Building the

Adjustable Back Chair and Ottoman

With Tom Dolese, Terra Firma Design NW

Construction notes, 2016

Wood dimensions for the chair

As for all my projects, I cut the pieces close to their final widths and then joint and plane down to final dimensions.

Front legs: Two @ 1- 5/8 inches square, by 24 inches long. These will be cut to final length after the joinery is complete.

Back legs: Two @ 1- 5/8 inches, by 2 inches, by 21 inches long. (These legs can be 1- 5/8 inches, by 1- 7/8 inches, by 21 inches long, which give you options for grain orientation using 8/4 wood thickness.) These will be cut to final length and dimension after the joinery is complete. Cut a 2 degree long point on the bottom and toward the back (usually on a chop saw) before the joinery is marked out.

Arms: Two @ 3 inches, by 1- 1/4 inches, by 29 inches long.

Front rail: One @ 3 inches, by 7/8 inches, by 22- 7/8 inches long.

Back rail: One @ 3 inches, by 7/8 inches, by 17- 3/4 inches long.

Side rails: Two @ 3 inches, by 7/8 inches, by 20 inches long. Cut to final length using template.

Sides of back: Two @ 1- 3/4 inches to 2 inches, by 1 inch, by 23- 3/8 inches long. (these can be made out of 8/4 dimension wood by ripping 1- 1/4 inches wide (thick) pieces off of the sides of boards 24 inches long).

Back assembly under upholstery: Alder or Ash wood.
Horizontal rails: two @ 2 inches, by 1- 3/4 inches, by 12- 7/8 inches long. Curves will be cut on band saw.
Lumbar slats: four @ 1- 3/4 inches square, by 17- 1/2 inches long. Lumbar shape will be cut on the band saw
Sides for the assembly: two @ 1- 1/2 inches, by 1 inch, by 21- 1/2 inches long.

Wood for the loose tenons and the ledger strips: Ash wood. Loose tendons: 5/4 inches thick, 3 inches wide by 2 feet long. Ledger strips: 4/4 inches thick, 6 inches wide, by 3 feet long.

Corbels: Cut two from one piece of wood @ 1- 1/4 inches, by 7/8 inches by 12 inches long.

Round pegs: Turn two from one piece of wood @ 1 inch square, by 7 inches long. Final dimensions are 1 inch long, by 7/8 inches diameter, with 3/8 inch hole (use "V" bit) that is 3/4 inch deep. 3/8 inch brass dowel is 1-7/8 inches long. Glue dowel into pegs with two part epoxy or Titebond III.

Splines for arms and square pegs for sides of back: For the splines you'll need a piece that is 3/4 inches, by slightly thicker than 1/4 inch, and 8 inches long. I use Ebony, Peruvian walnut, Bubinga, and Brown Ebony for the splines and square pegs (depends on the wood you are using to build the chair and your taste). The square peg material needs to be about 12 inches long and 3/4 inch square. We will plane it down precisely in the shop.

Plywood for the seat bottom: 3/4 inch shop ply that is 24 inches by 20 inches.

Wood dimensions for the ottoman:

Ottoman legs: Four @ 1- 5/8 inches square, by 15 inches long.

Ottoman side rails: Four @ 2- 3/4 inches, by 3/4 inch, by 12- 13/16 inches long.

Ottoman end rails: Two @ 3- 1/4 inch, by 3/4 inch, by 18 - 5/16 inches long.

Plywood for the cushion: 3/4 inch shop ply that is 20 inches by 14 inches.

Note: If you are bringing your own wood, we will joint it flat, plane to size and bring the pieces down to their final widths in the shop so all pieces will be identical dimensions. Cut your pieces about an inch longer than the finished lengths, about ¼" wider than their final width and make sure the wood is thick and flat enough to get the required thickness out of the piece. All shaping of the pieces is done after we do the joinery.

