be patient, think tasks through, and check your work. If you hurry, you will make mistakes and waste materials and may hurt yourself in the process. A few minutes of thought before starting work will make your whole day better.

### Project Timing and Work Crews

If possible, plan construction work for a dry weather season when the temperature is above freezing but below sweltering. There are complications if the weather isn't temperate and dry:

- **Wet—**If it's raining, construction materials will get wet and remain wet as you incorporate them into the building. Even brand new materials that remain wet for a while may swell, become moldy, and decay.
- **Cold—**You will find it more difficult to hang on to and manipulate cold, wet tools and materials. If you excavate when the ground is frozen, anything resting on that soil, such as a foundation, will have an alarming tendency to migrate to other locations or settle when the ground thaws.
- **Heat—**If you must work during hot weather, drink plenty of water and take frequent breaks in the shade. If you feel overheated, stop working.

Of course, you can accomplish work during adverse weather conditions—it just takes longer and often requires special measures to protect the site, materials, and workers. Dry, temperate weather occurs at different times of the year in different parts of the country. If you aren't familiar with the climate at the project site, ask several local people. Climate information you find on the Internet is accurate, but doesn't include local quirks.

Do not try to cram the work into a time period that is too short. Remember to allow more time than you think it will take to accomplish the work, especially if several members of the work crew are inexperienced. For example, consider the following time estimates for one experienced person working alone:

- **Replacing or repairing a log or crown end—**1 hour to 3 days, depending on size, location in the building, and complexity of the repair or replacement.
- **Nailing by hand to lay 1 square (100 square feet) cedar shingle roof—**1 to 3 days, depending on the complexity of the roof.

Plan to use an adequately sized work crew for the project. Remember that some log cabin materials are large and heavy. Although an experienced person may be tempted to work alone, it is much easier and safer for at least two people to work together. Four to six people is a good size for a cabin restoration crew. Ensure that at least one person on the crew is experienced and capable of explaining the work methods and requirements to the less experienced crewmembers. If the crew will move large logs, ensure that the crew is large enough to safely lift the logs (figure 51). If the crew includes an experienced foreman, construction specialist, roofer, or expert rigger, you probably can get by with a smaller crew.

Figure 51—This crew of six people is adequate to safely move large logs using timber carriers (timber tongs attached to crossbars).

## Materials and Cost Estimates

Figuring out what materials you need for preservation projects can be a challenge. Using the historic and condition assessments and keeping the three rules of thumb in mind, make a list of all necessary materials. Include big items, such as logs, shingles, and windows; small items, such as nails and screws in the right sizes and shapes; building paper; adhesives; paint or stain; and disposable tools, such as dropcloths and paint-roller covers. Order any materials that aren't readily available at the local lumberyard well in advance of the planned project work dates. Plan to have transportation available to get all the materials and tools to the worksite ahead of the work dates.

When estimating the project cost, be realistic. Consider these general estimates for supplies:

- **Logs—**Free to $400 each, depending on whether you cut your own trees or purchase the logs from a local logger, sawmill, or log home builder.
- **Lumber—**Free to $10 per 10-foot-long 2 by 4, depending on whether the lumber is standard dimension or rough sawn, treated or not, salvaged from another project, or purchased. Custom-cut lumber that matches historic dimensions costs twice as much as lumber purchased off the shelf.
- **Cedar shingles—**About $200 to $400 per square, depending on grade, length, and availability.

You may be able to obtain free or reduced-cost materials at construction salvage yards; from friends, family members, and coworkers; or from hardware and antique stores, yard sales, loggers, construction companies, log home builders, and sawmills. It may take a long time to locate cheap or free materials, so start looking well in advance of the project start date.

## Site Preparation

Before you start to work on a building, look around the site. Find and designate suitable areas for staging, storage, trash, salvage, and parking. If you must prepare some materials before using them in the cabin, designate a work area.

Have sleepers available so you can stack lumber and other materials off the ground in case rainy weather turns everything to mud. Have tarps, ropes, and poles on hand to cover materials and work areas in case of rain and to provide shade if the weather is hot. Have stickers (wooden spacers) ready to use when stacking lumber so that air can circulate and the lumber will stay straight. You can cut stickers from any species of dry, unwarped wood; they usually are ¾ inch thick and about 1¼ inches wide. Ensure that dry storage areas are available for tools.

