


ARTSTUDI 262: The Chair 

Blood, Sweat,
and Tears Chair

To Be Re-
placed With
a Proper
Glamour Shot

SPRING 2013

Cam Bennett

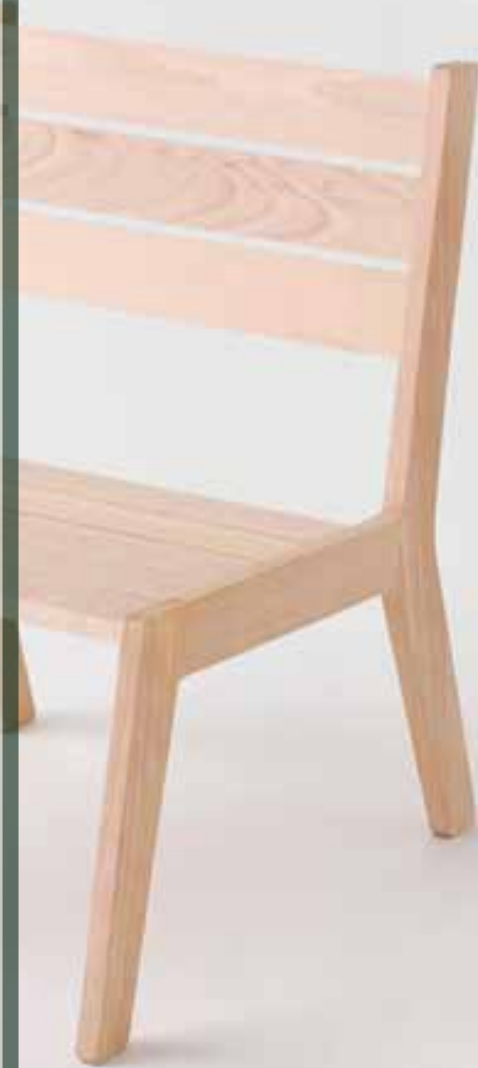




I've never enjoyed a class as much as the Chair. I've never been as exhausted and spent as at the end of this quarter, but I've also never designed and built something I love as much as my chair. I made quite a few mistakes during the process, but if you fall in love with your chair and take the class and process as seriously as you can, you won't regret taking this class. Don't cut corners and make sure to plan meticulously and you'll have an experience not possible in any other class

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I had little knowledge of chair history and design before I took the class, and so I used the first few weeks of the quarter to familiarize myself with designers, both famous and obscure. If you're struggling with your design, compiling a collection of chairs that you admire or that you think are beautiful can help you identify common characteristics and elements to incorporate in your chair. Design doesn't exist in a vacuum and there's no shame in borrowing from existing pieces you enjoy.



