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Delaware Chair

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By Kerry Pierce

The inspiration for this chair came from an original built in Delaware in the 1700s. The design, a transition between elaborate carvings and simpler styles, was built, unchanged, for nearly a century.

Post-and-rung chairmaking, the discipline practiced in the construction of this chair, is a bit of a woodworking outlier. It involves some uncommon skills like bending wood, dealing with complicated (non-90°) geometry and weaving a seat. And, it doesn't proceed from measured drawing directly to the fabrication of wood components. Instead, there are some critically important intermediate steps involving the construction of simple jigs, some bending forms and a variety of patterns and story sticks.

These devices make it possible to fabricate accurate components in relative ease — once you've got them in hand, you'll be able to make as many copies of this chair as you like, without ever once taking out your rule or tape measure, or referring to the measured drawings. Plus, you can use the mortise jigs and bending forms for this chair in the construction of almost any post-and-rung chair.

The Role of Story Sticks

Before you can begin any chairmaking operation, you need to understand the role of the four kinds of story sticks in the process. The first is the simple pattern that presents the profiles of slats and arms. The second is a stick cut to the length of the rungs with the tenons marked on each end, as well as any ornamentation — such as is found on the front "show" rung or stretcher. The third

is a length-measuring stick for elaborately turned items [Photo 1]. The last is the post stick, which not only provides the overall length of the part but also the lengths and diameters of the turned elaborations along that length. On one side of the post stick, you'll find the mortise locations for the front-rung mortises; on the back of that stick, you'll find the locations of the side-rung mortises.

This particular chair requires a front-post stick (shown in Photo 2), a back-post stick and sticks for the front, back and side rungs. These should all be cut to the full length of the finished parts they represent. On this chair, the back seat rung is shorter than the back "show" rung, so on the back-rung story stick, you need to mark off two different lengths. (This difference is a result of the fact that the chair's back ladder tapers as it rises from the floor.) In addition, this chair requires two length-measuring sticks, one for the front show rung and another for the front post. In Photo 1, you'll see a length-measuring stick in use.

By referring to a story stick, you can quickly mark off turned elements, making it easier to make multiples of those parts.

Turning the Parts

Thirty years ago, when I decided to shift my woodworking efforts from casework to chairmaking, I searched for lathes capable of the 44"-46" between centers that back posts typically require — and could not find any for under a grand in 1985 dollars. My solution was to alter a $220 Craftsman lathe so that it could accept parts of theoretically infinite length. [Photo 3]

Photo 1

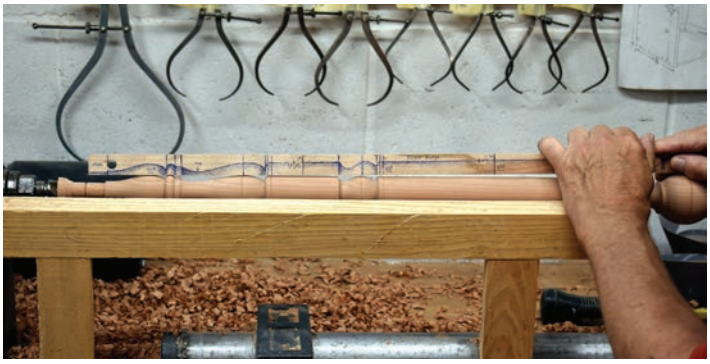
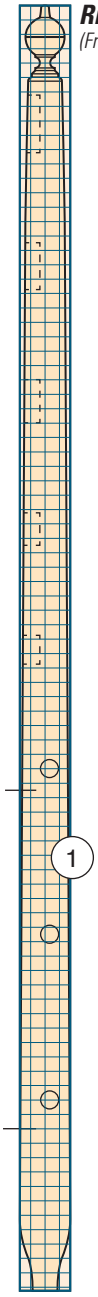


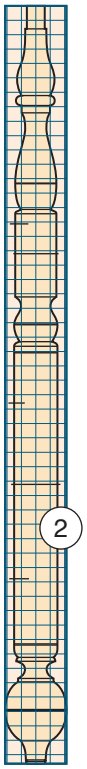
Photo 2

Photo 3

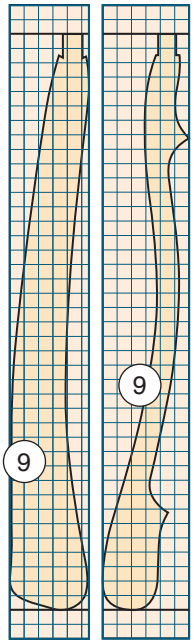


Right Back Post
(Front View)

