

Chapter 4

Building the Log House

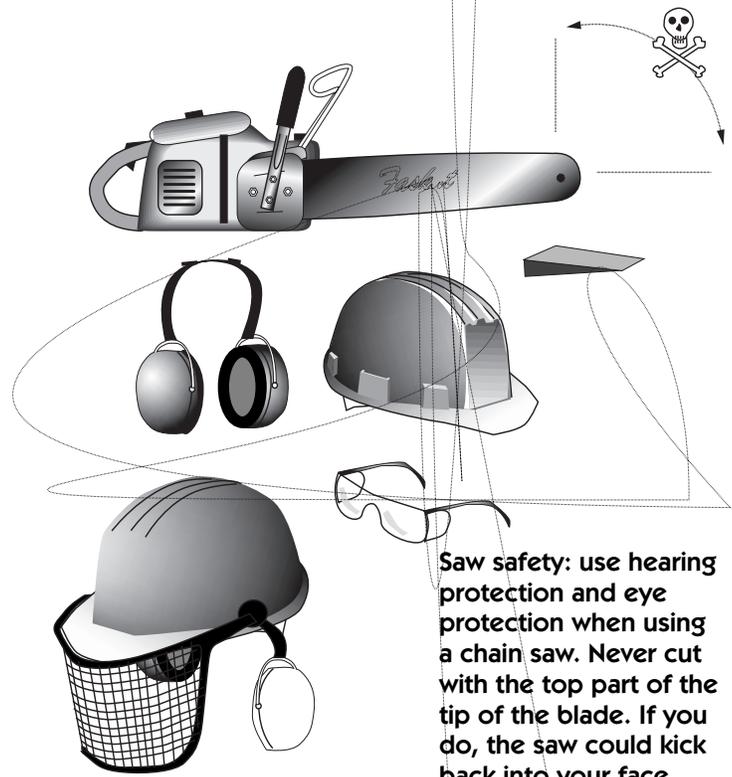
In the Woods

Trees are a renewable resource if logged on a sustainable time schedule of a hundred or more years between harvests. The way to ensure a perpetual source of house logs is selective logging.

House logs are best cut in winter, when the sap is down and the logs can be skidded over the snow with minimum damage to the logs and the environment. Bark beetles are dormant in winter, and a long winter drying season may dry the logs enough to keep the beetle population down in the spring. Bark beetles will not invade dry logs.

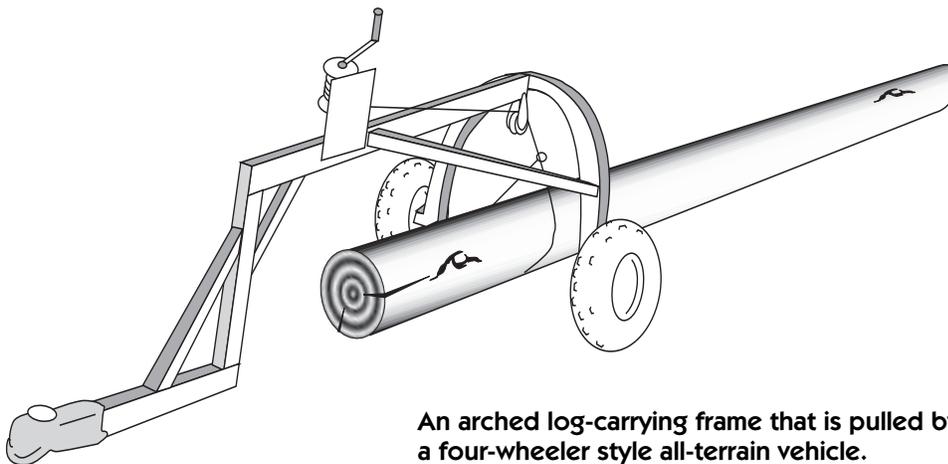
Choose trees that are of the length and diameter that will suit your needs. Think in terms of cutting a matched set of logs with the same mid-point diameter.

Leave the remaining trees undamaged by traveling lightly on the land as you skid the logs out of the forest. The trees left behind will benefit from having more light and space to grow in.



Saw safety: use hearing protection and eye protection when using a chain saw. Never cut with the top part of the tip of the blade. If you do, the saw could kick back into your face.

A modern equivalent to horse-logging is a four wheeler fitted with an arched log-carrying frame equipped with a 2,000-pound capacity electric winch powered by the 12-volt battery system of the off-road vehicle (see drawing below).



An arched log-carrying frame that is pulled by a four-wheeler style all-terrain vehicle.

Sawmill Island

(As told by Robert Charlie, director of the Cultural Heritage and Education Institute.)

Sawmill Island is located directly across from Old Minto, which is about 30 miles downriver from Nenana. Old Minto was originally settled in 1912 by a group of Athabascans from the Minto Flats area. Today, Old Minto is the site of a cultural heritage camp. One of the reasons that Chief Charlie originally settled in Old Minto in 1912 was the abundance of timber found at Old Minto and across the river on Sawmill Island. Sawmill Island is about 1.7 miles long. The timber served many purposes, but it was primarily used for fuel by the community members and later for contracts with the United States government.

In the early 1920s, Robert Charlie's uncle, Arthur Wright, who was one of the first Native ministers for the Episcopal Church in Alaska, used timbers from Sawmill Island to build Old Minto's first school. The two-story structure was about 60 by 80 feet. Arthur Wright had a small portable sawmill located on the island. Also built of timbers from Sawmill Island was the Episcopal Church that stills stands today. The Cultural Heritage and Education Institute is working to preserve it as a historical site.

Years ago, there were four or five winter trails to the island that led to dry timber areas. Everyone in the village used the island to get wood. Also, you could walk into the woods in the summer, and pick gallons of cranberries.

During World War II, the federal government was busy building Galena Air Force Base. About that time, Robert Charlie's dad was the first contractor with the Alaska Railroad (federal government) to sign for cord wood. The first year he signed for 50 cords of wood, the second year for 100 cords of wood, and the third year for 150 cords. Most of that wood came from Sawmill Island.

Later on, Robert's dad signed a contract with the federal government to produce 1,000 cords of wood. People from his village produced the 1,000 cords of wood. Robert's brothers and dad cut about 360 cords. People would stack the cords along the river and the steamboats would use them to power the boats up and down the Tanana and Yukon rivers. During the war, the federal government leased steamers from Canada and had another three steamers that traveled these rivers, hauling materials to the Galena base.

Today, Neil Charlie's allotment is partly located on Sawmill Island. Robert Charlie says that his family used to have their fish camp on the island. He remembers as a child seeing old slabs of wood and sawdust where Wright had his portable sawmill.

Whether you are clearing your own land or logging a timber sale, keep waste to a minimum. Maximize the use of local wood products whenever possible. Birch makes good cabinet building material and flooring or window and door trim. Aspen and poplar or spruce make good paneling, wainscoting, and trim. Douglas fir, hemlock, and white spruce can be made into framing lumber or timbers for post and beam construction.

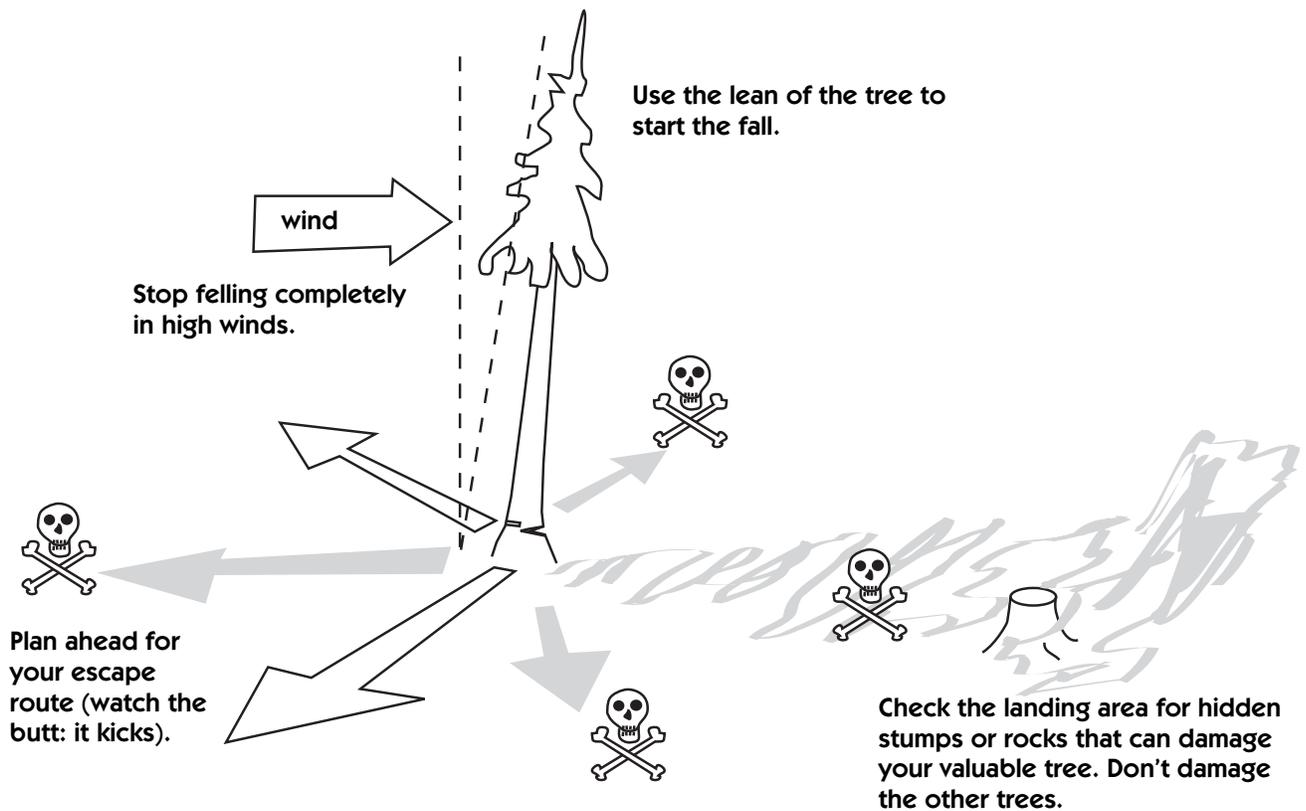
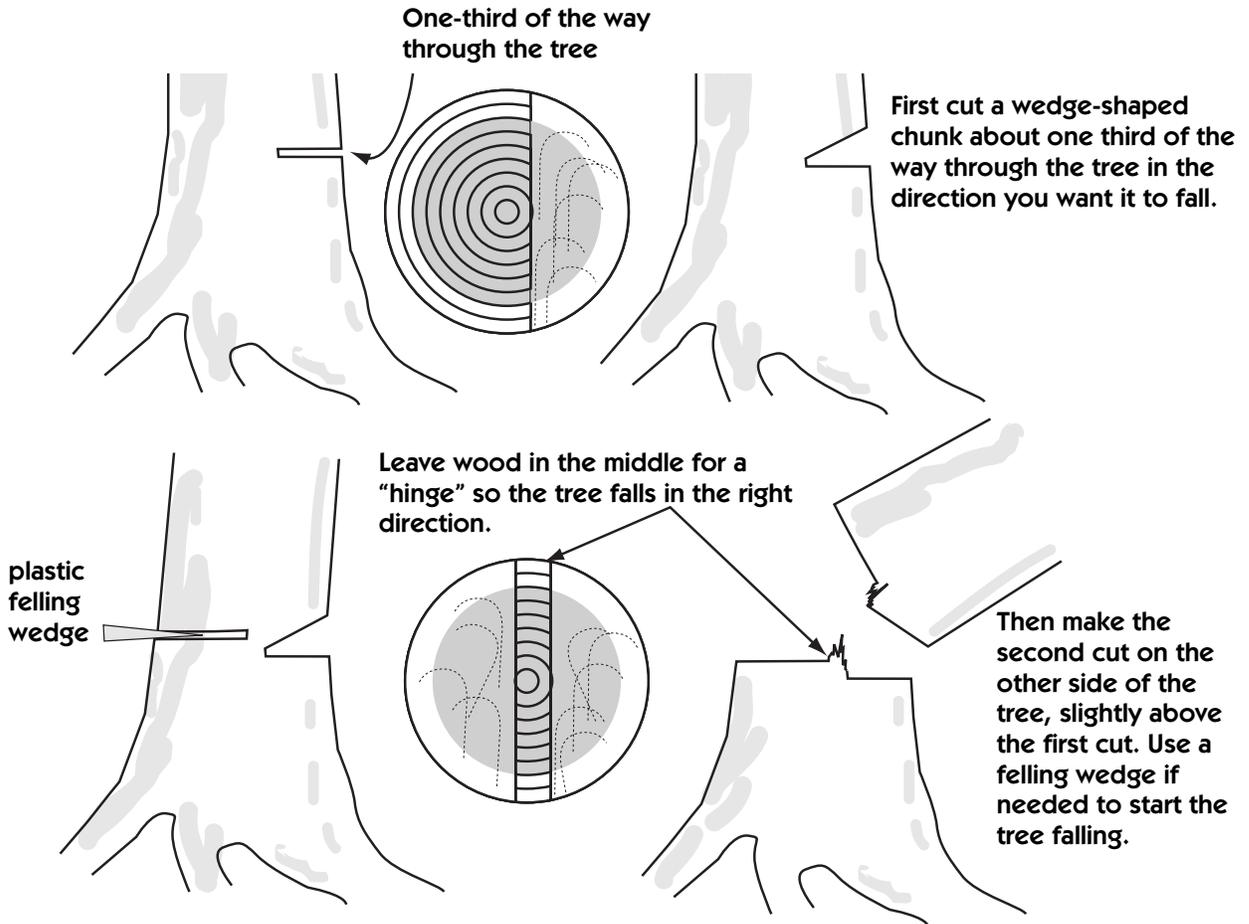
White spruce trees are likely to be the logs of choice for building in interior or southcentral Alaska. Large, straight aspen or white poplar can also be used. In southern Alaska, yellow cedar and western red cedar, Sitka spruce, Douglas fir, and western hemlock all are excellent log building materials if they are straight and of the size required for your building. Alaska yellow cedar is very strong and very durable and suitable for cabinetry and furniture, power poles and pilings, decking, bridges, and housing.

Don't peel too far ahead of the actual placement of the logs on the wall, since the bark protects the wood from mechanical damage, mold, and mildew.

Weathering

Logs may have to be treated with a dilute solution of mildewcide after peeling to keep them from turning green or black with mold. Some builders prefer to use a solution of borate crystals dissolved in water and sprayed on the logs to retard mold growth. Borate is less toxic to the environment and to the log workers than some other chemicals used to protect logs from mold.

Safe tree felling



After a couple of years lying around with the bark on, logs will start to rot and may become bark beetle habitat. At this point, it may be best to peel the logs and treat them with a water-repellent wood preservative to keep them sound until you can begin to build.

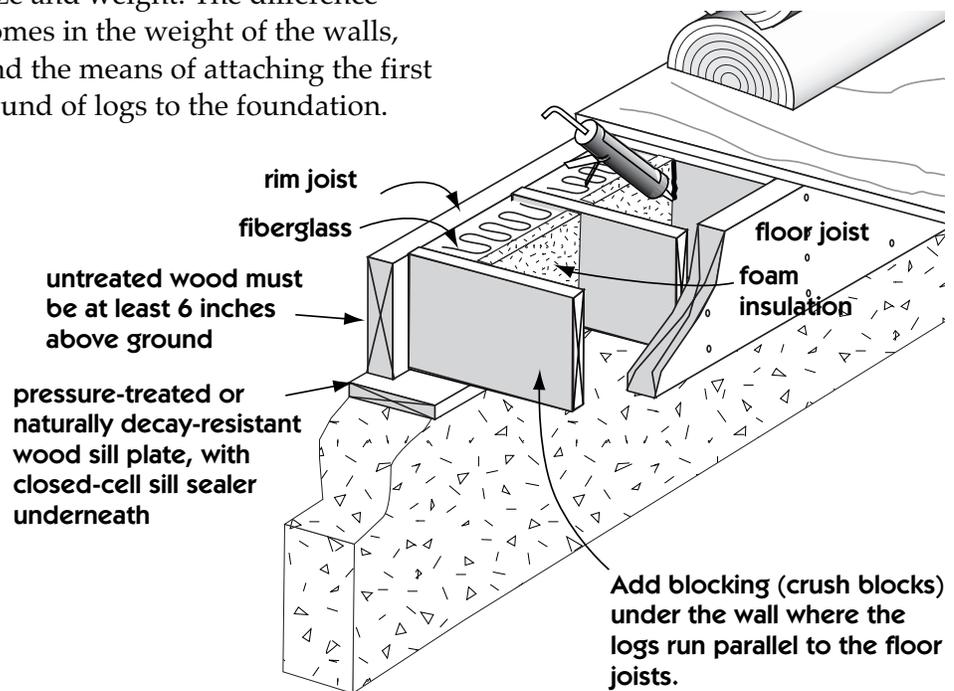
Spring is the worst time to fell and peel a log. However, if you must use wet, green logs, place them on the wall as soon as possible so that they take a set in line with the shape of the building.