Most old buildings are surrounded by shrubs and trees that someone may have intentionally planted or that just may have appeared over time. Generally, you should remove shrubs or trees within 3 feet of the building before beginning preservation work. However, if the landscaping has historic value, work with the heritage staff or archaeologist to establish a plan to protect the plants and landscape features or remove them during the work and replace them later.



# Safety First

Before you begin actual preservation work, a few words about safety: preservation and construction work can be dangerous, so be careful—after all, you want to be able to enjoy the fruits of your labors. Forest Service workers must follow the precautions in their job hazard analysis (JHA). JHA examples are available to Forest Service employees at the Northern Region Safety and Occupational Health JHA web page <http://fsweb.r1.fs.fed.us/safetyhealth/jha.htm> or the Region 1 Historic Preservation Team website <http://fsweb.r1.fs.fed.us/e/FacilitiesAndEnvironmental/HistoricPreservation/safety.htm>.

As you read this guide, you will notice that some of the photos show people who aren't following current safety requirements. The author collected the photos over many years, and some of them are much, much older than the current safety requirements. Always follow the current safety requirements, despite what people did (or did not do) in the past.

Here are a few safety tips from experienced preservation workers:

## Personal Safety

- Pay attention. Be aware of yourself, your coworkers, and the jobsite.
- Communicate frequently with other workers.
- Do not work alone.
- Do not wear loose clothing or jewelry. Tie long hair back.
- Lift correctly (with your legs, not your back) and ask for help if you need it.
- Wear personal protective equipment, such as gloves, safety glasses, hearing protection, hardhats, chain saw chaps, and leather boots, as necessary.
- Be aware of the weather.
    - Wear sunscreen and a hat on sunny days.
    - Cover work areas during wet or freezing weather to limit slippery surfaces.
    - Do not operate powertools outdoors or work on roofs during electric storms or high wind conditions.
- Keep your fingers and toes out of places where they might get pinched.
- Know the location of the first aid kit, land line phone, cell phone, and radio, and know the route and method for evacuating an injured person to the nearest hospital or emergency clinic.

## Jobsite and Work Area

- Keep a clean and tidy jobsite and work area.
- Avoid tripping hazards—maintain clear walkways.

## Structural Issues and Hazards

- Before the project begins, inspect the building for hidden defects, weak points, rotten structural members, rodent and insect infestations, and other hazards. Observe clues of building defects, such as:
  - Bulging, buckling, sagging, or cracked walls, floors, ceilings, windows, and chimneys.
  - Piles of sawdust, evidence of rodents, or moisture problems indicated by mold and rust.
  - Inadequate or missing joists, rafters, beams, columns, and foundations.
- Do not work in areas with evidence of defects or hazards until you mitigate them.
- Bees, wasps, and hornets frequently build nests in and around buildings. Remove the nests and avoid stings.

## Hazardous Materials

- **Caution:** Follow your respiratory protection program when you must use a respirator (including an N-95 respirator). Check with your safety officer for more information.
- Do not underestimate the hazards of asbestos.
  - Hire an accredited asbestos inspector to sample and test any material you suspect may contain asbestos.
  - Have an accredited asbestos contractor or Forest Service employee certified in asbestos mitigation (figure 52) remove the materials, if necessary.
  - Information about the safe removal of asbestos is available from the local safety officer, an environmental engineer, or from the Forest Service Facilities Toolbox asbestos web page <http://www.fs.fed.us/eng/toolbox/haz/haz02.htm> and the Occupational Safety and Health Administration (OSHA) asbestos web page <http://www.osha.gov/SLTC/asbestos/index.html>.



Figure 52—This properly attired and certified crew is removing asbestos shingles from a Forest Service building roof in Gunnison, CO. The asbestos shingles were under a newer layer of composition shingles.