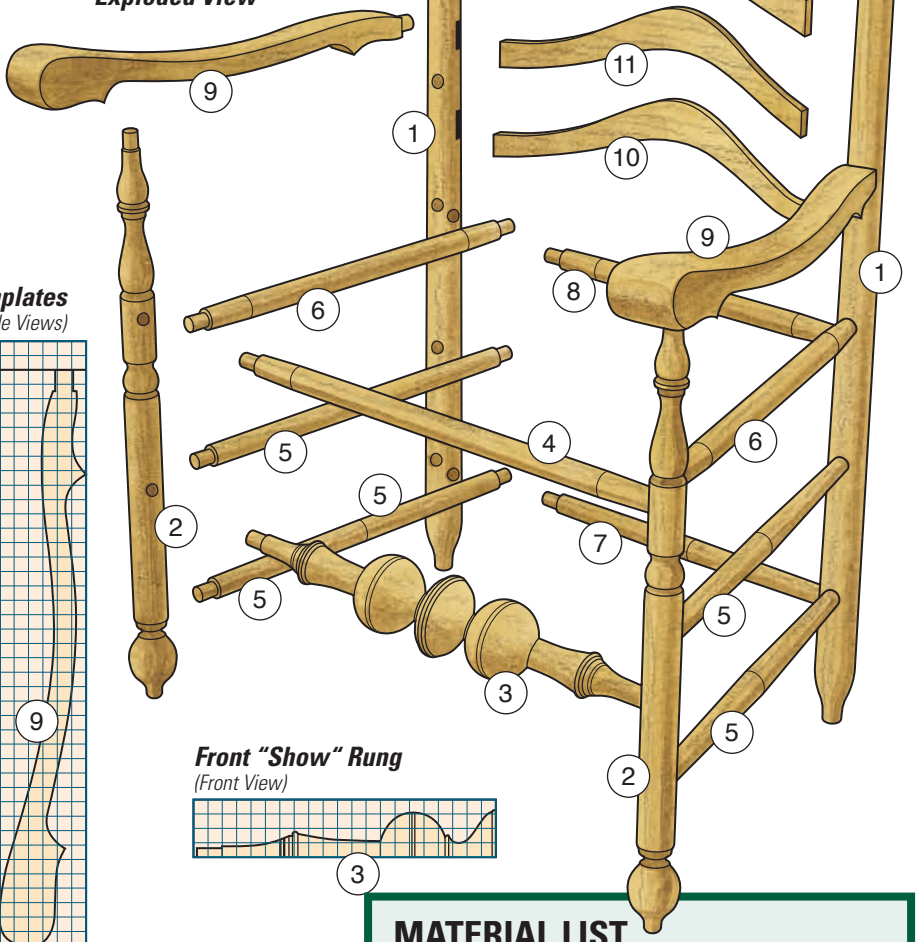
All gridded drawings
Each square = 1/2"



Front Right Post
(Front View)

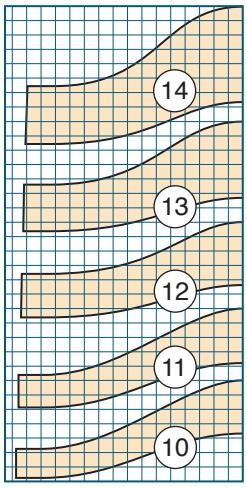


Arm Templates
(Top and Side Views)

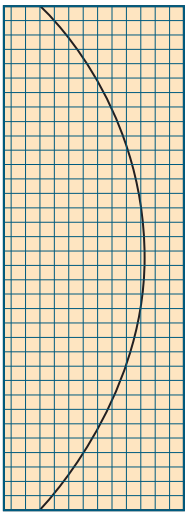


Exploded View

Front "Show" Rung
(Front View)



Slat Profiles
(Front View)



Slat Bending Jig
(Top View)

MATERIAL LIST

		T x W x L
1	Back Posts (2)	1¾" x 1¾" x 44⅝"
2	Front Posts (2)	2⅛" x 2⅛" x 26 5/16"
3	Front "Show" Rung (1)	3⅛" x 3⅛" x 20¾"
4	Front Seat Rung (1)	1" x 1" x 20¾"
5	Side "Show" Rungs (4)	1" x 1" x 17¾"
6	Side Seat Rungs (2)	1" x 1" x 17¾"
7	Back "Show" Rung (1)	1" x 1" x 16¼"
8	Back Seat Rung (1)	1" x 1" x 15⅞"
9	Arm Blanks (2)	2¾" x 3" x 22"
10	Slat #1 (1)	5/16" x 3½" x 15⅞"
11	Slat #2 (1)	5/16" x 3⅝" x 15¾"
12	Slat #3 (1)	5/16" x 3⅝" x 15⅝"
13	Slat #4 (1)	5/16" x 4 3/16" x 15¼"
14	Slat #5 (1)	5/16" x 5½" x 14⅞"

I'm a self-taught turner, and my toolkit is quite small, consisting only of the four tools you see in Photo 4. At the top is a 1½" roughing gouge; below that a 1/4" spindle gouge; below that a 1/2" skew with square corners, and finally, at the bottom, you see a tool I use for creating rung tenons.