Build the main body of the chair:

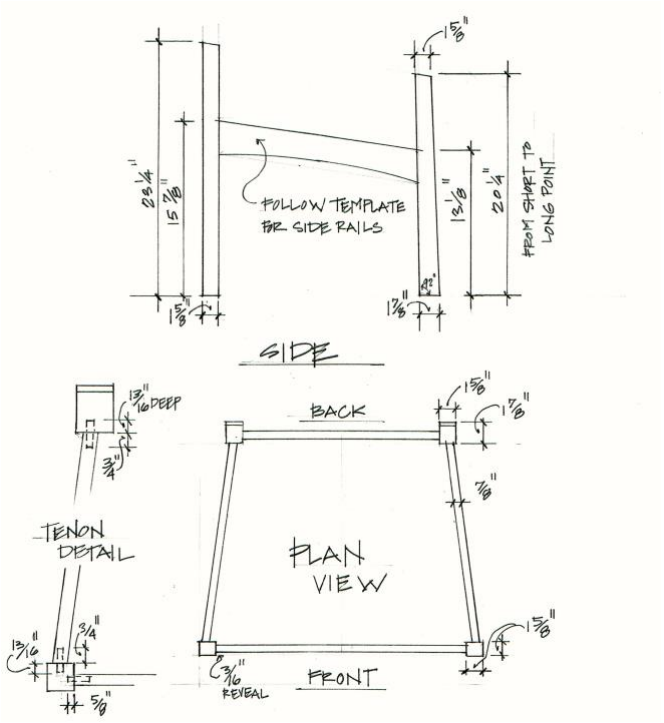
Start by building the main body of the chair.

Cut your side rails to length and to the corresponding angles using your templates. Tilt the blade over to 8 degrees accurately with a wixey gauge. Cut your front and back rails square and to length. Square off the bottom of your front legs and cut the bottom of the back legs with a 2 degree long point to the back (I use a chop saw). The legs will be cut at an angle and to their final length on their tops once the joinery is complete, so make sure you reference off the bottoms for marking out your joinery.

Mark out and mortise the seat rails:

All the seat rails have a 1/4" shoulder at the ends of the 3/8 inch mortise and the ¾ inch deep mortise is centered. I start mortising the ends of the rails first, and do the corresponding mortises in the legs as I go. I like to keep the same side to side setting on the mortiser (for the length of the mortise), so I cut all the mortises

for the back of the side rails and then in the fronts of the back legs, for example, and then move on. You can do the fronts of the side rails along with the front and back rail mortises all at the same time since the mortise can be the same width for all of this joinery.



For the 8 degree angled mortise on both ends of the side rails; set a 1- 1/2 inch square block, 10- 5/8 inches back from front face of mortising machine.

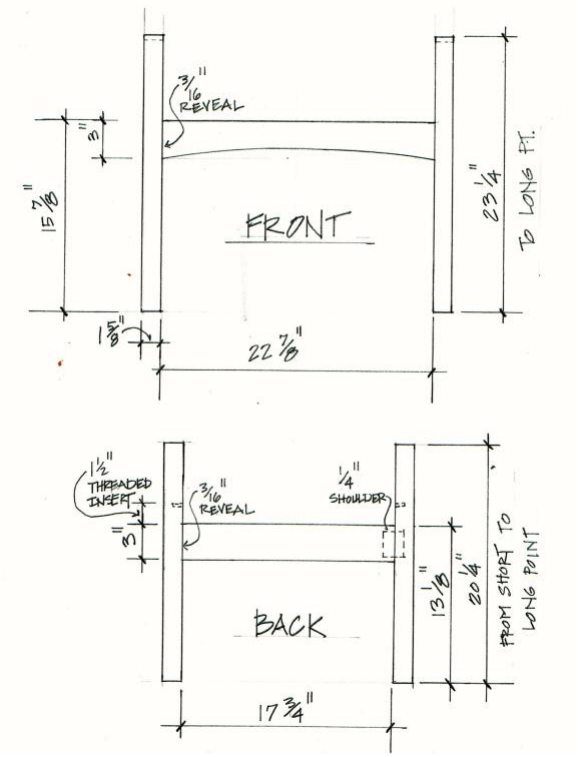
The mortise in the front of the back leg is 13/16 inches deep, as is the mortise in the back of the front leg. I mark these mortises out on the legs so I will end up with a 3/16 shoulder on the outside of the rails to the outside of the legs.

The distance from the bottom of the back leg to the top of the side rails is 13-1/8 inches (top of the mortise will be 12-7/8 inches with a ¼ inch shoulder). I mark these out using a long adjustable square. I square this line around to the inside of the leg for the back rail mortise since the bottom of the back leg isn't square.