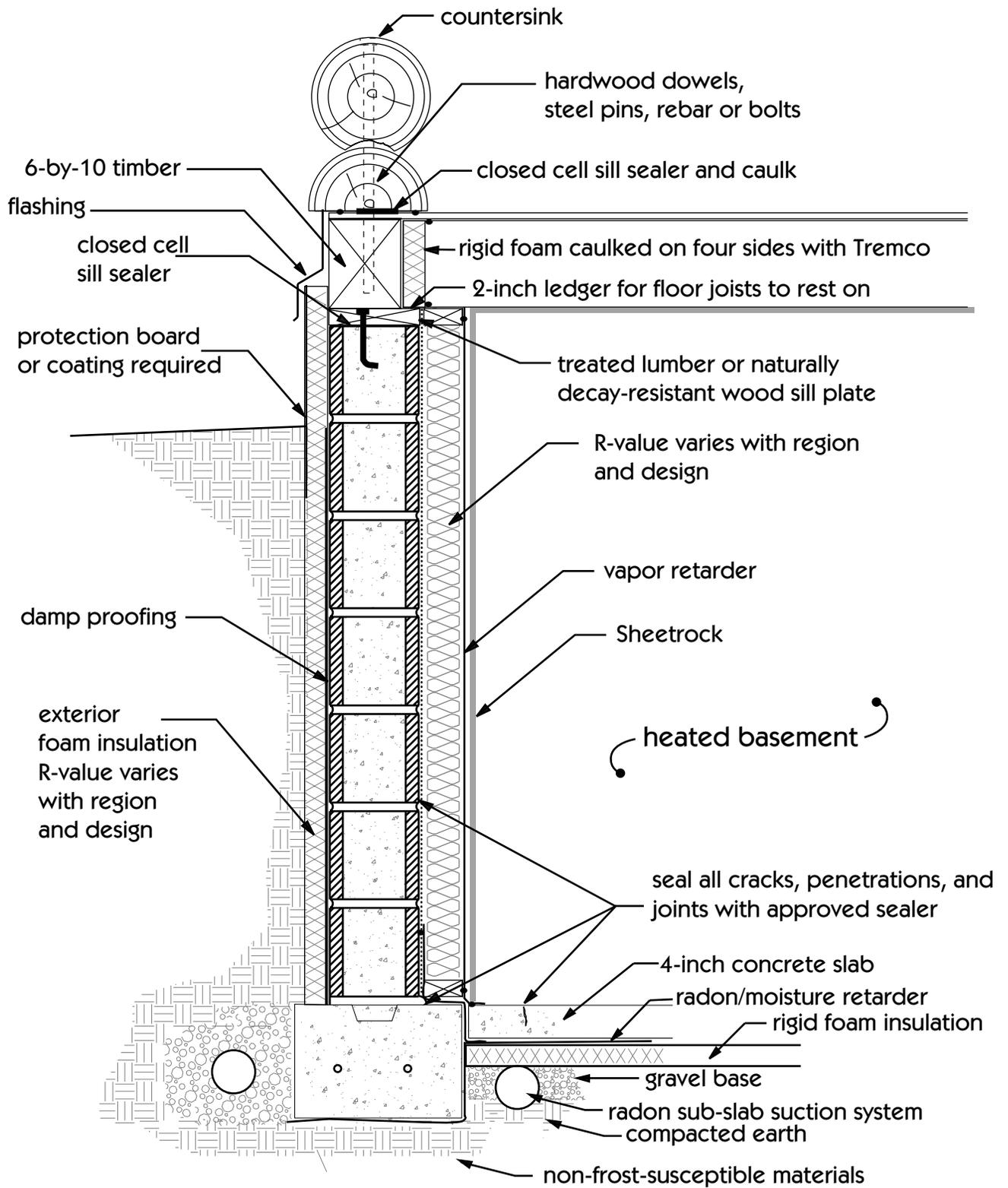
If the logs begin to turn green with mold, wash them with a solution of household bleach and detergent, rinse thoroughly, and allow to dry completely. Protect them with a water-repellent wood preservative and allow them to season before applying the final finish.

The Foundation

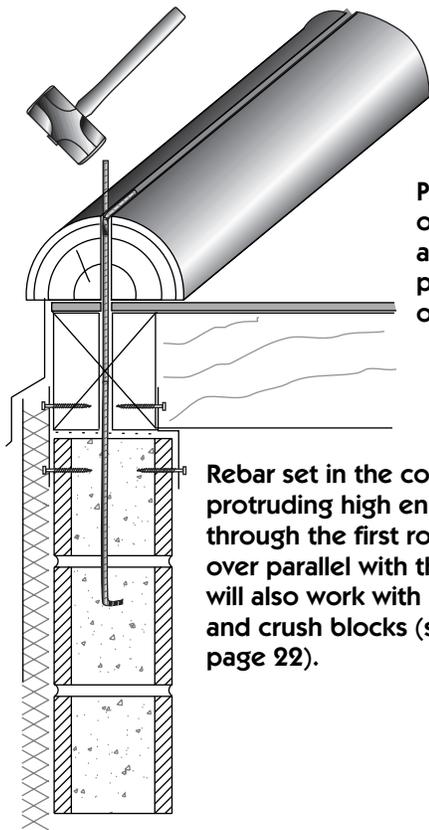
As we noted earlier, the configuration of a foundation for a log house is the same as a good foundation for any structure of comparable size and weight. The difference comes in the weight of the walls, and the means of attaching the first round of logs to the foundation.

There is an ongoing debate of whether to place the first logs directly on top of the treated foundation sill plate or on top of a timber of the same height as the floor joists. If you use a timber for a rim joist, it is a relatively easy matter to attach the first round of logs, using whatever pinning system you use for the rest of the log wall. Some log builders prefer to build on top of the plywood subfloor, which has been framed to the outside of the sill plate. In either case, the logs or timbers must be securely attached to the foundation with long anchor bolts or with coupling nuts connecting all-thread rods to the anchor bolts. Some builders extend $\frac{1}{2}$ -inch rebar 18 inches to 2 feet out of the foundation, drill the log accordingly, and bend the rebar tightly against the first logs with a sledge hammer. If the logs sit on top of a floor, additional blocking should be installed where the joists are parallel to the lay of the logs.





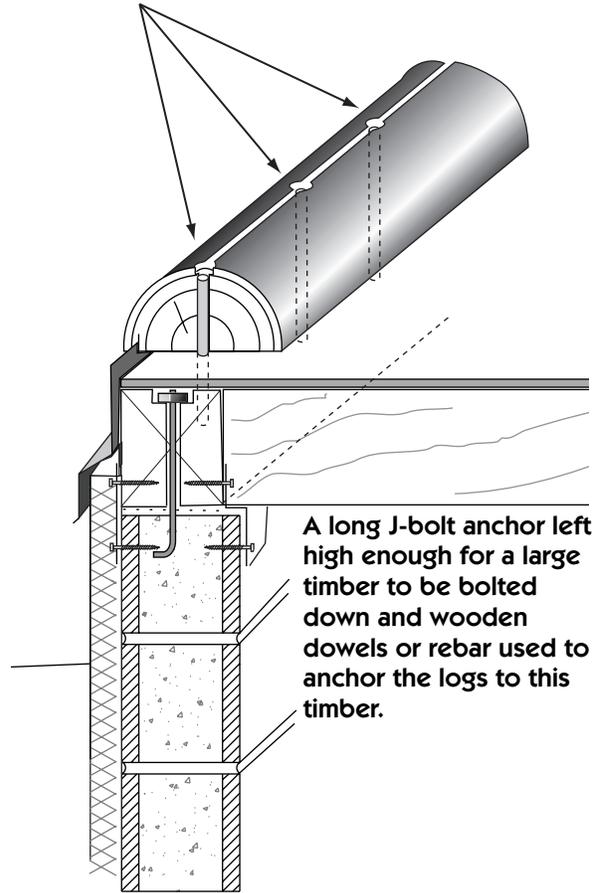
Options for attaching the half log to the foundation



Plan ahead and decide on the method of anchoring before you pour concrete or install piers.

Rebar set in the concrete and left protruding high enough to come through the first round and then bent over parallel with the log. This method will also work with a standard rim joist and crush blocks (see illustration on page 22).

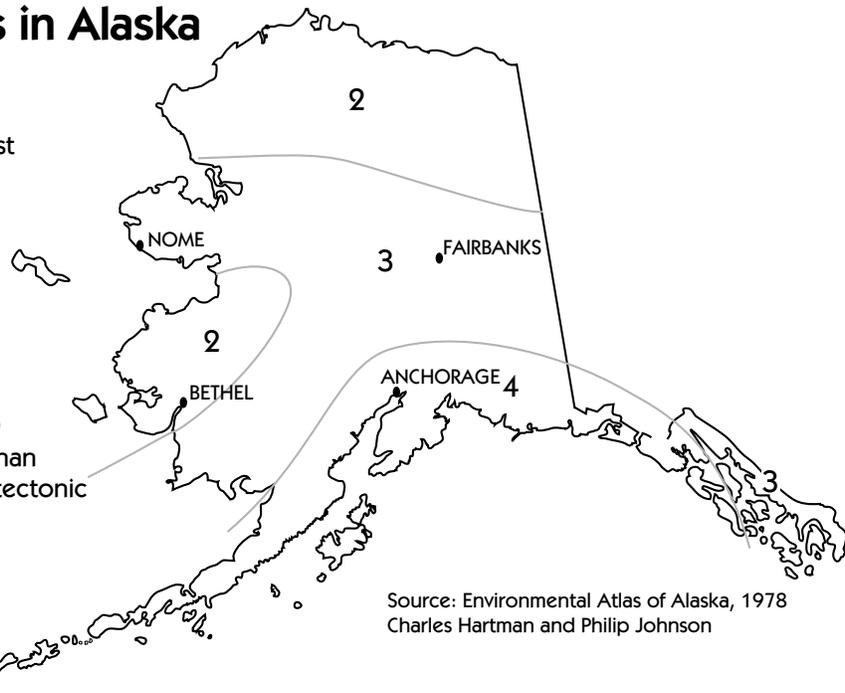
countersink 1"



A long J-bolt anchor left high enough for a large timber to be bolted down and wooden dowels or rebar used to anchor the logs to this timber.

Seismic zones in Alaska

Zone	Possible max. damage to structures	Magnitude (Richter) of largest earthquake
0	none	less than 3.0
1	minor	3.0–4.5
2	moderate	4.5–6.0
3	major	greater than 6.0
4	potential damage is greater than zone 3 due to geologic and tectonic features	

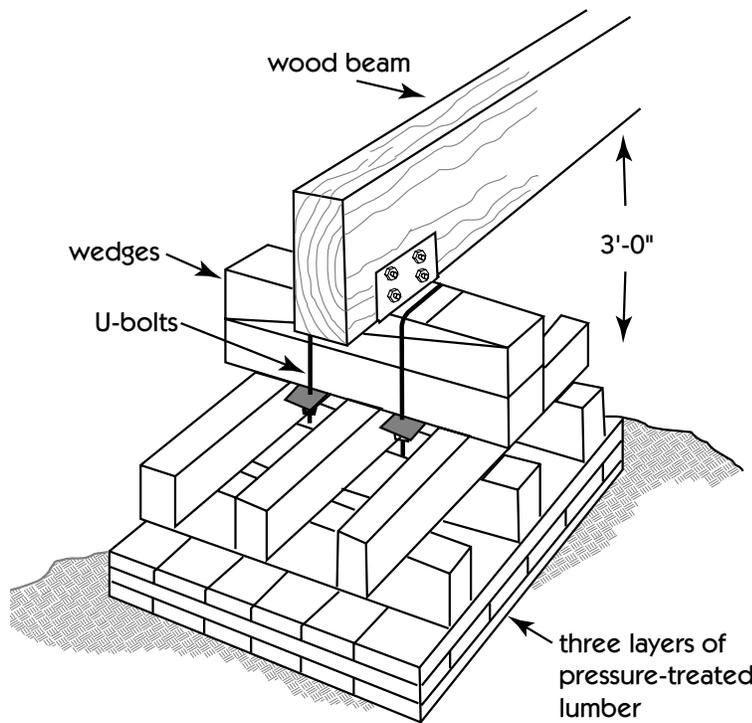
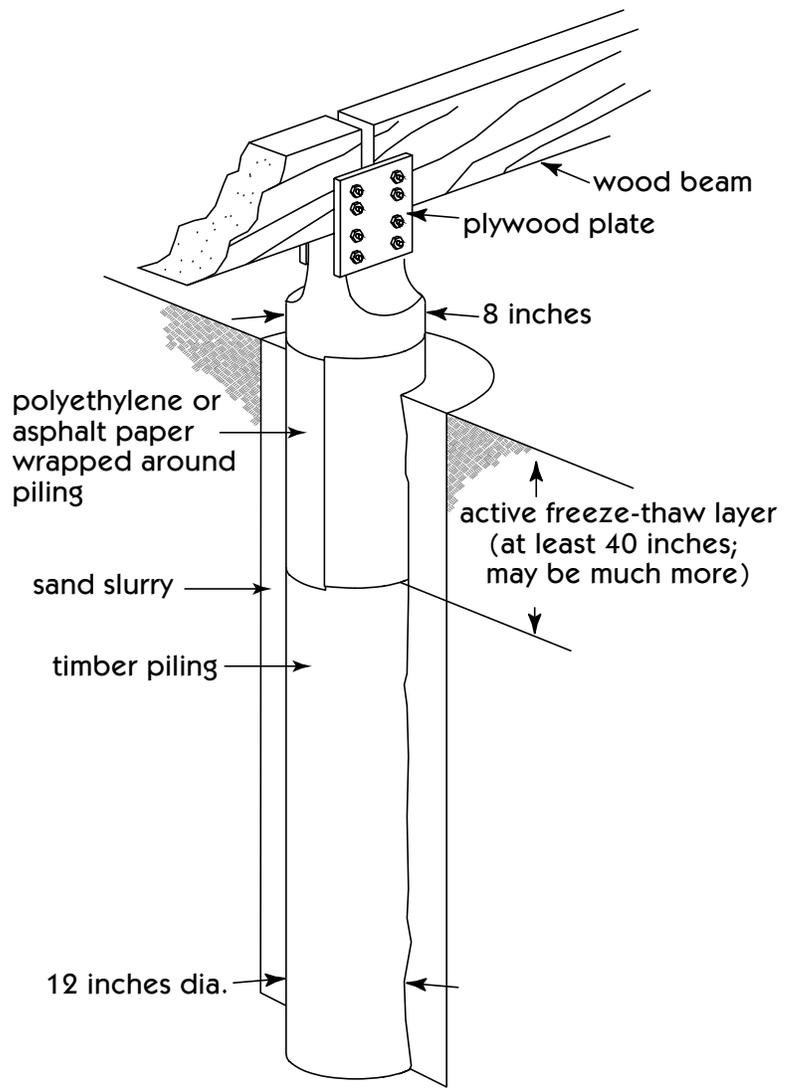


Source: Environmental Atlas of Alaska, 1978
Charles Hartman and Philip Johnson

Most of the engineered plywood I-beam systems have compatible laminated rim joists, which may eliminate the need for extra crush blocking along the ends of the joists. Follow manufacturer's directions. In any case, build it strong so that the connections of the logs to the foundation, the connections between logs, and the connection of the roof to the logs are all designed to meet the engineering requirements of your specific earthquake zone, wind load, and snow load design levels (see seismic zones map, previous page).

Permafrost Foundations

One way to support a log structure on permafrost is to build it on pilings that are drilled, driven, or dug to below the active seasonal frost layer and deep enough to provide lateral sway bracing. It should be drilled deep enough into the permanently frozen ground to freeze the piling in place. The floor must be well insulated and situated



Examples of foundations for permafrost



A nice-looking post and pad foundation installed near Fairbanks.

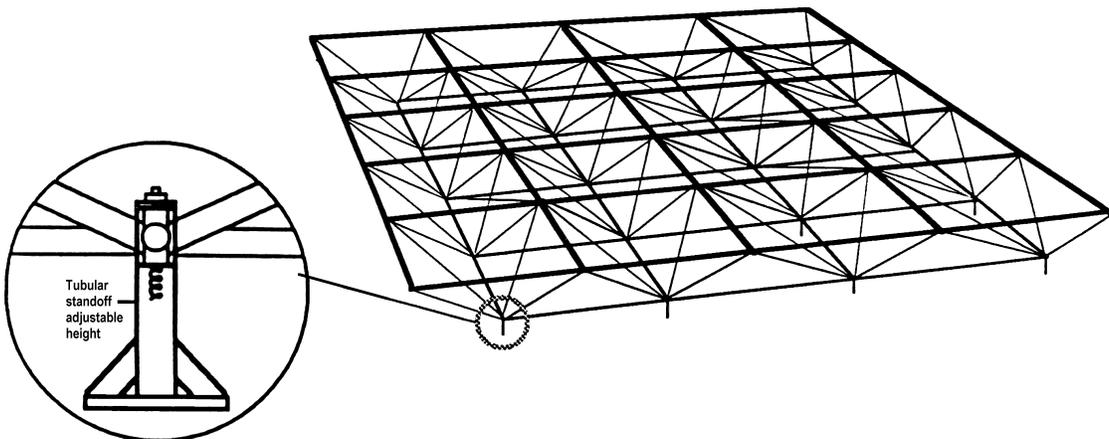


The Triodetic brand space frame is one option for building on permafrost.

about three feet above grade to allow outside air to flow under the house in winter to keep the ground frozen and to shade the surface in summer from the heat of the sun. Avoid disturbing the organic ground cover that insulates the soil. (See *Building in the North* by Eb Rice for an in-depth discussion. See Appendix D.)