You begin the creating the turned parts for this chair by converting the square turning blanks into appropriately sized cylinders using your roughing gouge, as shown in Photo 5. Please notice the homemade length-of-part tool-rest I'm using on this front post blank (you can see it better in Inset Photo 5). I believe it simplifies the turning process by eliminating the necessity of moving the rest along the bed (although my belief is often not shared by some more highly skilled lathe technicians).

With a pair of calipers, check the diameter of the part (Photo 6). With a pencil, indicate the lengths of the part's turned elaborations (Photo 7). Next, mark these locations with lines lightly inscribed

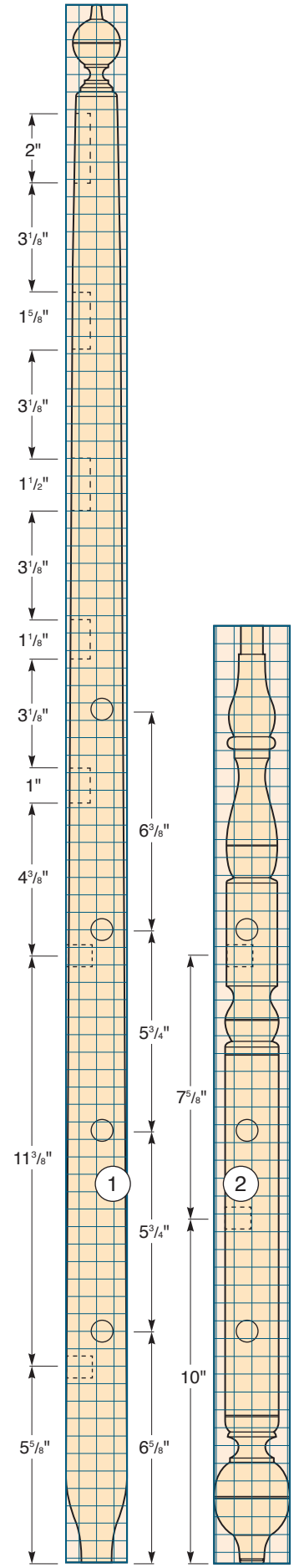
Photo 4

Photo 5

Photo 5 Inset

Photo 6

Photo 7



with the point of your skew resting on edge with the point down (Photo 8).

My turning techniques, developed myself over more than 40 years of turning, are somewhat idiosyncratic. When I'm forming the convex element of a bead (or a half bead, as I'm doing in Photo 9), I begin with my skew resting on one corner tilted at a 30° angle just north or south of the inscribed line. I then bring the tip into the work and roll it into the line, taking care not to touch the work with any part of the skew's edge other than the point. Repeated cuts of this type can create a clean-surfaced convex shape of any size.

Although I start my beads with my skew, I do most of my actual shaping of beads, and all my shaping of coves, with a 1/4" spindle gouge. In Photo 10, I'm creating a large cove by rolling the gouge toward the center of the cove while keeping the gouge's bevel tight against the work. I use my skew to cut the small lip and filet adjacent to the front post's large cove (Photo 11).

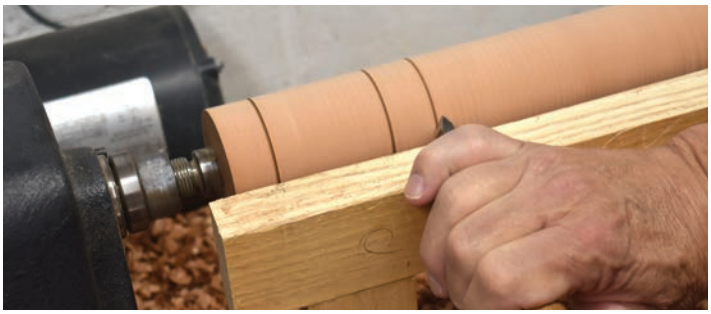


Photo 8

Photo 9

Photo 10

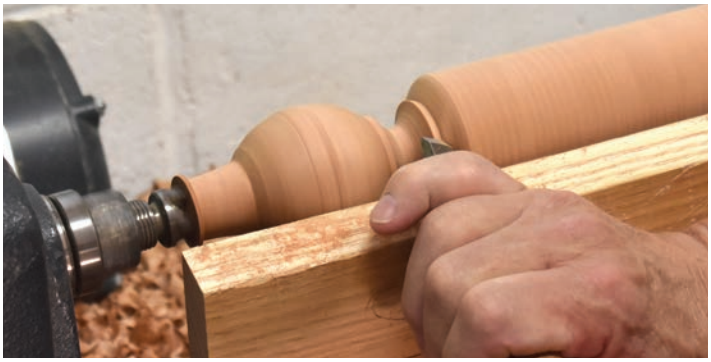


Photo 11

In Photo 12, I'm using the same gouge — again with the ground bevel tight against the work — to finish the shaping of a giant bead, in this case the ball at the bottom of the foot. You can create beads using nothing more than your skew, but it's tricky to do much more than start a bead with that tool — at least it is for me. I find it's much safer to switch to my gouge once the bead has begun to take form.

