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IN THIS ISSUE

Working With Green Timbers

Full Scribe Dovetail Joinery

Managing Our Forest Lands

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Full-Scribe Dovetail Joinery

Building a log house with square logs

By Robert W. Chambers

I specialize in unusual log and timber construction styles, and look for jobs that will let me try something different. Full-scribe, full-dovetail joinery is perhaps more rare than it should be. There seem to be two reasons for this. First, the necessary techniques are not at all well known. Second, compared to round-log notching it is quite a bit more expensive. But it is a handsome and effective notching style, and deserves more attention.

Before we can get into the meat of dovetail joinery there are a few basics of scribe-fit construction to be reviewed. I use only hand-peeled logs—this means they still have their natural bumps, bows, sweeps, and taper. Before laying logs, inventory the entire set, noting the length of each log and its diameter at both ends. Also make brief notes on any unusual characteristics—bow, sweep, catfaces, scars, etc.

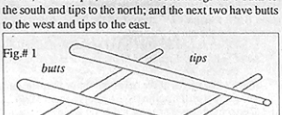
Use the inventory to figure the average, as well as the extreme range, these characteristics take. On a recent project, butts averaged 16 1/2" diameter (range: 14 3/4" to 18 1/2") and the tips averaged 12" (range: 11 1/2" to 13 3/4"). The mean average log diameter was 14 1/4". The dimensions used in this article are examples from the Erickson project—for more on these buildings see Fine Homebuilding #34.

Alternation

Logs taper, and so the first basic tenet is: on each wall, alternate the tips and butts. This keeps the walls level as they get taller. Looking at any one wall, half the tips are on the left, and half are on the right. Each end alternates: tip, butt, tip, butt, tip, butt, and so on. Whenever the wall has an even number of logs, measure its height at each end. If it isn't level, try to improve it with the next log—selecting one with the amount of taper needed to even things up.

Parallel Walls

The second rule is that within each course of logs, parallel walls have their butts at the same ends. In the drawing below, for example, the the two bottom logs have butts to the south and tips to the north; and the next two have butts to the west and tips to the east.

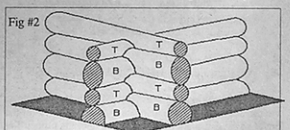


Parallel walls orient butts in the same direction

Try building you own little four-sided log house out of wooden stick-matches. Use Figure 1 to start it right, and then continue like this: the third pair has tips to the south; the fourth pair has tips to the west; and the fifth has tips to the north. Keep going until you have seven rounds (28 matches), remembering to alternate directions on each wall.

Corner Order

Now look at the order of intersection of two walls. It isn't tip, butt, tip, butt, tip, as you might guess. Instead it is tip, tip, butt, butt; tip, tip, butt, butt; and so on. The third fundamental of scribe-fit logwork is that corner order is a repeating pattern of four elements: TTBB. This makes it necessary to think ahead to the next two rounds—anticipating what log ends are coming: a butt and then a tip? two butts? Errors accumulate quickly if you don't anticipate—it's easy to get into a spot where no log will save you.

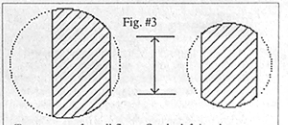


Corner order is TTBB, while each wall alternates TBTB

Don't be confused by the way any particular corner starts at the bottom. Each corner in the "match" house starts at a different spot in this pattern. One corner starts at the first tip, another at the second tip, another at the first butt, and the last at the second butt of the pattern. But all the corners have the tip, tip, butt, butt pattern, no matter where they happen to start.

Sawing and Hewing

Dovetail joinery requires flat, vertical surfaces at the log ends, so we saw the logs to give us the size flats we need for notching. They are sawn to a thickness of 8 1/2", hewn on the outside with a broadaxe, and planed on the inside. In this example, the average tip notch was 8" tall at its widest spot, so to allow some flexibility in positioning notches on the flats, and to accommodate larger than average notches, the tip flats needed to be at least 10" tall.



Two causes of small flats. On the left is a log sawn off- center, usually caused by sawing the bow off. On the right is a small diameter log.

Most logs have a bow, and we saw them to preserve the bow. Sawing the bow off, as in Figure 3, produces flats too short for notching. Avoid the causes of small flats: logs that are sawn off-center, and tip diameters that are too small. The thickness to which you hew is determined by the diameter of the smallest tips in your set of logs.

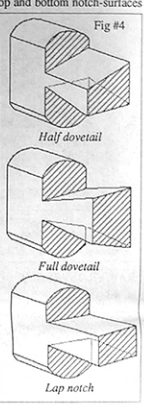
Planing

The outside, hewn, flat does not bear on any notch surface, and so doesn't have to be carefully surfaced. But, the inside flats at each end of the log will bear on the vertical end-grain of the intersecting logs. To ensure that they are not twisted (out of wind) with respect to each other, carefully plane them parallel to each other. With the log on horses, inside surface up, use a level to make sure that the notch areas (the last three feet or so of each end) are correctly planed.