Another permafrost foundation is post and pad, where a bed of gravel is placed on the undisturbed vegetation mat and treated wood timbers are embedded in the gravel and tightly stacked in alternating layers to support either posts or beams to support the building. Some builders are building a treated timber system of railroad ties and horizontal beams to support a home on a gravel pad.

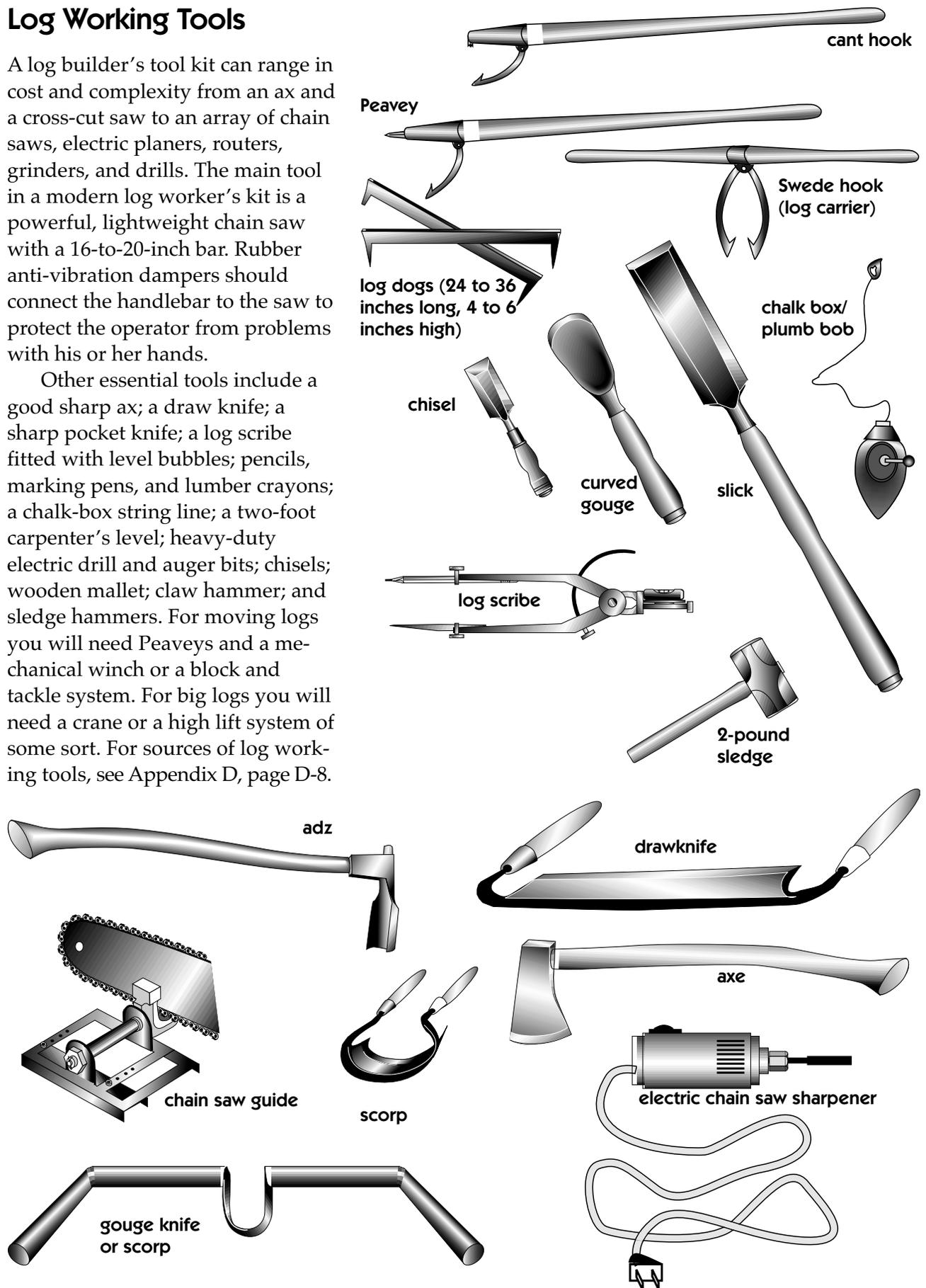
A promising new-high tech permafrost foundation called Triodetic has been used extensively in the Canadian north and has been used in arctic Alaska in the last few years with apparent success. The Triodetic foundation system incorporates a series of interconnected triangles of steel tubes to form a bridge over unstable soils.



Log Working Tools

A log builder's tool kit can range in cost and complexity from an ax and a cross-cut saw to an array of chain saws, electric planers, routers, grinders, and drills. The main tool in a modern log worker's kit is a powerful, lightweight chain saw with a 16-to-20-inch bar. Rubber anti-vibration dampers should connect the handlebar to the saw to protect the operator from problems with his or her hands.

Other essential tools include a good sharp ax; a draw knife; a sharp pocket knife; a log scribe fitted with level bubbles; pencils, marking pens, and lumber crayons; a chalk-box string line; a two-foot carpenter's level; heavy-duty electric drill and auger bits; chisels; wooden mallet; claw hammer; and sledge hammers. For moving logs you will need Peaveys and a mechanical winch or a block and tackle system. For big logs you will need a crane or a high lift system of some sort. For sources of log working tools, see Appendix D, page D-8.



Half Logs

The first round begins with a pair of half logs. These are usually run the shortest length of the building. When supported at each end, either on the wall or on a pair of skids, a log will usually come to rest with the bow down and the straight edges to the sides. Roll the log back and forth with a Peavey to locate the very straightest lie and hold it in place with a log dog or with wedges with the straight edges of the log to the sides (see illustration #1, next page).

Use a chalk line to snap a line down the center of the mass of the log. Use a level to mark vertical lines on each end of the log at the centerline just established (see #2, next page).

Then roll the log over until the end marks are horizontal. Dog securely and snap a line down the length of the log on the other side.

If you have an attachment to turn your chain saw into a two-man saw, then sawing the half logs is relatively straightforward since each of you have a line to guide the saw. If you are cutting single handedly, you may want to place an observer on the far side to signal up or down.

If you cut the half log from a vertical position, with the log lying with the centerline on top, it is best to have only one sawyer cut the entire length of the log from one end to the next without changing direction. That way, if one person's sense of vertical is a little bit out, at least it will be consistent and won't compound any error.

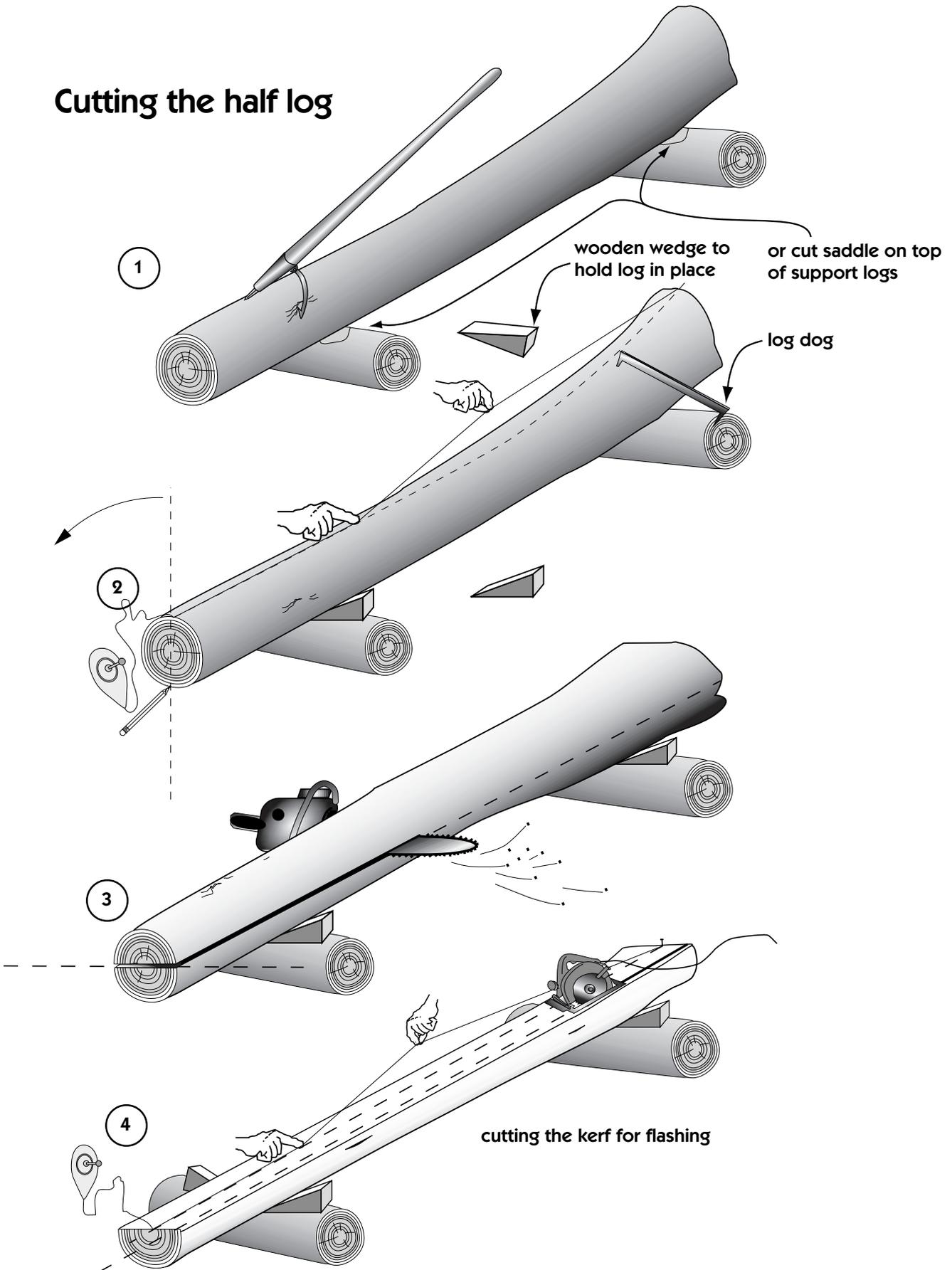
Once the log is sawn in half, secure both halves in a horizontal position and brush the surface straight and smooth with the edge of your chain saw. This is an acquired skill and will come with a little practice.

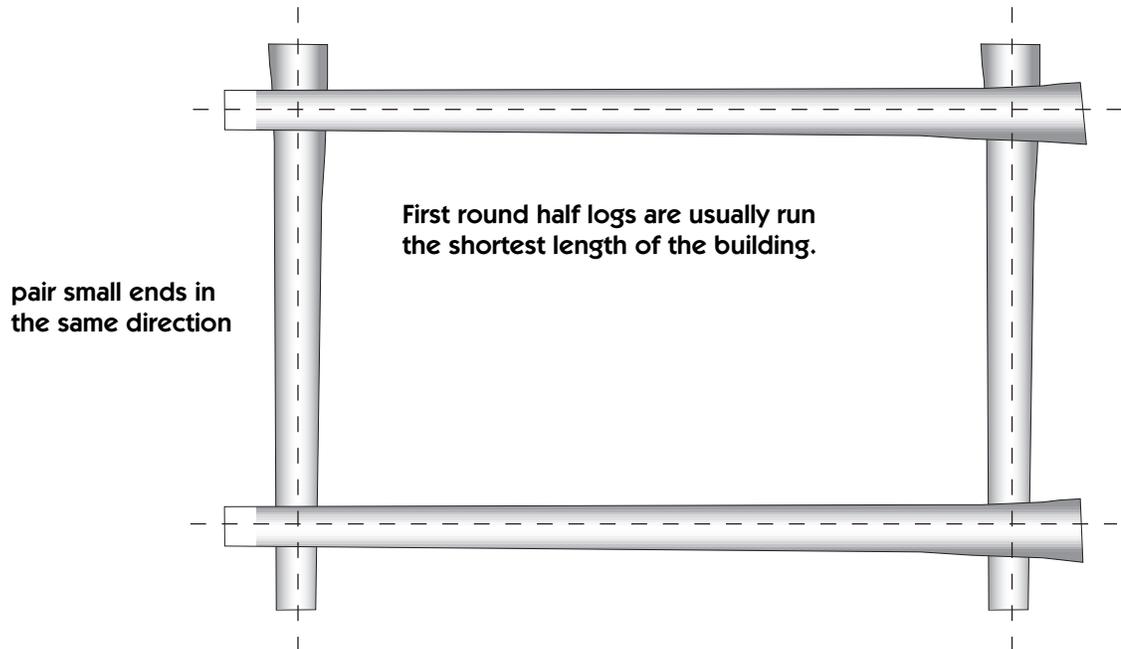
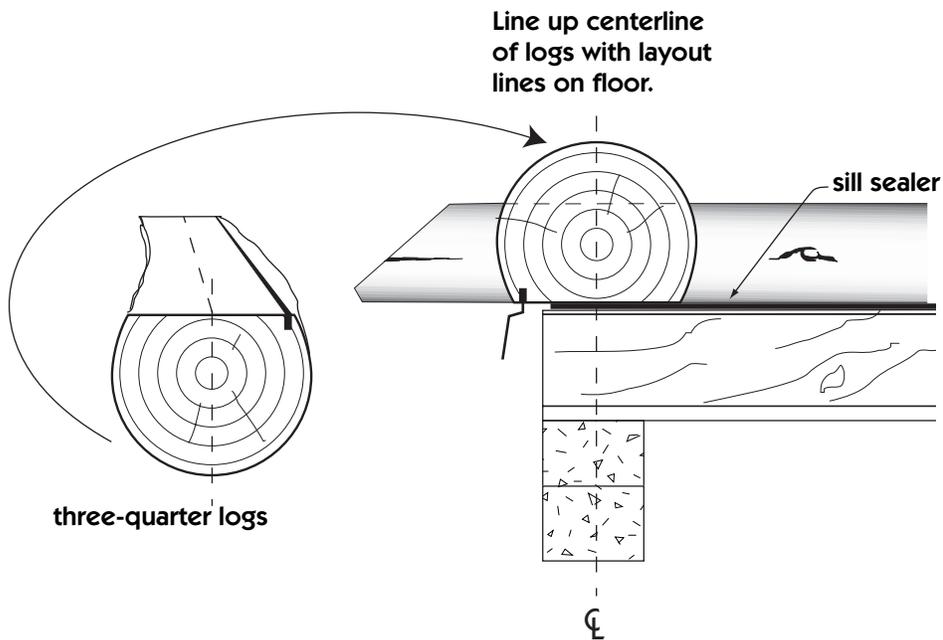
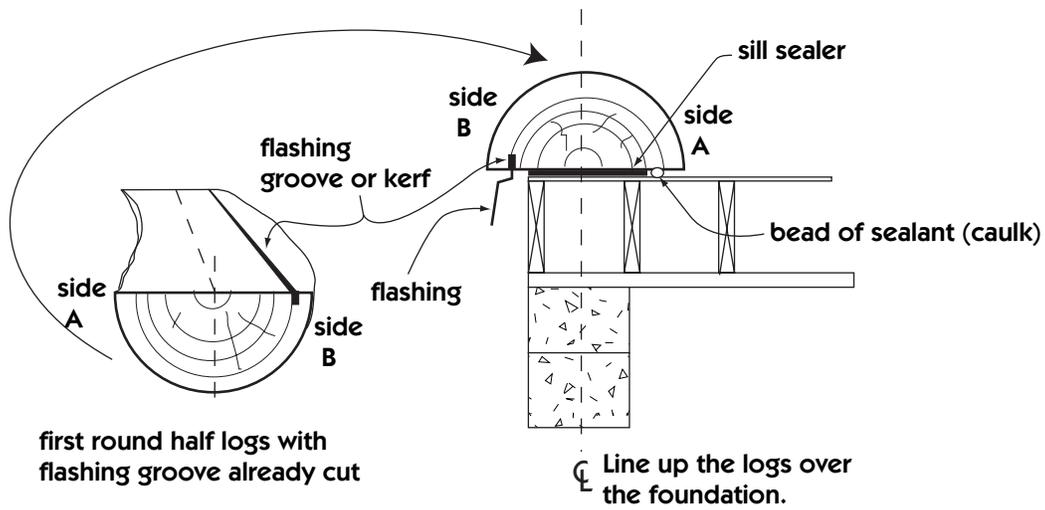
Snap a center line on the bottom of both half logs and snap another parallel line near the outer edge just outside the foundation (see #4, next page). Cut a 1/4-inch-deep kerf at the outer line with a circular saw to hold a metal drip edge flashing. If you do not have metal flashing available, cut a 1/4-inch deep groove with a chain saw to serve as a drip break and to prevent water from flowing under the first round of logs.

