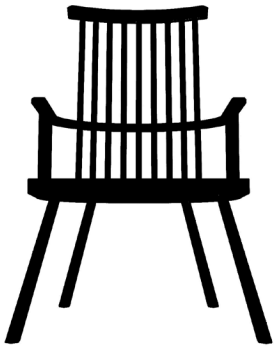
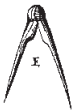


BUILD A CHAIR FROM BULLS%$T

by Christopher Schwarz
Illustrations by R. Keith Mitchell

Lost Art Press



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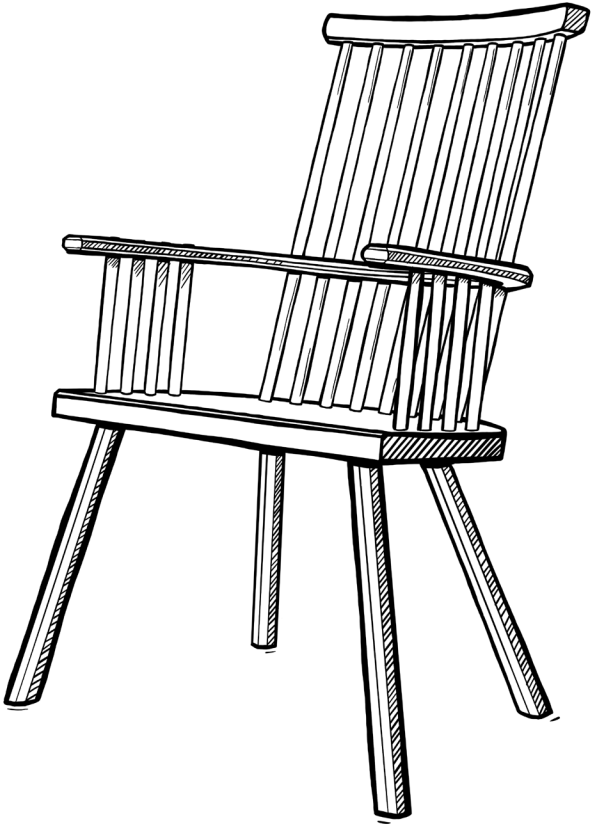
Full-size PDF patterns for the chair are available for free download at lostartpress.com. You can then print out the patterns at any office supply store or reprographics supply store.



1
INTRODUCTION

THE SUMMIT OF OUR CITY'S DUMP, officially named "Rumpke Mountain," looms some 1,074' above sea level and is the highest point in Hamilton County, Ohio. It's taller than all the seven hills surrounding Cincinnati, which has a lot of ups and downs.

For many, this landmass of litter, this mountain of muck, this horn of hog scraps, stands as a symbol of our throwaway society. We buy oodles of cheap things, and when we grow slightly bored with them, we drag them to the curb to be cast onto a mesa of dreck that refuses to decompose.

But there's a second way to regard Rumpke Mountain: In a hundred years or so, it might be a source of raw materials for future generations to mine after we run out of petroleum, methane and nice socks.

Or we can choose option three: We can see this man-made crap-covered crag as both a scourge and resource. Because (this is important) Rumpke Mountain isn't going anywhere.

The same could be said for big-box home improvement stores. On one hand, these Wall Street-powered steamrollers destroyed a long list of small businesses: mom-and-pop hardware stores, independent millwork shops, lumberyards, nurseries and tool rental outlets.

Home centers also poisoned the U.S. market for tool manufacturing. Their focus on price instead of quality is one

of the reasons most tools are now made overseas. And that a high percentage of those tools suck.

On the other hand, home centers have democratized the world of raw materials. How? Here's a list:

• Anyone can shop there, whether you're a licensed contractor or a young mom. No one will question your right to buy things there – or to just loiter and ponder.

• All the products, from 2x12s to tool handles, can be picked up individually and examined by customers. You can pick through a pile of 100 boards to find the lone example free of knots, splits and twists. That behavior will get you mocked or shunned at traditional lumberyards.

• The array of raw materials at a home center is stunning. This allows you to use materials from one department (6x6 cottonwood beams from landscaping) in surprising ways (legs for a workbench).

• You can easily return stuff. If you buy a drill and it is weak (that is, the drill didn't break – it just wasn't powerful enough), you can return it – no questions asked.

• Home centers are open late. Most lumberyards and professional tool stores close by 6 p.m. And few are open on Sunday. In contrast, some urban home centers are open 24 hours. And most of them are open late enough that you can visit after you put the kids to bed. Almost all home centers have Sunday hours.

• Home centers have ridiculous sales at times, especially on tools. I wait until Christmastime every year to stock up on table saw blades (they always offer a two-blade pack for the price of one blade).

So, you can despise home centers for everything they've ruined. But – like Rumpke Mountain – they aren't going anywhere. And so you can use home centers and their avarice to your advantage.

Well, that's what I tell myself every time I pull into the parking lot of my local Lowe's.

"Feast your eyes upon me, y'all, because I'm a rebel. I'm a tenon-trimming revolutionary who is turning the tools of the oppressor against itself.

"I am a guerrilla of glue."

Truth is, the home center is my only option at times. And that's the case for most Americans. In fact, it's almost impossible to avoid home centers at least some of the time. So, like most people, I regularly saunter into my local home center with my revolutionary tail between my legs.

I shop there, but I have no urge to help home centers make more money. As I wander their aisles, I think about something odd during almost every visit: Maybe this place could help new woodworkers.

You probably know this already, but one of the biggest barriers new chairmakers face is finding good materials and the tools they need to build a chair.

So stay with me here for a moment.

I've been building and studying folk chairs since 2003. And if there is one thing I've learned, it's that the people who made these chairs used whatever they had on hand. These chairs were built using sticks cut from a hedge, legs from the firewood pile and a seat pilfered from a forest owned by a local lord.

You might think that chairs made from crap materials look like crap. (Garbage in, garbage out.) And to be honest, some do. But many don't. In fact, some of these folk chairs – made from materials modern woodworkers would burn – are so beautiful that they keep me up at night.

That fact got me wondering: Can you build a comfortable and beautiful chair using basic tools and humble materials found at a home center?

The answer is "yes." Tool handles can be stout legs. Straight-grain dowels become sticks/spindles. And arms and seats can be made from bits of construction material that are typically thrown away or burned on a job site.

Here is how we're going to do it.

The most important aspect of the chair in this book is that it can be built without jigs, hard-to-find materials or specialty chairmaking tools. All the weird angles in the chair have been rendered into simplicity using a method that I call "sandwich drilling." I didn't invent this drilling process. I've seen plenty of evidence that chairmakers used the technique for centuries. It's just kinda been forgotten.

What is sandwich drilling? Here's what it looks like. You clamp the arm piece to the seat piece. You place the drill bit where the template tells you. You tilt the drill bit 10° and bore through both the arm and seat. Because the holes are drilled simultaneously, they will be at the same angle and will line up at assembly.

(Yes, there is some complexity behind the scenes in designing a chair with this process, but after making a chair or two using this method, it will become obvious via osmosis.)

The arm of the chair is made from home-center plywood. Because of this, you don't need to steam-bend the arm piece. You simply cut out the plywood, and the overlapping plies inside of it will make your arm as strong or stronger than solid wood.

The comfort of this chair comes from its wide seat, the geometry of the backrest and the tilt of the seat. You've probably noticed that the seat is flat and not scooped out, like many Windsor chairs. Seat-scooping tools are among the big barriers to making chairs. Finding good scooping tools is hard, and learning to use them takes time. Honest, a scooped-out seat is a little more comfortable than a flat one. However, the tilt of the seat and backrest are more important to the chair's comfort than the shape of the seat (in my experience).

Also, people sit on flat stools all day without complaint. But if you want to add some comfort, add a cushion or a sheepskin – that's what our ancestors did.

The overall look of the chair is intended to appeal to contemporary and traditional tastes. Its design is "broadly British," though some of its lightness comes from American Windsor chairs. The silhouette of the chair is cribbed from antiques, but its lines are straight and simple enough to fit into a contemporary apartment. The chair has a bit of a formal look because of the number of sticks, but that formality is balanced by the lightness of its parts.

You might be wondering about the chair's joinery. Is it a compromise because of the materials or the tools? Not at all. The joints in this chair are better than 100 percent of

the manufactured chairs I've seen, and they're as good as the joints in many of the handmade chairs out there. That means tight mortises and tenons, wedges, pegs, glue and some natural tension in the parts.

This chair is designed to outlast you. Which is more than I can say about most of today's flat-pack furniture.

Which brings us back to Rumpke Mountain.

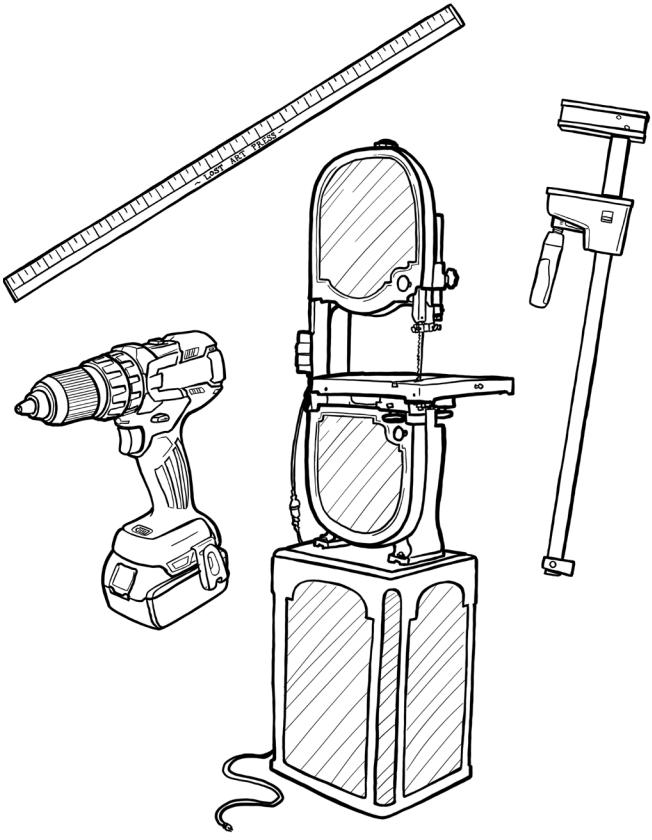
Whenever I stand in the checkout line at the home center, I look at the stuff everyone else is buying. Their carts are filled with cheap plastic entryway doors, good-enough-for-one-job drills, plastic mouldings and the ubiquitous sheets of wooden lattice. These are a reminder that just because we "do it ourselves" doesn't mean we "do it right." There's a reason that home centers have enormous aisles devoted to gap-filling spray foam and caulks – with just a few shelves of glue for joinery.

I suspect that most of the stuff bought at home centers ends up in the landfill sooner rather than later because I see this stuff piled at the curb every Friday morning.

But if you dig deep through an entire bunk of 2x12s at your home center, if you examine the grain on every replacement tool handle, if you spread out all the 5/8" oak dowels on the cement floor and roll them around like pool cues looking for the straightest ones, if you do all this, you can build a chair from all this bulls%$t.

And if it's a good chair – comfortable and sturdy – it might never be banished to Rumpke Mountain.

Scraps from this chair can be used to make a stool (see the first appendix at the back of the book).


~ LAST AIR PASS ~

2
TOOLS FOR BULLS%$T

YOU CAN BUILD this chair using tools from the home center, though that isn't always the best or cheapest place to get tools. But I will say that there are two excellent reasons to buy tools from the home center: You can handle the tools before purchase, and returns are easy if a tool sucks.

Here is a list of the home center tools that I used to build this chair. Of course, there are different tools you can use to perform every woodworking operation, so this list isn't comprehensive. If you want to cut out your parts with an angle grinder, that's fine by me.

10" Band Saw

Small band saws are about the size of a sewing machine and make about the same amount of noise. Plus, they are powerful enough to cut through 2"-thick oak. These inexpensive saws are perfect for small or temporary shops because one person can move the machine easily. You can clamp the saw's base to a kitchen counter or dining table and go to work. Most of these small saws attach to a shop vacuum, so they don't huff out a lot of dust.

You might not ever outgrow this saw.

Warning: The factory blade that comes with the saw likely stinks. Replace it immediately with a quality 3/8" or 1/2" skip-tooth blade.

One alternative to buying a small band saw is to buy a good jigsaw, but a quality jigsaw is about the same price as a good 10" band saw. So I recommend the band saw.

Electric Drill

A quality corded or cordless drill is essential for woodworkers and homeowners. You get what you pay for when it comes to drills. Buy the best drill you can afford, and it might serve you for a decade or more. Signs of a quality drill include an all-metal chuck, batteries that offer both high voltage and high amperage, plus a smooth-operating, variable-speed trigger. Another thing to consider: If you've never heard of the brand name of the drill, that's bad.

Sliding Bevel

A sliding bevel is necessary for chairmaking. The quality of these tools varies wildly. A good sliding bevel will lock so the blade doesn't move (except under a lot of pressure). Also, the tool's locking mechanism shouldn't prevent you from placing the tool flat on your work. Most sliding bevels have a blade that is 6" or 7" long, which is fine for most work. Plastic sliding bevels that obey these rules are fine.

5/8" Spade Bit, Extra Long

It's easier to tilt a long spade bit to the correct angle than with a short one. When you shop for a spade bit, look for one that has triangular "ears" at the rim. These will cut a cleaner hole and last longer.

1" Auger Bit

An auger bit has a screw at its tip to pull the bit into the work. This screw makes it easier to drill large holes. If you can't find a 1" auger at your home center, a 1" extra-long spade bit will work.

Brad-point Bits

You need a couple of small brad-point bits to make this chair: a 3/16" bit to help make the patterns for the chair and a 1/4" bit to peg the comb to the long sticks. Most furniture makers prefer brad-point bits (instead of twist bits) because the sharp point at the tip of the brad-point bit prevents the bit from wandering as you start your hole.

Block Plane

Some of the block planes at home centers are surprisingly good. Others are only good for throwing at ducks or kids in your yard. Read reviews of the different brands to figure out which is which because it can be difficult to tell in the store (the planes are usually trapped in hard plastic). Don't be afraid to return the plane if you can't get it to work. Sharpening a block plane isn't hard. Usually, a couple of sharpening stones or pieces of sandpaper can do it. If you are taught a sharpening technique that seems overly complicated, just turn around slowly and leave the room. You are in the presence of a sharpening obsessive.

Small Handsaw

I prefer a Japanese-tooth saw with a straight handle, such as a ryoba or dozuki. You can find these saws at good home centers.