Choosing Dovetails

Corner joints come in hundreds of styles (see Hermann Phleps, *The Craft of Log Building*, Lee Valley Tools, 1982). Half-dovetails, which are quite common, have notch-faces that tilt in one direction. This article is about full-dovetail joinery—the top and bottom notch-surfaces tilt at compound angles.

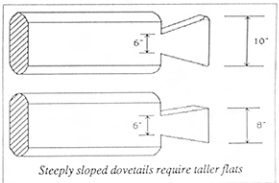
Both dovetail styles are self-draining, that is, rainwater blown into the notch will drain towards the outside of the building. But the full-dovetail is also self-restraining and self-tightening. The compound angles of full-dovetails securely lock together—the only way a log can move is straight up. I've been watching, but I haven't seen this happen yet.



Dovetail Slope

The slope of the dovetail is greatly influenced by the logs you use: their size, straightness, and the thickness to which they are sawn, or hewn. If you are going to attempt full-dovetail joinery, then do not use my dimensions. Instead, make the scale-drawings I will describe to determine what slope you can use.

At one extreme, a dovetail with no slope is a lap joint. A lap joint has level surfaces that trap and hold water, promoting rot, and do nothing to restrain the logs from shifting. At the other extreme, a steeply sloped dovetail will drain easily, but make it tough having enough wood to notch, especially at the tips. A steeply-sloped dovetail requires very tall flats to avoid having the dovetail pin extend into wane.



Steeply sloped dovetails require taller flats

In the above drawing you can see two dovetail notches of equal size (size of dovetail notches will be explained later). The low-sloped dovetail requires much smaller flats than the highly sloped notch. If the notch extends off the flattened surfaces, there will be wane in the notch, illustrated in the drawing below. This looks sloppy, and is a

haven for wasps. Worse, it can be an easy route for cold air and wind-blown rain directly into the house. One of the most common problems with full-dovetail layout is wane in the notch, and much of this article is devoted to the ways to avoid it.

Using the inventory of logs, make scale drawings of

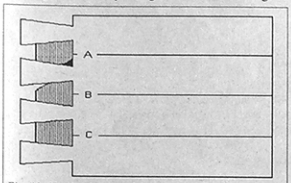


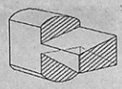
Fig. #6: Notch A has harmful wane; notch B has harmless wane; and notch C has no wane.

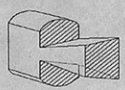
dovetails—each notch the same size, but each with a different slope. Some slopes should be discarded because they look too much like a lap joint. Others are so steep that the notch-faces run off the flats onto wane. I like a slope of 1" in 8" —steep enough to look like dovetails and yet not steep enough to give me problems notching. And since the logs are 8" thick, it is easy to remember when laying out—the faces drop or rise an even number: exactly 1" on each edge. The slope you choose for dovetail joints could be quite different, and should depend mostly on the height of the flats at tips.

Wooden Zippers

My goal is not simply to dovetail the corners, but to make all the notches the same size, with each notch centered on its log.

I have seen dovetailing by other builders in which the notches at the butts are huge and at the tips are tiny. At the corners the pattern looks very unbalanced and clunky. Off-center notches also look bad, and more importantly, are less roll-restraining, include more sapwood (which is prone to rot), and are more likely to have wane-in-notch problems.





Some sets of logs are more difficult than others (excessive taper is a culprit), but to a large extent you can choose where the dovetails are located on each log. Imagine two separate scribe-fit log walls: no corner notches, just two walls, one starting with a half-log sill, the other with a full-log sill. Now imagine joining these two walls at a right angle. My point is: the long-grooves, not the notches, determine the position of each log. The long-grooves are determined by the shapes of the logs, which is something we can't change. But the dovetails are located by our choices, and there are an infinite number of combinations of notch size and placement (though they are not all equally attractive or functional). Some decisions will produce lumpy-looking corners, others won't. I consider dovetails to literally be the wooden zipper joining two scribe-fit walls, and I want to make decisions that will result in equal-sized, centered notches.

Chinked

Information on chinked, half-dovetail construction is fairly easy to find. Drew Langsner's *Logbuilder's Handbook* (Rodale Press, 1982) offers directions based on Peter Gott's work. Snap a centerline on the hewn surface of each log and then measure up and down from that reference to establish notch size. The notches are centered on each log, and the diameter of the log at each end determines notch size. But with chinked buildings, the unique shapes of the logs are not involved—you simply add chinking to fill that uneven gap.

Scribe-fit

With scribe-fit logwork, however, the exact shape of the logs is all that matters: the widest gap between two logs determines the scribe setting. All layout and fitting must be adjusted to accommodate the widest gap. So the goal is to make the scribe as predictable as possible, a guess that is off by 1" can substantially change the size and location of the notches, making it impossible to get that wooden-zipper look. The only information on scribe-fit dovetails I've found is in B. Allan Mackie's *Notches of All Kinds* (Log House Publishing, 1983) —a book I often refer to.