Transfer the center line to the top of each half log, using a level to extend a line on each end of the log. The half logs are then placed on the foundation with the center marks lined up with the wall centerlines marked on the foundation or floor. Place any bow to the outside. Butt ends should run the same direction so that when you reach the top of the wall, the top round will end up with the butts facing the same way to support a long roof overhang at the gable ends if desired, and the top round will be easier to finish in any case. Some builders choose to alternate the butt-tip lie of the half logs and subsequent plate logs.

Use closed-cell sill seal or EPDM gaskets to provide a weather-tight seal between the half logs and the floor or foundation. Caulk the first logs to the floor with a bead of sealant along each side of the sill seal.

Cutting the half log





Three-quarter Logs

The second logs to be placed are often referred to as three-quarter logs because about a quarter of the log is cut off the bottom to rest squarely on the foundation or floor. Slab off the bottom of the three-quarter logs to provide a flat width of about six inches, using the same techniques described for cutting the half log. The width of the flat bottom of the three-quarter logs may vary from end to end in order to leave enough wood over the notches. Always consider the height of the log to be crossed and the diameter of the butt or tip that will be crossing over the log you are working on.

Cut a 1/4-inch deep kerf for flashing parallel to the centerline of the log just outside the foundation or floor line. Place the two three-quarter logs on top of and at right angles to the half logs, with the centerlines lining up with the centerlines marked on the floor or foundation.

Check to be sure that the flat bottoms are exactly parallel to the floor and shim them to level if required so that when notched to fit over the half logs, they will lay flat on the floor, evenly compressing the closed-cell seal sill gasket material under the bottom round.

There are several ways to notch this first round together. This and a host of other notches are discussed in detail by B. Allan Mackie in *Building With Logs and Notches of All Kinds* (see bibliography in Appendix D for these and other books). All notches should be self-draining and should restrict the flow of heat, air, and moisture in and out of the structure for the life of the building.

Compression-Fit Saddle Notch

The current notch of choice by professional log builders is the compression-fit saddle notch. The shoulders of the log below are saddle-scarfed off at an angle that forms, in cross section, the shape of a domed pyramid with the sides sloping toward the top, leaving about a 3-inch domed top. The top



Prebuilding the log walls at a convenient place before reassembling at the final homesite. The logs are peeled just before use to keep them in good shape.



A good modern log home built with a compression-fit saddle notch.

should be about the same width as the lateral groove of the next log.

By cutting the scarfs (see page 34) you remove the sapwood, which tends to shrink and compress more than the heartwood does. You also create a better locking shape so that the top log fits over the log below like a huge pipe wrench, preventing it from twisting or turning. You have to cut a relief opening in the top of the notch so that the sides of the notch can bear the weight of the logs as they shrink and settle.

The compression-fit notch comes to us from Scandinavia via Canada thanks to the reinvention of an ancient Norwegian log building technique by Del Radomske, a Canadian log home builder, inventor, teacher, and author. Radomske noticed that his once-perfectly fit full-scribed round notches were opening up after a few years of shrinking and settling. After perfecting the saddle notch, he observed that if there should be 75 percent of the weight of a log resting on the notch and the remaining 25 percent of the weight on the long or lateral groove, then

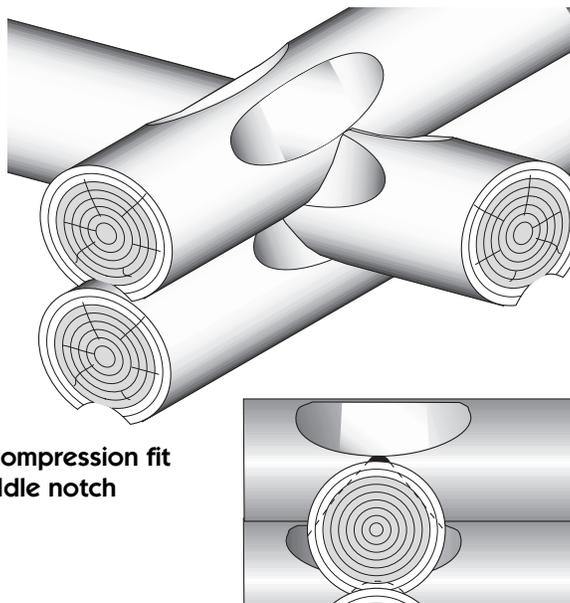
it would make sense to overscribe the lateral groove so that as the logs settled and shrunk, the lateral groove would not hang up and hold the notch open. He experimented with first a $\frac{1}{8}$ -inch overscribe, then $\frac{1}{4}$ -inch, and evolved into an average of $\frac{3}{8}$ -inch larger scribe setting for the lateral groove than for the notch. Over-scribing works best when combined with a saddle notch. The compression-fit notch, sometimes called shrink-to-fit, is designed to get tighter as the logs settle and shrink. Radomske is still experimenting with this shrink-to-fit system, as are numerous other log builders who search for perfection.

Round Notch

The round notch full-scribe technique typically uses identical scribe settings for both the long groove and the round notches. It would probably be better to overscribe a round notch building, but the log should bear on the top of the notch and not on the sides. The round notch will not keep the log below from twisting. To tie the logs together, drive hardwood pegs, dowels, through-bolts, or lag bolts, or pin them with rebar into pre-drilled holes through each round of logs to the rounds below. Keep track of the pins with marks on the logs so that you don't hit them when cutting out a window or spline.

Log Scriber

A modern log scriber consists of a 10 or 12-inch divider fitted with a pencil holder and adjustable level bubbles. The principle of scribing is based on parallel lines. The bottom leg of the scriber rides along the



A compression fit saddle notch

lower log and the upper leg traces its shape on the upper log. The level bubbles are adjusted to maintain horizontal and vertical control of the dividers so that the exact shape of the lower log, including bumps or depressions, is transferred to the upper log. Many log builders use indelible pencils, and some spray the logs with water or window washing solution from a mist bottle to darken the line. Some builders adapt the pencil holder to accept Sharpie-style felt-tip pins. This type of marker is especially useful if you are scribing icy logs.

The First Scribe

The first scribing you will do is to fit the three-quarter logs to the half logs. If you choose to use the saddle-notch technique, you may first cut scarfs on the shoulders of the half log. Some log builders round notch the half and three-quarter logs. The shape of the scarf is often marked on the log, using a template to lay out scarf dimensions to ensure consistency of appearance.

The scarf cut is made with a chain saw, using a sweeping motion somewhat similar to using a paring knife to remove a small bruise on an apple. The sloped plane of the scarf must be consistent to provide a uniform bearing surface for the sides of the notch in the log above. Sand or plane the face of the scarf smooth.

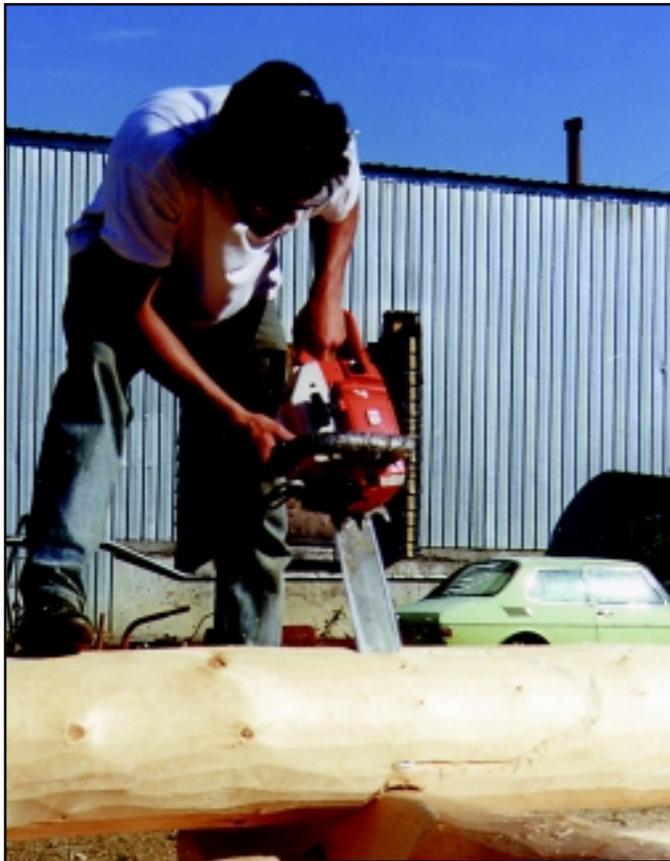
For the first round, the notches should be under-scribed about a half inch so that with shrinkage and settlement the flat bottom of the three-quarter log will not hang up on the floor and cause the notches to open. This first round will require a wide scribe setting,



Use a benchmark to set the level bubbles for consistency.



Using a layout board to mark the log for a scarf. See drawing #3, page 37.



and considerable care must be taken to ensure that the level bubbles are set exactly so that the points of the scribe are perpendicular to the floor. This setting can be verified by checking against a plumb line marked on a perfectly vertical surface previously established near the building site.

Scribing the Notch

The log to be notched is placed so that the center line of its mass is exactly over the wall center line marked on the subfloor or foundation, with the straightest sides parallel to the floor. With the straightest sides top and bottom and any bow to the outside of the building, dog the log firmly in place so that it will not budge with people sitting or walking on it.

With the exception of the first round, which is flattened on the



cutting the scarf



brushing with the chainsaw to smooth the scarf

bottom and therefore has a predictable depth of notch, all other logs must be “rough” notched or “first” notched to drop the new log to within 1 1/2 or 2 inches of the log below. This is easily done by opening the scribe to the space between the logs just inside the notch at each end. Mark this setting on the

top of the log and reduce the scribe setting by the distance you wish to use for your final scribe, say 2 inches or three fingers width. Scribe the first notch with this new setting.

Hold the scribe gently with both hands, and keeping the level bubbles between the lines, scribe



Scarf is sanded smooth, ready for final scribing. Note stress relief kerf on top of logs to promote controlled checking.



Hold the scribe gently with both hands, keeping the level bubbles between the lines.



Scribing for the groove

from the bottom up and the top down on both sides of the lower log. Move to the other side of the new log and scribe with the same setting.

Move to the other end, open the scribe to the space between the logs and close the dividers down by the same amount as the other first notch. Repeat the same procedure for the other notch.

When you cut the rough notches and roll the log back in place, the log should be parallel to and $1\frac{1}{2}$ to 2 inches above the lower log. Place the center of the log exactly over the center of the wall below. Mark on top of the lower log with an indelible pencil and a plumbed 2-foot level the exact location where the new log crosses the lower log for future reference.

Final Scribing

Stand back and evaluate the general lay of the log to be final scribed. Note the largest gap and shim the log if necessary to maintain a consistent lateral notch width of about three or four inches.

Set the scribes to the largest gap between the two logs, then open them up about $\frac{1}{8}$ inch and final scribe the two notches at this setting. Remember, you will open the final scribed setting at least $\frac{3}{8}$ inch to over-scribe the lateral notch.

Overscribe the log end extensions another $\frac{1}{4}$ inch to prevent them from hanging up, since the interior of the log walls are generally heated and will dry out more rapidly than the unheated log ends.

Back on the Ground

Once the log being worked on has been scribed all the way along both sides, up and over the logs at each intersecting wall, and around both ends with a continuous line outlining the shape of the logs below, then the log dogs can be removed and the log boomed down off the wall and placed on log cribbing of a comfortable height to do all the chain saw work with both feet on the ground.

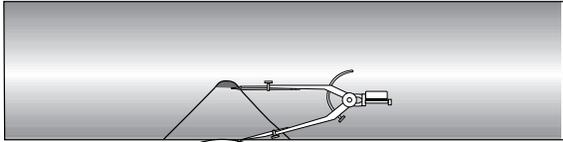
We have found it faster and safer to do most of the chain sawing standing on the ground. If you don't have a crane to easily move the logs, which is often the case for owner builders, you can do all the chain saw work up on the wall. This is dangerous work, on or off the ground. Totally concentrate on the task at hand, yet be aware of what is going on around you. Practice safety at all times. Always wear eye and hearing protection.

Do not get between a moving log and a hard place. When undoing a log dog, have someone hold the opposite end of the log with a Peavey with both of you standing to the inside of the house and no one below you on the ground. Sometimes a very crooked log can roll with a lot of force and throw a log worker off the wall. Work in pairs and look after each other.

Cutting the Notch

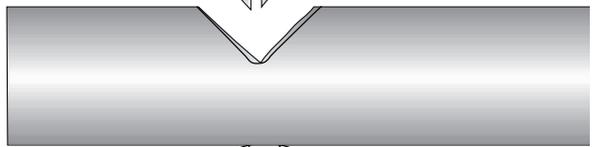
If you are using a chain saw to cut the notch and you are working with dry logs, it is a good idea to score along the scribe line with a sharp knife to prevent splinters from extending beyond the scribe line. You could also use a sharp ax held in one hand and a mallet to tap the

1



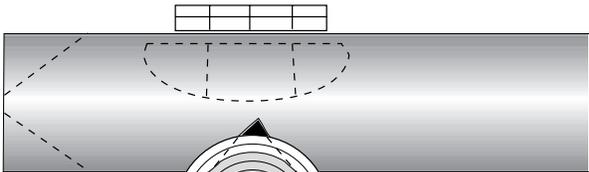
A rough or first scribe

2



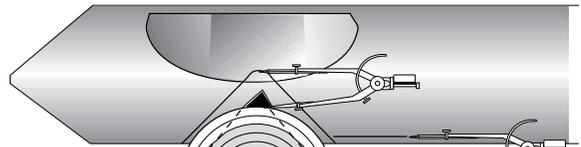
Remove the wood in pieces and roll the log over.

3



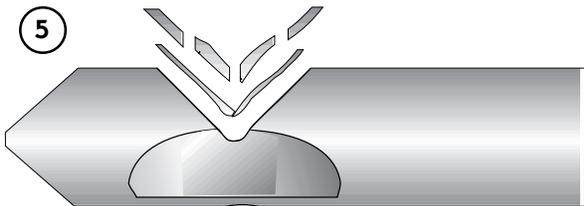
Use a layout board to keep all the scarfs the same.

4



The final scribe

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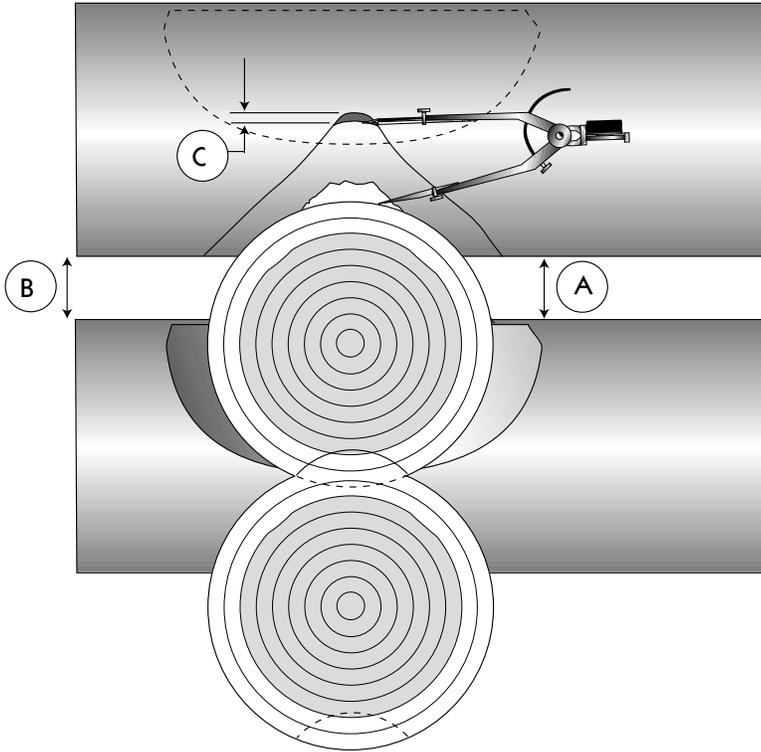
Most of the wood is cut with a chainsaw, but cut the last quarter inch with hand tools.

6



The notch should be smooth and slightly cupped to accommodate insulation and prevent hanging up on the lower log.

- (A) overscribe about $\frac{3}{8}$ -inch
- (B) overscribe $\frac{5}{8}$ -inch
- (C) $\frac{5}{8}$ inch



The final scribe is visible on this log on the skids, ready for cutting.

head of the ax as if it were a large chisel to score the line.

Cut from one side of the log at a time so that you can see when you are getting close to the scribe line. Leave about a quarter of an inch of wood between your saw and the line so that you don't turn an expensive log into firewood by cutting beyond the scribe line. Cut the remaining wood with a sharp axe, chisel, or a sharp pocket knife.