Mortise the front end of the side rails; the ends of the front and back rails.

The distance from the bottom of the front leg to the top of the front rail; and the distance from the bottom of the front leg to the top of the side rails are 15-7/8 inches (top of the mortise will be 15-5/8 inches with ¼ inch shoulder on rails). Can mark out all of these mortise positions with a long adjustable square.

The mortises in the sides of the legs are shorter, so as not to interfere with the side rail mortises (which bear most of the stress). These are 11/16 inch deep (your tenons will be shorter). The front rails will all have a 3/16 reveal or shoulder and the shoulder on the outside of the back rail will also be 3/16 inch as if the back leg is 1-5/8 inches square.



Make tenons
Thickness plane tenon stock precisely and cut to fit mortises. Cut the longer tenons first, rounding over the ends slightly, putting them part way into the corresponding mortises as you go, so as to keep from them getting mixed up when they are being glued in.

Glue tenons into rails:
Glue the tenons into the seat rail ends with Titebond III. Let set for at least an hour before assembling with your chair legs.

Cut the tops of the legs:

Cut the tops of the 4 legs to length and at the proper angle. I usually mark out the rough angle on the legs to help insure that they are cut correctly.

Cut the back legs first, setting the Unisaw with slider to 19- 15/16 inches, with bevel set at 11 degrees using the Wixey to set the angle. The long point will be toward the front of the leg.

This should give you a leg that is 20- 1/4 inches long to the (2 degree) short point on the bottom to the long point on the top of the leg.

Check how that angle compares on the front leg and adjust length and angle to suit on the front leg.

Ended up cutting the front leg at 9 degrees with a Wixey setting the angle and with my Unisaw slider set at 22- 15/16 inches, which should give you a leg that is 23- 3/16 inches, bottom to the long point.

For your own set up, just to clarify, you can cut the front leg at 9 degrees, with the length to the long point of 23- 3/16 inches, and the top of the back legs at 11 degrees, with a measurement from the short to the long point of 20- 1/4 inches.

The long point on top is going to be toward the front for all legs.

Drilling the tops of the legs:
Drill the tops of the legs for a 3/8" dowel. This hole is centered on the legs and is centered from the front as if all the legs were 1 and 5/8" square. I mark them all out using the same adjustable square setting.

Set the front legs up with a fence on the mortiser (with drilling attachment) at the corresponding angle, and once the first front leg is drilled with the set height and 7/8 inch depth, all the rest can be drilled with the same setting.

You will have to reposition the fence when drilling the back legs. Drill slowly so the holes are consistent.

Put 3/8" by 1.5" dowels in the holes to help protect the ends of the legs.

Note: Do not glue these in yet since we'll be putting dowel centers in these holes to locate precisely where the corresponding holes will be drilled in the bottom of the arms.

Threaded inserts:
Drill 13/32" holes, 1 inch deep for the ¼-20 threaded inserts on the inside of the back legs; 1- 1/2 inches up from the top of the back rail and 13/16 inches in from the front of the back leg.

Chamfer the top of the holes slightly and then with the *drill press unplugged*, put in the threaded inserts using a threaded rod with stop bolts and the drill press to get the insert in straight. Finish screwing it in with a 6mm allen wrench.

Shaping/sanding:
The bottom of the front and side rails can have arched curve profiles. The front rail usually gets the "spider" curve, keeping this curve shallow or the front rail can look too small, and the side rails can be the #2 or #1 curve.

Round over (1/8 inch rounding over bit) and sand all your parts.

Note: Before you start sanding, make sure you have clearly marked on the front and outside of the side rail tenons, showing the direction that is up, forward and either right or left. Mark out orientation triangles on the tops of the legs.

Make Clamping Cauls:
Cut the following angled caul blocks out of 1.5" square stock

Right Side Front (RSF) 8 degrees long or fat point to the left with the block orientated up and the 9 degree long or fat point to the left and down.
Left side front (LSF) 8 degree long or fat point to the right and the 9 degree long or fat point to the right and down.
Right side back (RSB) 7 degree long or fat point is to the left and the 12 degree long or fat point is up and on the left.
Left side back (LSB) 7 degree long or fat point is to the right and the 12 degree long or fat point is up and to the right.
Glue on with liberal coat of Titebond lll to the top of 1- 1/2 inch, by 1/4 inch, by 6 inch long MDF pads.