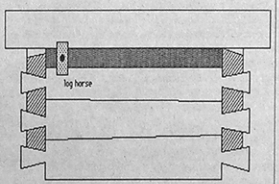
Scribing - Positioning the Log

To make the scribe predictable, we want an evenly-shaped gap between the top log on the wall and the next log to be scribe-fitted. Look at the profile of the top log and then select a log from the pile that matches that shape closely. If there is a bump 4' from the butt of the log below, it would be ideal to have a hollow 4' from the tip of the log you choose. Order logs several feet longer than the length of the wall so that you can jockey the log left or right to match shapes. Having a bow down followed by a bow up would be the worst situation—a wide gap in the center of the span, and no way to even the gap. I have often lifted two; or even three logs onto the wall looking for the best match.

Place the log on the building, planed side facing in, hewn side out, and its ends resting on the up-facing dovetails of the two intersecting logs below (See Photo 1). Peavy the log so that the planed surfaces near the notches are plumb. The hewn surfaces do not need to be plumbed, since they do not bear on any notch surface.

Log Horse

Next, it will probably be necessary to raise one end of the log or the other in order to even the gap between the two logs. I use a homemade device called a log horse to raise the low end of the log (the end resting on the lower of the two notch shoulders). As you tighten the nut on the heavy threaded rod, the opposing wedges are drawn together and the log is cradled as it is lifted.



A log horse lifts one end in order to even the gap.

DOVETAIL continued on page 12

DOVETAIL *continued from page 9*

Widest Gap

Because the logs have natural, irregular shapes there is always one spot between them that has the widest gap. Using an inside calipers, held with the two points as plumb to each other as possible, look for that spot. If it is mid-way between the notches, nothing more can be done to improve the shape of the gap between the logs. If it is left of center, then you should raise the right end a bit and see if this makes the space more uniformly shaped. Ideally, we want to move the widest gap towards the center of the log. If the widest gap is on the right, then raise the left. This is the optimum scribe—one that produces a long-groove that is fairly narrow and even. (While the optimum scribe is our goal, it pays to be flexible: there are times when we sink one end deeper than this, by making its long-groove wider than optimum, to set ourselves up for easier notching with the next log.)

Experienced log builders will be familiar with positioning of the next log to even the gap—it is most often done by rough-notching (removing wood from the high end), instead of raising the low end. Do not try rough-notching dovetails because it's likely that you will make the log too short to fit snugly between the plumb faces of the notches below.

The Scribers Move

A pair of scribers is the foundation of scribe-fit logwork. In the past, it was necessary to modify a pair of dividers. Now, scribers are designed and made for logwork—they have a bubble-level attachment that is used to keep the two points plumb, and both legs should be capable of holding a pen or pencil. The concept is to trace the exact contour of the bottom log onto the varying terrain of the log above. Since both logs have distinctive bumps, knots, and other (sometimes perverse) shapes, the scribe-lines wander. Almost miraculously, quality scribe-fit logwork is so tight that a strip of paper cannot be slipped between the logs—they look like they grew together.

Once the widest gap is found, the scribers are set to that amount plus about 1/8", and the entire bottom surface of the log, inside and out, is scribed. If you didn't open the scribers a bit, then the logs would just touch at the point of the widest gap. A tangent point is tough to weatherproof—it has no width. By opening the scribers you create a long-groove with a continuous outside edge and a separate continuous inside edge. Opening the scribers even wider won't change the quality of the fit, it simply lowers the final elevation of the log by widening the long-groove. This can get you out of a pinch (like when tips will be next and the current log is too tall to let them cross), but it is better to select a smaller log.

The notches could be scribed, but since their edges are straight lines I simply transfer scribe heights at four critical points and then later connect those dots. Where the log rests on a notch (usually only one end of a log, since the other end was raised off the notch to even the scribing gap), I mark that point. As we will see, it helps to transfer a line around the bottom of the log. With a level, draw plumb lines up from each of the four corners of the notch of the log below. Using the scribers, trace the curve of the top of the intersecting log below onto the inside vertical surface of the log you are scribing. This will help lay out the up-face of the notch.

Before lifting the log off the wall, make sure that all points have been transferred and all of the long-groove edges scribed. Missing three inches of long-groove is a heartbreaking experience, and it is nearly impossible to put the log back even close to where it was when scribed.

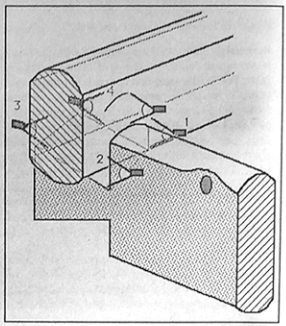


FIGURE 8: Scribe the four critical points onto the flats of the log above. Also scribe the curve of the top of the log below onto the inside face - this will be used to lay out the up-facing notch surface.