For a small notch you may only need to cut one vertical slice down the center of the notch and one angled cut along each side of the notch.

Repeat the three cuts from the other side of the notch, and knock out the chunks of wood with the back of your ax or with a hammer. A larger notch may require a few more slices. With practice, an experienced log worker can remove most of the wood within the scribe line in only a few large chunks.

Brush the remaining wood to be removed from the notch with the bottom quarter of the nose of the saw bar. Clean up the sides and the bottom by sweeping sideways back and forth with the bottom sector of the tip of the bar. Work from the top down and from the center of the log to just short of the scribe line.

When you're done, the notch should be smooth and slightly cupped to accommodate insulation and prevent hanging up on the lower log. The sides of a compression-fit notch must have strong edges to carry the weight of the log when the lateral notch is overscribed (see Appendix B, page B-13, Log Building Standards).

Cutting the Lateral Groove

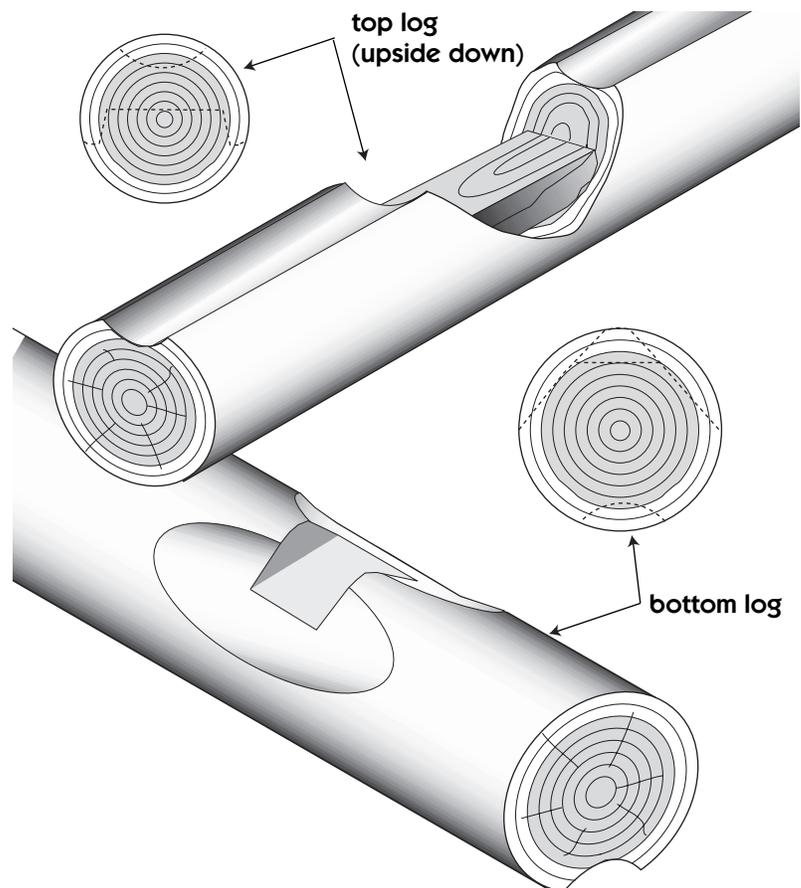
The long V groove is no longer in favor since it removes more wood than necessary and in some cases weakens the logs to the point where they slump on the wall and open up the notches, which are no longer carrying the weight. A more perfect groove is the continuous cope, which is tedious with a chain saw but can be done with a gouge-type adz or with a specialized tool called the Mackie gouge knife, also known as a scorp.

The W cut groove is most frequently used now by log building professionals. This cut removes much less wood than the V groove. Instead of making two deep cuts to create a V, you make four shallow cuts to form a W (see next page). A narrow groove is tighter and stronger and faster to cut than a wide groove.

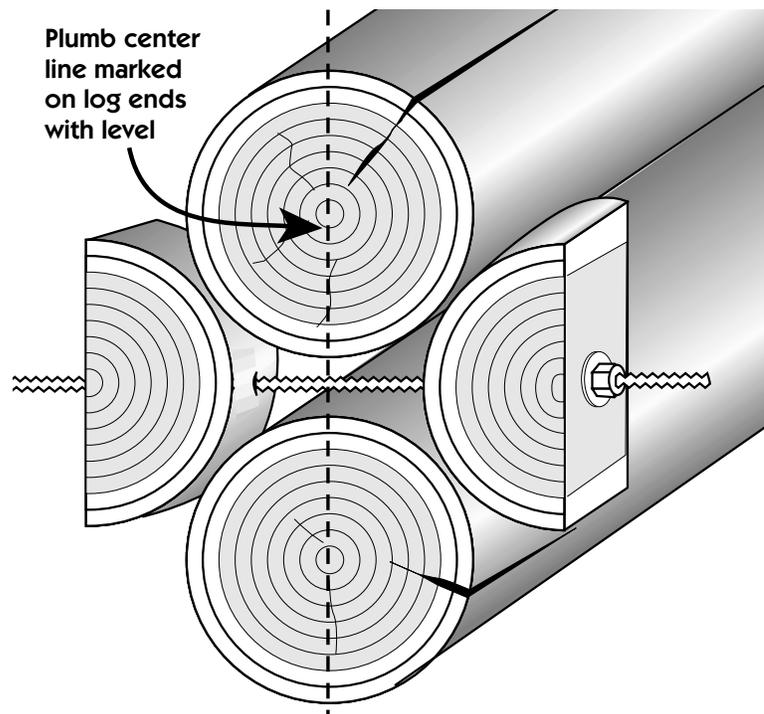
Begin by cutting just inside the scribe line with the saw aimed just above the center or radius point of the log. Make the first cut about an inch or two inches deep, depending on the size of the log and the shape of the log below.

The second cut is a repeat of the first cut from the other side of the groove. The third cut is a line starting at the top of the first cut and connecting at the bottom of the second cut. The fourth cut removes the wood remaining near the first cut, and a W will be formed in cross-section.

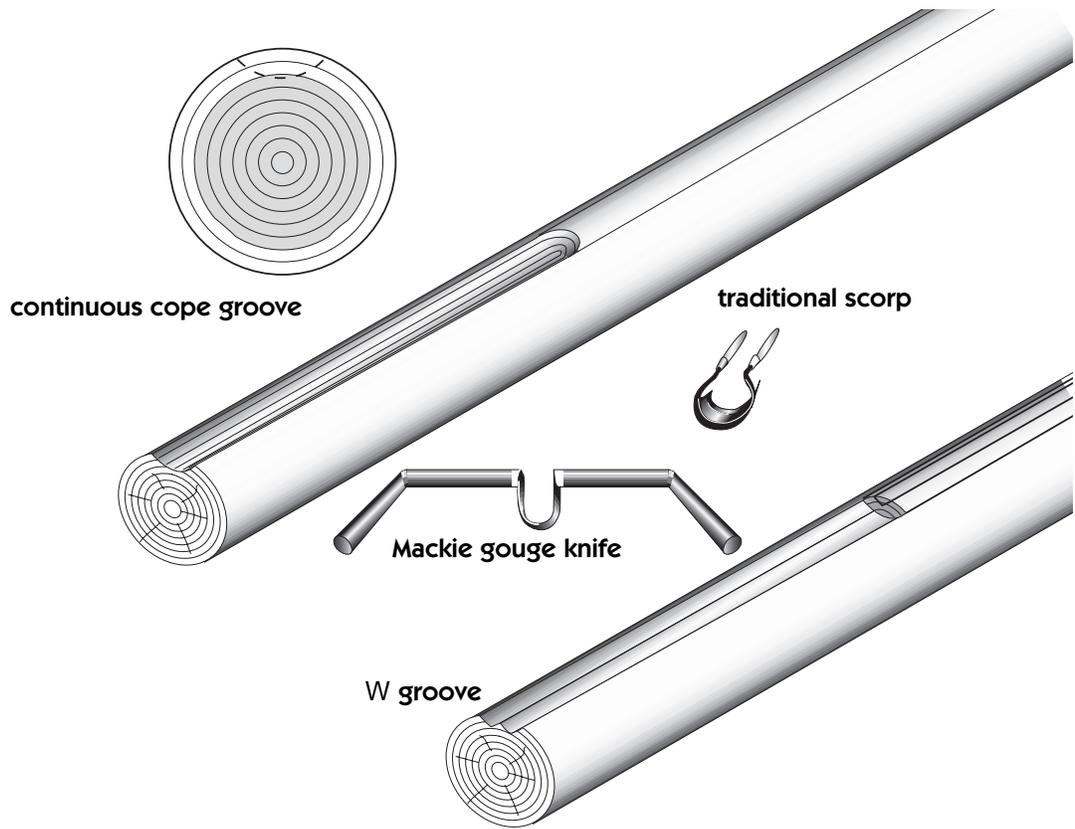
You may have to remove some of the center portion of the W if a trial fit with a short piece of log similar to the log below hangs up and will prevent the log being worked on from settling properly. If necessary, the center of the W is



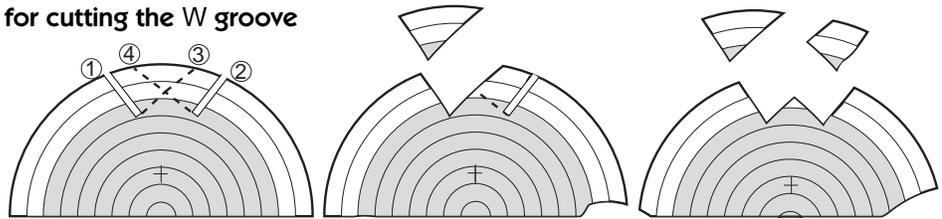
A lock notch is used when a log tip is too small to be notched without weakening it considerably. A lock notch can also be used on the plate log at the top of a wall for added strength to keep the walls from splaying outward.



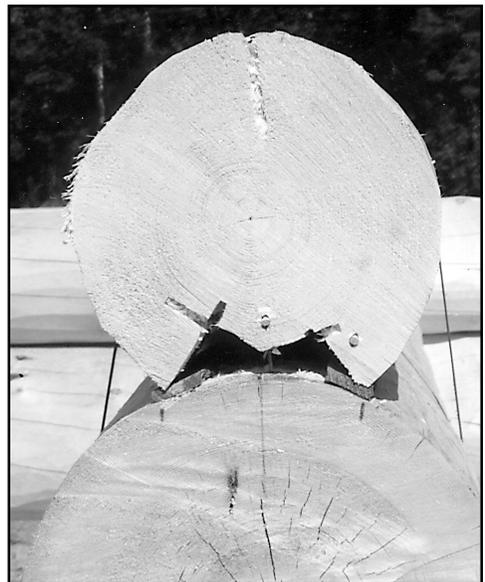
Site-made log holders keep logs aligned at a precut door or window during scribing.



A sequence for cutting the W groove



Cutting the groove with a chainsaw.



A W-groove in a log. Note shims to keep the clearance for the overscribe.

easily removed with a long-handled curved gouge or with a scorp as described earlier.

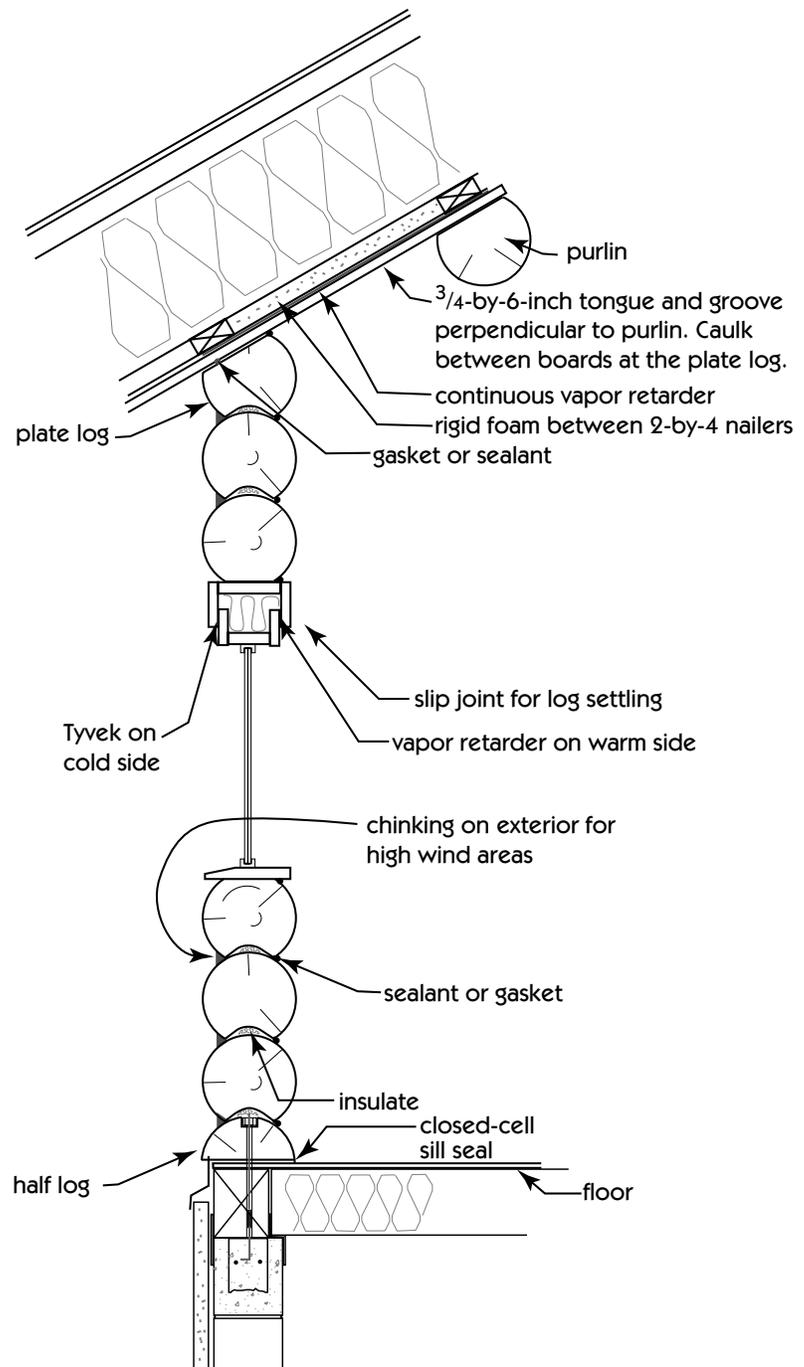
The Log Walls

Carefully align the center of mass of succeeding logs as they are positioned for scribing. Since you are working with a natural material, some of the logs will be curved. The overall objective is to have the average center of all the logs bear down on the center line of the wall, which in turn bears on the centerline of the foundation.

Considerable time should be taken rolling and sliding the log with a Peavey to be sure the log is well centered and the straightest sides are top and bottom with any curve to the outside of the building. Station a log worker at each end of the log to be aligned with Peaveys in hand. Each person should eyeball the log and make small adjustments until both ends are well centered. Stand back from the wall several feet and hang a plumb bob as a sight line to examine the lay of the log. Do this from each end to satisfy yourself that the wall is going up straight and plumb. Dog the log securely and scribe and notch as described above.

As the walls get higher, you need to keep a check on the height of all the walls and keep the even-numbered rounds about the same height. Carefully select logs that are of the correct diameter to maintain equal log wall heights. Strive at all times to cut about halfway through the log with the corner notches. This is of course the ideal and can only happen if the logs were turned on a lathe to exactly the same diameter.

If a small tip must notch over a large butt, a lock notch should be used to leave enough wood to avoid breaking the tip (see illustration, page 39). See *Log Building Construction Guide* by Rob Chambers for a detailed discussion of log selection (see Appendix D, References and Bibliography).



Airtight Log Walls

The log walls must be airtight to resist the flows of heat, air, and moisture. This can be accomplished with the use of tar-saturated foam strips such as EM Seal, EPDM gaskets, or backer rod and flexible chinking materials such as Permachink or equivalent, and tight-fitting log work. Seal the

cracks between logs on or near the inside surface to prevent moisture-laden air from reaching the dew point and condensing between logs, causing accelerated self-destruction. Properly fitted, full-scribe logs will not require any visible chinking such as was used in the old days to keep out the weather and keep the cat inside. In high wind and rain environments you should air-seal both inside and outside the logs.



Sealing the vapor barrier around a log ridge pole.

Finishing the Logs

On the inside, two coats of log oil or clear acrylic latex or polyurethane varnish should be enough of a vapor retarder to slow the flow of household water vapor through the logs. You will want to treat the outside of the logs with a UV-inhibiting water repellent preservative log oil or stain. Clear exterior finishes do not last as long or protect the logs as well as pigmented finishes. There are many products on the market designed to



Both fiberglass and backer rod installed on a log.