3/4" Chisel

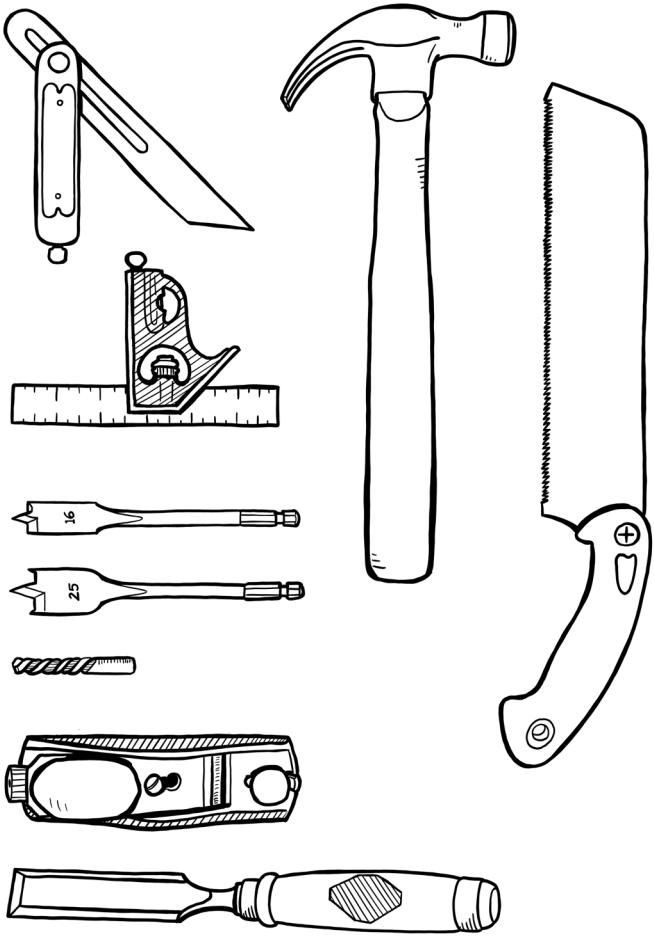
You need a chisel to make wedges and to (sometimes) split open a tenon to accept a wedge. I'm not a fan of plastic-handled chisels, but that's what you are likely to find at the home center. Not only is the plastic uncomfortable, it's heavy. And heavy chisels tire you out. So, if you have a choice, look for a 3/4" chisel with a small, short handle.

Four Bar Clamps, 24" Long

You need four clamps to build this chair. The clamps help you glue the parts together to make the seat and hold the work in place as you drill. Good clamps last lifetimes. If you can afford to buy nice parallel-jaw clamps, do it. If you cannot, then four quality F-style clamps will do.

12" Combination Square

These tools are essential for woodworking because they perform many layout chores and help you check things for square. The best ones are all-steel with easy-to-read markings on the blade. The OK ones are aluminum. And the questionable ones are plastic. If the square isn't square, take it back and get a replacement. Also, get one with a bubble level on it. It will help you get the chair's seat level.


16
25

Yardstick

These cheap wooden tools are surprisingly useful for making chairs. Even the free ones at hardware stores are fine.

16 oz. Nail Hammer

This standard nail hammer is a good size for assembling a chair and driving in the wedges. I prefer a hammer with a wooden handle.

Sandpaper: #80 Grit & #120 Grit; Sanding Block, Cork or Rubber

The #80-grit sandpaper is good for shaping pieces (such as the arm) and removing the machine marks left by the band saw. The #120-grit sandpaper produces a smooth surface that is good for paint. Don't buy the cheap sandpaper; it won't last for more than a few moments of work. You also need a handheld sanding block (it can be a block of wood) to wrap the sandpaper around. Sanding without a block is slower and can leave a wavy surface behind.

Utility Blades

Because home centers don't sell card scrapers, you should buy a pack of utility blades instead. They work right out of the box to scrape any existing finish off your legs (especially if you are using tool handles for your legs). They also scrape toolmarks off your sticks and the sticky paper labels and UPC symbols.

Glue Brush

You need a small brush to get glue into the mortises. If you don't own a small paintbrush, buy an acid flux brush in the plumbing department. A single brush (less than $1) can last for five years if you clean it after you use it.

1-1/2" Paintbrush with Angled Tip

The width and shape of this type of brush are ideal for painting a chair. If you are using latex or chalk paint, make sure you buy a brush designed to be used with water-based paints.

Sanding Sponge, #320 Grit

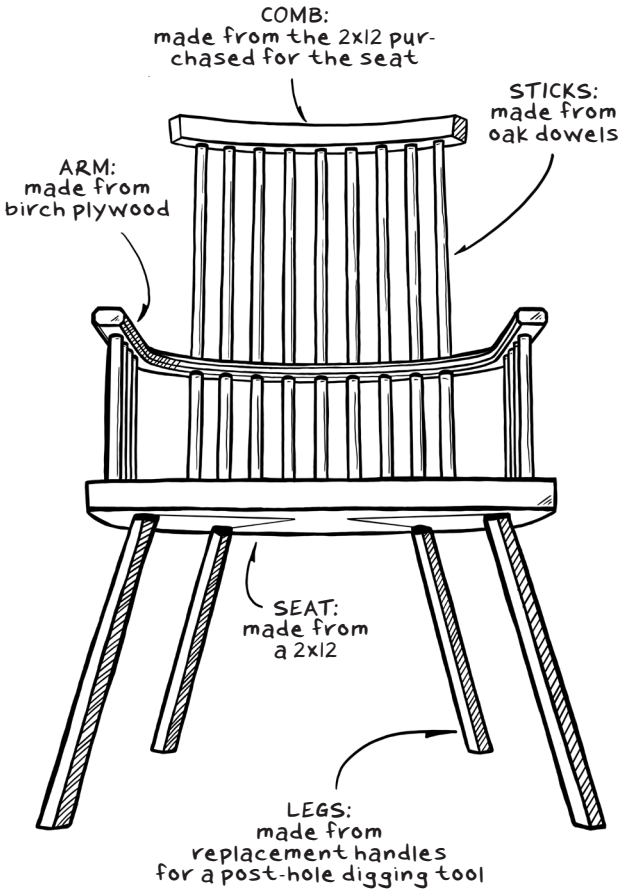
This fine abrasive sponge levels the paint between coats, making the chair smooth to the touch.

Chip Brush

These inexpensive, natural-bristle brushes are good for applying goop, such as colored wax.

Woven Wiping Cloth/Shop Towel

To remove the wax, you need a woven cotton towel that has a little texture and won't smear lint all over the chair (which is what T-shirt fabric will do). These towels are sold in a variety of places in a home center. They're sold with glass-cleaning fluids where they are called "wiping cloths" and are usually blue. And they are sold with the car waxes in the automotive department as "shop towels," where they are usually red.


COMB:
made from the 2x12 purchased for the seat
STICKS:
made from oak dowels
ARM:
made from birch plywood
SEAT:
made from a 2x12
LEGS:
made from replacement handles for a post-hole digging tool

3
MATERIALS

YOU CAN PURCHASE the raw materials needed to build this chair from any home center in North America.

Not every home center stocks every one of the parts listed below, but you can adapt. For example, your home center might not carry replacement handles for post-hole diggers, which is what I like to use for chair legs, but you can use oak handrails or some other tool handle instead.

There are always alternatives. Sometimes, you just have to wander into an unfamiliar department of the home center to find them.

Remember: This is like harvesting raw materials from a forest. Everything you need to build a chair is there. You just have to keep looking – or get creative – to find it.

Chair Legs

You need four legs: 1-3/4" x 1-3/4" x 20" is ideal (though they can be as small as 1-1/2" x 1-1/2" x 20")

Notes: Look for clear wood and straight grain. Look for oak, hickory or ash.

The legs for a chair must be strong, with straight grain and few (or zero) defects, such as cracks, splits or loose knots. The good news is that sometimes the manufacturer of a product has done the tricky work of wood selection for you.

For example, replacement tool handles almost always have dead-straight grain; otherwise, the handle would split after 30 whacks.

Oak, ash and hickory are the common "strong" woods you'll find at the home center. These are the best species for legs. Avoid the soft white pines and poplar components. They aren't as strong.

The girth of your leg material matters. An ideal chair leg will measure 1-3/4" x 1-3/4" x 20". But legs can be as skinny as 1-1/2" x 1-1/2" x 20".

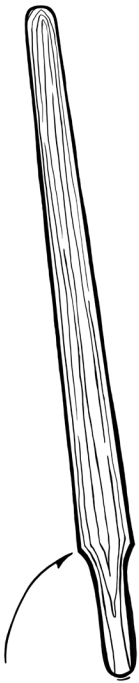
So, where will you find leg material in a home center?

Oak handrails in the stair-building department are an easy place to find leg material. Handrails can be as girthy as 2" in diameter. The round handrails in my area are just shy of 1-3/4" x 1-3/4". And the grain is typically poker straight. Sometimes, handrails are made of several pieces of wood laminated together. These are strong enough, but they are ugly and need to be painted.

Tapered table legs in the furniture-parts department are nice because the taper makes it easy to form the tenon on the skinny end of the leg. The table legs in my local home centers are usually ash, 1-1/2" round and 28" in length. Saw off the skinny section of the leg and save the scrap to make wedges for your chair.

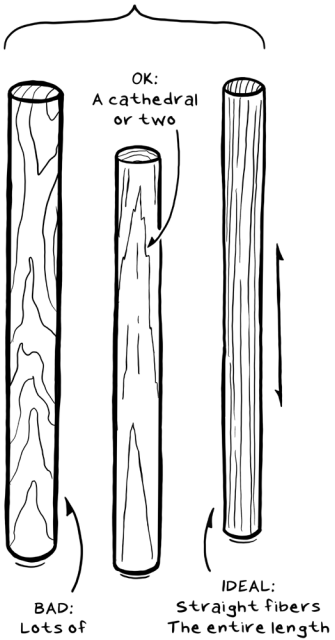
My first choice for legs is replacement handles for post-hole digging tools. These handles are bigger (about 1-5/8" in diameter) than typical shovel handles, are oak and are 48" long. So you can get a set of four beefy chair legs from two handles, with some scrap left over to make wedges. Avoid

With tool handles, Manufacturers pick Straight grain.



You'll see cathedrals only where the handle becomes narrower

Dowels are not selected for straight grain. So look carefully.



buying tool handles that are only 36". Once you cut the 20" section you need for one leg, you have 16" left over. That's a lot of waste. Plus, you'll have to buy four 36"-long handles to make four chair legs – that's expensive.

Other options for legs: Replacement closet rods. These are inexpensive but usually a little skinny for legs (but sometimes not). Also, be sure to check the grain on the closet rods to make sure it's straight. Another choice is to buy tight-grained yellow pine or Douglas fir construction lumber and saw the legs out using your band saw. If you can find boards with tight growth rings and straight grain, you can make legs with them.

Chair Seat

You need a board: 1-1/2" x 16" x 23-1/2"

Notes: Almost any material can serve as a chair seat. Stronger woods are better.

Historically, many seats for folk chairs were poached from forests owned by rich landowners or the crown. So, there wasn't a lot of time to be picky about the quality of the wood. As a result, many folk chairs have seats that look like crap, but they survive just fine. Luckily, the only time you'll get the constable called on you in a home center is when you climb the racks like a monkey (or you steal).

My preferred seat material is sinewy construction lumber – the stuff carpenters use for joists and rafters in houses. This heavy-duty wood is usually a softwood, such as yellow pine, Douglas fir or hemlock. And it's heavy, strong and cheap.

It's also available in different widths and lengths. I usually buy a 2x12 x 8' for a seat, which is the shortest length available. That board gives me material for two seats and two combs. You might pick through the longer-length boards. They have fewer knots and defects because those boards are used to span greater distances. But the longer stuff is difficult to transport home. Most home centers will cut down a 2x12 at no charge. They'll also cut down a piece of plywood for you. Just be sure to give them slightly oversized measurements to avoid disappointment.

Why do I prefer construction lumber over other options? Because it is both strong and cheap. A 2x12 x 8' is about $14, or about $7 per chair seat. That's a bargain.

But if you don't want to use construction lumber, you can use countertop or butcher-block material. Heck, some home centers sell 1-5/8"-thick oak or poplar boards that can simply be glued up into a seat.

Some budding chairmakers have asked if they could laminate two 3/4"-thick boards into a seat that is 1-1/2" thick. Yes, but I don't recommend it. You'll need additional clamps to glue them together, or a bunch of screws (used as temporary clamps) plus some extra glue. It's a pain.

Sticks

You need nine long sticks: 5/8" diameter x 25-1/2"

Plus eight short sticks: 5/8" diameter x 10-1/2"

Notes: Sticks should be straight-grained and free of defects. The dowels should be straight, not warped.

MATERIALS

The best material for the sticks is 5/8"-diameter oak dowels, which are sold in 36" lengths. One 36" dowel can be crosscut to make one short stick and one long stick. Dowels are the most expensive part of the chair (you'll likely spend $40 to $75 on the nine dowels you need to make one chair).

But if you choose good dowels, your chair will be strong and easy to build. Dowel stock is usually perfectly sized and nicely sanded, so there isn't a lot of work needed to make the sticks. Just cut them to length, sand them a bit if you like and use them.

If you become an expert in building Bulls%$t Chairs, you'll probably want to build a lowback chair, which has only short sticks. If you ever reach that point, here's a tip: Buy cheap drumsticks for the short sticks. If you buy them from music superstores (the home centers of the instrument world), you can get 24 drumsticks (type 7a) for about $18. Each drumstick is dead-straight maple, is a bit more than 1/2" in diameter and has more than 12" of straight material (after cutting off its tapered tip). The price works out to about half of what you would pay for a 5/8" dowel. (I sure wish they made 36"-long drumsticks.)

Armbow

You need one piece of plywood: 3/4" x 18" x 23", preferably maple or birch

Notes: The plywood should have no voids on its edges. It should feel dry and be as flat as possible.

Using plywood for the armbow is the most controversial

part of this chair. But it makes sense, and it works well.

The armbow of a stick chair needs to be strong. The best way to get a strong armbow is to find a curved branch in the woods that is the correct shape. The second-best way is to bend an arm to shape using heat. And the third-best way is to glue up three or four pieces of wood to make a laminated arm – usually called a "pieced" armbow.

Using plywood for an armbow means it can be any shape – not just what you scrounged in the forest. You don't have to have special equipment (a steambox, bending form, windlass and clamps) to bend it. And it's strong all along its length because of the layers of overlapping plys.

What's the disadvantage of a plywood armbow? It's ugly as dogs%$t. So you have to paint it.

Plywood comes in stupid sizes, mostly 4' x 8' sheets that are difficult to pick up, move and cut (but other than that – they're aces). Home centers cut the big sheets down into smaller sheets (2' x 4' and 2' x 2') and sell those. But the smaller sheets are expensive. A full sheet of 3/4" oak plywood might be $89. The 2' x 4' sheet runs $38. And the 2' x 2' is $20.

It's no fun to haul a full sheet of plywood home, so I buy the smaller bits when making these chairs.

Plywood, like any raw material, must be selected with care. You can't just pull a sheet off the pile and know it's going to be good enough for a chair. Here's how I do it: I'm a picky asshole. First, choose birch or maple plywood because it splinters less than oak. So, avoid oak unless you have no choice. Go through all the 2' x 4' pieces of plywood in the

rack at the home center. Inspect all the edges and look for the voids (missing bits of material).

I pick pieces that have zero voids. My experience is that voids on the edges of the ply are a warning sign that there are voids throughout the sheet. Perhaps the person who made this sheet of crap plywood was a new hire, hungover, hated their job or was having a bad day.

There is definitely variation in plywood from one sheet to another. Maybe not enough to matter in a kitchen cabinet. But for a chair? Yes.

After picking a piece without voids, I run my hands over the faces and edges of each piece of ply (and later remove the inevitable splinters). Does it feel colder than other pieces? If so, that piece is probably a bit wet and might warp. Wet ones go back in the rack.

Then, I lay the dry ones on the concrete floor of the home center to see which ones are flat. (If I pulled this at my regular lumberyard, I would get side-eye. But at a home center, no one even gives you a second look.)

I pick the best piece of 3/4" x 2' x 4' piece of ply, then stack all the rejects back in the rack like playing cards – neater than when I found them.

Comb

You need one piece: 1-1/2" x 5" x 21"
Note: Make the comb from scrap from your seat.

The comb is made from scrap left over from your seat material if you made it from 2x12 construction lumber. If you

don't have any leftover material for the comb, you can buy a 2x6 in construction lumber for the comb. Or find some other piece of wood at the home center.