Glue up the main body of the chair:

First glue the side rails to the legs with the clamping cauls made above. Double check your orientation of your pieces. *Note: put the clamps on the outside of the assemblies.*

Protect the wood with MDF pieces. Make sure you put a full wet coat of glue in both mortises first, then skim one of the rail tenons and immediately put it in the corresponding mortise, then skim the other tenon and put it in right away. I use "Davy board strips (a dense paper board) to apply directional pressure to close both sides of the joint, if need be. Once these have set, you can chisel off any glue squeeze out. I prefer to keep the side assemblies clamped up overnight if I have the time since these joints have a tendency to open up slightly when you clamp and glue up the whole chair.

I use MDF pieces (held temporarily with spring clamps) to protect the wood from the clamps when gluing up the whole chair. Hold the clamps slightly off of the legs to keep from marring them, also. Clamp the back of the chair first (since the back has a tendency to open up if you clamp the front first). Put a full coverage coat of glue in all 4 mortises and then skim and insert the back and front rail tenons in their mortises. Make sure their faces are out and their tops up. I do a dry run here, too. Put on a flat bench to check that the chair is sitting flat (you can sometimes adjust the clamps a bit to bring the 4 legs down flat).

Mark and drill the arms:
Cut the front of the arms on the table saw @ 9 degrees (on saw) and 8 degrees on miter gauge, readjusting the gauge for the other side. The long points are toward the outside of the arm and up. The arm has a 1/2 inch shoulder in front of front leg, on the bottom of the arm.

With the chair turned up-side-down on top of the arms, and positioned with a 1/2 inch shoulder in front of the leg and 1/4 inch shoulders to the insides of the legs, mark out the 8 degree bevel on the underside of the arms using a 1/4 inch piece of MDF pressed up against the leg to give you the angle and spacing. Draw the position

of the top of the legs on the bottom of the arms at this time, too. Make sure the arms are oriented correctly when you do this.

Cut out the 8 degree bevel on the band saw and finish with a hand plane. You could clamp both arms together and plane down if you wanted them exactly the same. Put the flipped over chair (gingerly) on top of the bottom of the arms where you want them with dowel centers in the holes in the tops of the legs and press and mark for the holes to go into the arms.

Drill 3/8 inch holes (with the drill press) in the arms no deeper than 3/4 inches. Make sure you don't blow past the stop on the drill press here.

You can now set up to drill the back of the arms for the peg locations. They are 3/8 inch holes, 1- 3/8 inches deep. The center of the center hole is 4- 7/8 inches back from the front of the back leg and the other two holes are centered 3/4 inch on either side of this hole. The center of all three holes is 7/16" above the *bottom* of the arm to allow for shaping.

Use the mortiser (with drilling attachment) to drill all of the "right" arms with the same setting and the same backing fence, just moving the drill right or left to match the marks and then without changing anything but the fence, do the same thing for the "left" arms. Make sure you set the side to side stops tightly before you drill each time. The holes can be followed up with a "V" bit that is .377 inches. This works better for the brass dowel. I do this carefully with a cordless drill. The peg holes in the arms can also be drilled using an 8 degree wedge jig on the drill press if you don't have a horizontal drilling machine.

Mark the end of the back of the arm 1 inch behind the center of the farthest back hole. Cut this off square on the table saw, perpendicular to the 8 degree bevel.

Shape the arms:
Using the shaper jig, flush trim the profile on the top and front of the arms. You'll need a long spindle on your shaper to do this. The end of the profile is 2 inches back from the long point.