- Use proper procedures to avoid health hazards when working around lead materials and lead-based paint.
  - If lead-based paint is in good condition and you won't disturb it during the preservation work, it may be okay to simply leave it in place.
  - Information about lead building materials, lead-based paint, and the requirements for working with buildings that contain lead-based paint are available from:
    - Your safety officer.
    - An environmental engineer.
    - The lead-based paint section of the Forest Service Facilities Toolbox <http://www.fs.fed.us/eng/toolbox/haz/haz03.htm>.
    - The U.S. Environmental Protection Agency's (EPA's) Lead: Renovation, Repair, and Painting Program web page <http://www2.epa.gov/lead/renovation-repair-and-painting-program>.
    - The OSHA lead web page <https://www.osha.gov/SLTC/lead/>.
    - The National Park Service's Preservation Brief 37, "Appropriate Methods for Reducing Lead-Paint Hazards in Historic Housing" <http://www.nps.gov/tps/how-to-preserve/briefs/37-lead-paint-hazards.htm>.
  - You can purchase lead-based paint check kits and swabs at local hardware stores. Only kits recognized by the EPA are considered reliable and accurate, so check the lead test kit's certification before you buy <http://www2.epa.gov/lead/epa-recognition-lead-test-kits>.
  - Hiring trained, certified testing professionals is the most reliable way to determine the presence or absence of lead-based paint; they will use either a portable x-ray fluorescence machine or perform lab tests of paint samples.
- Be aware that mold growth is a result of moisture problems.
  - To eliminate mold, first eliminate the moisture problem and dry the area.
  - Most molds aren't toxic, but may cause or worsen asthma or allergies. To be safe, avoid skin exposure or inhalation.
  - To clean up mold, follow OSHA practices in "A Brief Guide to Mold in the Workplace" <http://www.osha.gov/dts/shib/shib101003.html> or hire a certified contractor to remove it.
  - You may have to replace absorbent materials, such as ceiling tiles (figure 53) and carpet, that become moldy.
  - For more information on mold and mold removal, see:
    - EPA's "Mold" web page <http://www.epa.gov/mold/moldresources.html>.
    - The Centers for Disease Control and Prevention's "Mold" web page <http://www.cdc.gov/mold/>.
    - The American Industrial Hygiene Association brochure "The Facts About Mold" web page at <http://www.aiha.org/about-ih/Pages/Facts-About-Mold.aspx>.
    - The OSHA "Safety and Health Topics: Molds" web page <https://www.osha.gov/SLTC/molds/>.

Figure 53—The original fiberboard ceiling tiles shown in this photo (taken before renovation of the living room at the Adams Camp Ranger's House) are moldy and damaged by moisture.



- Hantavirus is more common in Western dry-climate States than in the rest of the United States.
  - Hantavirus is primarily transmitted to humans when they inhale airborne dust from dried rodent droppings (figure 54). About a third to one-half of the people diagnosed with hantavirus pulmonary syndrome die from it, so do not take chances.
  - If you find rodent droppings in a cabin, use proper procedures to clean them out before doing any other work. Prevent reinfestation by screening, covering, or filling all openings more than ¼ inch in diameter.
  - Information about rodent dropping cleanup and hantavirus is available:
    - In the hantavirus section of the Forest Service Facilities Toolbox <http://www.fs.fed.us/eng/toolbox/haz/hanta.htm>.
    - On the National Park Service hantavirus risk reduction web page <http://www.nps.gov/public_health/zed/hanta/hanta_risk_redux.htm>.
    - On the OSHA "Safety and Health Topics: Hantavirus" web page <https://www.osha.gov/SLTC/hantavirus/>.
  - In the Forest Service hantavirus JHA <http://fsweb.r1.fs.fed.us/safetyhealth/jha/osha-h/JHA-hantavirus.doc>. **Note:** Forest Service employees must comply with the hantavirus JHA.
- Information about other hazardous materials that may be present in buildings is available in the Hazardous Substances in Buildings section of the Forest Service Facilities Toolbox <http://www.fs.fed.us/eng/toolbox/haz/index.htm>.

Figure 54—The renovators uncovered this rodent nest studded with droppings when they removed damaged fiberboard wall and ceiling panels at the Adams Camp Ranger's House.