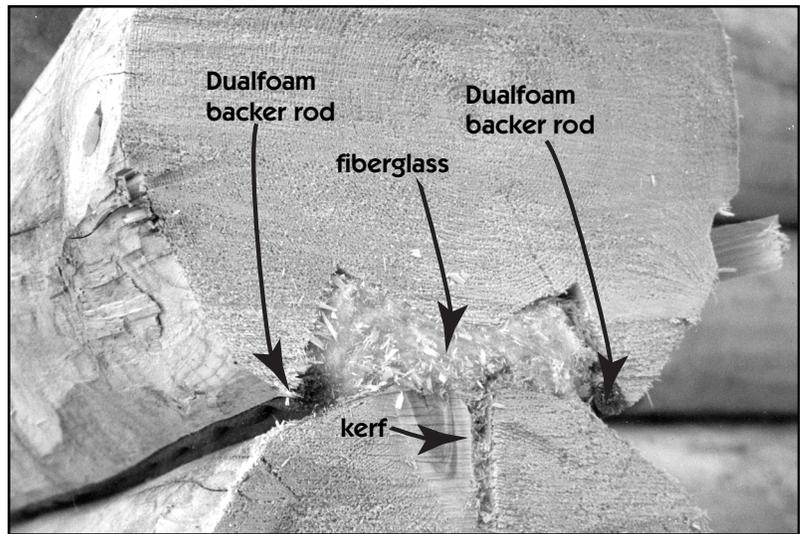


Logs ready to be lifted into place.

finish logs, so do your homework to see what is recommended in the literature and by the various vendors or in the trade journals.

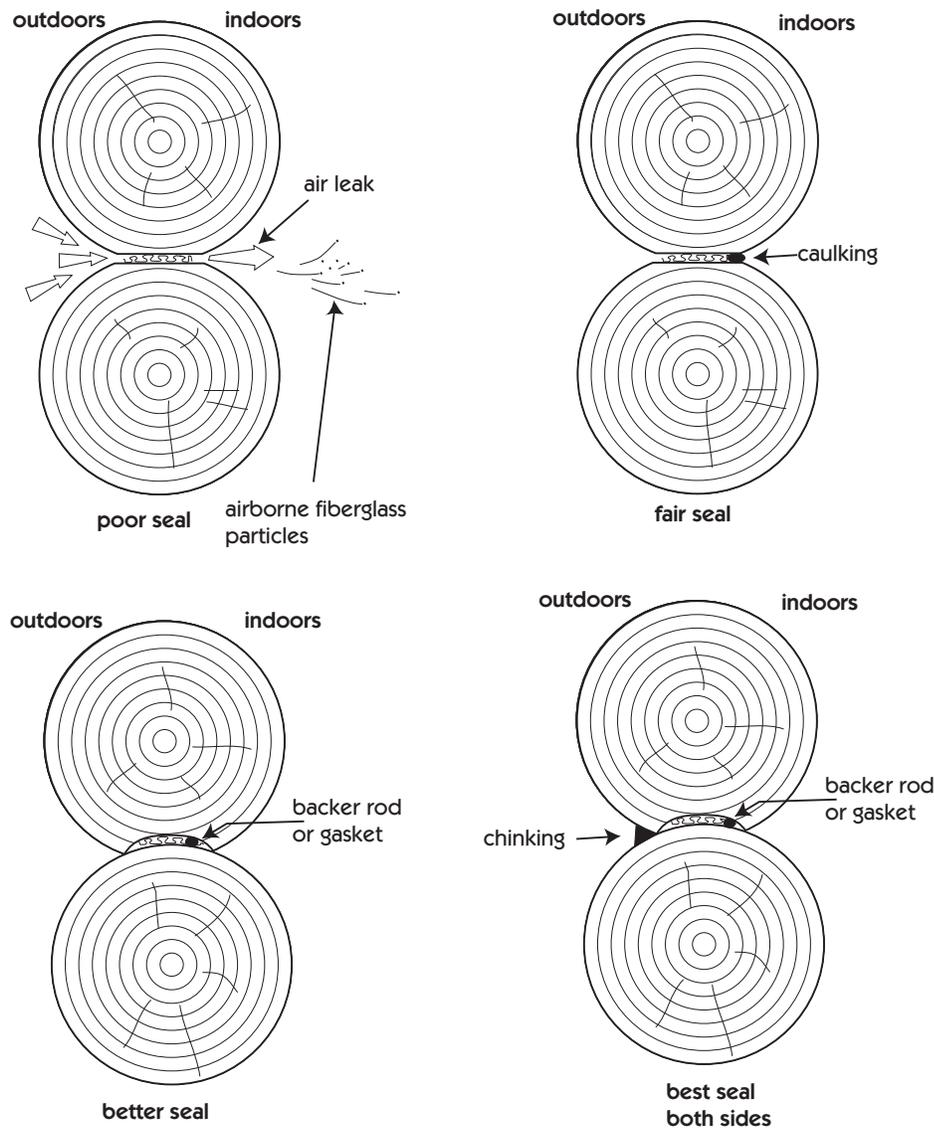
Chinking and Sealing

Fiberglass chinking or fiberglass sill seal alone will not create enough of an air seal to pass a blower door test. Unless the log work is very tight and will remain airtight over time, it is not likely to pass the airtightness requirements of BEES.



A closeup of the log in place with fiberglass and gaskets.

Fiberglass sealing of log walls: good and bad



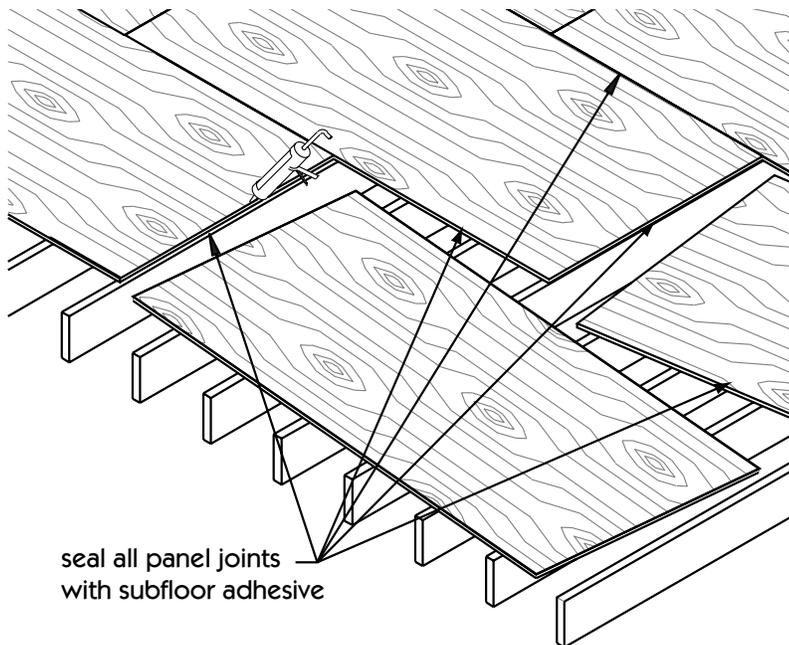
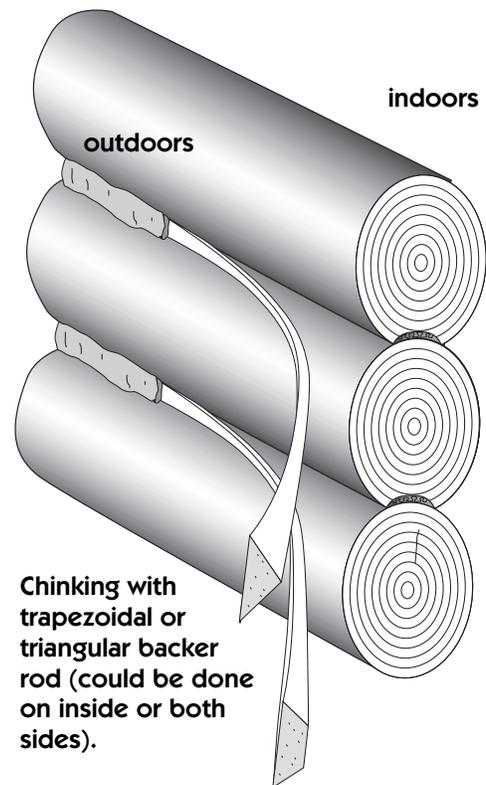
“
Fiberglass chinking or fiberglass sill seal alone will not create enough of an air seal.
”

There are several log chinking materials available to make a log house tight.

The log building details presented in this book describe how to construct scribe-fit chinkless log homes. However, some people like the looks of chinking, and many older log homes may be in need of chinking to reduce infiltration between the logs.

Modern chinking systems require the use of triangular or trapezoidal-shaped backer rod to form an even, flat surface upon which to spread the chinking material. Use a flexible chinking material such as Perma-Chink or Weatherall over the backer rod for a durable seal between the logs.

Old-time chinking materials such as sphagnum moss or oakum are rarely used in today's log homes. Clean sphagnum moss is a good alternative insulation for log building in the bush but may not be in the AkWarm computer files.

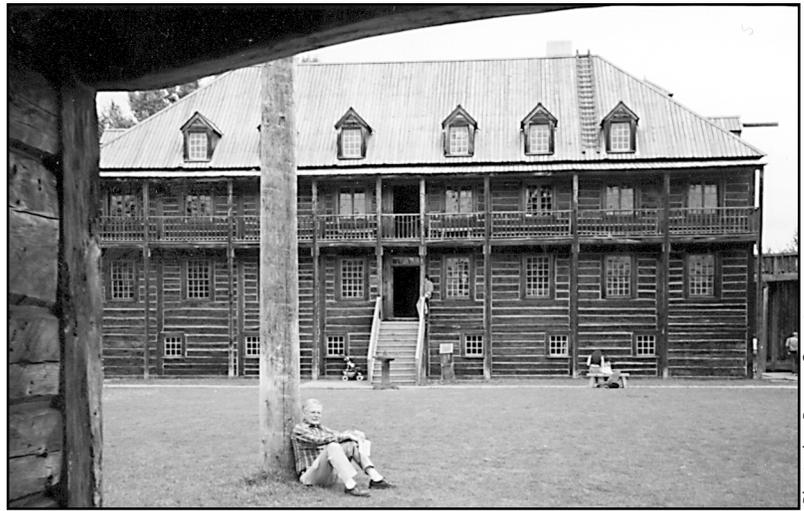


Glue joints between pieces of plywood and glue the plywood to the joists. Ideally, use $\frac{3}{4}$ " tongue and groove exterior grade plywood. Glue, nail, and screw for a squeak-free floor system.

Short Log Construction

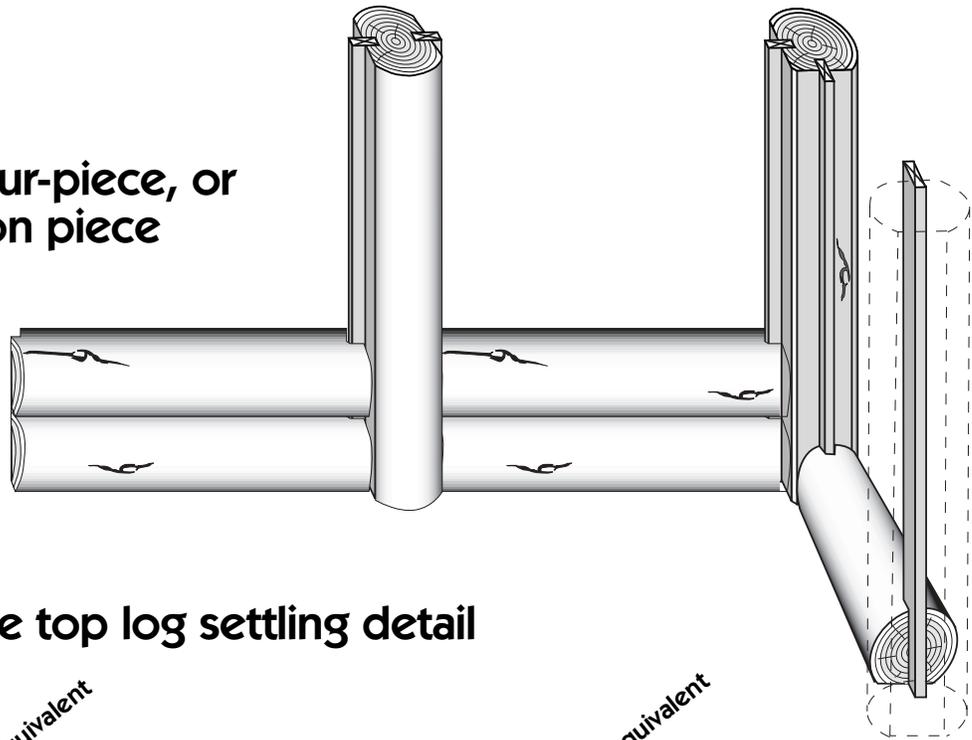
If you do not have any lifting equipment, you can build a good log house using logs short enough to be handled by a couple of people. A traditional method of stacking up short logs to frame a wall is known by its French name as *pièce-sur-pièce*, or *piece-on-piece* in English. This is a variation of squared post and beam construction where a horizontal infill of round logs is fitted between vertical round log posts. The vertical posts are flattened on two sides and grooved to accept a tenon fashioned on each end of the log infill pieces.

An alternative to mortise and tenon joinery is to groove both the post and the infill log ends to receive a 2-by-4 spline to join them. This method of construction can use a wall jig to ensure consistency, allowing for all of the wall components to be prefabricated off site even before the foundation is completed. Combining post and beam and square timber framing techniques with round logs squared off only where two or more beams connect can allow you to fabricate precisely engineered structural timber frames or trusses in the shop.

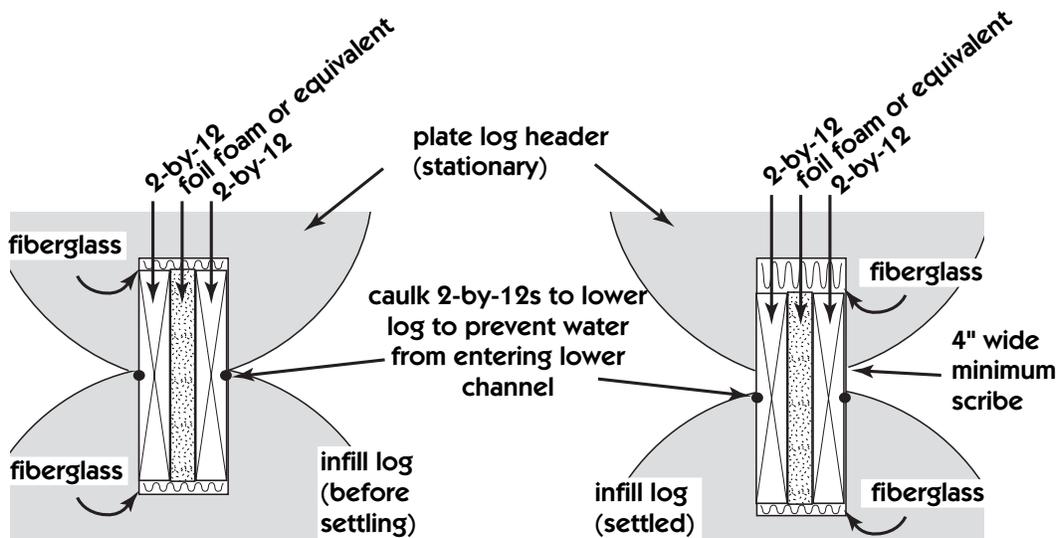


This large building, rebuilt at the site of old Fort Edmonton, Canada, was built piece-sur-piece.

Piece-sur-piece, or piece on piece

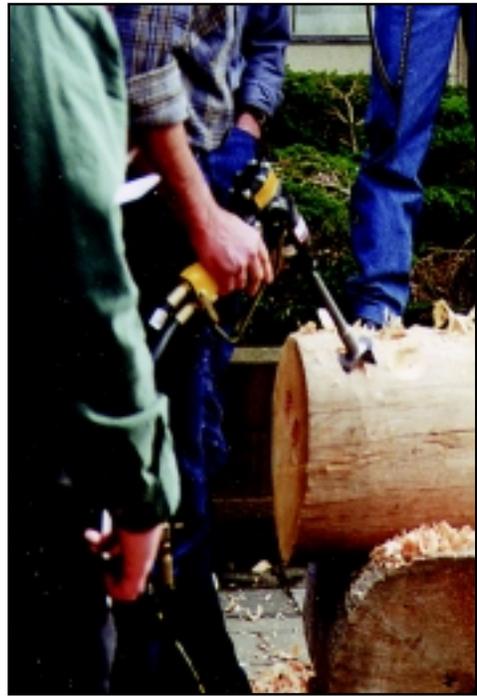


Piece-sur-piece top log settling detail

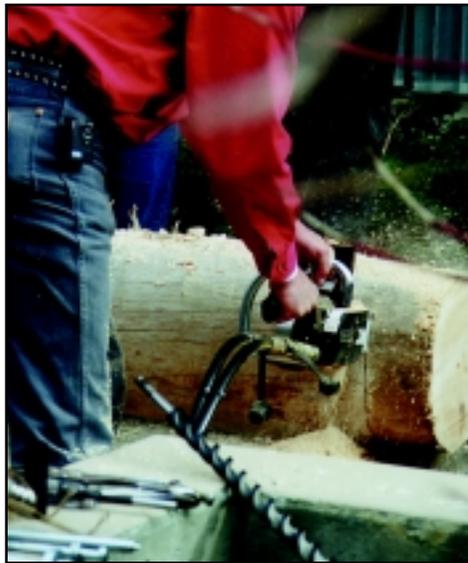


Making It Easier

Most timber framing tools and log working tools can be powered electrically or even hydraulically. Cutting out frames and trusses inside in the winter can greatly extend your building season and give you a jump on the spring building season. You can have the house structure ready to install on the foundation as soon as the floor is completed. However, gasoline-powered chainsaws should not be used when working inside a confined area because deadly exhaust fumes could build up inside the building. Hydraulic or electric tools are safer inside.