DOVETAIL LAYOUT—Down-face and plumb lines

The rest of the layout is completed on the ground. The known points are connected by straightedge (if you didn't scribe the notches, but just transferred points as detailed above). To transfer straight lines over the curved surfaces of the top and bottom of the log, I use a flexible rule. On the bottom, you might also have a mid-point marked to help you—this is where the log rested on the notch below. If more accuracy is required, there is another method for transferring straight lines over irregularly curved surfaces. Hold straightedges on the inside and outside opposing plumb lines.

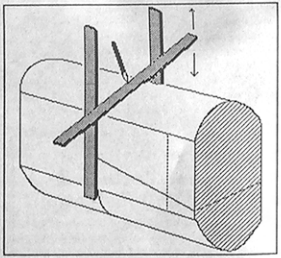
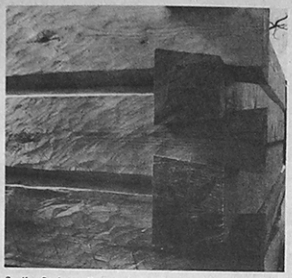


FIGURE 9: Transfering a straight line over an irregularly curved surface. Layout of the down-face is complete.

Slowly rock a third, rigid straightedge on top of the log, keeping its ends touching the plumb rules. As you rock the straightedge, mark with a pencil wherever the rule touches the log. It'll take a little time to coordinate this, and a second

DOVETAIL *continued on page 13*

DOVETAIL*continued from page 12*



Scribe-fit dovetail corner.

Check the distance between the shoulders of the notches the lines you've just drawn). It should exactly equal the inside length of the building.

Notch Extensions

I like to extend the notches beyond the walls. I think that having the dovetail pins stick out highlights the joinery—the corner looks less severe, tall, and boxy. It adds interesting shadows and a three-dimensional look that is otherwise lacking. Most old log buildings that are lap notched or dovetailed don't have notch extensions, and I'm not sure why. The extensions might catch a bit more rainwater, which would be a detriment, but I take additional steps to keep water out of the notch, as I will detail soon.

To lay out the notch extensions, draw lines 12" from and parallel to the notch-shoulder plumb lines. The log ends will be cut off here. With 8" thick walls, this makes the notch extensions 4". Again, transfer the cutoff lines around the top and bottom rounds with a flexible rule (no need for the extra accuracy of the other method here). Score all the cutoff lines with a razor knife and cut the log to length at both ends. Try to make one smooth cut because it will make continuing the layout lines across the end-grain easier.

At this point you should have the following lines on each end of the log: four plumb lines (the inside pair are the shoulder of the dovetail, the outside pair are about 8" from the shoulder lines); lines transferred around the top and bottom rounds at the shoulder plumb lines; and two sloped lines (the edges of the down-face of the dovetail notch). Now, using a straightedge, connect the two sloped lines across the end grain. The layout of the down-face of the dovetail is complete, but don't cut it out yet. We'll be needing those lines to lay out the up-face, which we can't do until we establish the size of the notch—and that is where Part 2 of this article will begin.

About the author: Robert Wood Chambers lives in River Falls, Wisconsin where he builds, and writes about, log and timber homes. He is President of the Canadian Log Builders Association, International—a worldwide organization of people interested in log construction.

§

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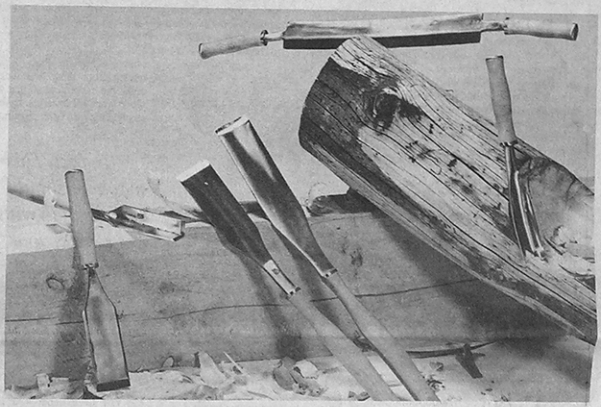

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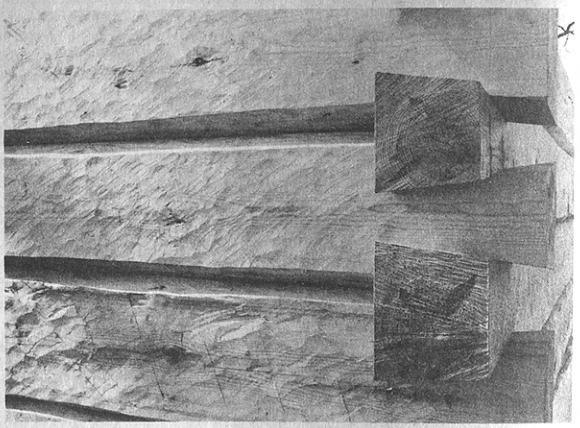
FULL-SCRIBE DOVETAIL JOINERY

Part 2

By Robert W. Chambers



Part 1 of this article reviewed the fundamentals of scribe-fit log construction: the tips and butts of logs are alternated to keep walls level; this produces a corner order of tip, tip, butt, butt; logs are positioned to even the gap between them before they are scribed. Part 1 also introduced hewn logs (left naturally round on top and bottom), and the full-dovetail notch, with its up- and down-faces that tilt at compound angles. Preventing harmful wane in the notch depends upon hewing the logs to avoid small flats, choosing a dovetail slope that does not unduly waste the height of the hewn flats, and keeping the dovetail pin centered on each log. Esthetically, the goal is equal-sized, centered notches. Part 1 ended with completing the layout of half a notch, the down-face, which is scribed-fit from the notch surface below.