## Tool Use

- Learn how to properly operate each tool by reading the tool's manual or by getting instructions from experienced employees.
- Use the right tool for the job. A wrench isn't a good substitute for a hammer, and vice versa.
- Keep tools clean and in good working condition.
- Store tools properly.

## Log Work

- Set logs on sawbucks and use log dogs to prevent them from rolling (more information is available in the Selecting and Preparing Logs section of this guide).
- Check each log thoroughly for nails before beginning log work. Use a metal-detecting wand if one is available.
- When using an axe, do not allow other people to stand in the chopping area or within the distance that chopped materials may fly.
- Do not operate a chain saw or crosscut saw unless you have proper training and certification for the work that you need to do. The Chain Saw and Crosscut Saw Training Course is available through your unit's normal training process (course materials are available at <http://fsweb.mtdc.wo.fs.fed.us/php/library_card.php?p_num=0667%202C01>).
  - Read and follow the chain saw operations requirements in Forest Service Health and Safety Code Handbook 6709.11, part 22.48 <http://www.fs.fed.us/im/directives/fsh/6709.11/FSH6709.pdf> (beginning at page 20-47).
  - Wear proper personal protective equipment when operating a chain saw. Maintain a comfortable position and good footing.
  - Start the saw with the chain brake engaged. Do not drop-start a chain saw.
  - Keep track of the people around you. Shut off the saw if they get too close.

### Working on Roofs

- Follow OSHA fall protection requirements explained at <https://www.osha.gov/SLTC/fallprotection/index.html>.
- Follow the fall protection requirements in Forest Service Safety Code Handbook 6709.11, part 33, at <http://www.fs.fed.us/im/directives/fsh/6709.11/FSH6709.pdf> (beginning at page 30-12).
- Wear a hardhat.
- Ensure that the railings on your scaffolding are solid to prevent accidental falls.
- Use a guardrail system with curb boards, a safety net system, or personal fall-arrest systems if you are 6 feet or more above either the ground or a lower level of the building, such as a flat porch roof. In practice, this requirement means that you must have fall protection for almost all roofing projects.
- Use roof jacks and planks for sloped roofs, when the next shingle layer is high enough on the roof that you cannot stand on the scaffold and reach your work area.

### Confined Spaces

Sometimes, log cabin preservation requires work within a space that isn't designed for continuous occupancy and has a limited or restricted means of egress—a confined space. For instance, cisterns and sewer manholes usually are confined spaces. Some crawl spaces and attics may be confined spaces.

- Have a qualified person evaluate all confined spaces to determine whether you need a permit to work in the space.
- Follow the unit's confined space plan and the applicable confined space procedures in Forest Service Safety Code Handbook 6709.11, part 38.2 <http://www.fs.fed.us/im/directives/fsh/6709.11/FSH6709.pdf> (beginning at page 30-38), to determine whether working in the confined space requires a permit or not.

### Lockout and Tag-Out

Log cabin preservation frequently includes work around powered equipment or machines or live electric wiring.

- Follow lockout and tag-out procedures to protect against the hazards of machinery or equipment starting unexpectedly or the release of hazardous energy.
- Understand the lockout and tag-out requirements explained in Forest Service Safety Code Handbook 6709.11, part 38.3 <http://www.fs.fed.us/im/directives/fsh/6709.11/FSH6709.pdf> (beginning at page 30-42), and in your unit's lockout and tag-out plan.

## Out of the Mud

You've inspected the cabin, identified the parts you need to preserve, planned the project work, and assembled supplies. Now comes the fun part—the actual preservation work.

### Raising and Leveling

Many old cabins sag or rot over time. Your first preservation work is to raise and level the building if it requires a new foundation, foundation repairs, new sill or spandrel logs, or if it's out of plumb, out of level, or out of square. Next, you need to install cribbing so the building won't move while you make repairs.

In this guide, when referring to lumber dimensions, "x" is used in place of the word "by" to indicate the thickness and width of a board. Thus, a nominal 2-inch-thick board (actually about 1½ inches thick) by 4-inch-wide board (actually about 3½ inches wide) is shown as "2x4." This nomenclature is the standard among builders, lumber yards, and sawmills. The nominal dimensions represent the approximate dimensions before the boards are planed smooth.