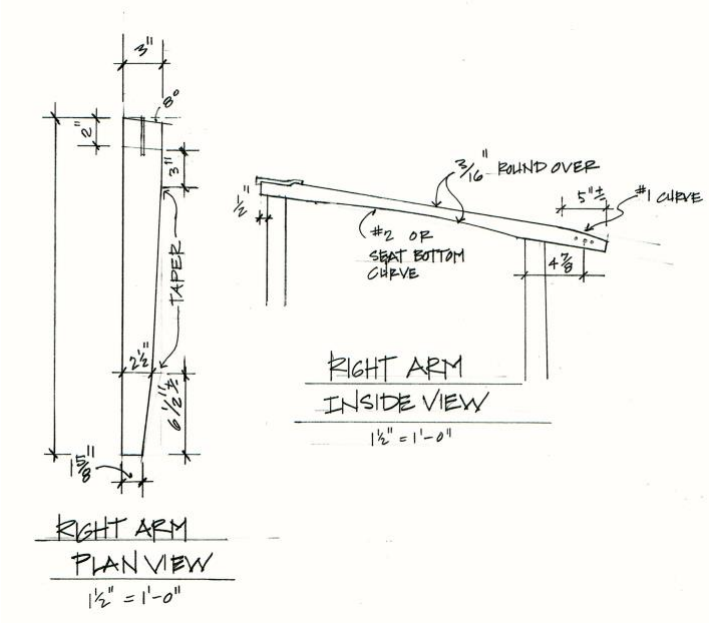
Do them all, bringing the arm up to the layout line on the jig, then reposition the flush trim bit above the bearing with spacers and finish the profile.

With the 3 inch tall Shelix you can do all of this with one setting, making multiple small cuts. *Go slow at the end of the cut so don't blow out the top end of your arm*.

Mortise for the 1/4 inch spline 2- 1/2 inches back (from the long point) and 5/16 inches deep in front (check your spline if it's pre-made since you don't want to go too deep), centered and along the axis of arm. Start at the back of the mortise and work down to the profile in front or you can end up taking too deep of a cut where the top of the arm profile rises up.

Set the stops so the endmill is still engaged with front of the arm so you don't plunge into air at the front. Remember that the long point is toward you and that there is less wood below. Chisel the back of this mortise square.

Mark and cut the bottom of the arm with the #2 curve (or "seat bottom curve" for a more graceful look) marked out about 1" behind and forward of the leg intersections.



Mark and cut the back taper in arms leaving 7/8 inches from the bottom and start the #1 curve about 5 inches in front of the back end. Now you can taper the arm from 3 inches just behind the cloud lift detail in the top front of the arm to 1- 5/8 inches in the back.

When sanding the bottom of the arms use a sanding block in the areas above the legs to keep very flat so the joint comes together nicely. I use a random orbit sander to sand the rest of the arms (except the edges).

You can round over most of the arm on the router table with the arm set on its edge. I use a 3/16" round over for this. I usually sand and shape the arms on a blanket on the bench.

Note: Be careful if you clamp the arms using the dogs on the bench, you can easily split out the top of the long point.

Cut and glue the corbels:
Cut the corbel pieces at the same angle as the top of the front legs (9 degrees) and remember that they have right and left orientations.

Mark out with the template and holding two down on the bench, biscuit 2.5" down from the long point with the fence set so the biscuit is centered with the fence referencing off of the front of the corbel (set the fence at just over 3/8 inches (looks like 1/8 inches) on my joiner).

Put the chair on a blanket on floor or low bench and 2- 1/2 inches down from the long point (squared off line on leg) of the front leg, center a biscuit in the side of the leg, holding the joiner carefully and plunging in. Have the fence on the front of the leg for consistency. I set the biscuit joiner fence at 13/16 inches for this. Make sure you put the biscuit in the top of the front leg, on its side (easy to get confused here*). Make sure you do this before you glue on the arms.*

Glue the arms:
You can glue on the arms now. I use Wetzler clamps (two of them are just long enough for the fronts) with MDF pads. I clamp the back of the arm first, adjusting the clamp to apply pressure where I want it, and then the front.

Note: Make sure as you are intent on clamping that you don't glue the left arm on the right side and vice versa.

Make the splines:
After the arms are glued on, plane down stock for your splines. Make slightly thick so can sand a bit to fit. I used 5/8 inch, by 1/4 plus inches, by 2- 1/2 inch stock. Scribe with a pen, cut on the band saw, put the spline in the mortise and cut the front with a handsaw (carefully), sand and glue in the splines in the front of the arms.

In the class, we can use the router jig to shape the splines. Make small cuts and nibble down so you don't blow the pieces out. We cut the mortise for the splines 5/16 inch deep for these (about 3/8 inch deep toward the back). Check the size of your spline if it's pre-made to make sure the depth of the mortise is what you want for the spline's reveal. Round over the top back corner of the spline before gluing in and relieve or chamfer the bottom back edge.

Sides of back:
Remember there are right and left pieces.