A hydraulic drill being demonstrated at a log building conference. Note the one-handed operation.



No exhaust fumes is one benefit from using hydraulic chain saws indoors during winter construction.



The portable hydraulic pump for driving the tools.

The Plate Log

The plate log, sometimes called the cap log, is the top wall log upon which the roof system rests. The plate logs and the purlins and ridgepole are usually picked out and set aside at the beginning of the job. They are straight and have straight grain and are usually the biggest and best, strongest and longest logs since they usually extend five or six feet beyond the gable ends. The plate logs should

be chosen from this select group of the finest logs to end up level and the same height from the floor in all four corners. The plate logs may have to be fitted with locking notches to resist outward thrust from the roof components. The plate logs could also be through-bolted at the windows and door headers and pegged or pinned on close centers where there are no windows.

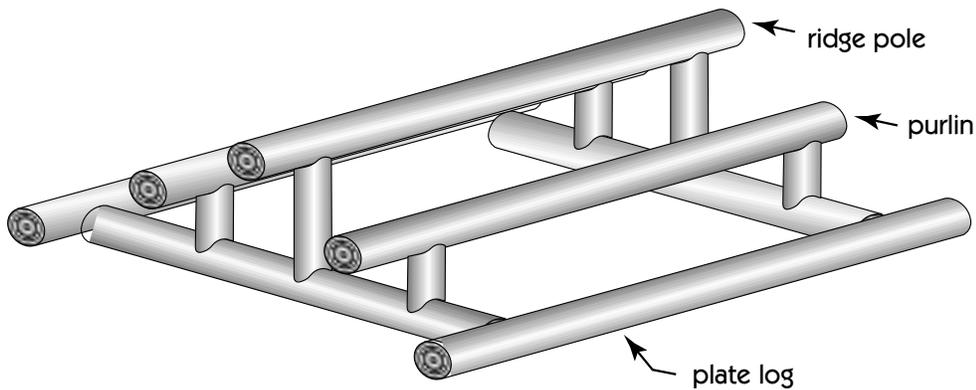


Plate logs, purlins, and ridgepoles are higher stress areas, and the biggest and best logs should be saved for them.



Choose the best logs for critical places such as plate logs, purlins, and ridgepoles.

More Than Just Logs

Traditional Athabascans used the spruce tree in many ways. One important way was for medicinal purposes. Several parts of the tree, including the top, the inner bark, needles, and the sap, were used to treat heart problems, kidney trouble, ulcers, stomach sicknesses, weak blood, colds, sore throat, sores, burns, and tuberculosis. Shamans used the top of the spruce to get rid of bad spirits. Dust from the spruce cone was prescribed to dry up runny ears, and the pitch was used as an antiseptic and to stop bleeding. People used the inner bark for bandages.

Spruce trees provided shelter long before Europeans used them for log cabins. Athabascans used the outer bark for roofing and flooring, the boughs for insulation, and of course logs for building walls and roofs. Spruce logs are also used to build weirs, fish traps, fish racks, canoes, rafts, and other things.

People still use the outer bark of the spruce tree on fish cutting tables to keep the fish from slipping off. They also use it as a dye. Boughs could be made into makeshift snowshoes or serve as mattresses for people and dogs.

Dead spruce wood was useful for smoke for tanning hides and keeping away mosquitoes, and made dye for moosehide. Of course, spruce is a good firewood. Also, the wood could be carved to make utensils, tools, toys, fish traps, and weapons. The roots became lashing for fish traps and snares and were woven into baskets and fishnets.

Spruce pitch is a useful glue, antiseptic, chewing gum, waterproofing, and hair dressing.

The information above comes from Eliza Jones and *Dena'ina K'et'una: Tanaina Plantlore*, compiled by Priscilla Kari, and *Upper Tanana Ethnobotany* by Priscilla Russell Kari.

Windows and Doors

Typically, heat loss through walls accounts for only about 20 percent of the overall energy use of a building. Air leakage typically accounts for 30 to 35 percent of heat loss.

Windows and doors need to be installed with airtight connections to the logs with a spline system notched into the ends of the logs, which allows the logs to settle without increasing air leakage.

Choose windows and doors carefully for your new log home. In order to score well on an energy rating, you must install windows and doors with high R-values. The most energy-efficient windows have some sort of low emissivity (low-E) coating on multiple panes. The panes should be separated with nonconductive spacers. The space between the panes may be filled with an inert gas such as argon or krypton to reduce convection currents between the panes and increase the insulation value of the window. This energy-efficient glazing system should be fitted into an airtight insulated frame. Windows should have an R-value of at least R-3, but R-4 or higher would further reduce heat loss and improve your energy rating.

Doors must be R-7 or better. Handmade doors are often crafted to complement a log home and can be built with a core of very high R-value rigid foam.

Caution! Door and window cutouts in a log wall are probably the most dangerous of all chain saw operations in a log house. Since the top of the window or door cutout is over the sawyer's head, the likelihood of a kickback and serious injury to the head and face is very high. If you must cut out window

or door headers over your head, wear a hard hat and hang on tight to the chain saw.

The safest way to cut out the top of a door or window opening is while it is still on the skids where it was placed for notching. Measure the exact location for the window on the bottom side of the header log. This will be at the window height plus the rough frame dimensions plus the anticipated settlement space. This will usually be from 7 to 10 inches greater than the height of the factory-built window frame.

Straight, accurate side cuts can be made using a chain saw lumber mill attached to vertical 2-by-4s or 2-by-6s. If you have more than one window of the same size, a jig made of 2-by material can be fabricated and moved from window to window. In any case, the vertical legs of the jig should rest on the floor, and it should be accurately plumbed and temporarily nailed to the log wall to keep it from moving during the cutting operation.

Cutting the Splines

Windows and doors should be attached to the log walls using a vertical 2-by wood spline notched into the log ends on each side of the opening. If a log wall with a door or large window must hold up a huge snow load, it would be wise to use 1/4"x1"x2" steel C-channel for spline material in addition to the wood spline.

These spline notches are often cut with a chain saw using a technique similar to cutting the long W-notch. Be especially careful as you approach the top of the window. Chances are that you will hit

the header with the top of the saw bar, resulting in a dangerous kickback situation. Use a very sharp saw chain at high RPM to minimize kickback and hold on tight to the chainsaw. A much safer method of cutting these spline notches is to use a heavy-duty router to cut a spline groove in the log ends. Nail a vertical 1x4 to the log ends to guide the router.

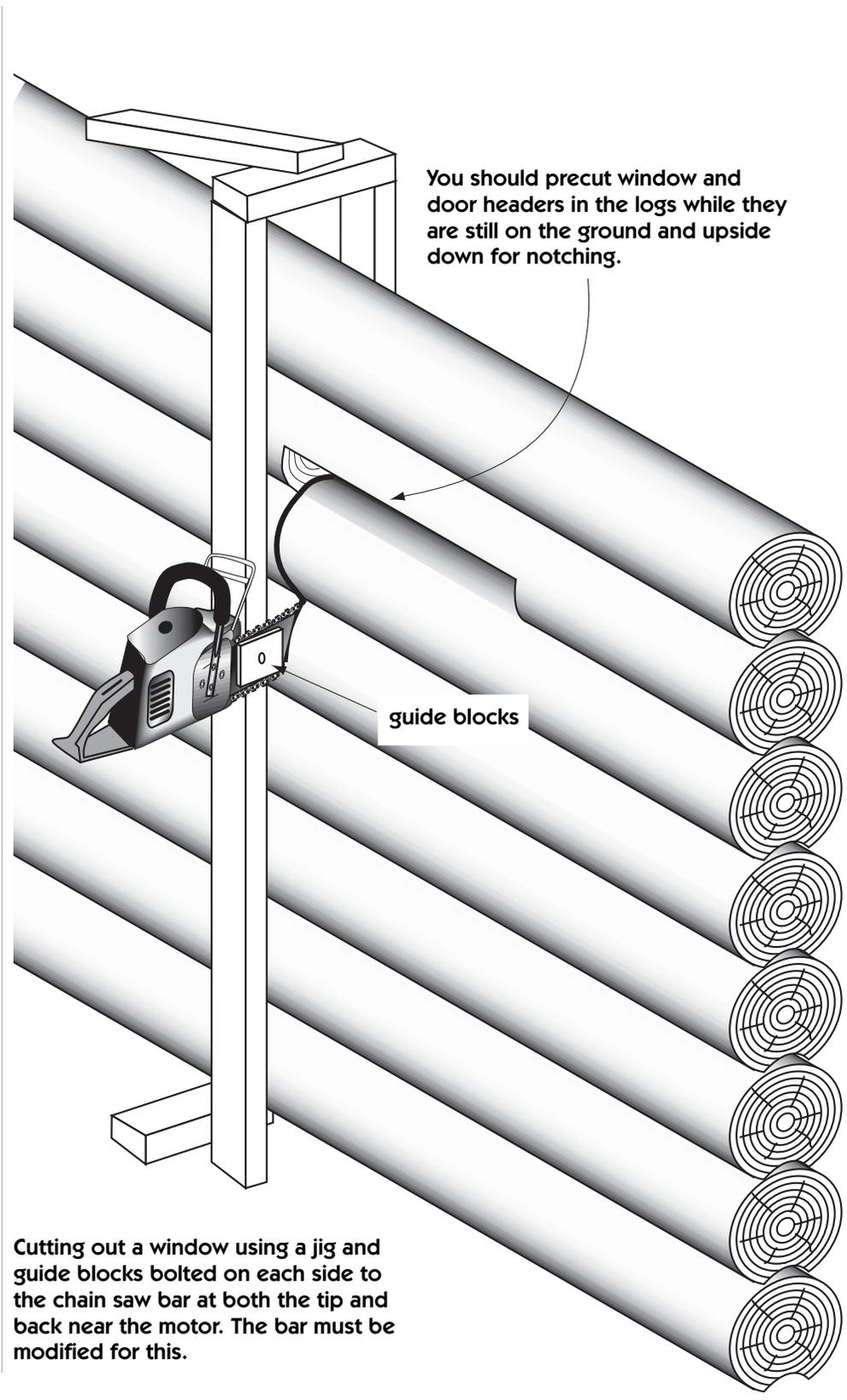
Door and window installation in a log structure requires unique details to maintain an airtight fit as the logs shrink and settle. The 4-to-6-inch settlement space over doors and windows must be insulated and fitted with an airtight vapor retarder that will remain effective over time.

Placement and Planning

Windows and doors in a log home should be located with consideration for solar aspect, prevailing winter winds, roof avalanche potential, and the structural elements of log construction. Face the majority of windows south for natural light and passive solar heat.

Open doors in so that you can get out if snow drifts pile up outside the door. Better yet, orient the house so that prevailing winds keep your front porch clear of snow. Do not put yourself and others in harm's way by placing an entry door under the eaves of an avalanche-prone roof. Metal roofs are notorious for dumping lots of snow all at once. Locate entry doors in the gable end of the house or under a protective roof.

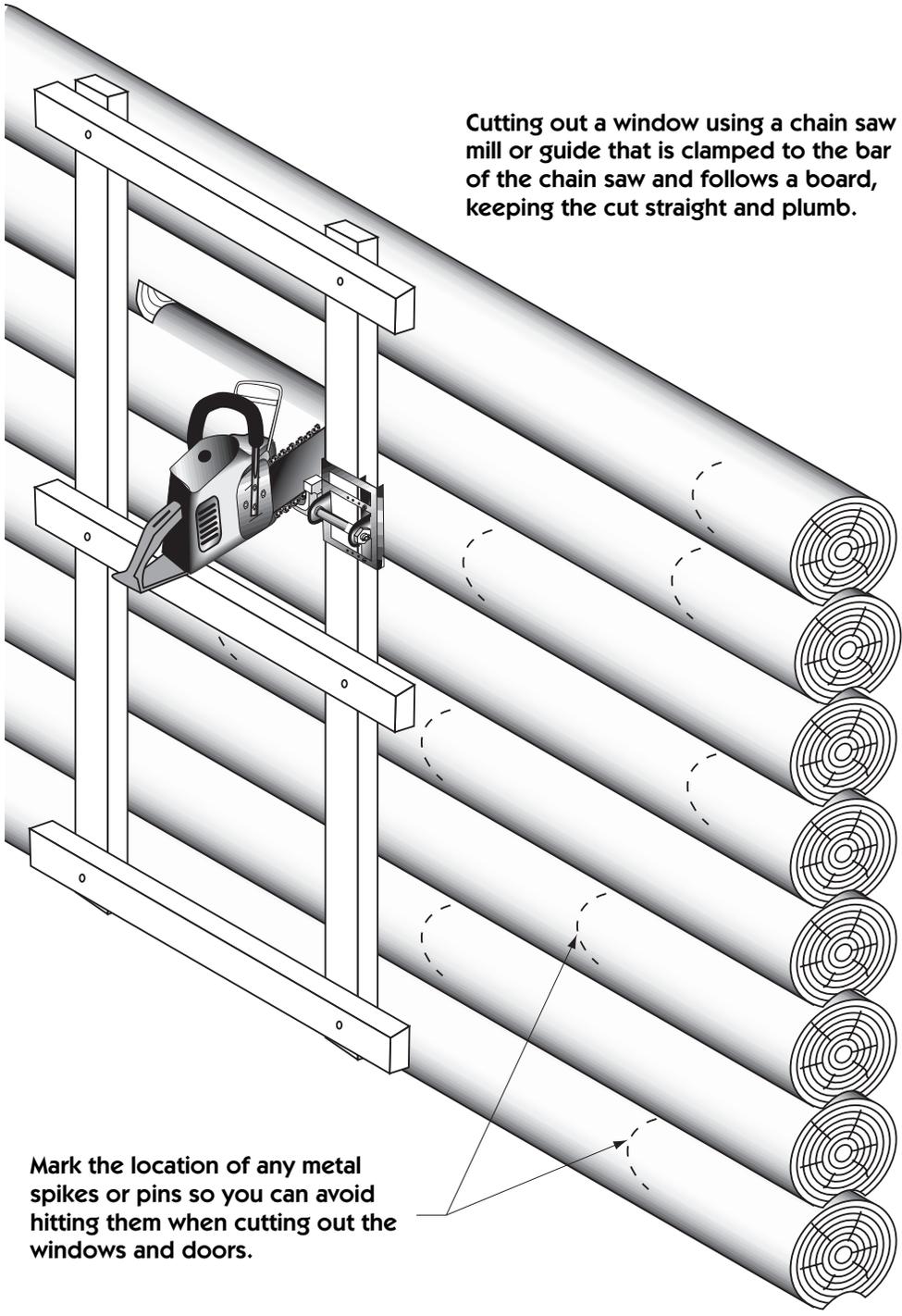
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Air leakage typically accounts for 30 to 35 percent of heat loss.
”



You should precut window and door headers in the logs while they are still on the ground and upside down for notching.

guide blocks

Cutting out a window using a jig and guide blocks bolted on each side to the chain saw bar at both the tip and back near the motor. The bar must be modified for this.