### Supplies Needed To Raise and Level a Building

- Surveying level or professional quality laser level.
- Telescoping survey rod or direct reading grade rod.
- Markerboards (also called "storyboards").
  - Use rulers, 1x4s, or other scrap lumber as markerboards.
- Cribbing (figure 55).
  - Prepare several sizes of solid, unwarped boards and lumber, such as 1x4s, 2x4s, 4x4s, 6x6s, and 8x8s.
  - Cut the wood into 1½- to 2-foot lengths.
- Miner's wedges.
  - Buy or make quality miner's wedges (figure 56) from straight, tight-grained wood—you will hammer them into place, and poor-quality wedges will split and splinter.
- Sledge hammers (figure 56).
  - Larger sledge hammers swung using both hands are sometimes called double jacks. Smaller sledge hammers swung using one hand are called single jacks.
- Framing hammer and other hammers, as desired (figure 57).
- Band clamps (figure 58).
- Assortment of pinchbars, pry bars, and crowbars (figure 59).
- Screw jacks and bars.
  - Use only screw jacks (bell-base jacks or house jacks are the most commonly used types) because hydraulic jacks raise a building too fast and can bleed off unexpectedly, which will cause the building to drop suddenly. Screw jacks (figure 60) come in many different sizes, from 4 inches to 2-feet tall.
  - Use rolled steel bars to turn the jack head and steel pipe that fits over the bars as cheater levers.
- Liquid bubble levels: torpedo, 12 inch, 24 inch, and 48 inch.

Figure 55—Cribbing requires the use of many different sizes of lumber, as well as wedges.

Figure 56—Large and small sledge hammers and an assortment of miner's wedges are essential tools for jacking and cribbing.

Figure 57—Each hammer in this assortment is best suited for a slightly different purpose.

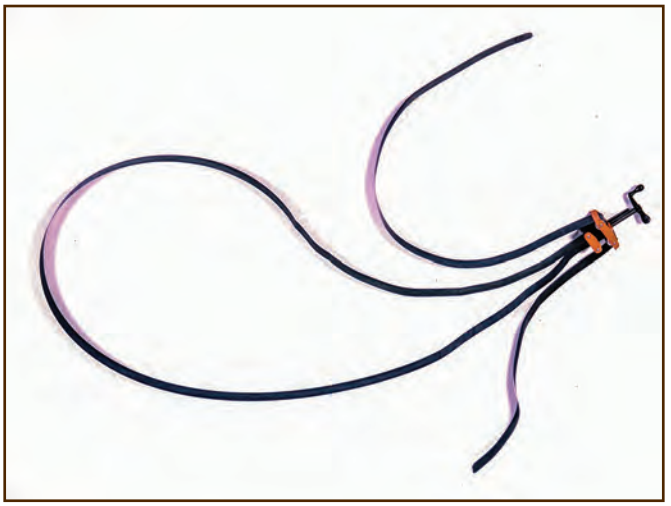

Figure 58—Use band clamps to hold log walls together when the walls are elevated above their foundations.

Figure 59—Bars come in many different configurations, providing shapes appropriate for all sorts of prying tasks.

Figure 60—Screw jacks are available in many sizes, from 4 to 24 inches tall. Place the small plate between the jack head and the log to prevent damage to the log.

First, determine how out-of-level the building is. Set up the surveying level (figure 61) or laser level, and establish a couple of solid reference benchmarks outside the work area. Then, survey the building to determine the high and low points of the building floor or foundation. Be sure to record the measurements and reference them to the benchmarks. Determine which portions of the building you need to adjust and how far you need to move each part. Set up the level far enough away from a corner so that at least two sides of the building are visible. Open the building doors and windows so you can see the far interior wall(s) of the building to track the progress of as much of the building as possible from this location. Because you need to keep the level in one place during the jacking process, set up the level on a tripod or stable base. If you are careful, you can remove the level from the tripod or base each night and replace it in exactly the same place every day. Using a level isn't difficult, but you must use it correctly to obtain good results. To save yourself some headaches if you don't know how to use a surveying level or laser level, or if it's been a while since you used one, enlist the aid of someone who uses the instruments routinely.