The comb should be free of knots and cracks so it is strong. That's why it's important to pick through the racks of 2x12s and select clear ones. The grain pattern on the comb isn't important because the chair will be painted.

Template Material & Backing Boards

You need one piece: 5mm x 2' x 4'

Notes: 5mm plywood is often called "underlayment" at the home center. You can also make your templates from posterboard or hardboard.

We use 5mm underlayment plywood to make patterns, build crates and as a backing material to protect an exit hole when drilling. It's inexpensive and easy to cut with a saw and shape with sandpaper. You don't have to purchase the underlayment to make a chair. You can make patterns from posterboard, and you can back up an exit hole while drilling with almost any scrap wood.

Pegs

You need: one bamboo skewer or 1/4" dowel

Note: Any pegs will do, even ones you whittle from scrap.

The comb is attached to the sticks with glue, plus three wooden pegs. For many years, I used bamboo skewers or chopsticks from Chinese takeout meals.

Wedges

You need one oak stair tread: 1" thick

Notes: Look for stair treads that are solid oak. Some have a composite core. And I prefer treads that are one piece of oak – not several pieces laminated together.

Oak wedges are important in chairmaking. For this chair, I made mine from an oak stair tread. You can shave the wedges out with a chisel or saw them out with a band saw.

Yellow Glue

Standard yellow glue is fine for this chair. You don't need waterproof or water-resistant glues. Stay away from the polyurethane glue and epoxy. They don't offer any advantages when making a chair, and clean-up is difficult.

Spray Adhesive

This aerosol glue is great for sticking paper patterns to stiffer materials, such as thin plywood, hardboard or posterboard. We use it all the time.

Chalk Paint

Any paint will work for this chair. I like the flat sheen provided by chalk paint, which the home center can tint to any color you want. You don't need much paint, so buy the smallest container possible.

Wax

After painting, apply a coat of wax to give the chair a soft glow. Use clear wax for a contemporary look. Or buy a brown-colored wax for a more traditional look.

My Receipt from the Home Center

Building a chair from home center bullshit is expensive. But it's not as expensive as I thought it'd be. During the last 21 years, I have built hundreds of stick chairs for sale and made hundreds more with students during classes. So, I have a good idea of how much the wood costs to make a chair.

With good (but not luxury) materials, each stick chair costs me about $125 when I buy rough wood from the lumberyard. That usually means red oak for the legs, stretchers and sticks, plus a different species for the seat, arm and comb. These days I use soft maple, elm or sycamore for those parts. The rough lumber requires expensive machines and quite a bit of work to process, and there is a good deal of waste – hence the $125 price tag.

So here's the total for the wooden parts for one Bulls%$t Chair. The prices shown here are from December 2024 and are published retail prices from Menards, Lowe's and Home Depot in Kentucky. None of these products were on "sale."

Price List for the Bulls%$t Chair Parts

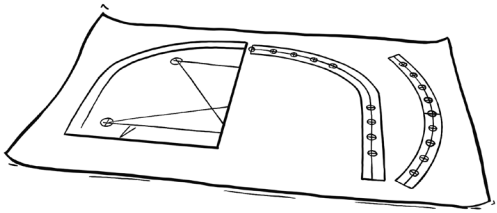
- *4 oak legs (cut from 2 replacement handles for a post-hole digger): $29.94*
- *1 seat and 1 comb (from half of a 2x12 x 8'): $6.88*
- *9 long sticks and 8 short sticks (from 9 dowels 5/8" x 36"): $44.91*
- *1 armbow (from half of a 3/4" x 2' x 4' birch plywood sheet): $18.90*
- *3 oak pegs (from a 1/4" dowel): $1.67*
- *1 oak stair tread for wedges (1 linear foot): $8.48*

Total: $110.78

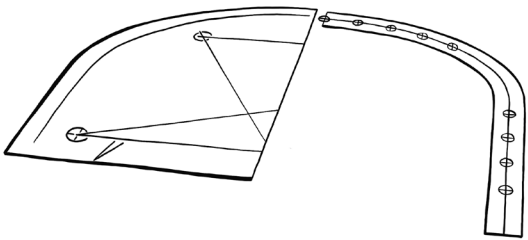
Note that I live in the Midwest/Shallow South, where prices are generally lower than on the coasts. However, you could get that price even lower by shopping at a home center that offers a rebate or cash back if you use their credit card.

To be honest, I was shocked at how the material cost from the home center wasn't much different than my cost from the lumberyard. You could argue that the lumberyard materials are better than the home center materials. But you could also argue that the home center materials don't require big machines to process them into chair parts.

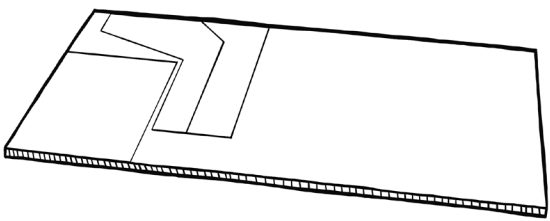
For once, bulls%$t sounds like it's priced fair.



1. Print out the patterns at an office supply store.



2. Cut out the patterns with scissors.



3. Lay out and cut chunks of 5mm underlayment that are slightly bigger than your patterns.

4
MAKE PATTERNS

Tools & materials needed:
Scissors
Yardstick
Spray adhesive
5mm underlayment plywood
Band saw or jigsaw
Sandpaper, #120 grit
Sanding block
3/16" brad-point bit
Drill

IF YOU ARE AN IMPATIENT PERSON, please read this sentence: You will regret skipping this chapter. Patterns are invaluable while building a chair, and they are a permanent record that allows you to make the same chair again. Plus, the patterns can be a springboard for new chair designs.

Patterns don't take long to make. Begin by printing out the paper patterns (the chair's 22" x 34" patterns can be downloaded for free on our website by anyone). Cut out the shapes for the seat, arm and comb. Use scissors on the curved areas. On the straight areas, use a yardstick to guide your cut (grasp one leg of your scissors like a knife for this).

Use the band saw or jigsaw to slice out chunks of 5mm underlayment for the patterns that are slightly oversized. Use

the factory corners of the plywood for the 90° corner on the seat pattern.

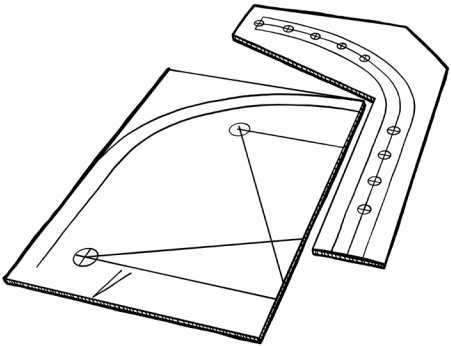
Then, apply spray adhesive on the backside of the paper patterns and immediately press them to the plywood. Smooth the paper flat against the plywood.

Cut out the three shapes with your band saw or jigsaw, staying as close to the line as possible. Then, wrap #120-grit sandpaper around your sanding block and smooth the edges right to the lines.

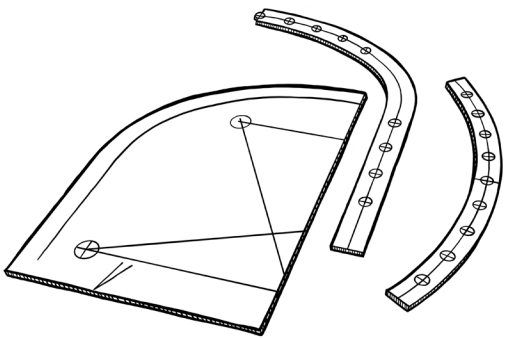
Save any scraps of underlayment so you can clamp them below the seat while drilling the mortises for the legs. (This will reduce blow-out on the exit hole.)

Now drill a 3/16"-diameter hole in each of the mortise locations.

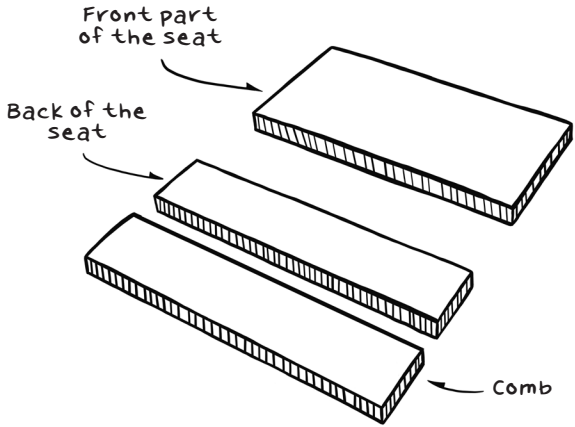
One last little bit: I write the name of the part (comb, arm etc.), the name of the chair and the date on each pattern so I can always tell which patterns are the most recent.



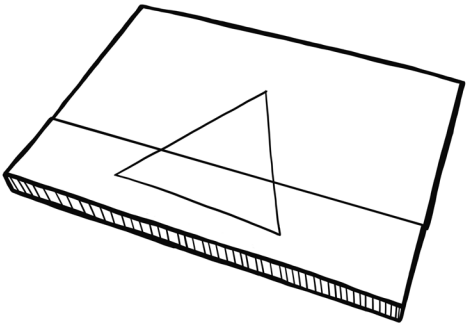
4. Stick the patterns to the underlayment using spray adhesive.



5. Saw out the patterns and sand their edges smooth.



1. Crosscut two pieces for the seat. Rip one piece down the middle.



2. Press the edges together and draw a triangle across the joint.

5
GLUE UP THE SEAT

Tools & materials needed:
2x12 x 8'
Band saw
Block plane
Yardstick
Clamps
Glue

THE SEAT IS GLUED UP from two pieces of wood from a 2x12. You don't need any special joinery or fasteners between the two pieces of wood – just a nice tight seam and some yellow glue. The hard part is getting the two mating edges to meet up (well, it's only difficult if you don't own an electric jointer or a long jointer plane).

I'm going to describe how to make this joint with a block plane. As edge joints go, this one is pretty small. So it's doable with a small plane.

Begin by crosscutting your 2x12 to get the two clearest sections that are 24" long. Take one of the sections and rip it in half along its length using a band saw or jigsaw. One half will get glued to the other 24" section. The other half will become your comb, so set it aside.

The chair will be painted, so you don't have to worry too much about how the grain looks. What is important is that

you make the edge joint as easy as possible on yourself. So, I recommend you join the two boards along their factory edges. It's a bonus if the boards' heart sides face up, toward the sitter's bum. (Look at the annular rings on the end grain of the board. If the rings are smiling, that's the heart side.) This arrangement ensures the legs won't splay out any more as the seat dries and perhaps warps.

Now draw a triangle across the joint so you can get the boards back to this same orientation with ease.

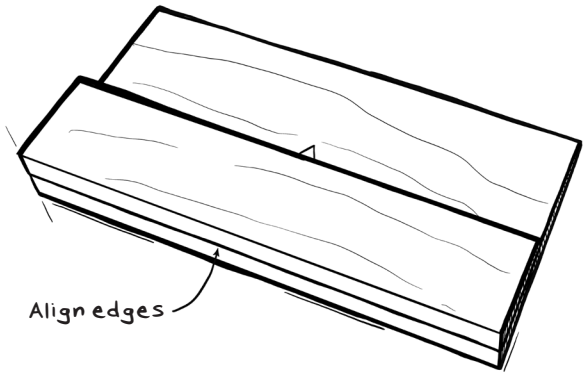
Next, "fold" the two boards like you are closing a book, with the triangle on the inside of the book. Align the two edges of the joint along the book's "spine" as best you can. The better the alignment, the less work you'll have to do. Now clamp the two pieces in a vise with the two edges facing the ceiling.

You might notice that the long edges are a little rounded from the factory. That's OK. The planing you are about to do will remove the rounding.

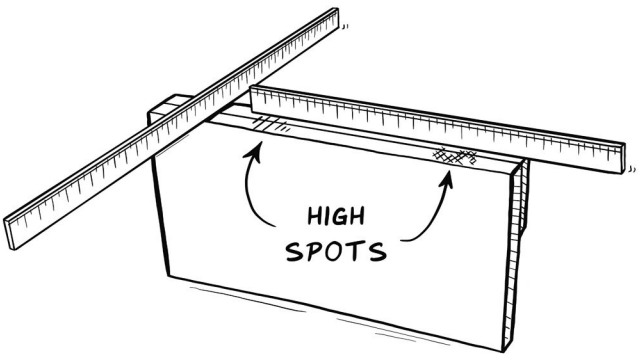
So here is your goal: Plane both edges so they are a single flat and true surface.

If you have never used a handplane in your life, this might sound crazy. But this is what planes do. You just have to allow them to do it. So let's go.

You can use a plane with its factory cutting edge for this operation. The goal is to set it so it's taking a wispy light cut (less than the thickness of a sheet of copy paper). And that the cut is a consistent depth across the mouth of the tool. The thickness of the cut is controlled by a knob at the back of the tool. Getting the cut consistent across the mouth is a



3. 'Fold' the two parts together with the triangle on the inside. Align the edges with care.



4. Check edges with a yardstick. Mark the high spots.

matter of lightly tapping the blade left and right with a hammer until you get what you want. (Hint: Test the blade's setting on a small piece of scrap.)

Before you begin, place your yardstick on its edge on the two edges of the board. Are there any unusually high spots? Mark those spots with a pencil.

Then – moment of truth – use the plane to first slice away the high spots you marked. Take just a shaving or two. Then, use the yardstick to observe the result.

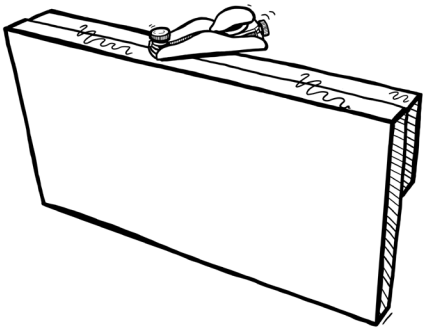
Most beginners take a cut that is too heavy at first. So don't be afraid to reduce the plane's cut if the yardstick tells you that things are changing quickly and unpredictably on the work below.

Once you get the plane cutting predictably and lightly, focus on getting the two surfaces flat and in the same plane. First, work the high spots and avoid the low spots. Eventually, you will get to the point where you can take full-length shavings along both edges.

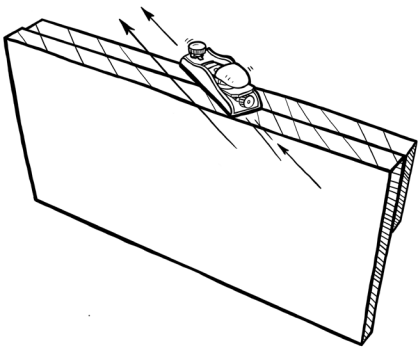
This is a milestone. Pause. Examine the surface with your yardstick – both along the length of the edge and across the edge (which is about 3" wide). Look for high spots. Mark them with a pencil. Shave them down with your plane.

Once you have the high spots knocked down as best you can, use the block plane to make diagonal strokes across the edges. Slice across the board at about 30°. Overlap your strokes just a tad, like mowing a lawn. Go 30° one way, then 30° the other way.

When you are producing shavings from all over both edges, it's time to change your strategy again.



5. Remove high spots with a block plane.



6. Plane diagonally across both edges one way ...

Plane parallel to the edges, overlapping your strokes again. Check your progress with the yardstick and the blade of your combination square.

If this is your first time, it might take some time. Maybe an hour. But in time, you will be able to get edges ready for gluing in minutes (I promise).