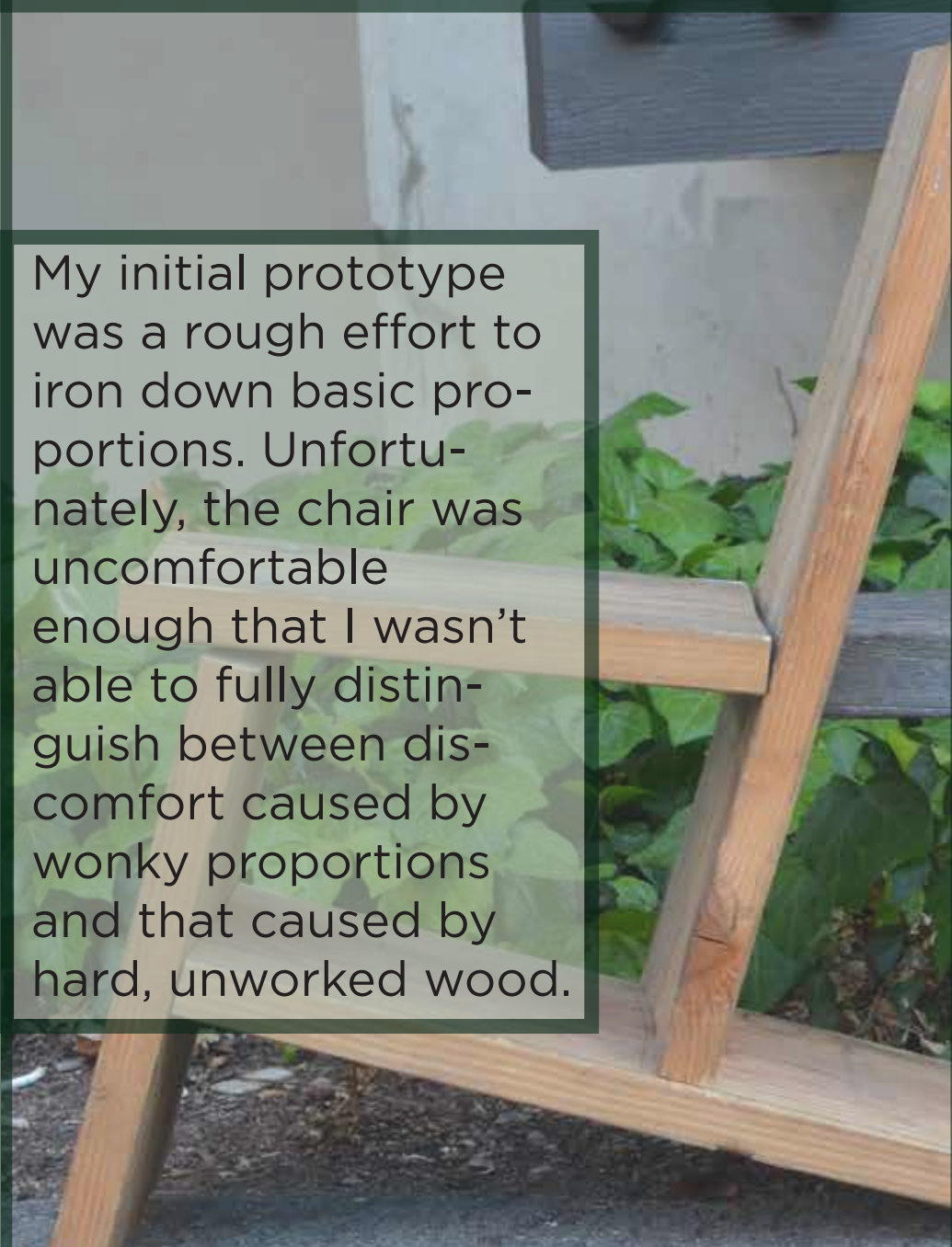
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To Be Added
Later

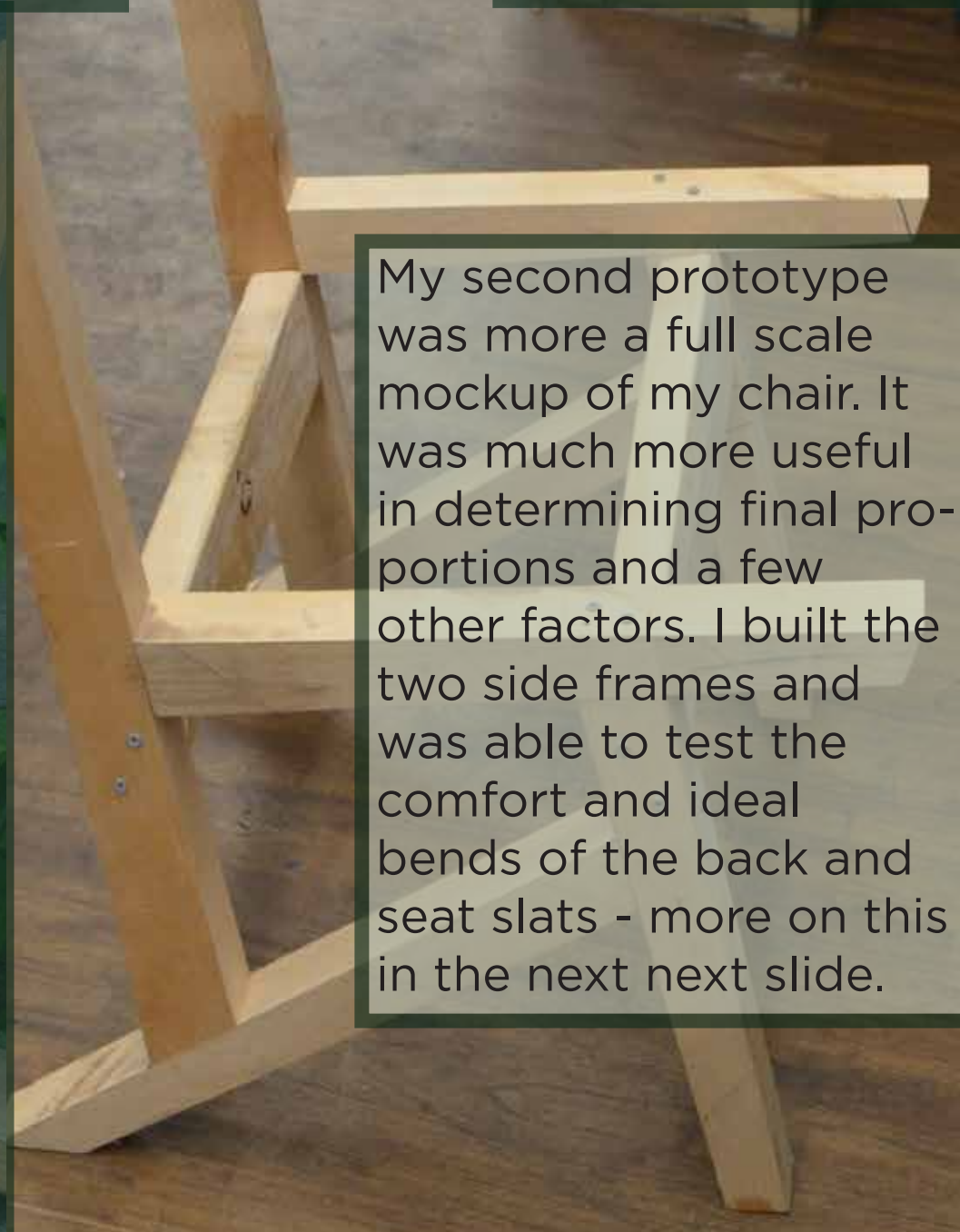
My initial concept sketches I settled on my final design. After this, I sketched out variations of this in order to iron out my final proportions and find my final form. I did a final mockup in CAD but didn't find it particularly useful in determining dimensions. I did make an illustrator model of the cross section of my chair, which I used to laser cut Duron pieces to serve as models for pieces I later cut.