Information about using levels can be found at <http://www.engineersupply.com/How_to_Use_Berger_Transits_and_Levels.pdf>. Information about using levels and transits is also available at <http://www.askthebuilder.com/using-transits-laser-levels-and-optical-builders-levels/>.

Use markerboards (figure 62) to easily see whether you are jacking up the building evenly. You can make markerboards from rulers, 1x4s, or other scrap lumber. If you're using lumber, mark each board in ½-inch increments and number the increments. Focus the level on the exterior corners, at the mid-wall, and wherever visible on the interior walls. Tack up markerboards in each of these places. Record the number that you see at the horizontal crosshairs. Then, as the building moves, you can see how each corner or portion moves relative to the rest of the building and the ground.

If necessary, brace and stabilize the building. Use band clamps, whalers, interior bracing, or a combination of these methods, depending on the circumstances. Band clamps are metal bands with a tightening mechanism (figure 63) that can

Figure 61—You can use a builder's transit or level to establish high and low points on a building and track jacking progress.

Figure 62—Preservation carpenters attached markerboards (circled) made from 1-inch-thick lumber to the sill logs of the Sage Creek Cabin (Custer National Forest, Northern Region) so they could use a transit to check that the building rose evenly and remained level.

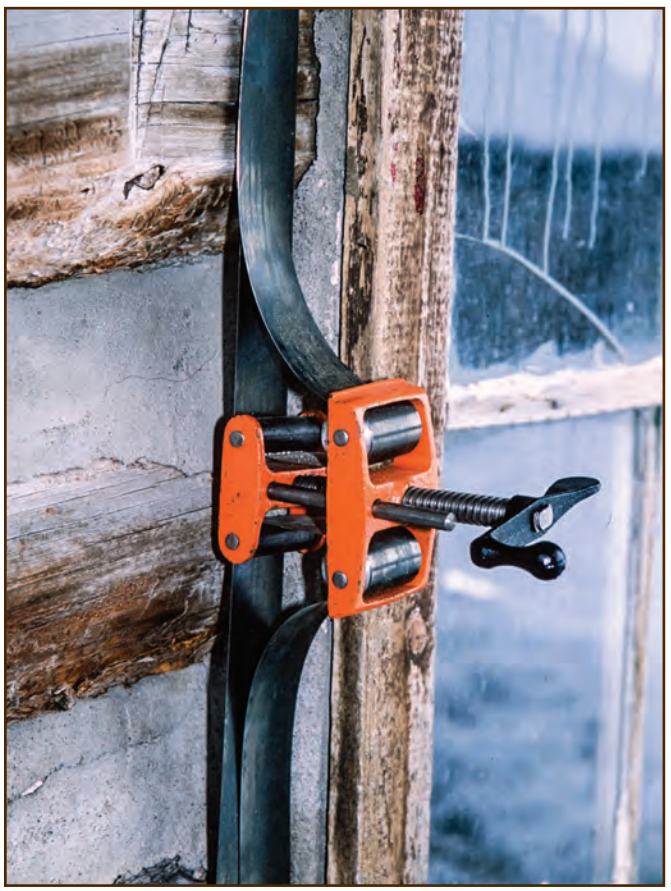

Figure 63—Workers can adjust this band clamp using the tightening screw, which has an offset handle.

encircle a log wall from top to bottom and hold all the logs together (figure 64). Whalers are paired timbers (one board on either side of the wall) that are through-bolted or nailed to each log, creating a log and timber "sandwich" (figure 65) to stabilize the wall. Interior bracing methods include "X" braces, plywood sheeting, and shore posts (figure 66).

Because stabilization won't completely eliminate shifting while you raise the building, you also may want to remove doors and windows or apply electrical tape "Xs" to the windows to improve flexibility and keep the glass in place if it cracks. If the cabin has masonry daubing, expect some of it to crack and fall out—this is normal and is easily repaired.

The following jacking and cribbing process works for raising an entire building or for bringing only a portion of the building back into level with the rest of the structure. If you only need to raise part of the building, you may not need markerboards, but you certainly will need a building level or laser level to track progress and confirm when you achieve leveling.