I do my lathe sanding with 2"-wide shop rolls. If you have some really rough surfaces, you might want to start with 100-grit, but more often you'll fiind that 150- , then 220-, then 320-grit, is enough.

Long, Slender Turnings

Long, slender components, like the back posts of this chair, tend to flex away from the lathe tool. Successful turning of such components requires several accommodations.

First, I turn that half of the post closest to the head stock; then flip the post end-for-end so that the unturned end is closest to the headstock. This allows me to take advantage of the fact that the headstock is much more stable than the tailstock. Second, once one end of the post is roughed in, I increase the lathe's speed from about 875 rpm to about 1,350 rpm. For reasons I'm not physicist enough to explain, this extra speed helps to stabilize the spinning part under your lathe tool.

Third, when turning long, slender parts, it's absolutely essential that you learn to use your off hand as a steady-rest, as I'm doing in Photo 13. Notice that the thumb of my off hand is on the roughing gouge to keep it in place, and the palm of that hand is supporting the back side of the spinning part to reduce its tendency to flex away from the tool's cutting edge. Although you can't see it in this photo, my fingers are dangling, not wrapped around the spindle. Wrapping could cause my fingertips to be drawn into the gap between the part and the rest. Notice also that the thumb of my off hand is resting inside the roughing gouge. This helps maintain the tool/work interface. Without this off-hand steady-rest (or an engineered metal steady-rest), it's impossible to turn such long, thin parts.

And fourth, you must be patient. While you can work pretty aggressively on those sections of the back post near the head stock, when you're working near the middle of the part's length, you must be patient enough to remove material in very small increments.

A word about safety here: Although I've turned hundreds of back posts and thousands of chair parts without injuring myself, on one occasion, a back post I was turning broke free from the centers and cartwheeled through the air of my shop, tapping me lightly on the shoulder as it passed. I don't know what went wrong, but I suspect that I had not sufficiently secured the part in the lathe before turning the machine on. A lesson in the cost of absentmindedness. Before attempting to turn anything in your lathe, be sure you have tightened up the tail stock so a turning blank won't cartwheel through your shop, possibly causing serious injury. (You'll also want to inspect your turning blank to be sure that it has no sections of decaying wood, no cracks — nothing that could cause it to come apart under the stress of being turned.)

Photo 12

Photo 13

Marking for the Mortises

The key to successful chair construction is the accurate marking, boring and chopping of the many mortises on each of the chair's four posts.

Before that happens, of course, I have made the tenons for these mortises. After I've converted a 1"-diameter rung blank into a cylinder in the turning process, I mark the tenon shoulders with an incised cut. I then hollow out the tenon until its least diameter is 5/8", and I finish the tenon using my upside-down chisel as a scraper.

Now, the mortise marking process begins by drawing two lines along the lengths of each post exactly parallel to the post's axis of rotation. One line represents the rung-mortise locations on one face of the chair. The second line represents the mortise locations on the adjacent face of the chair.

To make these lines, you need two things: First, you need a way of dividing the outside diameter of the post into equal segments and then locking the lathe's rotation at any of these divisions. You can achieve this by using your lathe's indexing head.

The indexing head on your lathe is a metal disk centered on the lathe's axis of rotation. A number of holes are drilled into the periphery of that disk, dividing the rotation into equally spaced segments. My lathe has 36 of these holes, which allows me to divide the part's rotation — and therefore its outside diameter — into 36 equal segments, each of which represents 10˚of the post's outside diameter. These 36 stops are counted off through the use of a spring-loaded pin on the headstock. This pin also allows me to lock the lathe's rotation at any of these stops. You will want to use your indexing head to get as close as possible to 80˚ on the front posts and 100˚ on the back posts.

The other thing you need is a simple little jig that will hold a pencil so that its point is exactly the same distance from the bed of your lathe as the lathe's axis of rotation (Photo 14). Once you've selected which face of the post will be facing forward, lock the indexing head, and — with the jig — draw a line along the length of the post. The mortises on one side of the post (in this instance, the front-rung mortises) will be bored along this line. Then, move the indexing head eight stops, relock the head and draw a second line along the length of the post. The mortises on the second side of the post (in this instance, the side-rung mortises) will be bored along this line. You've now drawn two lines 80° apart, each perfectly parallel to the lathe's axis of rotation.