Drill a 3/4 inch hole first about 1/8 inch deep or a little deeper, 5/8 inch up and centered from the bottom on the inside of the side piece, and then drill 1/2 inch hole through for the plastic insert.

Drill a 3/8 inch hole 3/8 inch deep on the outside, centered 3" and 17" down from the top, then drill a 7/32" through hole. Chisel square the upper holes for a 3/8" peg (the bottom holes are covered by the arms). Chamfer the inside of the 7/32" hole slightly.

Back assembly under upholstery:

1. The horizontal curved or crest rails are marked out using a “G and G” curve that is marked in from the front 1/16 inch, and then the back cut is marked from the front at 15/16 inch, and the 1/4 inch mortise has 3/8 inch shoulders in front, top and bottom. The curve is being cut out of the 1- 3/4 inch side and the mortises are parallel to the 2 inch dimension. The ¼ inch mortises in the rails are 5/8 inch deep. Do these mortises and mark out the mortises for the lumbar slats before you shape the crest rails. The top and bottom rails are identical.

2. The mortises in the side pieces are centered. Remember, that there are a right and a left. Leave a little slop in the length for the top mortises. The mortises should be 5/8 inches deep (if you make all the mortises in the side rails a little longer then you don’t have to keep the side pieces oriented for right and left).

3. The layout lines for the lumber slats are 1 inch (from back) and then 5/16 inches (from the back) and the back of the mortise is 9/16 inches in from the back. Mortise in the slats is 1/2 inch deep and the corresponding mortise is 5/8 inches deep in the curved rails. Cut the curves on the horizontal rails on the band saw and then mortise for the lumbar slats (you’ll have to position this mortise carefully). Cut out the lumbar slats on the band saw and round over everything. None of this has to be sanded since all wrapped in foam and fabric or leather. Make the spacing for the slat mortises so the slats are 1- 1/4 inches apart, starting from the center. *Note: Make sure when gluing up the backs that you orient all the lumber slats the same way and have the lumbar facing forward.*

Remember to dado the outsides of the sides of the backs 1/8 inch deep with a 5/16 inch shoulder. Round over all of the outside edges of the back assemblies.

Build the Ottoman:

The ottoman is a straightforward piece compared to the chair.

The bottom of the front and side rails can have arched curve profiles. Use the “seat bottom curve” on the bottom of the short rails and the #2 curve on the bottom of the longer rails.

Bevel the inside corners of the legs on the router table with a chamfering bit and a stop, making about 4 passes to get the desired ½” wide chamfer, which comes down to the bottom of the rails. *Note: Make sure this is done before you glue up the ottoman.*

Mortise the ottoman rails and the legs as above for the chair. Locate the top of the longer rails 3 inches down from the top of the leg. Locate the top of the shorter rails 1/4 inch and 3- 1/2 inches down from the top of the leg, which will give you a space of 1/2 inches between the short rails.

Install the ledgers after the cushion is upholstered. I like the cushion to stick up slightly above the top of the legs. Screw the ledger strips to the longer rails only, there is no need for them on the shorter rails.

Foam for upholstery:

The seat bottom for the chair is webbed.

The chair seat foam is 1- 1/2 inch HRF-2953.

The back is wrapped with 1 inch foam that is a bit less firm, HRF-2743, and there is no foam on the sides of the shaped wooden back.

For the Ottomans, either 4 inch HRF-2953 or HRF-2743. Two 2 inch pieces glued together would also work.

Installing the upholstered back:

Once you have the back upholstered and the chair and side pieces finished, you can put the back on. First center the side pieces on the back, making sure they are oriented properly with the back (which has an “up” and “forward” orientation), screwing them on through the top holes (with a 2 inch long #10 screw) with a 5/8 inch projection of the upholstered back above the side pieces. Put the turned pegs into the middle holes in the arms and thread the bolts through the bottom of the side pieces into the threaded inserts in the back legs, leaving some “slop” here. You can adjust the position of the side pieces before you screw in the bottom screws so they are approximately centered on the back and the back hits both of the turned pegs at the same time.

You can center the chair back in the chair body by tightening/loosening the two bolts.

Tap the beveled pegs into the top holes and sand and finish them. I leave them a bit proud and don’t glue them in so it will make it easier when the chair is reupholstered.

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