If you raise the entire building to replace logs or foundations, take the opportunity to level the building, if necessary. The best way to determine what is level on a log cabin is to use the head jambs of doors and windows and the top plate logs as level guides. You will have to use some judgment in determining which of these options you should use as the level guide, or whether a compromise level that doesn't quite match any of them is more reasonable. Remember, log cabins were rarely completely plumb, square, or level when newly built. The goal should be to make the cabin as close to level as it originally was.

After you set the level, place the markerboards, and stabilize the building, you are ready to build jacking and cribbing platforms. Create an access point for each jack and the adjacent cribbing by digging a hole below the log you will lift that is deep enough for the jack and platform. The most efficient method is to set the jack directly under the log wall. If the bottom logs are rotted, cut a hole vertically from the bottom of the wall through any rotted logs up to a sound wall log. If necessary, remove a portion of the foundation to reach the lowest sound log. After you create the access point, use some

Figure 64—Preservation carpenters used band clamps to hold the logs together on the front of this cabin in Nevada City, MT, during a renovation project. Clamping allowed the carpenters to remove the rotten sill logs and to raise the building without risking collapse.

Figure 65—Whaler systems "sandwich" logs between bolted timbers to keep them in place during renovation activities.



Figure 66—The roof of this cabin is temporarily supported by a beam on "X" braced shore posts.

of the 2x cribbing (figure 67) to build a solid, level base for the jack to sit on. If you used whalers to tie the walls together and the whalers are strong enough, you can use them as stable jacking points (figure 68). In this case, excavate the hole for the jack and platform under the whalers, not the wall. Remember, if the jack base isn't solid and level, your building won't rise correctly and the jack could kick out, allowing the whole building to drop.

Figure 67—This jack is set up on level cribbing directly under the log wall.

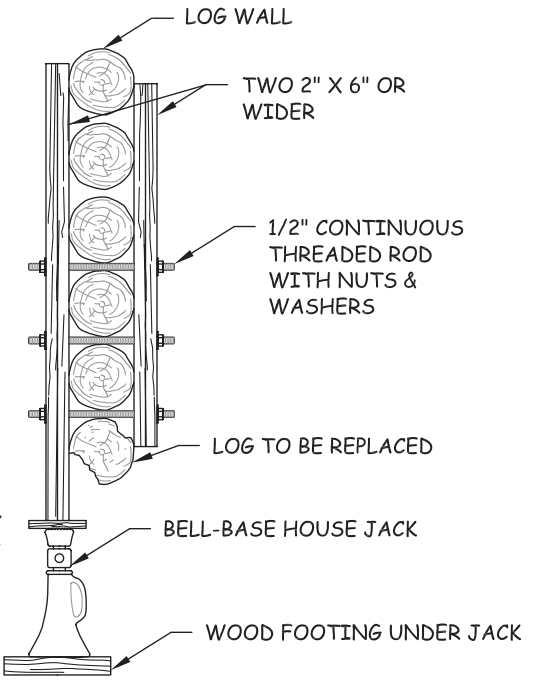


Figure 68—This drawing shows how to use a whaler as a jacking point. Notice that the whaler is shorter on the right side to allow you to easily remove the bottom log.

If the building needs a new foundation but doesn't have full-length or full-width floor joists, you will need to insert supports that extend the full width of the building during the raising and leveling process (figure 69). People often refer to these supports as needles. Needles can be steel beams, heavy timber beams, or built-up wooden beams constructed from three or four 2x8s or 2x10s tied together using cleats or through-bolts (figure 70). If you're using needles, excavate the holes for the jacks and platforms outside the walls, where the ends of the needles will be. Arrange the needles under

Figure 69—Preservation carpenters set up a jack and cribbing outside the log wall of the Sage Creek Cabin (Custer National Forest, Northern Region) to support the laminated wood needle. The needle helped to support the cabin as the carpenters raised it.