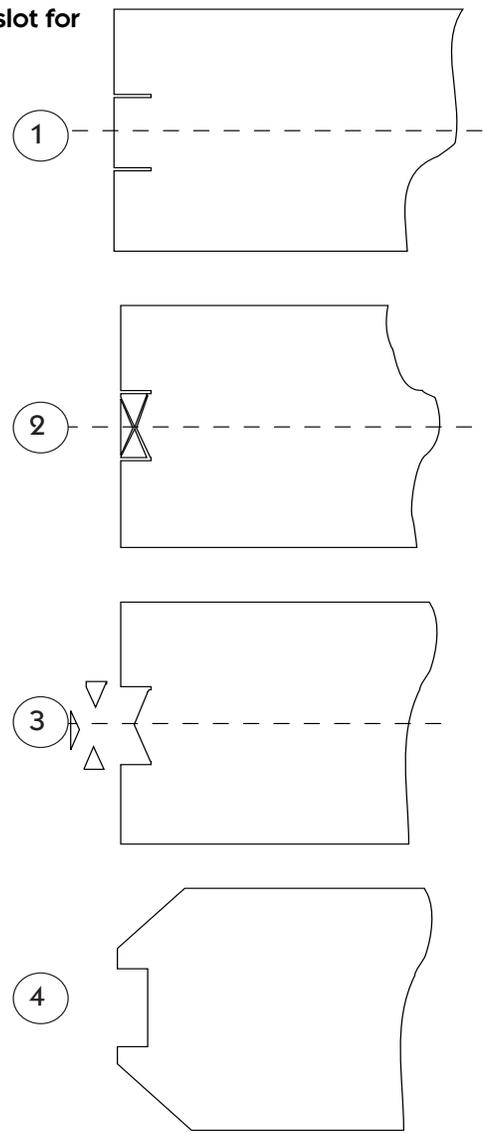
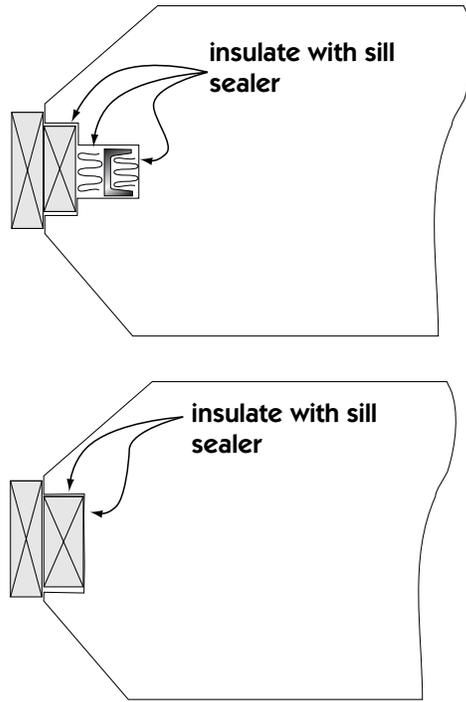


Cutting out a window using a chain saw mill or guide that is clamped to the bar of the chain saw and follows a board, keeping the cut straight and plumb.

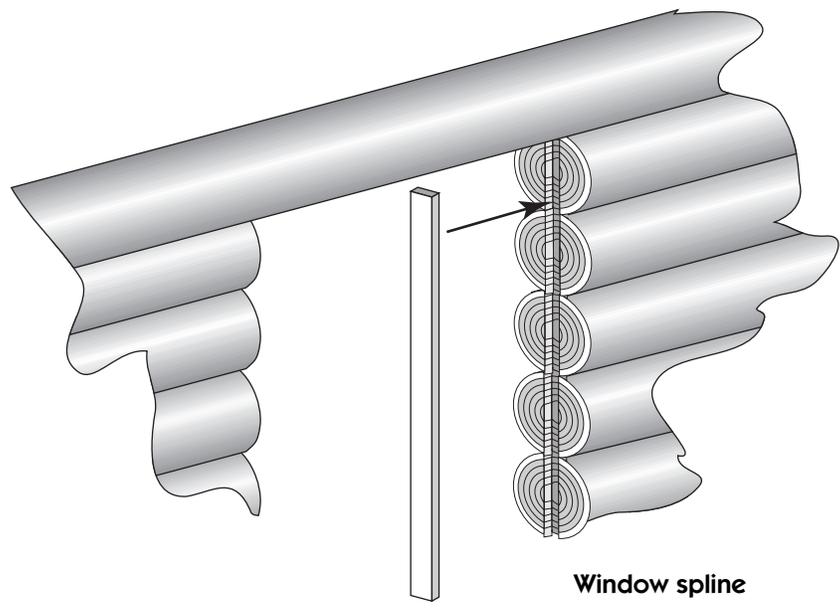
Mark the location of any metal spikes or pins so you can avoid hitting them when cutting out the windows and doors.

Cutting a slot for the spline

If the wall is considerably weakened by the window or door openings, you may have to use a steel C channel for reinforcing the spline.



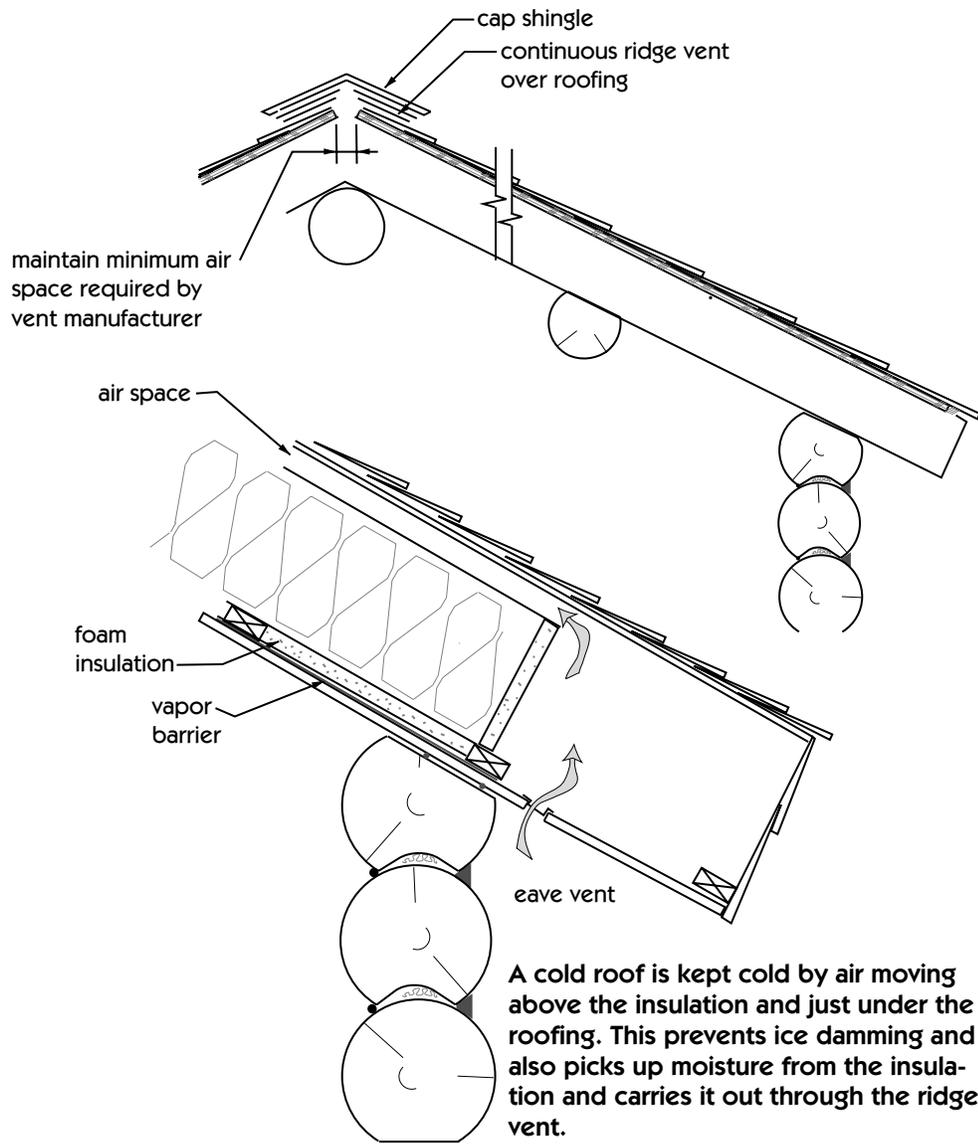
But much preferred is a wooden spline because it won't attract water condensation and the damage that comes with it.

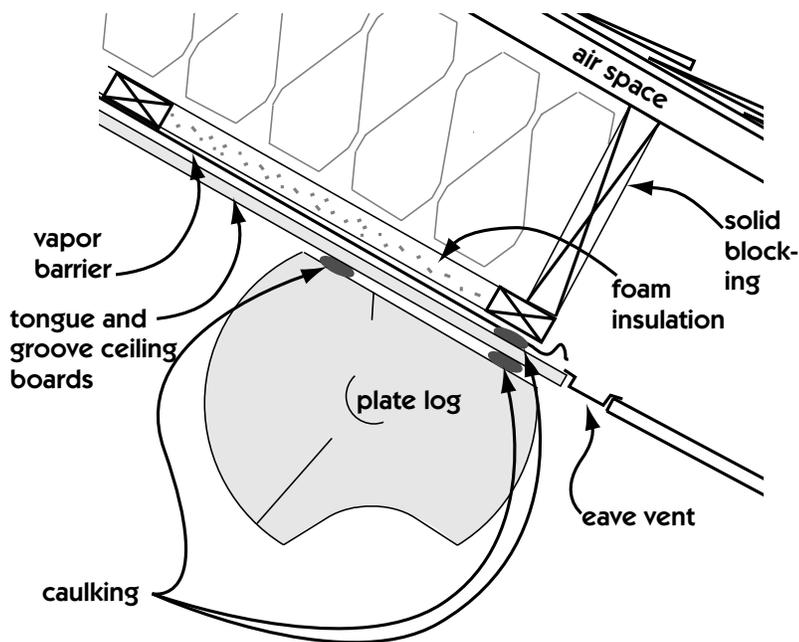


The Roof

Once you have built an airtight log wall, you must then follow up with an energy-efficient roof, air sealed with continuous sheets of 6-mil polyethylene with all penetrations taped or caulked and the ceiling tightly sealed to the log work. There are many ways to put a roof on your log creation to shelter it from the elements. The classic log house had a low-pitched roof with generous eave and gable end

overhangs. The gables were made of logs, which supported purlins and a ridgepole and log rafters or a ceiling completely framed with evenly sized poles lying side by side. A modern equivalent uses the same log gables and purlins and ridgepole techniques but replaces the poles with tongue-and-groove spruce or pine paneling, topped off with an insulated rafter-framed roof.





Sealing the Ceiling

Any style of roof should have an airtight vapor retarder, and the joint between the plate log and the ceiling should be caulked. Each tongue and groove ceiling board should be caulked in the groove where it passes over the plate log. The roof rafters should be deep enough to reach the insulation levels required by BEES. There are many different ways to build log trusses or post and purlin or other log roof systems that are beyond the scope of this book. The bibliography has many good books on log building and roof framing (Appendix D).

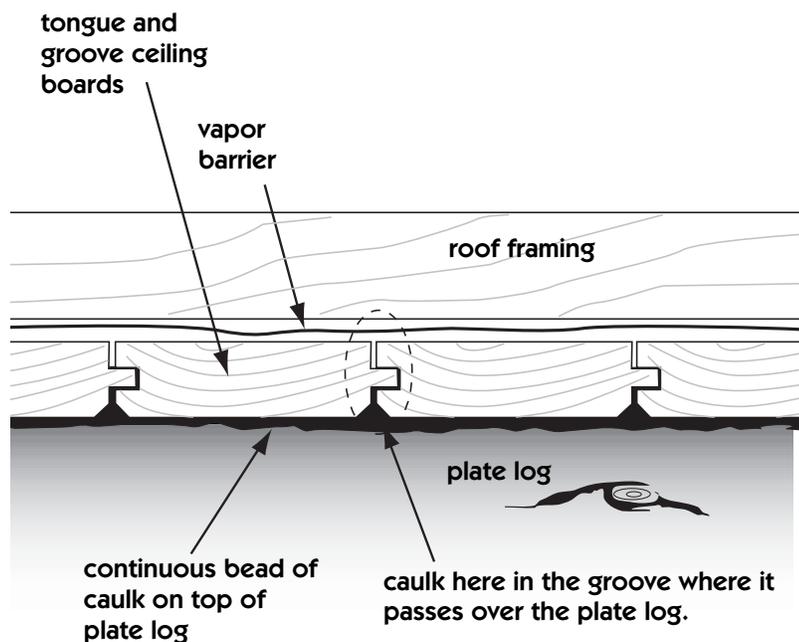
Hot Roof or Cold Roof?

The designer must decide whether to build a hot (unventilated) or a cold (ventilated) roof. This decision is usually based on the likelihood of snow building up on the roof during the course of the winter. If snow will accumulate, then a cold roof is in order.

Snow buildup insulates the roof, causing snow near the roof surface to melt from the heat of the building. This melted snow runs down the roof and refreezes at the edge, forming ice dams. These dams cause water to back up underneath the shingles or metal roofing.

Liquid water in the roof cavity is a problem. The solution to this problem is to provide ventilation in the attic, so heat from the building does not melt the snow. Provide a minimum of 2-inch continuous air space over the insulation and continuous screened eave and ridge vents.

If the building is on a site exposed to high winds and no snow is likely to accumulate on the roof, an



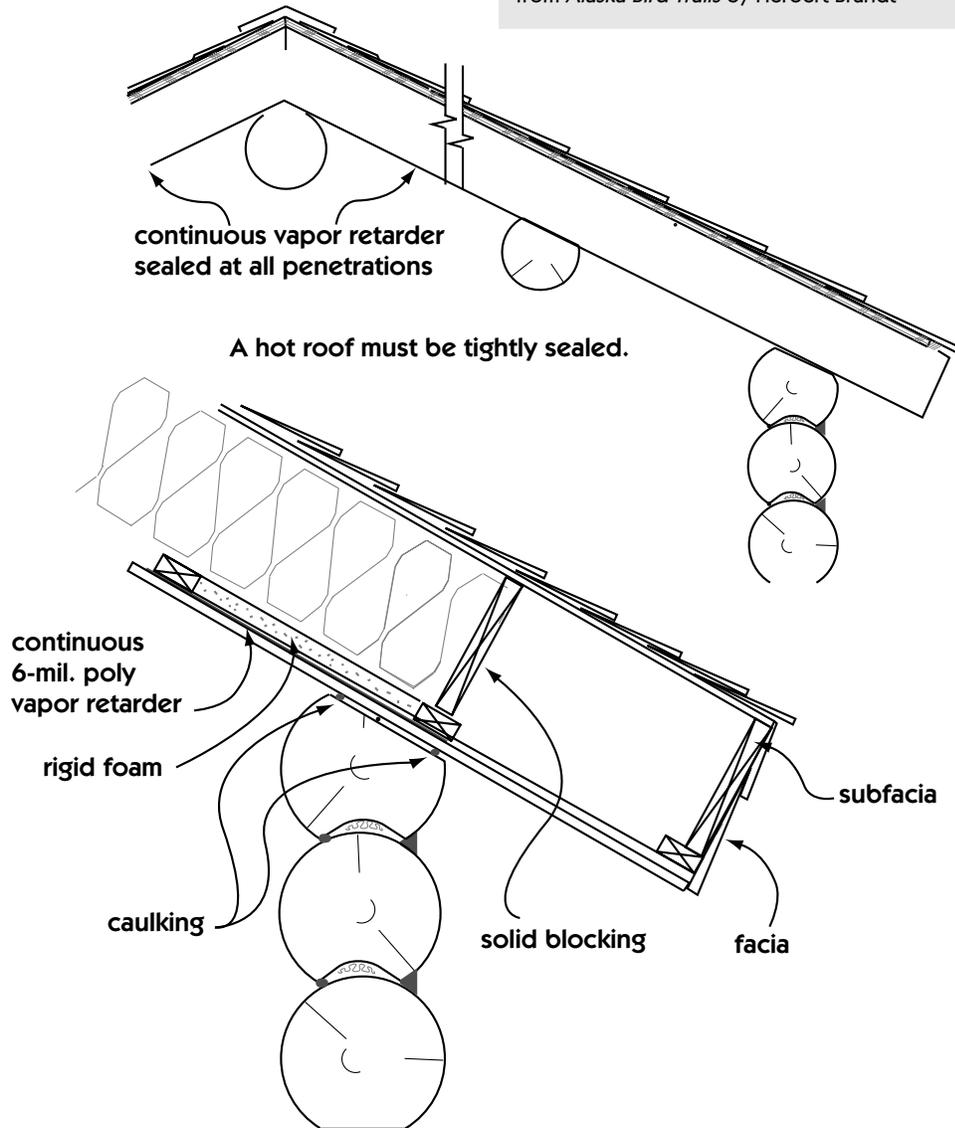
airtight hot roof may be desirable. A number of snow-resistant ventilated roof designs have been experimented with over the years with varying degrees of success. Whatever design you choose, keep in mind that an attic full of snow will not last long. A hot roof must be tightly sealed.

All roofs must be designed to accommodate snow loads and be securely anchored to resist wind and seismic loads.

The Roadhouse, 1926

“The Alaskan roadhouse is a unique institution, and turns a bleak, formidable country into one of hospitality. Nestled in a clearing in the spired spruce forest, built entirely of rough logs neatly notched together at the ends, the road house presents a cozy and picturesque appearance. The building is divided into a kitchen and a bunk room by means of a frail partition. In the center of the bunk room is a huge cast-iron stove capable of taking a four-foot green log, which burns all night. Above the stove is suspended a large rack on which the weary traveler hangs his damp shoes and clothes, that he may put on dry apparel in the morning. Everything is very comfortable and cozy. In one corner is a small space partitioned off for an occasional woman traveler. The beds are two-storied bunks made of strips of raw moose or caribou hide, called ‘babish,’ laced across the bottom. The bed is entirely without linen, but the blanket and quilts are ample. The floor is spread with shavings, and Cleanliness varies according to the owner, but as a rule, each takes pride in his place and keeps it fairly neat.”

from *Alaska Bird Trails* by Herbert Brandt



Hot roof with no vents at eaves, gables, or ridge