NOTCH SIZE

The up-face is not scribed—we choose where to put it, and our choice determines notch size. But how tall to make it? When I first attempted scribe-fit dovetails, I made a series of scaled drawings of dovetail corners using notches of all one size. But no matter what notch size I tried I could not keep the notches centered—and the error accumulated as the walls got higher. This off-center error came from the taper of the logs and the tip, tip, butt, butt order at the corners. The notches cannot all be exactly the same size and also centered, there must be a compromise.

Fundamentals Lead to Rule of Thumb

I tried another idea. It is a fundamental principle of log building that there is twice as much wood at a corner as there is in each wall. For example, when two 8' tall scribe-fit walls intersect, there is 16' of wood at the corner. When all the notching is done, there must be 8' of wood at the corner. This means that, on the average, each notch must remove half the height of each log.

I knew from an inventory of the logs for the Erickson buildings that the average mean diameter was 14 1/4". The process of scribe-fitting "uses up" some of each log's height—each log must be lowered to the point where the largest gap is closed In this example scribing used up about 1 1/4" per log. This meant that each additional log added, on the average, 13" to the height of a wall (14 1/4" - 1 1/4" = 13").

Losing 1 1/4" to the scribe-fit is a bit more than usual. In round-log construction, the log can be rotated so that the bow is out or in, making the gap between the tops and bottoms of the logs—the scribing surfaces—more even. But hewn logs, because they are sawn to preserve bow, are placed with their maximum bow up or down, and this causes a wider range in the gaps between logs. The less optimum the gap, that is the more crooked the logs, the more height will be "used up" per log.

Because, on the average, half the height of the log must be removed at the corners, my average notch had to be 6 1/2" (half of 13"). The tip and butt notches were going to have to be slightly different sizes in order to keep them centered, so I tried a scale drawing with 6" tip-notches and 7" butt-notches (6+7=13). It worked on paper, now to lay them out on wood.

Laying Out the Up-Face

An easy way to visualize the shape of a full-dovetail pin is to remember that the up-face tilts the opposite way of its down-face. Because the down-face is already drawn, use it to find your way around the up-face. Here's how I do this. Starting with the inside slope (A to B): the down-face slopes down towards the log end, so the up-face

will slope up. Across the end grain (B to C): the down-face slopes up, so the up-face slopes down. And from C to D (the hewn surface), the down-face slopes up, so the up-face slopes down. Just keep in mind that the up-face and the down-face are always either both converging or both diverging.

If this were a tip notch, the height at A would be 6". The log is 8" thick, and the dovetail slope is 1:8, so at B the height is 8" (1" up on the up-face plus 1" down on the down-face). At C it is again 6" (1" down plus 1" up from B); and at D it measures 4" (1"+ 1" smaller than at C). We are always either adding or subtracting 2". In practice, I measure 6" at A, 8" at B, 6" at C, and 4" at D and then connect the dots.

Now you can see why I recommend the slope be a whole number (like 1" in 8")—there is much less chance of error. If the slope were 1 3/16" in 8", and we had a tip notch of 6 5/16", then the height at D would be.....well you see what I mean.

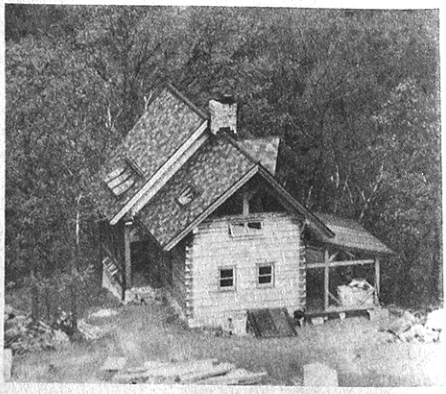
There are only two places where notch height can be measured correctly. This is because the amounts 6" and 7" refer to the average thickness of the dovetail pin, a fairly complex idea to visualize considering that the two dovetail faces are sloping at compound angles. The average thickness of this pin is 6" (A+B+C+D = 6+8+6+4= 24, divided by 4, equals 6), and so notch height can be directly measured at either A or C, and nowhere else.

A common layout error is to let the 4" notch extensions fool you: the slopes are 1" in 8", so be sure you don't lay them out to 1" in 12" (8" notch + 4" extensions). That's one reason why I draw plumb lines at B and C (see Part 1 of this article)—they remind me to measure height at the end of the notch, and not at the end of the dovetail pin.