An important note here: you need to mark both a right and a left front post *and* a right and a left back post. To achieve this, I use the indexing head pin to lock the lathe's rotation with the desired grain facing *up* on a front post, then use my jig to draw a line for the front-rung mortises along the length of the post. Next, I click off eight counterclockwise stops on my indexing head, lock it, and draw a second line along the length of the front post for the side-rung mortises. Then I place the *other* front post in the lathe with the desired grain facing *down*, toward the lathe bed, and lock the indexing head to draw a line for the front-rung mortises. Eight clockwise stops on the indexing head brings me to a lock position for a second line for the side-run mortises. Repeat for the back posts.

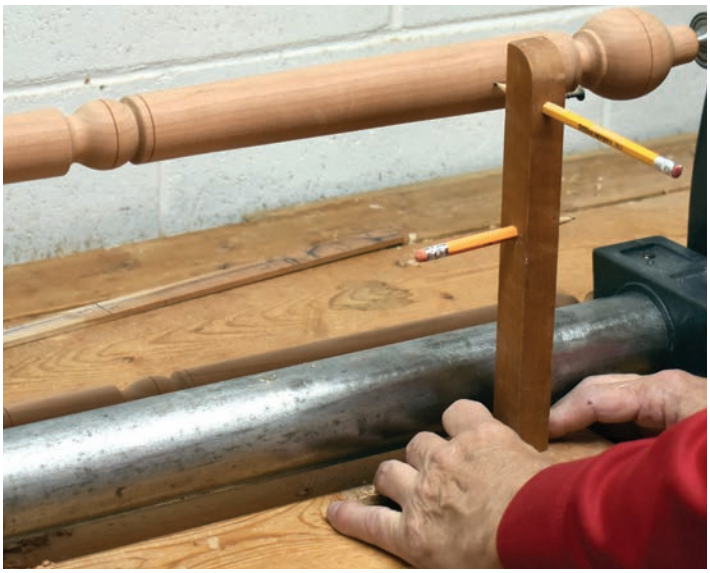


Photo 14

If you do a few practice runs with your marking, checking after each to make sure you the lines in the right places to produce right and left front and back posts, you can save yourself some grief at assembly. The checking process is pretty simple: Once you've established lines on all four posts, gather them in your hands in the positions they will occupy in the finished chair. If your two front mortise lines meet, and your two back mortise lines meet, and boht sets of side mortise lines meet — you're in good shape.

After the lines have been located on the outside diameters of your posts, it's time to once again pick up your story stick. After you've marked the locations of the rung and slat mortises on the back posts, while the post is still mounted in your lathe with the indexing head's pin engaged to stop the part's rotation, use a marking knife to lay out the limits of the slat mortises. Unlike the rung mortises, which are centered on one of the lines you just made, the slat mortises are laid out with that line marking their fronts. The back side of each slat mortise is 5/16" (the thickness of the slats) behind the line. The little marking jig shown in Photo 15 — which consists of a bit of wood screwed to a 6" metal rule — comes in very handy for scoring the limits of slat mortises on round posts because it has two points of contact, holding the straightedge in constant alignment.

Front- and Back-Rung Mortise Jig

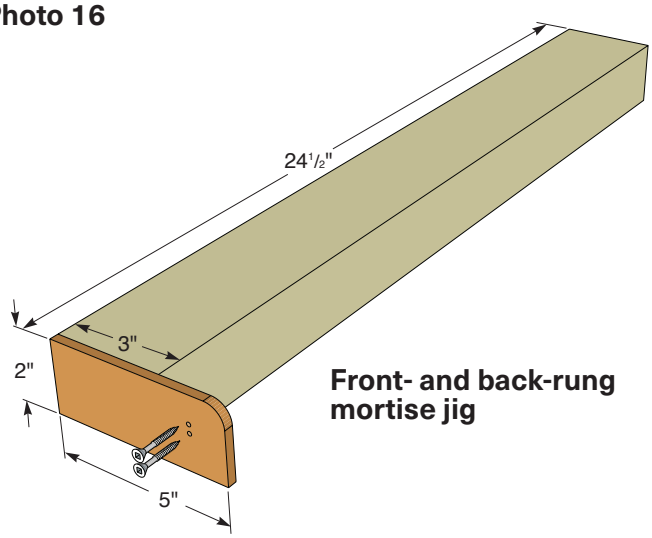
The various front/back and side-rung mortise jigs I've designed over the last 30 years have all been positioned on a 13" x 28" wood deck I've fixed to the small metal table that came with my drill press. Those dimensions shouldn't be taken as exact. They probably represent the length and width of a glued-up panel I pulled from a bunch of oddments leaning on my shop wall. But you will need a wooden deck of approximately that size on which to secure your mortise jigs.