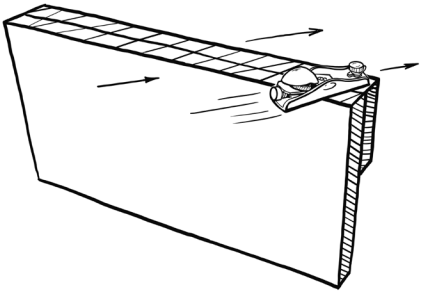
Get things as close to flat as possible. Tiny gaps of light that look like the thickness of a human hair are OK. The clamps will squish those together. (Eventually, any hand-plane user can create a light-tight joint with ease.)

When things are as close as possible, take the pieces out of the vise. Unfold them. Show the edges to each other and press them together. They should meet without any huge gaps. And they shouldn't rock against one another.

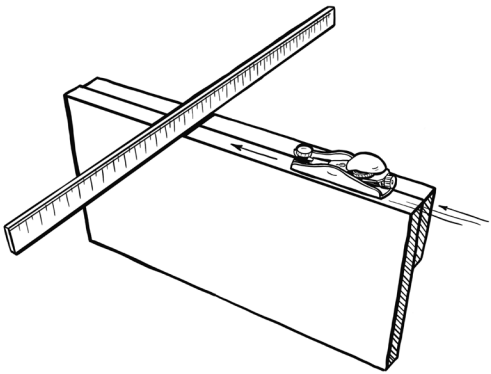
Is your joint good enough? Put the pieces in your clamps (with no glue) and clamp them tight. Does the joint close up entirely? If not, keep planing and checking your progress with a yardstick and the blade of your combination square. If yes, release the clamps, apply glue (a thin and consistent film is the goal) and clamp them up for real.

Whew. Use a wettish rag to remove the squeeze-out using circular motions (wax on, wax off). Let the glue cure for at least 30 minutes. Note: Construction lumber is usually wetter and has more resin than furniture-grade lumber. Water and resin slow down the glue's work. Glue technologists have told me it's best to keep the work in clamps for a few hours when gluing construction lumber.

Remove the clamps. Scrape off any glue squeeze-out. If you have any noticeable gaps in the joint, you can reinforce



7. ... then plane diagonally the other way.

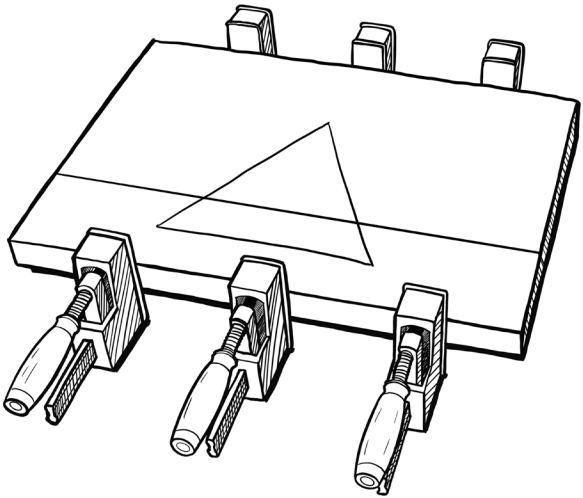


8. Plane parallel to the edges. Then check your work to see if the edges are flat and coplanar.

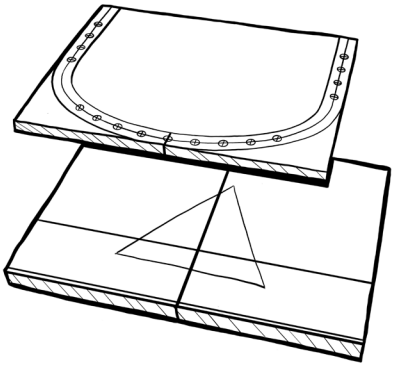
the joint by screwing three steel mending plates across the joint on the underside of the seat or across the joint on end grain. The plates are cheap and come in a variety of sizes – 1-1/8" x 6" is a typical size for these plates.

Adding steel plates is a 100-percent historically correct approach with folk chairs. Metal mending plates show up on old chairs all over the world and through all time periods. Don't be ashamed of it; just try to do it better next time.

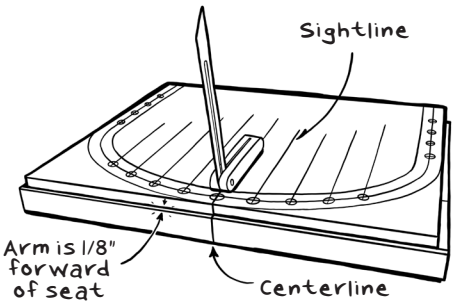
Congrats. Honestly, this is the most difficult task in making this chair. The rest is simple.



9. Dry-fit the seat. If you can clamp the parts with no gap, then repeat the process with glue.



1. Lay out the arms and seat for drilling.



2. Position the arm piece. Draw sightlines. Set the sliding bevel to 10 degrees. Drill mortises through both the arm and seat for the nine long sticks only.

6
DRILL MORTISES IN THE SEAT

Tools & materials needed:
Plywood for arm (left square)
Seat (left square)
Nine 5/8" x 36" oak dowels
Clamps
Drill
Sliding bevel
5/8" extra-long spade bit
Combination square
Handsaw
Band saw

DRILLING THE MORTISES for the sticks is easy if you do it while the parts are square and you use the "sandwich" method of drilling the holes shown here. There's no propping things up on jigs and using lasers and/or special drilling tools; the sandwich method is simpler. First, clamp the arm to the seat and drill the mortises for the back sticks at a 10° angle. Then, move the arm back a bit, clamp things again and drill the vertical mortises for the short sticks.

Begin by drawing the shape of the arm plus the location of its mortises on your plywood blank using your half-pattern.

Take care that the two halves you draw are parallel – there should be 20" of space between the hands of the arm. And the back of the arm's pattern should touch the back edge of the plywood.

Where the two halves touch is the centerline of your arm. Draw this centerline down the back edge of the plywood.

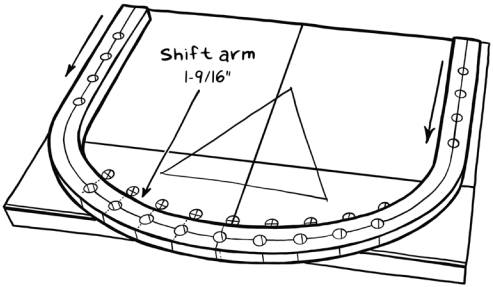
On your seat blank, draw a centerline on the face of the board and down its back edge (the half-seat pattern can help you mark the line on the seat's face). Then, use your combination square to draw a line that is 1/8" in from the back edge of the seat. Place the plywood on top of the seat blank. Align the back edge of the plywood with the pencil line you just drew on the seat blank. Now align the two centerlines.

Clamp the two pieces together and to your bench. Make sure the nine mortises for the long sticks hang off your bench so you don't drill into your workbench. Clamp a backing board under the seat if you are concerned you might drill too deeply and splinter the underside of the seat.

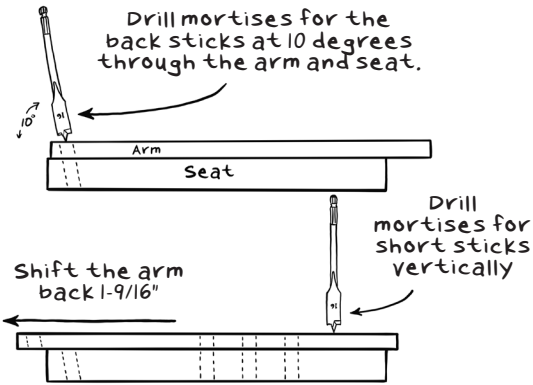
One last layout chore: Use your combination square to draw nine "sightlines" through each of the mortise locations and perpendicular to the back edge of your plywood. These will help you place your sliding bevel.

Set your sliding bevel to 10° off 90° (use the marks provided on the seat pattern to help set your bevel). Wrap a piece of tape around the shank of your spade bit to act as a depth guide. The tape should be 2" from the tips of the triangular spurs. This means the lead of the bit will poke through the underside of the seat. That's OK.

Place your sliding bevel on one of your sightlines. Place



3. Cut the arm to shape. Put the arm back on the seat and shift it back 1-9/16". Drill mortises for the eight short sticks vertically.



4. Profile view of shifting the arm.

the lead of the spade bit on a mortise location. Tilt the bit to match the blade of your sliding bevel. Make sure the bit is lined up with your sightline.

Drill through the plywood and into the seat. When the tape reaches the plywood, stop. Repeat for the remaining eight mortises for the back sticks.

Remove the clamps. Saw out the shape of the arm with your band saw or jigsaw.

Now prepare to drill the vertical mortises for the short sticks in both the arm and seat.

Return the now-roughly shaped arm to where it was while you were drilling. You can secure the arm precisely by inserting two 5/8" dowels through two holes in the arm and seat. Make a tick mark on the edge of each hand of the arm. Extend this tick mark onto the seat below.

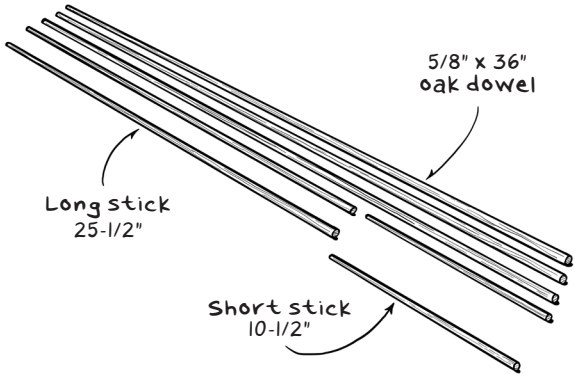
Now slide the arm 1-9/16" back toward you (use a ruler to guide you). Make sure the center of the arm still lines up with the centerline on the seat. Clamp the arm and seat to your bench, with the mortises for one hand hanging off your bench. Add a backing board below if you like.

Drill the four mortises in that hand dead vertical. Use your square or a spotter to help. Stop drilling when the tape reaches the plywood.

Then repeat the process for the arm's other hand.

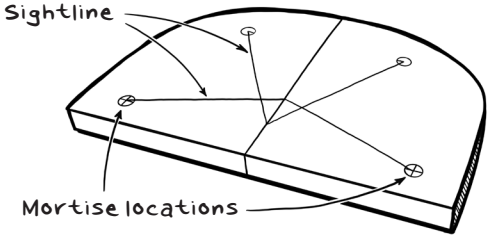
Unclamp the seat and arm. Draw the shape of the seat on the seat blank and (if everything looks correct) saw out the seat shape.

The last thing to do is to cut your sticks to length. Saw all nine of your dowels so that one part is 10-1/2" long and the

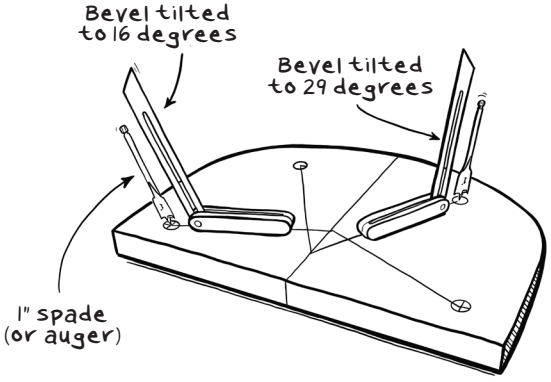


5. Cut the dowels to length to make short sticks and long sticks.

other is 25-1/2". These are your short sticks and long sticks. Remove any paper labels on the sticks.



1. Lay out sightlines and mortises on the underside of the seat.



2. Drill mortises in the seat by lining up your drill with the sightline and tilting the bit to match the sliding bevel.

7
MORTISES & TENONS FOR THE LEGS

Tools & materials needed:
Leg stock
Seat
Scrap 5mm underlayment
Yardstick
Sliding bevel
1" auger or spade bit
Drill
Band saw
Combination square
Utility blades (for scraping) or block plane
Clamps

TO DRILL THE MORTISES for the legs, you need two things. First: the sightlines provided on the seat pattern. You will point your drill along these lines as you bore. Second: the resultant (or drilling) angle. This is the angle you tilt the drill as you bore.

Both pieces of information are on the seat pattern. All you need to do is follow the directions, and the job will be done.

Cue the anxiety. What if I can't drill perfectly? Will my chair look like ass? That's unlikely. Do your best, and the

legs will look fine. Chairs are a casserole of angles, so small imperfections are difficult for the viewer to see once the chair is assembled. Promise.

First, use the seat pattern to lay out the location of the leg mortises on the underside of the seat. The lines connected to the mortises are the sightlines I talked about above. Use the pattern and yardstick to reproduce the lines on the underside of the seat.

Begin by drilling the back legs through the seat's underside. Clamp the seat to a scrap piece of 5mm underlayment on your benchtop with the rear leg mortises hanging off the edge of your bench. Set your sliding bevel to 29° off 90° (this angle is on the pattern). Place the sliding bevel on the sightline for one of the rear legs.

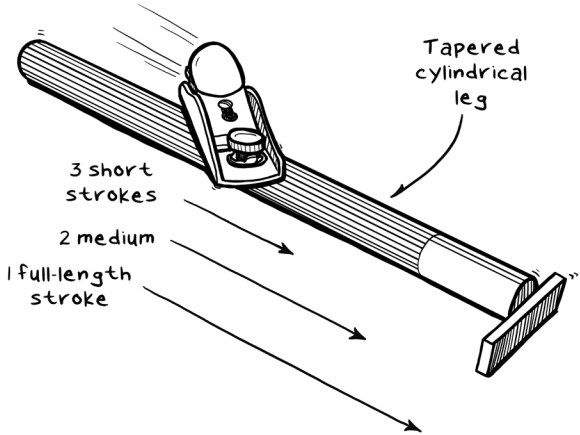
Chuck your 1" auger or spade bit into your drill. Press its tip to the mortise location and tilt the bit to match the angle of your sliding bevel.

If you're using an auger, use a slow speed when drilling. The lead screw will pull the bit through the work. Focus on keeping the auger parallel with your sliding bevel.

If you are using a spade bit, you will need to use a faster speed and push the bit into the work.

Drill the mortises for both rear legs. Then reset your sliding bevel to 16° (also on the pattern), which is the drilling angle for the front legs. Rotate the seat and the backing board so the mortises for the front legs are hanging off your workbench. Clamp the parts down and drill the mortises for the front legs.

Now it's time to cut the tenons on your legs. There are



3. If your leg parts are tapered and round, make the tenon by planing a reverse taper on the skinny end.

many ways to make the tenons; here are two. Which one you use depends on the bulls%$t you bought from the home center.

If you bought pre-made table legs that come tapered, then you'll make the tenon with a block plane. If you bought leg parts that are straight cylinders, you'll make the tenons on the band saw.

Let's start with the easier method: Making tenons on tapered stock with a block plane.

First, cut your tapered legs to 20" long. Be sure to remove the skinny end of the leg (not the fat end). Measure the diameter of the skinny end of the leg, which will become your

leg's tenon. The legs from my home center were just slightly thicker than 1" at their skinniest. Yours might be different.

The goal is to plane a cylindrical tenon that is 1" in diameter and about 2-1/4" long (which is long enough to pass through the thickness of the seat).

To transform a taper into a cylinder, first clamp a small stop block (a waste piece of 5mm ply is ideal) into your vise. Make it stick up about 1/2" from the jaws of the vise. Press the skinny end of your leg against the stop block with one hand. With the other hand, wield your block plane.