Adjusting layout—thinking ahead to the next notches

The rule-of-thumb for notch height (6" tips; 7" butts) should be re-evaluated at each notch. Always be thinking ahead. Visualize the next log scribed and in place, its long-groove resting on the log below. Imagine it projecting through (not over) the notch you are currently laying out. If point D is too low you may not be able to keep wane out of the next notch.

It is simple to check for wane in the notch of the next log. (Note that this is can be done even before you choose that next log.) Look at the elevation of the up-facing notch at D: where is D in relation to the top of the intersecting log below? This is why I scribe the curve of the top of intersecting log below onto the inside face of the current notch (Part 1, Figure 8). You want the elevation of D to be an inch and a half, preferably more, above the peak of that scribed curve. With a 1:8 slope this means at least 3" of wood between the scribed curve and the up-face of the notch.



It is now easy to see why steeply-sloped dovetails require taller flats. A 6" notch with a 1:8 slope is 8" tall at its widest (at point B), but a 6" notch with a 2:8 slope is 10" tall and would need taller flats to keep from extending into the wane. (The average thickness of these two notches is identical: 6+8+6+4 = 6+10+6+2. Note that the steeply-sloped notch is narrower at point D, 2" compared to 4", and so is also more difficult to keep D high enough to prevent wane in the next notch.)

If you used the rule-of-thumb notch size

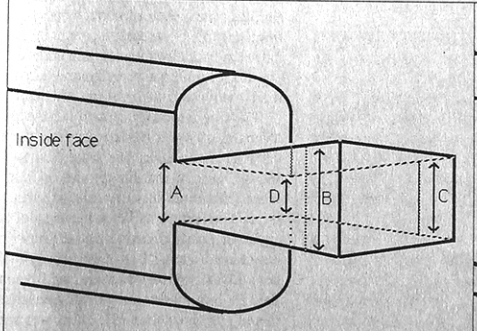


FIGURE 10 *Full-dovetail notch surfaces are always either converging towards each other, or diverging away.*

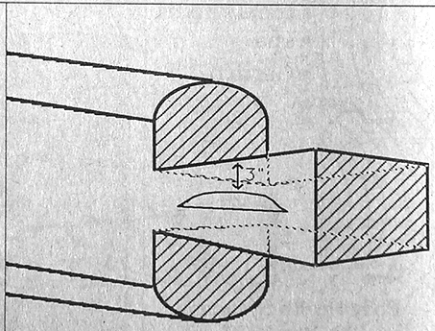
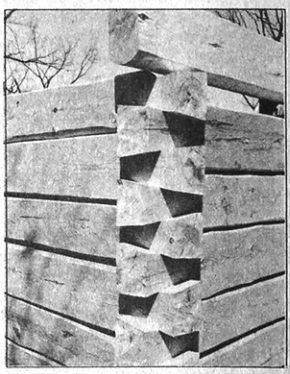


FIGURE 11 *To avoid wane in the next notch, leave at least 3" of wood as a shoulder above the log below.*

and point D is too low, there are several remedies. You can raise the whole up-facing dovetail surface a bit—perhaps using 7" for a tip notch instead of 6". Or you can resort to changing the slope of the C to D portion of the dovetail. Instead of dropping 1" from C to D, perhaps drop only 1/2"—the effect is to raise D 1/2" relative to the top of the intersecting log below. You don't have to worry about the next notch not fitting because its down-face is scribed and will automatically adjust to these changes. The up-facing notch is laid out by measurement (and occasional fudging), while the next down-facing notch face is always scribed to fit it.

Keep in mind that **the position of the next log depends on its long-groove, and not on its notch.** This means that you can raise or lower the layout of the current up-face and it will not alter the position of the next log. Our goal is to have the up-face high enough that it will intersect the vertical flat of the next log, instead of its wane. But avoid making the up-face too high, or it may throw the next notch off-center.

Instead of adjusting the current notch, you can remedy the wane-in-notch problem with the next log. This may be one of the times you won't use the optimum scribe—you could plan on sinking the next log lower at this end. Or, choose a log that sweeps down past the notch—one that gets low enough to provide a flat for notching at point D. Knots can be useful: the hewn flat flares down around a knot, so you can move the next log left or right to put a knot directly above the point D. Or, you could use a log that was sawn off-center, and has an unusually tall inside flat. In practice, I raise point D by combining these strategies—for example, I'll raise the tip-notch to 6 1/2" plus use a next log that has a knot I can put over point D.



Most of the time, using the rule-of-thumb notch size leaves point D at a good elevation for the next log. Think ahead to the tip, tip, butt, butt order. Getting the point D high enough to touch the flat (instead of the wane) of the next log is usually a concern only when a tip comes next. You will want point D higher than this minimum amount when a butt is next. In general, leave point D low when tips come next, and make it higher to prepare for butts.