Now to the front- and back-rung mortise jig: The purpose of this simple construction is to prevent the posts from rotating as they're passed under the lead point of your Forstner bit. If the post is not in exactly the same rotational position for drilling each mortise, you'll find that your rungs are jutting out in different, hard-to-reconcile angles. Before you lock that rotation, you need to determine that the lead point of your Forstner bit can enter the post at the center of its width. While this can be established via measurement on posts with consistent diameters, the tapered posts on this chair require a different approach. To make your determination, you need to eyeball the Forstner bit's lead point from the end of the post to see that it will enter the post halfway across its diameter. Perfection isn't required: If you're as much as 1/16" off in your estimation, the chair will come together just fine.

When the rotation of the post places the bit's lead point in the correct position, lock the rotation by turning two screws into the bit of scrap at the top of the front post (and into the foot of the back post). After locking this rotation, you will sight along a post and move the jig and post from side to side until you're in the correct position to drill a mortise (see Photo 16). The post is tapered, so you can't simply hold it against a fixed fence.

Photo 15

Photo 16



Front- and back-rung mortise jig

A cautionary note: it's very easy to start drilling the side-rung mortises when working with this jig, and you must NOT do that.

With this jig, on the front posts, you will drill the front-rung mortises and, on the back posts, you will drill the back-rung mortises. If the post had a consistent diameter from one end to the other, you could set the depth of cut once, then drill each mortise, but here, too, the tapered front and back posts complicate the situation. My approach is to measure the depth of each mortise as I go, checking until each has reached the ideal depth of 15/16".

Slats and Slat Mortises

There is a good bit of preparation that must take place before chopping the slat mortises. In the case of this chair, I cut the slats from leaves consecutively sawn from a single block of cherry. Sometimes that isn't possible, however, and you have to match up material taken from several different sources. To reduce the likelihood of slats cracking during the bending process, grain should run generally from end to end.

After sawing out and planing your slats to a thickness of 5/16", cut out their profiles on the band saw. Then clean up the bandsawn edges with a spokeshave and a sharp rasp. The bottom of each slat is left perpendicular to the front and back faces, but it's important to have curves that arch smoothly along that bottom. The front of the slats' top midsection should be radiussed, as seen on the rear slat I'm holding in the pair in Photo 17. These radii disappear at the ends of the slats, where they will later enter the posts. The slat in front has not yet been radiussed, but it does have radius guidelines sketched in.

Once the slats' top and bottom edges have been refined, it's time to plasticize the wood prior to bending. Usually, I do this in a steamer, but the box on my steamer is a 4" length of PVC, which is too narrow for the width of the top slat, so I resorted to Plan B: placing the slats in a large turkey pan on our range and boiling them for 30 minutes. The actual bending is done between forms held in a vise and several pipe clamps. Photo 18 shows a form holding slats #1-#4, while Inset Photo 18 is a form holding three #5 slats. The slats need to be bent in separate forms because slat #5 is taller and it could bend forward over the shorter slats and then carry their impression in its face.

Keep the slats in their bending forms for at least five days. When you take them out, you may see that the profile of one of the smaller slats is imprinted on the adjacent, larger slat. You can remove most of this imprint by dribbling on a little water and letting the slat dry. Any imprint that remains can be removed with sanding.

Photo 17

Photo 18

Photo 18 Inset

Photo 19 is perhaps the most important photo in this article because it shows the essential relationship between the angles of the back post's rung mortises and its slat mortises. In order to chop properly angled slat mortises, you must understand what you're seeing in this image. The rung mortise on this back post was drilled directly on the line drawn with the post marking jig. The mortise for the slat you see arcing out of the post was cut with that line marking the front side of the mortise. Notice also that the slat mortise was cut so that the ends of the arcing slat both engage the position of the two back posts: one present, one not. This relationship between the angle and position of the rung mortise and the slat mortise is critically important. If the slat mortises are chopped at incorrect angles, the back ladder won't come together.

Assembly and Angles

When the slat mortises have been chopped (Photo 20), it's time to assemble and glue up the back ladder.

Photo 19

Photo 20

First, lay out all of the ladder's components, along with glue, a brush and a soft-headed mallet (Photo 21). (If you're a chairmaking first-timer, you might want to enlist an extra set of hands.) It's important to also have a preset pipe clamp nearby to aid in seating slats. Apply glue to each tenon and in each mortise, then push the tenoned components into place. Even if you planed narrow bevels onto the ends of the slats, they will often stick in their mortises during assembly. To seat them, tighten a pipe clamp across the ladder, then squeeze the pipe and slat together (Photo 22). This will pop the ends of the slats into place.