You will make a reverse taper, which will transform the taper into a straight-sided cylinder at one end. Begin planing about 8" from the end of the leg. Skew the plane about 30°. Plane from that point for about 3", then lift the rear end of the plane off the leg. Do this short stroke three times.

Now begin your next planing stroke 8" from the end and lift the rear of the plane when you go about 5". Do this medium stroke two times. For the last stroke, start the plane at 8" and plane all the way off the leg. Do this stroke once.

Rotate the leg a little and repeat the three reverse-taper strokes on that section of the leg. Rotate a little more and repeat. Rotate and repeat these strokes all the way around the leg twice. Then stop and examine your tenon. It should start to look like a cylinder. Test the tenon in a mortise in the seat.

How tight should the tenon fit the mortise? Tight enough that you must hammer it home, but the amount of force applied should be like knocking on someone's front door.

Repeat the reverse-taper strokes, the rotating and the testing until the tip of the leg enters the seat. Press the tenon in

hard and rotate it in the mortise. Remove it and examine it. The part that entered the mortise should be burnished (a bit shinier). Draw a line around the tenon where the burnishing ends.

Now repeat the reverse-taper strokes, but avoid crossing your pencil line – that will make the tenon too skinny.

Also, and this is important, once your tenon is cylindrical, don't use any more taper strokes. Simply plane the entire tenon to get it to fit. So keep an eye on the tenon.

After each test, move the line down the tenon and avoid crossing the line. During this process, you might have to start your planing strokes 9" (or a bit more) from the end of the leg. When the tenon goes all the way through the seat, you're done with that tenon. Now, do the other three.

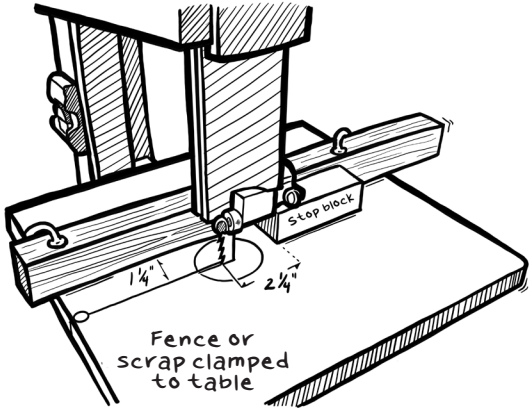
If your legs are cylindrical, make the tenon using your band saw.

First, measure the diameter of the leg. Let's say it's 1-1/2". The tenon is 1" in diameter, so there will be a 1/4" shoulder all around it. Set the fence of the band saw so there is 1-1/4" between the fence and the blade.

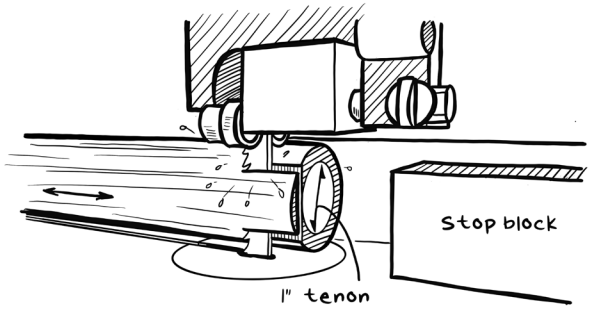
(If your saw doesn't have a fence, clamp a straight section of wood to the saw's table to act as a fence.)

Then clamp a block of wood to the fence that is 2-1/4" behind the teeth of the saw. This is a stop block, so all your cuts will be the same length.

Make a practice tenon using a piece of scrap leg left over from cutting them to 20" long. Turn on the saw. Press the leg against the fence and into the blade until it touches the stop block. With the saw still running, back the leg out of



4. If your legs are straight cylinders, add tenons to them using your band saw.



5. Dozens of cuts create the tenon and shoulder on the leg.

the blade, rotate it a tiny bit and repeat. Work kerf by kerf around the leg (if you just do it randomly, the waste splinters can make your life miserable). It will take dozens of cuts, but the round tenon will form, and the shoulder will appear.

When you think you are done, press the work against the stop block and the fence and rotate the leg in that position. The teeth will tidy up the shoulder as much as possible.

You might have to get creative to make the tenons on your legs, depending on the raw material you bought. If you bought a handrail to make your legs, for example, you should plane it round first, then tenon it with the band saw.

No matter what material you bought, you can create tenons with a band saw (just make the material round first) or a block plane (just taper the leg first, which is covered on the next page).

After you create the tenons, decide on the legs' final shape. If you want them to stay round, use a utility blade to scrape the varnish or lacquer off the leg. To do this, press the leg against the stop block in your vise with one hand. With the other, pinch a utility blade between your fingers so it is basically upright. Tilt it a few degrees forward, then scrape forward.

The blade will remove the lacquer and leave a tiny flat. You can keep the flats (I do), or sand them away.

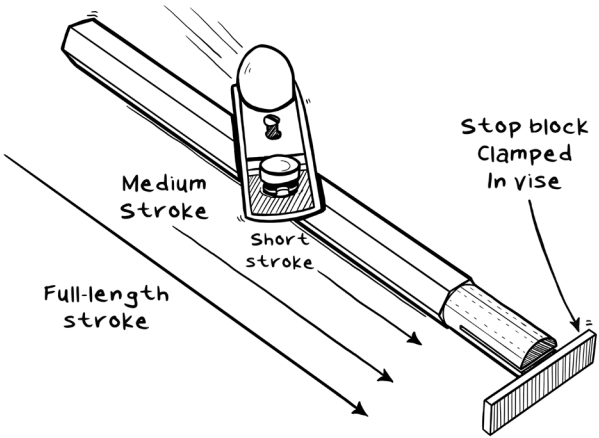
If you want your legs to be tapered, press the tenon against your stop block with one hand and plane the leg with the other. You will now make tapering cuts with your block plane. The first stroke begins 6" from the shoulder of the tenon. Start your stroke there and plane to the shoulder.

The second stroke begins 12" from the shoulder. Start your stroke there and plane to the shoulder. Make the final stroke along the entire leg (except for the tenon).

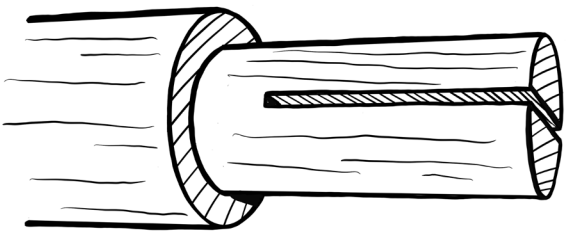
Rotate and repeat. This planing will remove the lacquer and taper the leg. You might get some tearing of the wood at this point. Unless it's catastrophic (huge chunks), ignore it for now. You can scrape or sand it away later.

You also can use the plane to make the leg round, faceted, octagonal or whatever.

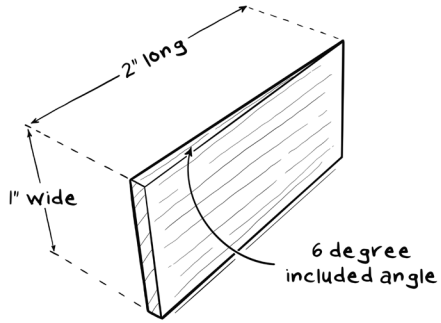
The final steps on the legs are to saw a kerf that's centered on the tenon and is about 2" deep. Then, use your utility knife to chamfer the leading edge of the tenon. The kerf will receive the wedge. Make the kerf with your band saw or handsaw. The chamfer will make assembly easier and prevent the tenon from blasting off the rim of the mortise in the seat.



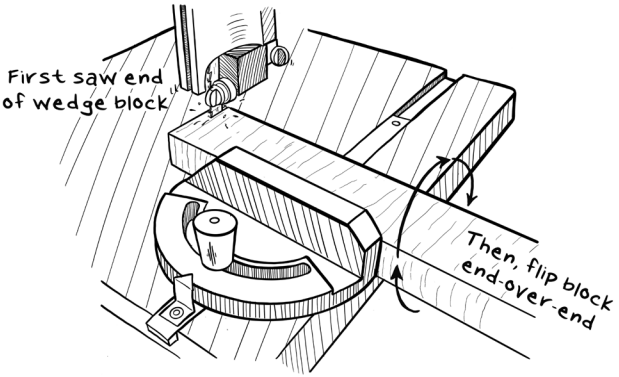
6. To taper the leg (and make it an octagon) take a short stroke, a medium stroke then a long stroke.



6. Cut a 2"-deep kerf in the tenon.



1. Wedges for chairs require dead-straight grain.



2. Set the miter gauge to 3 degrees. Rip the end off of your wedge block. Then, flip the block end-over-end.

8
MAKE WEDGES

Tools & materials needed:
Full 1"-thick oak stair tread or oak scraps from the legs
Block plane
Band saw
Combination square
Chisel

STICK CHAIRS are held together with wedges and glue, so making wedges is an important part of the chairmaking process. There are many ways to make wedges. Here are two.

Option 1: Buy a 1"-thick solid oak stair tread at the home center and use a band saw to make a lot of wedges quickly. The downside: Stair treads are stupid expensive. When you purchase one, look for boards with straight grain. That will make stronger wedges.

The stair tread I bought was 1" thick, 11-1/2" wide and 48" long. Begin by crosscutting off a 2"-long piece from one end. It's an odd-looking piece of material: 1" thick, 11-1/2" wide and 2" long.

Set the band saw's miter gauge to cut 3° (rotate the gauge's head to the right, not the left). Place the gauge in its track in the saw's table. Put your wedge blank in front of the gauge, with the end grain of the wedge blank facing the saw's teeth. Slice off one end of the blank. That piece of waste is trash.

Now flip the blank over so the end grain on the other side of the blank faces the blade. Push the blank up to the blade and move it until the blade almost touches the front corner of the blank. Saw off the end. The bit that falls off is a completed and usable 1" wedge.

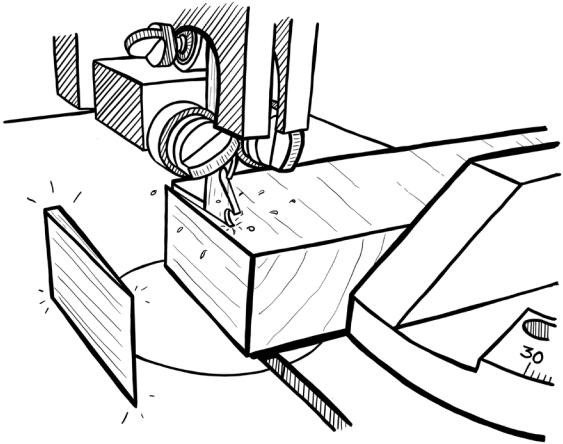
Flip the blank over, cut and repeat. If you position the block by eye, you will get some wedges with a skinny tip and some with a fat tip. That's OK. But you can make all your wedges the same by clamping a stop block to the table in front of and to the left of the blade. The stop block puts the wedge blank in the same spot every time.

Continue to cut wedges until your fingers get close to the band saw's throat insert. At that point, put the remainder of the wedge blank into the burn pile. If you need more wedges, crosscut another 2"-long chunk off your stair tread and start again on the band saw.

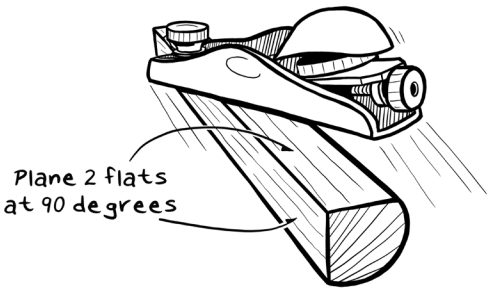
How many wedges do you need? I make about double what I need for the glue-up in case a wedge breaks or gets lost on the floor. Because we have four leg tenons to wedge, we need eight 1" wedges.

We need 16 nice 5/8" wedges for the short sticks. To make the 5/8" wedges, you have a couple of options: You can saw down your wedge block so it's 5/8" thick and make wedges like before. Or you can make a bunch of 1" wedges and split them down to 5/8" wide with a knife and a hammer.

Option 2: Make the wedges one at a time using a 1/4"-thick x 1"-wide x 12"-long stick of oak. You don't have to buy stair tread for this process. You'll probably have scraps left over from your legs that will work.



3. Repeat the sawing and the flipping. Every cut will produce a wedge.



4. To make wedges from leg scrap, plane two flats at 90 degrees.

MAKE WEDGES

If the scrap is round, plane one flat face, then plane a second flat face that is 90° to your first. These flats allow you to cut out the wedge blank safely. Now, saw a 1/4"-thick piece off the scrap. Both faces of the wedge blank should be flat. Then use your combination square to mark a 1" line on the scrap and rip the scrap to 1" wide.

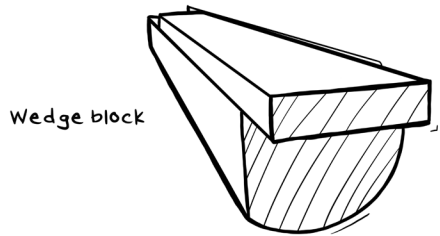
With this method, you make a wedge on the end of your wedge blank, cut the wedge free then repeat.

You form the 2"-long wedge shape using a chisel. Press the wedge blank against a piece of 5mm scrap underlayment clamped in a vise. Shave both faces of the wedge blank with the chisel so you get a pointed wedge. Crosscut it free. Repeat.

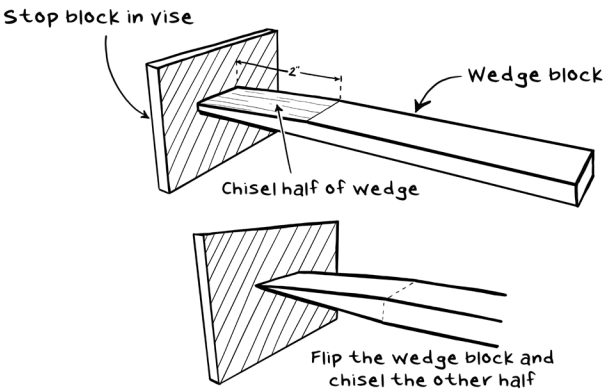
You can also do this on the band saw. Hold the wedge blank from behind the blade. Pull it back to make one angled face of the wedge. Then make the second angled face. Crosscut it free and repeat.

Make all the 1"-wide wedges you need. Then saw the wedge block down to 5/8" wide and make all the 5/8" wedges you need.

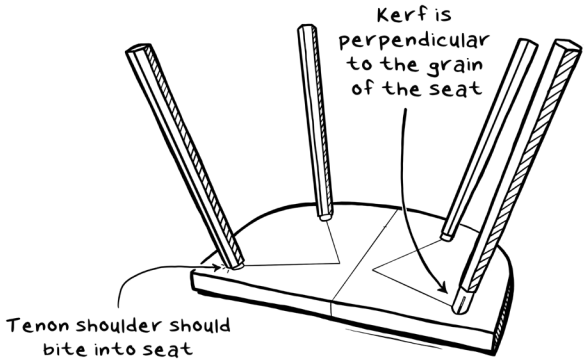
The last word on wedges: There are dozens of ways to make them. Find your way.



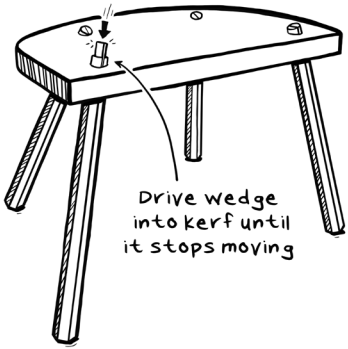
5. Saw out a 1/4"-thick x 1"-wide wedge block.