As for centering, strive to keep the tip notches very nearly centered on their flats because of the wane-in-notch problem. Butt notches do not need to be centered so critically because their flats are so tall they easily accommodate even large notch sizes. Butt notches are only 1" taller than tip notches, while butt flats are commonly 4" or more taller than tip flats. On the Erickson project, tip notches ranged from 5 1/4" to 6 1/2", and butt notches ranged from 6 1/2" to 8". Despite this range in notch sizes the corners of the buildings really do look like wooden zippers.

Thinking even further ahead

Thinking even further ahead is much less exact, but still necessary. Here are a few things to watch for. The most common trouble spot is when a tip must cross over a butt. The up-face of butt-notches tend to rise high above the intersecting log below, simply because there is alot of wood. If you frequently find yourself looking through the log pile for the largest tip you have, then you are not anticipating well enough. Eventually you won't have the log you need.

Looking at the butt, butt, tip, tip cycle in a general way, it is best for the first butt to leave a tall shoulder. The second butt will use up most of that height and will then leave a minimum shoulder for the first tip to cross. The first tip will then leave a modest shoulder that the second tip will have an easy time crossing. Leave as large a shoulder with the second tip as you can, because the first butt (of the second cycle) needs it to keep its notch centered. Think two logs ahead and solve the tip-over-butt crisis with the first butt, not the second one.

CUTTING THE NOTCHES

Once the layout lines are penciled I score them with a razor knife to prevent splinters when rough cutting. Place the blade into the wood and then move the straightedge over to rest against it—try this if you currently move the straightedge into position and then place the blade. I think you'll find my method faster and more accurate. The first score is very light (especially going with the grain so it won't wander), and the second is deeper. If you score a third time, like I do, you won't even need the straightedge.

I like the Makita 5012B electric chainsaw for wasting the majority of the wood. It is the only model I've found that has chain speed approaching that of a gas saw—about 5000' per minute. The faster the chain, the smoother the cut. Other electric saws I've tried buck and jump because the chain is so slow. A handsaw will do a nice job on the plumb cuts, but is kind of awkward ripping the notch-faces.

To work on the notches, I like having the log about hip-high, so I put it on a couple beefy sawhorses. To keep it secure, the log rests in small V's cut in the horses, and then is held in place with a chain and load-binder at each end. Each notch-face is roughed-out with two cuts. First, I cross-cut the dovetail shoulder. Next, I rip the sloping face of the dovetail. Hold the saw near the end grain and sight under the bar and down the edges of the dovetail (B to A and C to D)—this will get you started right. It is critical to start right, because it's tough to change the angle once the bar is trapped in its kerf. Stay away from the lines at first—maybe as far as 1/4". But as you get comfortable with the tool you should be able to leave 1/16" or less.

If you cut over the line on the up-facing notch you may be able to fix it by lowering the layout. Much of the notch is hidden, however, so don't bother unless it will be seen. Do not lower the up-facing slope unless you are sure that you can cover the point D with the next log. And, never change the layout of the down-face—those lines were scribed.

Up-Face flat

I use a slick to pare to the scored lines of the up-face so that it is absolutely flat—check it with a straightedge across the notch at all angles. If you rub a metal straightedge across the notch it will usually leave a mark—a bit of oxidation left only on the high spots. Pare those down and keep checking. If the up-face is humped it'll keep the next log from fitting; and if it's dished it will hold water and promote rot.

Down-face cupped

The down-face should be slightly concave. (It cannot hold water since it faces down.) This accomplishes two goals: first, it makes the notch rest on its edges. Obviously it is easier to get a tight fit along three 8" edges than on two 64 square inch flats. Second, it provides a pocket for caulk to seal the notch. Since caulk flexes in proportion to its thickness, you get a better seal with 1/4" of caulk than with 1/16". For the same reasons, pare both end-grain shoulders slightly concave.

First pare the down-face flat and then add a slight dish; this keeps you from making it too deep. The amount of dish should be on the order of 1/4" at the center, and tapering to none at the edges. And don't dish the notch extension at all—that will cause a gap. You might want to connect the outside plumb lines (at B and C) across the down-face after it is pared flat and before you start dishing. That will remind you to not dish-out the extension.

Gutter

When the notches are newly cut they are so tight that water can't get in, but as the dovetails dry and check they will probably open here and there. Full-dovetail notches are self-draining, that is they slope towards the outside of the building. But for insurance, the last step in notching is to cut a small gutter in the up-face to keep rainwater from penetrating into the notch. Using a circular saw set as shallow as it will go (1/8" deep is about right), make a cross-cut 7 1/2" from the end-gain shoulder. This gutter catches water and carry it out of the notch.

Locate the gutter so that it will always be covered, though just barely, by the down-face of the next notch. The gutter won't clog with debris as easily if it's covered. Keep in mind that the notches will shrink in width as they dry, that's why I cut it at 7 1/2" instead of 8".

Is this a proven technique? Well, no—in fact, I've never seen another dovetail gutter. But strategic weep holes is one reason why the wooden Stave churches of Norway have lasted for 1000 years (see *Scientific American*, August 1983: 96-105). If you put caulk in the notch, be sure it doesn't squish into the gutter and plug it. The gutter must be clean to work.