After assembling the ladder, you'll need to determine if the angles at which the back posts rise from the floor are the same. I place a framing square beside each post and evaluate the post angles by measuring, with my eyes, how well one side agrees with the other. Rack the ladder into correct alignment by keeping the base of one post on the floor, then pressing down on the other. It might require several attempts to align the ladder properly. You must also sight down on the ladder from above to determine if its components are in the same plane. You can correct any error by locking the back posts between your feet, then twisting the top of the ladder (Photo 23).

The front ladder is then assembled in the same manner, once again evaluating the angles at which the posts rise from the floor by eyeballing the relationship between those posts and the vertical leg of a framing square.

Photo 21

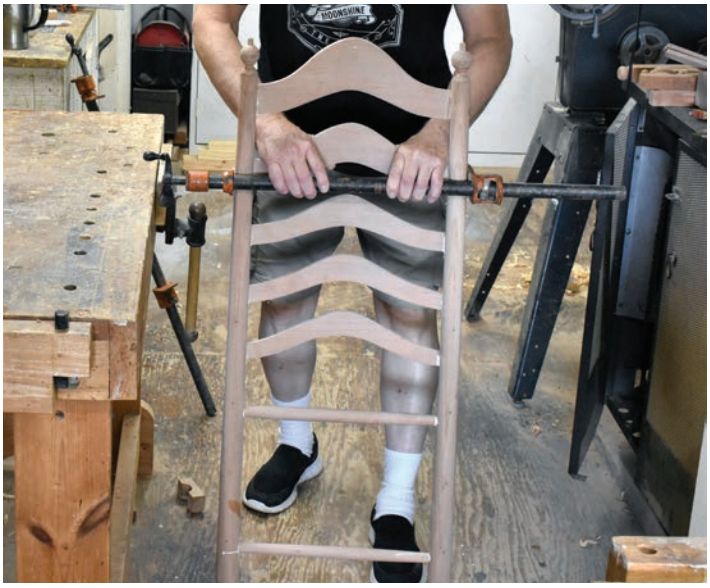
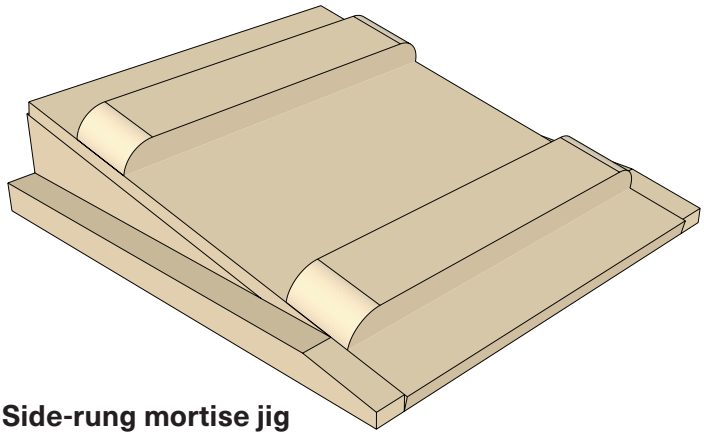


Photo 22

Photo 23

A Beneficial Mistake

After the glue has cured in both the front and back ladders (Photo 24), it's time to drill the side-rung mortises. The jig I use for this is nothing more than a wedge assembled from five pieces of wood (Photo 25). When it is turned with the high side closest to the post of the drill press table, you can accurately cut the side-rung mortises for the back ladder (Photo 26). The two short lengths of 2x4 screwed to the jig raise the posts so the back slats clear the jig's deck. When the jig is reversed, you can accurately cut the side-rung mortises in the front ladder (Photo 27). The 2x4s's are necessary here so that the turned ornamentation in the front stretcher clears the jig's deck. As you did with the front- and back-rung mortises, you must measure the depth of these mortises as you go because the posts on both ladders are tapered.



Side-rung mortise jig

1 Base (1)	3/4" x 19" x 24⅝"
2 Sides (2)	3/4" x 4⅝" x 24⅜"
3 Side Supports (2)	1½" x 1½" x 24⅜"

Photo 24

Photo 25

Photo 26

Photo 27

In Photo 28, you can see the secret to my chairmaking method: a mistake. Years ago, when working with one of my first side-rung mortise jigs, I discovered I'd miscalculated the angle of the wedge at the heart of that jig. The result is that the side rungs didn't quite fit simultaneously into both the front and back ladders. I had to force them into those mortises with a little effort. Forcing them in place results in a chair frame slightly under stress, and that stress that will keep the frame together even without glue. Maybe I wasn't smart enough to avoid making the error in the first place, but at least I was smart enough to recognize its value.

As you did with the front and back ladders, apply glue to all mortises and all tenons, then fit the rungs into place and squeeze them home with a pair of pipe clamps (Photo 29). The clamps should be removed once the tenons have been fully seated. If you see that one of the legs isn't sitting flat on a level surface, rack the frame until all four legs touch the surface. Remember: This must be done when the glue is fresh. If the glue has cured, the adjustment isn't possible.