6. Press the wedge block against a stop block and shave half the wedge. Flip the block over and shave the other half.



1. Glue the legs into the seat.



2. Paint glue on the wedges and drive them into the kerfs in the legs' tenons.

9
UNDERCARRIAGE & LEVELING LEGS

Tools & materials needed:
Completed legs
Seat
Wedges
Glue
Hammer
Chisel
Rag
Stiff toothbrush
Brush for glue
Paper to protect your workbench
Handsaw
Combination square (with bubble level)
Yardstick
Sliding bevel
Pencil
Small scrap blocks of wood, about 1" square

BEFORE YOU JOIN THE LEGS and seat, remove any machine marks, dents or scratches on your parts. It's easier to do it now than later.

Place some paper on your bench to protect it from glue

and water. Turn your seat upside down and prop it up on scraps on your bench so the leg tenons can seat fully in their mortises. Pour yellow glue into a cup and get a small brush. Keep some water, a toothbrush and a clean rag on hand to clean up excess glue.

Glue the legs in one by one. First, paint glue on the mortise walls. Then paint glue on the mating tenon. Orient the kerf on the tenon so it is perpendicular to the grain of the seat. Drive the leg into the seat hard with a hammer. The shoulder of the tenon should bite into the seat a bit.

Keep striking the leg until it stops moving. Then glue the second leg.

After the four legs are seated, wet the toothbrush and clean off any excess glue – you don't want it running down the legs. Turn the chair on its feet. Now it's time to wedge the legs' tenons.

The tenons for the front legs are likely sticking up almost an inch from the seat. That makes them difficult to wedge. Use your saw to cut them so they are about 1/4" above the seat. The rear legs likely do not need to be sawn down.

If the kerf in the tenons has closed up, drive your chisel into the tenon to reopen the kerf. Paint some glue on a wedge and insert it into the tenon. Try to tap the wedge so it is in line with the leg below. Then hammer it home until the wedge stops moving or the wedge splits.

If a wedge splits on the first strike, lever it out. Place the back of the chisel against the wedge, hammer it down, then lever the back of the chisel against the wedge to pry it free. Drive in a new wedge.

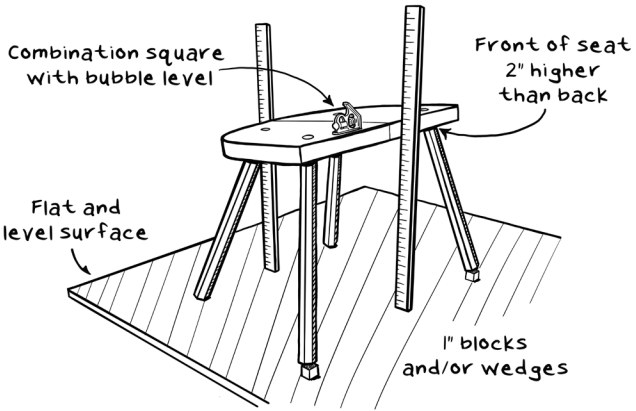
3. After the glue dries, saw the tenons flush to the seat.

If your wedges pop out of the kerfs when you hammer them, wait five minutes (or so) for the glue to tack up, then try hitting them again.

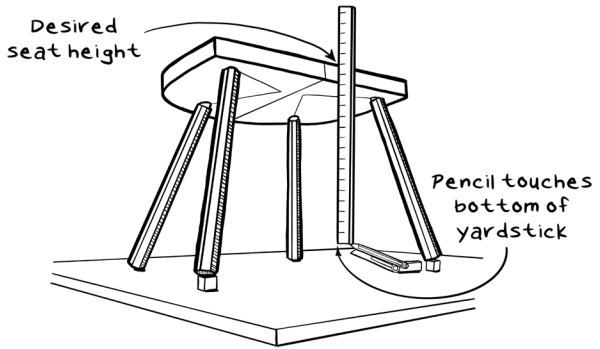
After everything is assembled, clean up the excess glue and let the chair sit for at least 30 minutes. Then saw the proud part of the tenons flush with the seat.

Now trim the feet. It's easier now than when the chair is fully assembled.

Sawing the feet sets the backward tilt of the seat (an important part of the comfort of this chair) and puts all four feet on the floor. It also sets the seat height. Most modern chairs are 18", which is too tall for short sitters. I like 16-1/2" to 17" for most people. But if you are unsure, err on the side



4. Level seat, then prop up the front legs so the front of the seat is 2" higher than the back.



5. Hold the yardstick at the desired seat height. Set pencil (taped to sliding bevel) to touch the yardstick.

of too tall. You can always trim the legs later. It's difficult to lengthen them.

Find a flat and level surface (or make one with a piece of plywood wedged from below). Place the chair on the level surface. First, level the seat from left to right. Place the bubble level (in your combination square) on your seat. Place wedges below the chair's legs to get the seat level. Also, all four legs must be in contact with the level surface. If any of the legs are up in the air, put some wedges under them.

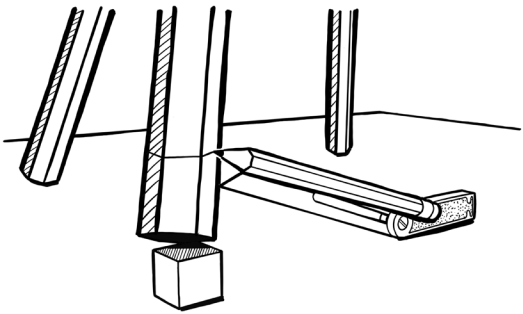
For this chair, you want the front of the seat to be 2" taller than the rear. So if the seat is 19" high at the front (before trimming the feet), you want it to be 17" at the rear. Use small scraps of wood to prop up the front legs until the front is 2" higher than the back.

Now dangle your yardstick off the front edge of the seat at the dimension you wish the seat height to be. The end of the yardstick will hang in the air between the front legs.

Tape a pencil to the blade of your sliding bevel. Tilt the blade until the point of the pencil touches the tip of the yardstick. Now, place the handle of the sliding bevel firmly on the level surface and scribe a pencil line around all four legs.

Saw the legs off at the lines with a handsaw. Round over the bottom edges of the feet with sandpaper because they are fragile right after you cut them.

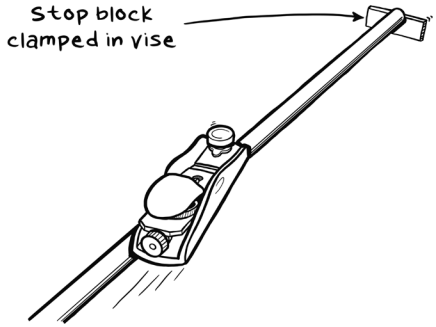
Check your work. Place the chair on your flat and level surface and see if all four feet touch. If they are off by more than a tad, pull one of the longer legs off the level surface so the other three legs are flat on the level surface. Use the level



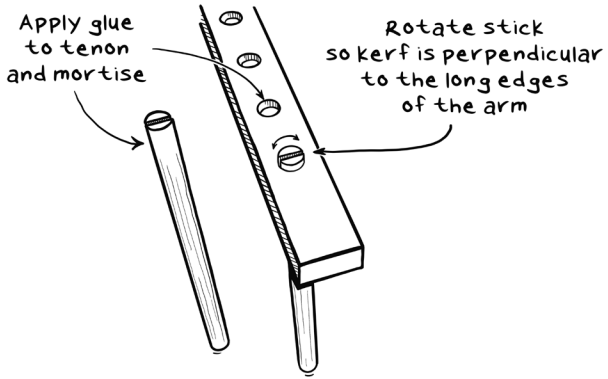
5. Scribe a line around all the legs. Cut the legs to final length.

surface and a pencil to mark the extra amount you need to saw off the scofflaw leg.

Don't be too persnickety. The legs will flex a bit when you sit in the chair, and floors in old houses are rarely flat. Plus, if the chair is on a carpet, it's unlikely you'll ever notice a little unevenness.



1. Plane or scrape away any flaws on the sticks.



2. Glue the short sticks into the arm.
And orient the kerf.

10
ARM & STICKS

Tools & materials needed:
Block plane
Sanding block
Sandpaper
Assembled seat and undercarriage
Arm
Sticks
Wedges
Glue
Brush for glue
Stiff toothbrush
Rag
Hammer
Chisel
Rag
Paper to protect your workbench
Handsaw or band saw
Yardstick

BEFORE YOU ASSEMBLE the arm and sticks, shape the arm to your liking. You can leave it rectangular or shape its corners so the arm feels like it's 100 years old. Shape the arm with your block plane and sandpaper. Fill any voids in the plywood or missing veneer with putty (we use Durham's

Rock Hard Water Putty, available at home centers).

Once you complete the arm, kerf the tops of the short sticks with a band saw or handsaw. Make the kerf about 1-1/4" deep. Then knife a small chamfer around the tenons that go into the seat. This will make it easier to get the tenons started in their mortises.

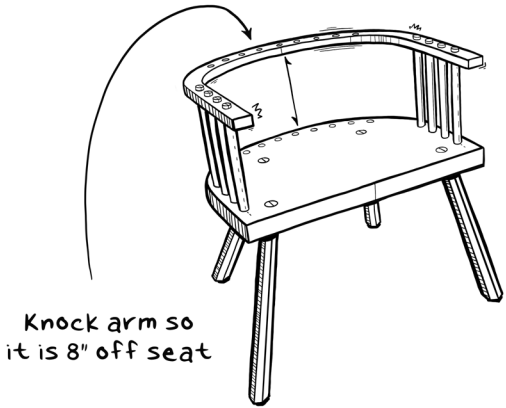
I don't do a dry-fit with this chair (but feel free if you want to). Instead, I plane all the sticks with my block plane set to take the wispiest shaving possible. This removes machine marks and makes the sticks feel more organic. Then, I test each stick in the mortises in the seat and arm. Sometimes, a too-fat dowel sneaks through the dowel factory. If its tenon is too tight, I plane it until it just fits.

Here's an overview of assembling the arm and sticks.

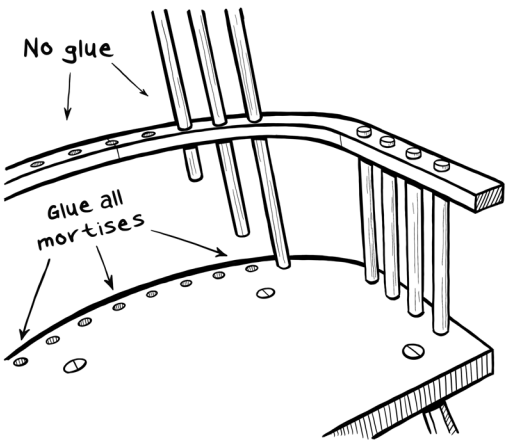
1. Glue the short sticks into the arm.
2. Glue the arm and short sticks into the seat. Knock the arm down until its underside is 8" off the seat.
3. Put glue in the seat mortises for the long sticks.
4. Thread the long sticks through the arm and into the seat. Knock them home.
5. Double-check the height of the arm.
6. Wedge the short sticks where they pass through the top of the arm.

Because all the drilling was of the "sandwich variety," the glue-up should be without much wrestling.

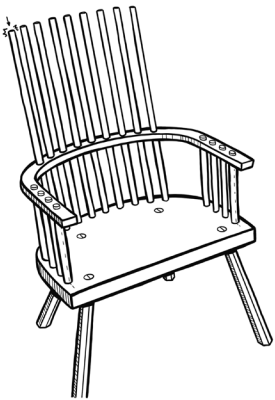
Let's go. First, cover the bench with paper to protect it. Get the glue, glue brush, paper cup, toothbrush and rag.



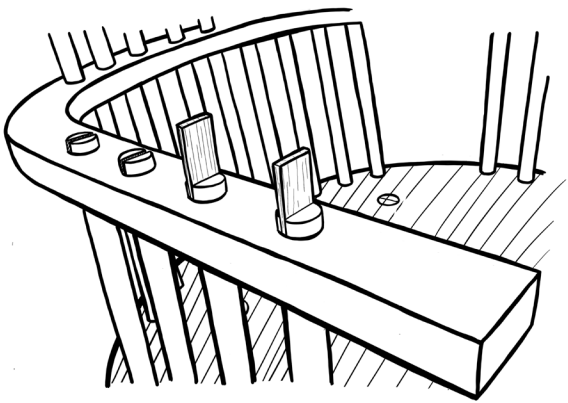
3. Glue the short sticks into the seat. Knock the sticks (and arm) until the arm is 8" off the seat.



4. Thread the long sticks through the arm and into their mortises.



5. Knock the long sticks into place. Check the height of the arm.



6. Wedge the tenons of the short sticks in the arm.

Have some water on hand.

Begin by putting some glue in a paper cup. Brush glue into the mortises in the arm for the eight short sticks. Paint a thin coat of glue on each short stick in the area that goes into the arm. Insert the short stick into the arm and rotate the kerf so it is perpendicular to the long edges of the arm. Repeat this process for each short stick.

Put the arm aside. Brush glue into the eight mortises in the seat for the short sticks. Use a little more glue than typical in these mortises because the short sticks are going in dry (clean-up will be easier this way).

Grab the arm assembly and push the short sticks into the mortises in the seat. Work quickly, but don't panic. Knock the short sticks down into their mortises. The arm should go along for the ride. Avoid hitting the arm unless you have to. To adjust the arm, hold a bit of scrap between the hammer and arm to avoid denting the arm.

Keep knocking the short sticks until they are all the way into their mortises. Knock the arm until the underside of the arm is 8" off the seat (measure this with your yardstick at several places and don't forget to measure at the back of the seat).

When the arm is in place, put glue in the nine mortises in the seat for the long sticks. Use a little more glue than usual. One by one, thread each long stick through the arm and into its mortise in the seat. Knock each down until it is seated fully.

Check the height of the arm on either side of the seat and at the back. Make any small adjustments to the height of the

arm with a hammer and a scrap of wood.

Now prepare to wedge the short sticks poking through the arm. If any kerfs have closed, open them up with a chisel. One by one, paint glue on a 5/8" wedge and drive it into the kerf. Hit it until it stops moving. Repeat.

Clean up glue squeeze-out with a toothbrush, water and a rag. Let the glue cure for at least 30 minutes. Then, saw the tenons on the short sticks flush (or nearly so).

This assembly process usually goes smoothly if you have prepared all your parts with care and have all the tools you need at hand.

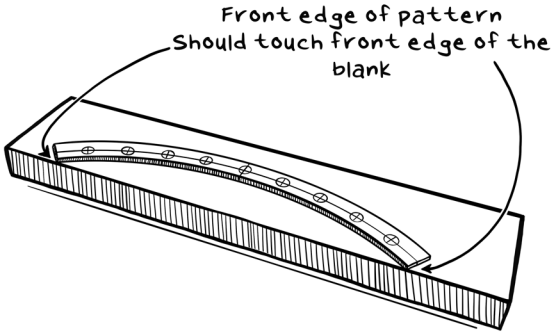
When things go awry, usually one of two things happen: 1) You crack the arm because you hit it too much (usually the plys delaminate) or 2) the glue locks the parts together before you can get them in place.

If the arm cracks or starts to separate, don't panic. Quickly swab some glue between the parts that are separating and clamp the plies together – mash them good. Then continue to knock the arm in place with the clamp still on the arm.