Figure 70—This preservation crew is constructing needles to support the Sage Creek Cabin (Custer National Forest, Northern Region) while they raise and replace the sill and spandrel logs.

the building to support all of the building's weight (exterior walls, load bearing interior walls, floor joists, chimney, etc.). You may need to excavate to provide enough clearance between the soil and the building to accommodate the needles. If you need to remove and replace only the lowest log, use a short needle on cribbing (figure 71) and band clamps around the other wall logs to provide solid support for the cabin above the lowest log.

After you build the jack platforms, construct a cribbing platform using 2x material adjacent to each jack (figure 72). You need to adjust the adjacent cribbing as you raise the building so that the cribbing holds the building solidly and steadily between each jacking raise and so that it limits the distance the building could drop if the jack fails during a raise.

Next, set the jacks in place. Begin raising the building slowly, cranking each jack only ¼ inch or one-quarter turn at a time. Check the markerboards frequently and listen and watch for signs of excessive stress, such as cracks in finish materials (don't worry about chinking and daubing) and loud popping and creaking noises. Some minor popping and creaking noises are inevitable, but loud noises can indicate trouble. If you hear or see signs of stress, check that you are raising the building evenly. Adjust as necessary. If signs of stress continue, you may need to back off and crank only ⅛ inch at a time or adjust the placement of the jacks. Keep in mind that jacking is always a slow process, and take all the time you need to minimize stress on the building.

As you raise the building, stop after every ½-inch rise to build up the cribbing. This process is referred to as "chasing the jack." Build the cribbing in a crosshatch pattern for maximum safety and stability (figure 73). You can replace several ½-inch-thick boards with 2xs as the building rises enough to accommodate the thicker boards. Always lay the cribbing plumb and level. Use a torpedo or small bubble level frequently to check the level on the cribbing, bars, and needles (figure 74). Every time you take a break or reset the jack, pound miner's wedges between the top of the cribbing and the bottom of the log to keep everything tightly supported (figure 75).



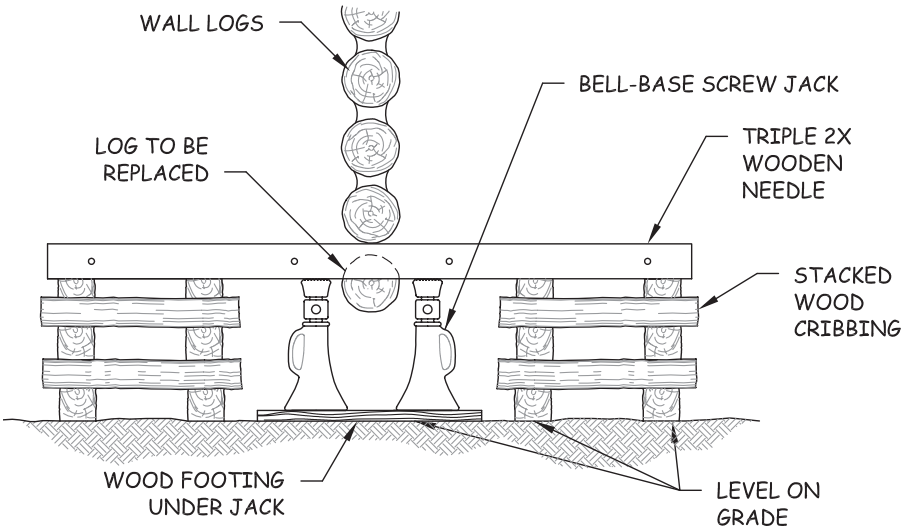


Figure 71—This drawing shows how to set up a jack and cribbing system to support a wall while you remove the bottom log.

Figure 72—Preservation carpenters stacked cribbing in several locations under needles and solid logs to support the Sage Creek Cabin (Custer National Forest, Northern Region) as they raised the cabin using jacks.




Figure 73—This crew at Garnet Ghost Town within the Bureau of Land Management's Garnet Resource Area in Western Montana employed safe cribbing and jacking techniques. They constructed a level, stable base in a crosshatch pattern to support the jacks and cribbing, then stacked the cribbing in a crosshatch pattern.


Figure 74—These crewmembers are using a bubble level to check that the jacks, cribbing, and jacking plates remain level.

Figure 75—This crewmember is pounding in miner's wedges to keep the support tight to the log.