Making Arms

There are two arm patterns: one for the arm as seen from above, the other as seen from the side. When tracing these two patterns on each of the arm blanks, it's important that the patterns are aligned so that the front and back of the patterns are in agreement. Notice that one pattern has been drawn on the side of the blank and a different pattern drawn on the top, with squared lines bringing these two patterns into agreement (Photo 30). It's also essential that the two arms are laid out so that you have a right and a left arm.

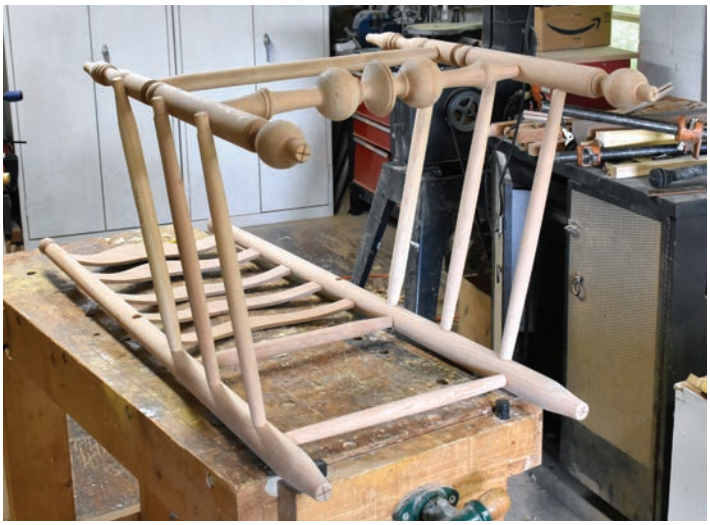


Photo 28

Photo 29

Photo 30

I begin by sawing out the arm as seen from above (Photo 31). It's important to remove the waste in the fewest possible pieces because you're going to need to reattach those pieces in order to make the next cuts. Once the arm has been sawn out in that orientation, reattach the waste using masking tape. Then redraw the lines on the uncut face where the masking tape has concealed them.

Return to the band saw with the arm rotated 90° and saw in the adjacent plane (Photo 32). It may be necessary to retape some of the scrap to keep the whole bundle stable. When the masking tape has been removed, a rough-cut arm will appear in the middle of the scrap (Photo 33).

Photo 31

Photo 32

Photo 33

To finalize the arm shaping, you must first fix the roughsawn blank in such a way as to allow it to be worked with various hand tools. I use a method involving a pair of wood blocks called "puppets" (or "poppets" in England). These are two blocks drilled at their bases to receive a length of 3/4" pipe between the heads of a pipe clamp. Near the top of one block, dish out an area to receive the nose of the arm; on the other end, drill a shallow 3/4" hole that will receive the 5/8" tenon on the other end of the arm, after first roughing in the tenon with hand tools (such as a pocketknife and a rasp). The pipe clamp and puppets are then secured in a vise with the arm blank held between the puppets (Photo 34). This can be a tricky assemblage to get situated your first time, so you might want to call on an extra pair of hands for help.

I use two different tools to do the shaping work: a four-in-one rasp (at the top of Photo 35) and a planemaker's float (at the bottom of the photo). These two tools make quick work of cleaning up saw marks. As you're working the arm, make regular sightings along the edges to be sure the lines there flow smoothly.

To shape the nose of the arm, set the puppets aside, and clamp the arm — nose up — in your vise.

The tenon end of the arm can be a little trickier to shape. I try to fit the shoulders of the arm to the contour of the post to which it will be fastened. To do this, I define the shoulders with a carving gouge of the correct radius (Photo 36), finishing up the tenon with a pocketknife and a small rasp. Because the arm rises from the back of the chair to the front, it's necessary to fudge a little on the tenon. I remove a bit of material at the top rear of the tenon as well as a little bit at the front bottom of the tenon.

To install the arm, hold its inside edge up on the outside of the chair's post. Then roll it up onto the tenon atop the front post while simultaneously feeding the tenon at the rear of the arm into its mortises in the back post. You might want to practice with an unglued arm.

Final Thoughts

All of this information on post-and-rung chairmaking can seem very intimidating. However, it's also a very forgiving discipline. In my teaching, I've discovered that it's possible for an individual with very little shop experience to transform a pile of wood into a serviceable chair within the limits of a 40-hour class. So if this chair appeals to you, don't be afraid to wade in.

If you do choose to dive into this chair, you'll be rewarded by one of the most satisfying of shop experiences. When you've finished, you can park yourself in a chair that you made with your two hands and contemplate the world around you with a renewed sense of accomplishment.

Photo 34

Photo 35

Photo 36