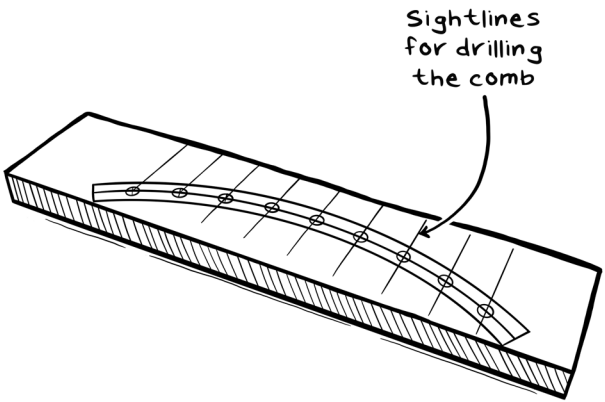
If the glue locks up your parts, again, don't panic. Yellow glue is elastic and easily reversed with heat. Use a hair dryer or (even better) a heat gun used for stripping paint. Wrap the joint in a moist towel to avoid scorching it. Blast it with heat for a minute or two. Then try to move the stick (or whatever has gotten stuck). This usually works.

If all else fails, remember that you can make another chair. You should be able to salvage a lot of parts from the messed-up chair to make your life easier with the new one.

And everybody screws up a chair or two as they are learning. I've botched my fair share.



1. Trace the comb pattern on the blank.



2. Draw the sightlines through the mortises,
90 degrees to the front edge.

11
ADD THE COMB

Tools & materials needed:
Board for comb
Sliding bevel
Drill
5/8" spade bit
Band saw or jigsaw
Sandpaper
Sanding block
Pegs
Drill bit for pegs
Glue
Hammer
Chisel
Brush for glue
Handsaw
Yardstick

THE COMB IS THE SIMPLEST PART of the chair. But getting it right requires a clear head because you are working upside down. It's easy to get turned around. That's because the mortises are angled, plus the front and back surfaces of the comb are also angled.

Place your comb pattern on your board so the comb is frowning at you. Place the pattern so the corners of the

frown touch the front edge of the board. Trace the comb shape and the mortise locations on your board.

Now, draw the nine sightlines on the board. Just like the nine sightlines on the seat, these are perpendicular to the front edge of the board and pass through each mortise.

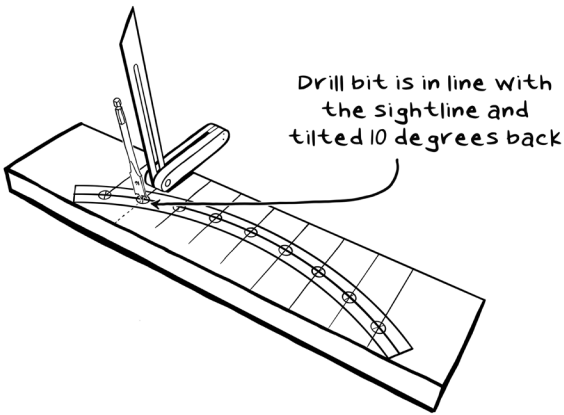
Clamp the board to your bench with the comb still frowning at you. Align the front edge of the board with the front edge of your benchtop. Set your sliding bevel to 10° (this angle is shown on the chair's pattern).

Place the sliding bevel on one of the sightlines with its blade leaning toward you. Wrap a piece of tape around the 5/8" spade bit so you don't drill through the comb and into your workbench (or dining table). This should be about 1-1/4" from the tip of the bit.

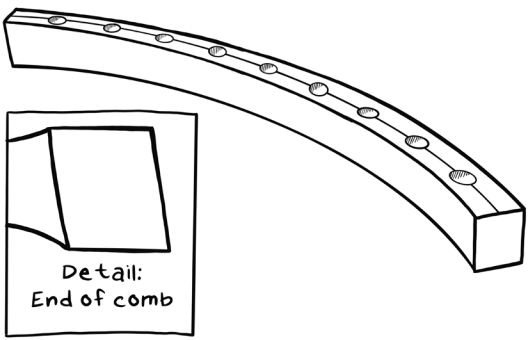
Tilt the drill bit 10° to match the sliding bevel. Make sure you are tilting straight back – in line with your sightline. Drill the mortise, stopping when the tape touches the comb. Repeat for the other eight mortises.

Now cut the comb free. Tilt your band saw's table 10°, or tilt the sole of your jigsaw to 10°. This is where it is easy to get confused. Use your sliding bevel to draw the 10° angles on both ends of the comb board. These lines will guide you. Saw out the comb. If you are using a band saw, make sure the inside curve of the comb faces the band saw's post during both cuts. If you are using a jigsaw, make sure the blade's angle lines up with the 10° marks you made on the end of the comb board.

Save the scrap from the cuts. These will become your sanding blocks to get the comb smooth.

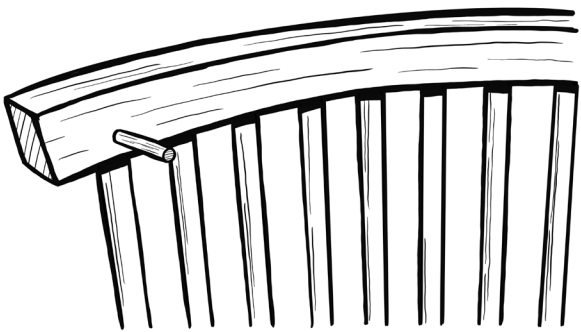


3. Drill the mortises into comb at a 10-degree angle.



4. Cut the front and rear edges
of the comb at 10 degrees.

ADD THE COMB



5. Glue the comb to the long sticks. Peg the comb and sticks.

Set the band saw's table (or the jigsaw's sole plate) back to 0° and trim the ends of the comb square.

Make the sanding blocks. Take the offcuts and saw a 6"-long chunk from the waste from both the inside curve and the outside curve. Clamp your comb in a vise. Wrap coarse sandpaper around the matching curved block and smooth the surface. Repeat for the other surface with the other block. Then, sand the comb with finer-grit sandpaper.

The ends of the comb can be left square, you can cut them at an angle or you can add an arc at the ends. The arcs shown on the chair in the book's Introduction are a 1-1/8" radius. Draw the arc on the front and the back of the comb on both ends. Connect the ends of the arcs across the top and bottom of the comb. Remove the waste with your block plane.

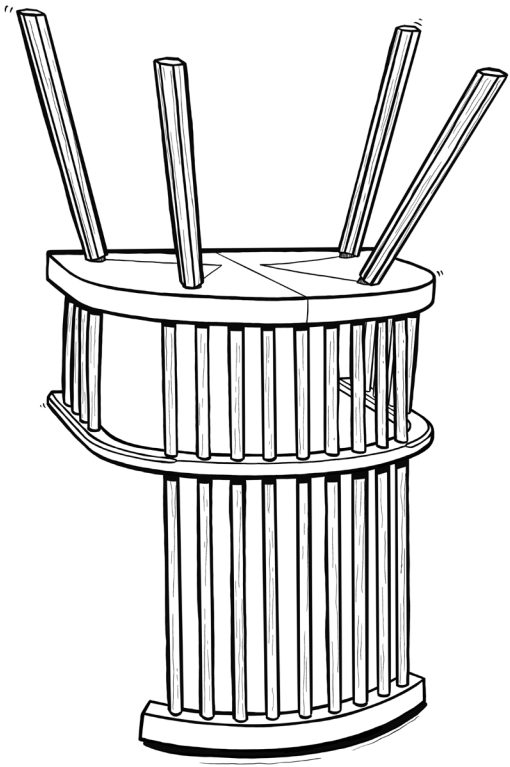
The long sticks should all be the same length above the arm. Use your yardstick to confirm this. Mark any that are too long and saw them down. The comb is attached with glue and pegs. First, make sure the comb fits on the sticks without glue.

If the sticks won't enter the mortises in the comb, the easy solution is to waller out the offending mortise a bit. Put the spade bit in the too-tight mortise, spin up the bit with your drill and wobble the drill a tiny bit to increase the diameter of the hole. Like dancing, it's not a science.

When everything fits, place the chair on its back on your workbench. Paint glue in the comb's mortises and knock the comb in place. Use your yardstick to confirm the comb is not crooked and is parallel to your chair's arm. Then drill holes through the comb and the two outer sticks for the pegs. Then drill a hole through the comb and the center stick. These three holes should pass through the sticks but not go all the way through the comb.

Whittle the tips of your three pegs. Put a dot of glue on the tip of one peg and drive it into the hole. Repeat for the other pegs. Then, cut the pegs flush to the comb.

Let the chair sit on its back for 30 minutes so wet glue doesn't leak out of the mortises and down your sticks.



1. First, paint the underside surfaces of the chair.

12
PAINT & WAX

Tools & materials needed:
Chalk paint
Wax, clear or antique
1-1/2" paintbrush, angled tip
Sanding sponge
Chip brush
Cotton shop towel or wiping cloth

MOST WOODWORKERS DISLIKE painted furniture because they are in love with wood grain. Clear finishes highlight the grain of the materials. Paint, on the other hand, shows off the silhouette or form of the piece.

You don't have to choose. You can like both paint and natural finishes. I do.

Because this chair is made of several different species, plus a plywood arm with raw edges, I think paint is the right choice. A clear finish will highlight the differences between the seat, arms, sticks and legs. Paint will unify them.

Feel free to try a clear finish first if you want to see for yourself. You can always paint over a finish after it has fully cured (curing usually takes three weeks).

A good paint for this chair is chalk paint, a water-based paint that dries to a flat, matte surface. There is no sheen. You can leave the finish as-is to burnish and age with use, or

you can add clear wax, colored wax or any clear finish over the chalk paint. Those topcoats will add some sheen and deepen the paint's color.

Here's how I apply the paint and wax.

First, put down paper on your bench and floor. Use sandpaper to ease all the sharp edges on the chair. Sand only enough to make the edges feel smooth. Dust off the chair, then place it upside down on the bench.

Begin painting everything you can easily reach with the brush. The legs, plus the undersides of the seat, arm and comb. Leave the sticks bare for now.

After painting those areas, grab the sticks and turn the chair over with its back facing you. Again, paint all the parts you can reach: the top of the arm, the back of the sticks, the seat area between the sticks and the back of the sticks.

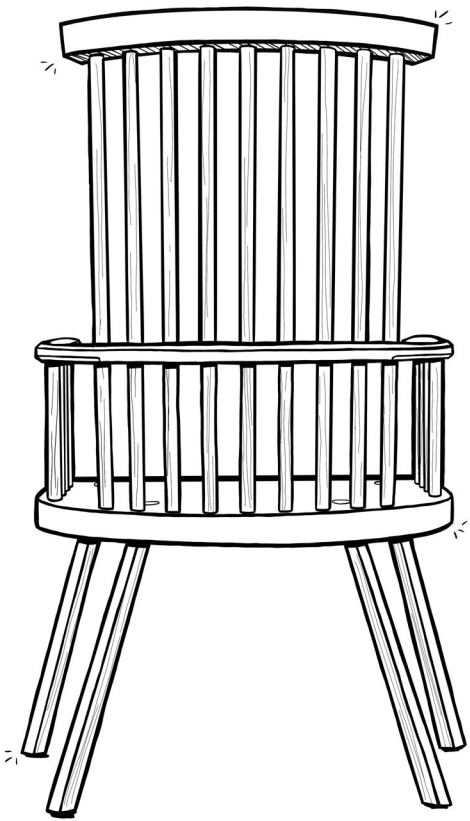
By now, the paint on the underside of the seat should be dry enough to touch. Lift up the seat and rotate the chair so its front faces you. Paint all of the remaining bare surfaces.

After you are done, use a lamp without its shade to look for bare spots that you missed and touch them up. Let the paint dry for about four hours (or longer, if necessary).

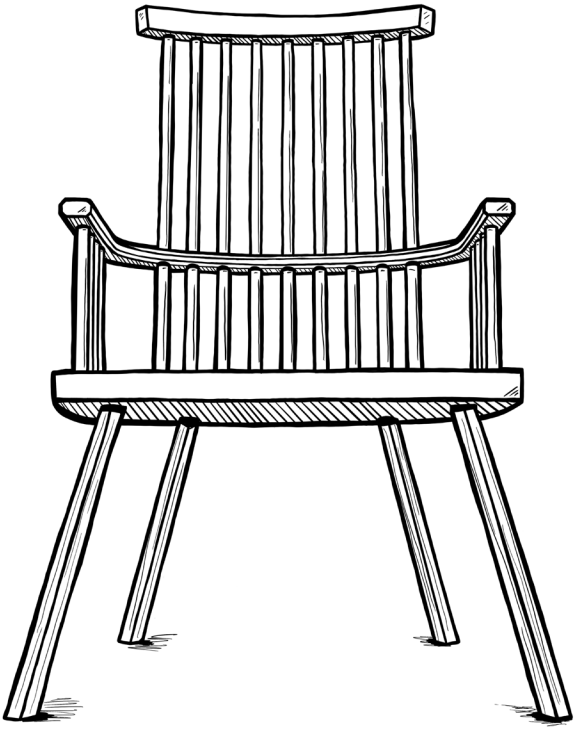
Level the first coat of paint with a #320-grit sanding sponge. Sand lightly to level the finish and remove any nibs in the paint. After you are done sanding, dust off the chair.

You can stick with one coat of paint if you like – most chalk paint covers quite well. A second coat provides more protection. Paint on a second coat on the chair's show surfaces only. Let that coat dry.

Feel the surface of the chair. If it feels rough, sand lightly



2. Paint the back surfaces of the chair.



5. Paint all the remaining surfaces.

again with the sanding sponge. If it feels fairly smooth, get out the wax.

Apply the wax with a chip brush. Brush it on like a thin coat of paint to the legs. Wait five minutes, then buff it lightly with a wiping cloth. A good deal of the wax will come off on the rag. That's OK.

Now wax and buff the seat. Then the arm and the sticks under it. Then the comb and the rest of the sticks.

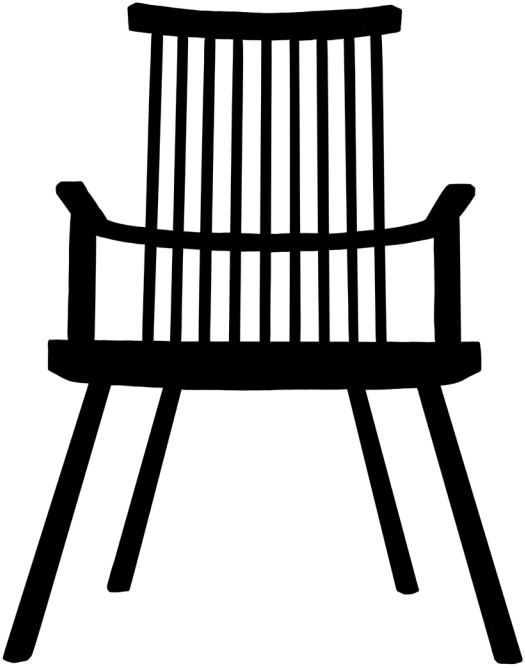
Whatever you do, don't apply wax to the entire chair and then buff it. The areas that you waxed first will be difficult to buff .

After a first buffing, look at the chair as a whole. Look for globs of wax you missed. Buff those. Let the wax dry overnight. The next day, you can still buff it, but the wax will be tough to remove.

Wax is forgiving. If you have a spot where there's too much wax and it has dried, apply a little fresh wax. The solvent in the fresh wax will loosen up the wax on the chair, and you can adjust things to your liking.

If you hate the wax job altogether, you can remove the wax with mineral spirits and a rag.