LONG-GROOVES

Logs tend to have just one large seasoning check that accounts for nearly all of the difference in tangential and radial shrinkage. This check forms at a weak spot in the log—usually where a deep cut has been made. Traditionally, the deepest cuts are long-grooves and this has caused logs to have seasoning checks that ruin tight fits.

Two-cut

In this method, two deep chainsaw cuts remove most of the wood from the groove, gut the log, and guarantee that the log will check from the groove to the heart. As the check widens, the long-groove edges move apart, no longer support the log, and the log slumps down to a lower point. The log comes to rest at a place where it wasn't scribed to fit, and won't fit. Internal hang-ups often accompany this process. When the logs are green, the long-grooves are

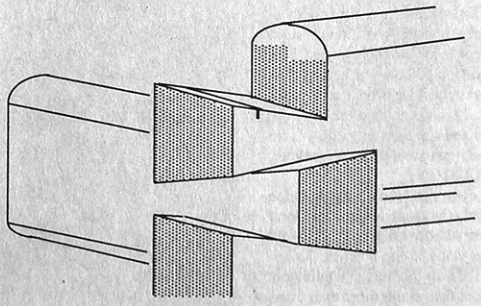


FIGURE 12 *The top notch face, not yet covered, shows the gutter.*

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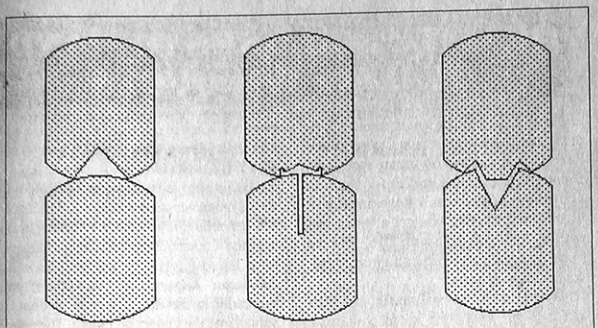

FIGURE 13 *Long-groove styles.*

tight, but as the logs dry the fits become embarrassingly bad.

Four-cut

The four-cut method makes a shallow groove, and so reduces checking problems. Unfortunately, it takes more time to cut and clean out. The fits are vastly improved by kerfing the top of the log below and encouraging the major check to locate there. I used the four-cut long-groove with kerfs on the Erickson buildings and the fits have stayed tight. Part of this is because many of the logs have their major checks not in the grooves, but on the hewn surfaces, where they affect the fits very little.

Double-cut

The newest long-groove, and the one I am currently using, was invented by Lloyd Beckedorf (Moose Mountain Log Homes, Box 26, Bragg Creek, Alberta T0L 0K0, Canada; contact Beckedorf about its use). It takes very little wood from the bottom of the log—only two small, shallow V's. Instead, it removes a great deal of wood from the top of the log below, which, like kerfing, promotes checking where it does the most good. It is faster than the four-cut long-groove and kerf, and the small V's are good places to put air-infiltration gaskets.

CONCLUSION

With hewn-logs the flats are for notches, and the rounds are for long grooves. Keep the dovetails on the flats and you'll avoid wane in the notches. To accomplish this: hew the logs to a thickness that will make flats at tips more than 1 and 1/2 times taller than average tip notches. For example, a 6" notch needs at least a 9" flat (remember that a 6" notch is 8" tall at its widest spot, point B). This will give you flexibility in locating dovetails slightly off-center, when necessary. Choose a dovetail slope that gives you some latitude in layout—steep slopes waste valuable flat height. Locate each up-face so that its lowest point (D) is above the top of the log below—how much above depends upon whether the next log is a tip or a butt.

Manage your scribe-settings. It is the long-groove, not the notch, that determines the position of every log. Carefully select each log to match the shape of the log below it—this will make the scribing gap even. Try to keep the widest gap in the long-groove, near the mid-span of the log. If the widest gap is in a notch, and so determines the scribe-setting, then the scribe will probably make your layout on this and future rounds difficult. Plan especially for tips that cross over butts, but always be thinking two rounds ahead.

Keep in mind that you choose the location for each up-face, but the location of the down-face of the next log is determined by that choice plus the scribe-setting. If the scribe-settings get out of hand, then you lose control over the size and position of notches. Only if you manage the scribe-settings will all notch faces (up and down) be the product of your choices. This (along with a set of good logs, and a bit of luck) is how you achieve the goal of nearly equal-sized, centered dovetails.

As you build, study the logwork you have completed. The walls will tell you more than any calculations and scale drawings. For example, continually re-figure the average height gained per log, and adjust your notch sizes if necessary. Be flexible—adapt the rules-of-thumb to reflect your logs and techniques. Someone once asked a famous violinist how he could perfectly hit every note. He replied that he often played out-of-tune notes—he just corrected them before anyone noticed. Log building is alot like that.

About the author: Robert Wood Chambers lives in River Falls, Wisconsin, where he builds, teaches, and writes about log and timber homes. He is past President of the