The final step is optional: Add some soft pads to the bottom of the chair's feet to protect your wooden floors. The adhesive-back felt feet sold at home centers are terrible and will fall off immediately. Don't bother. The only way to get those felt pads to stick to the legs is to use a two-part epoxy. Or you can cut out some leather scraps from some old shoes or work gloves and epoxy those in place.



AFTERWORD

IF I TOLD YOU that everything you needed to know to build a chair was in this book, that would be panda shit.

You probably still have 100 questions about chairmaking and chair materials, but don't let that stop you from making a chair. Because I can tell you that there are only three answers to your questions:

1. Probably.
2. Maybe.
3. You are going to have to try it for yourself.

"Is the grain in this stick straight enough?"

Prop the ends of the stick on some small blocks of wood and hit it with a small sledgehammer. That small act will teach you more about grain and wood structure than a week at the library.

"What's the weight limit on this chair?"

Build the seat and the legs and sit on it. You will know the answer immediately. If the legs feel too strained under your weight, you can add stretchers to shore them up. How do you add stretchers? There are maybe 100 people out there

who can tell you that in videos, magazine articles and books. Most of them are free.

"Can I use XXXX species for this part of the chair?"

Buy a small chunk of that species of wood and take it home. Get out a butter knife to act as a froe. Split the wood between the annular rings. Split it across the annular rings. Examine how the wood fails with every split. Put the split pieces back together to understand the split in three dimensions. Take some stick- and leg-shaped pieces and break them with a hammer. Shave and plane the wood.

After about an hour of dissecting this block of wood, you'll know more about the species than most of the people who work with it every day.

"But I want to build a lowback chair."

If you are waiting for the perfect design to start learning chairmaking, you might not ever begin. The first chair I built wasn't the design I desired in my head. Neither were my second or third chairs. And even if you do build your "perfect design" on your first attempt, that chair is probably going to have structural problems – or at least be wonky. I don't know a single person who was 100-percent satisfied with the first chair they made.

And whatever you do, know that people have made nice chairs using crappier material than what's at a home center. After years of studying folk chairs, I am astounded by how

well chairs live on with thin pine seats and arms that have the pith running through them.

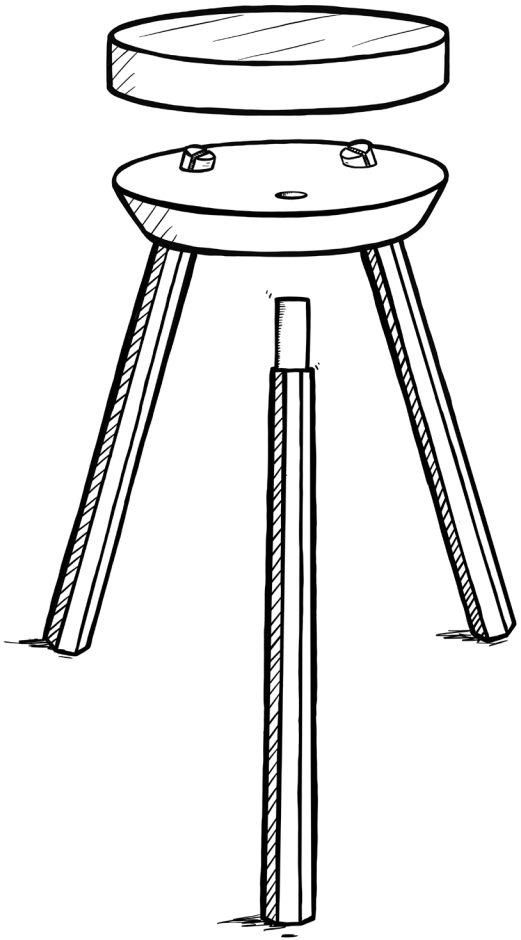
The point here is that it's now time to start answering your own questions. This book takes down one of the major barriers to chairmaking that I hear every day:

"I can't get good material."
"There isn't a lumberyard near me."
"I can't afford the materials."

If you think you can't build a chair now, maybe instead it's that you won't. And maybe it's time to invest in some golf clubs instead.

Answer your own questions. Find out for yourself what is bullshit and what is not.

Do that, and you can call yourself a chairmaker.



APPENDICES

STOOL FROM LEFTOVER BULLS%$T

Tools & materials needed:
2 seat scraps: 1-1/2" x 11" x 11"
3 legs: 1-1/2" diameter x 20"
Glue
Clamps
Band saw
Sandpaper
Sanding block
Compass (or a yardstick, plus a nail and a pencil)
Sliding bevel
Drill
1" auger
Wedges
Block plane
Hammer
Bubble level (on your combination square)
Handsaw

AFTER YOU MAKE a chair or two, scrap begins to accumulate, especially if you make a mistake or two during the process. Whenever my scrap pile allows it, I make a three-legged stool. We use them in the shop, or I sell them for beer

money. Plus I can build a stool in a few hours.

Building this stool uses the same materials, tools and processes as building a chair, so almost all the steps will seem familiar.

Except the first step.

The stool's seat is made from two scraps measuring 1-1/2" x 11" x 11" that are glued face-to-face to make a seat that is 3" thick. Make sure the two boards mate without a gap. You can plane away high spots to get them to fit together. Apply glue to one surface, trowel the glue evenly with a scrap of 5mm underlayment, then place its mate on top.

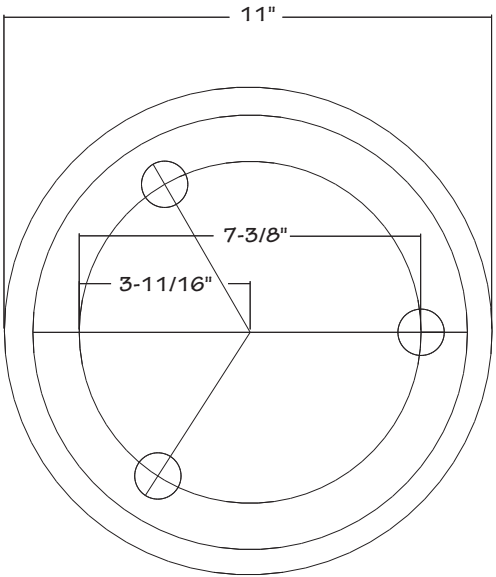
Clamp the two boards together. If you have more than three clamps, use those as well. After an hour, remove the clamps.

Draw an X from corner to corner to find the seat's midpoint on the underside of the seat. Scribe an 11"-diameter circle there. If you have a school compass, use that. If you don't, you can quickly turn your yardstick into one. Drill a small hole in the yardstick at the 1" mark. Then drill a second hole at the 6-1/2" mark. Push a nail through the hole at 1" then drive the nail in a bit at the seat's centerpoint.

Now, place the point of a pencil in the hole at the 6-1/2" mark and swing the yardstick around the nail.

Cut out the seat's shape on your band saw. Then set the band saw's table to 30° and cut an underbevel on the bottom half of the seat. The seam between the two seat pieces is the line to follow with your saw blade.

Now, lay out the joinery on the underside of the seat. After cutting the bevel, the underside of the seat should be



Underside of the three-legged stool

about 9-3/8" in diameter. To lay out the mortises, first scribe a circle that is 7-3/8" in diameter on the seat's underside. Use your compass, or drill a new hole in your yardstick at 3-11/16" and make the circle.

Keep your compass/yardstick at this setting because it will lay out the locations of the mortises. The radius of a circle is approximately one-sixth of its circumference. So choose a location for one of your mortises somewhere on the 7-3/8" circle. Then make two steps around that circle with your compass/yardstick. Where you land after two steps is the

location of the second mortise. Then make two more steps – that's the location of the third mortise.

Connect these mortise locations with the center point of the seat. These are your sightlines.

Set your sliding bevel to 18°. Place it on a sightline. Then, drill a hole at that location that is 2-1/4" deep and follows your sliding bevel. The hole should not go through the seat. Repeat the process at the other two mortise locations.

Clean up the machine marks on the seat with your block plane and sandpaper.

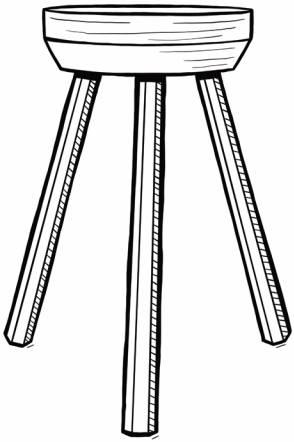
The legs for this stool are made exactly like the legs for the chair. If you start with round stock (such as handles for a post-hole digger), cut the tenons on the band saw. Make them 2-1/4" long. If you are making the tenons with a block plane, then plane and test the tenons until they all fit.

Then, taper the legs down to the tenons with a block plane. Keep the legs round, or make them octagonal.

Assemble the stool. Paint glue in one mortise, then paint glue on its tenon. Drive the leg home. Repeat for the other two legs. Let the glue dry for an hour.

The last construction step is to level the legs and set the seat height. Place the stool on a flat and level surface. Use your bubble level and wedges to level the seat, both front-to-back and left-to-right.

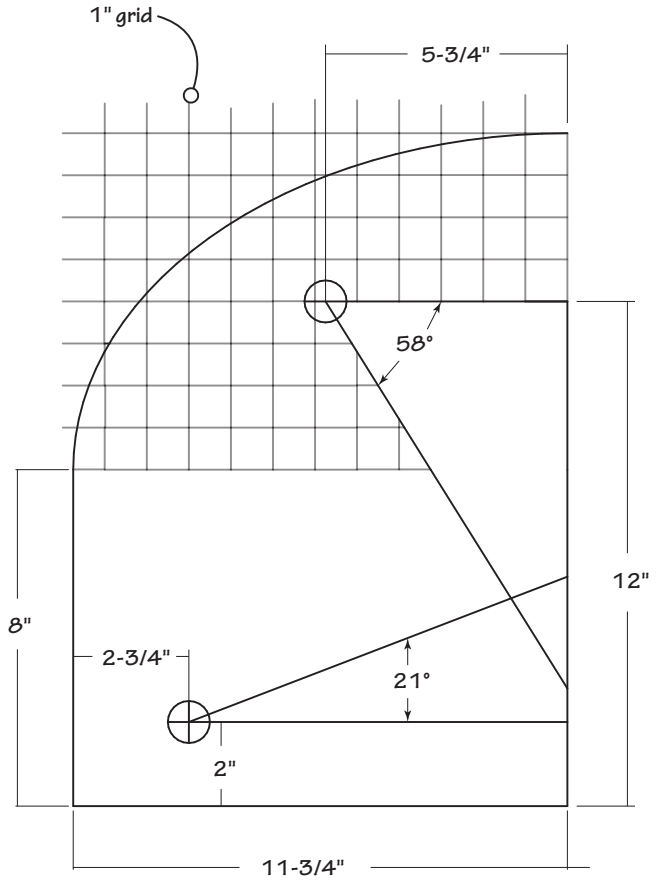
Then decide what the seat height should be. (Most people copy the height of their favorite existing stool. I like 17-1/2".) Tape a pencil to the blade of your sliding bevel. Hold your yardstick to the seat at the desired measurement. Move the blade of the sliding bevel until the tip of the pencil con-



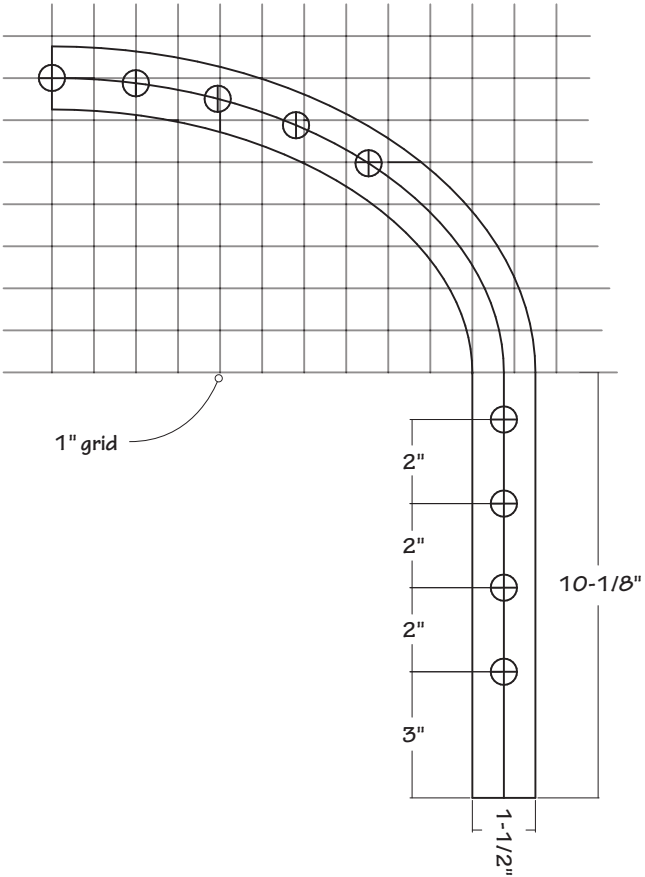
tacts the tip of the yardstick hanging down. Then scribe that distance around all three legs. Saw the legs to length, following your pencil lines. Sand the fragile edges of the feet.

For this stool, I usually paint the legs and the underside of the seat. I leave the top of the seat bare wood. (If I get paint on the top of the seat, I plane it off after the paint is dry.) If the grain behaves, a simple wax finish is enough for a shop stool.

GRIDDED CHAIR DRAWINGS



Gridded diagram of the chair seat



Gridded diagram of the chair arm

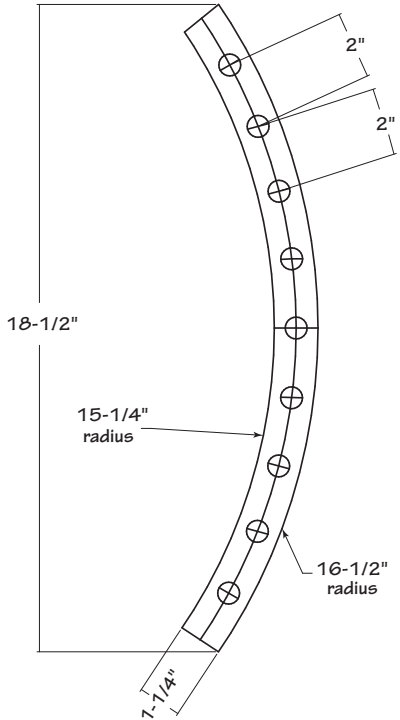


Diagram of the chair comb

CHAIR CUTTING LIST

No.	Item	T	W	L
1	*Seat*	*1-1/2″*	*16″*	*24″**
4	*Legs*	*1-1/2″*	*1-1/2″*	*20″*
1	*Armbow*	*3/4″*	*18″*	*23″*
9	*Long sticks*	*5/8″ diameter*		*25-1/2″*
8	*Short sticks*	*5/8″ diameter*		*10-1/2″*
1	*Comb*	*1-1/2″*	*5″*	*21″**

*slightly oversized for trimming

Note: Full-size PDF patterns for the chair are available for free download at lostartpress.com. You can then print out the patterns at any office supply store or reprographics supply store.

COLOPHON

"Build a Chair from Bulls%$t" is set in Garamond Premier Pro in 11-point type on a 13-point grid. Keith Mitchell's illustrations use a custom font called "Keiths Hand" in 9-point type. The book block uses #70 coated matte paper, which has been Smyth sewn with cotton covered nylon thread. The cover is Brillantia 4009 cloth on 98-point boards with Lustrofoil Matte 197 stamped on the cover and spine. The end sheets are in Rainbow Earth. Printed in Michigan, USA, for Signature Book Printing and Lost Art Press.