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Prototyping



My initial prototype was a rough effort to iron down basic proportions. Unfortunately, the chair was uncomfortable enough that I wasn't able to fully distinguish between discomfort caused by wonky proportions and that caused by hard, unworked wood.



My second prototype was more a full scale mockup of my chair. It was much more useful in determining final proportions and a few other factors. I built the two side frames and was able to test the comfort and ideal bends of the back and seat slats - more on this in the next next slide.

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Materials

I got all of my wood from MacBeath Hardwoods in South San Francisco. They have a pretty ridiculous selection of domestic and exotic hardwoods. I made the trip with two other members of the class, which I highly recommend. Going to MacBeath, I didn't really know everything I should have about my material - what types of deformities can be easily fixed with planing, how the grain looks when wood is cut at different angles, and other important information. The people at MacBeath are really helpful but it's imperative that you know as much as possible about what you want, so as to avoid spending more money than necessary on materials. Nevertheless, I also made sure to buy more than I needed, which paid off at the end of the quarter.

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The back and seat of my chair consist of bent slats, each of which is approximately $\frac{3}{4}$ of an inch thick and $1\frac{3}{4}$ inches wide. I say approximately because material is inevitably lost in the finishing process (depending on your material of choice), which is something to consider when dimensioning your chair. I used a lamination process in order to bend the slats into their final configuration. I cut 4 strips of beech, each 2 inches wide and $\frac{1}{5}$ of an inch thick, and laid them together with wood glue between each layer. In the picture on this slide, I've made two bundles of 4 strips and clamped one bundle to each side of my buck. When the wood glue dries, the resulting pieces remain curved. It's important to ensure that the buck is evenly shaped and the clamps can create evenly distributed pressure.

Notes on the bending process:


- If you can, use a wood glue that won't cause "creep", in which a flexible glue allows the individual strips to slide relative to each other and the bent pieces to straighten out. The glues that I've seen recommended are a West Systems Two Part Epoxy, Dap Weldwood Plastic Resin Glue, and Unibond 800
- Make sure clamping pressure is even and hard. If there are large gaps with no pressure, the glue will collect in those areas and the seams will be evident
- Test multiple radiuses for springback and ease of clamping
- I made my bucks out of MDF; I traced a pattern on one piece of MDF, cut and sanded it to my desired shape, and used that piece to rout out multiple MDF pieces which I used the brad nailgun to fix together
- If you're doing a good amount of bending, buy a few clamps - they're cheap, useful, and you won't always be "that guy" who's using all of the shop's clamps
- Make sure you laminate consecutive strips (as they were cut) together so the grain is consistent and there are no areas with weird or inconsistent colors. Draw a V on the piece of wood you're cutting the strips from so that you can keep track of the order after you cut them.
- Keep the bundles aligned vertically and flat together, otherwise you'll have deformities that prevent all of your pieces from being uniform
- Don't skimp on the number of clamps you use - if you have too few, your piece will be weaker and have obvious seams
- Consider making a female buck in addition to a male buck - it will help create even pressure and require fewer clamps
- If you need to, double up your bucks like I did in the previous picture. I started out using the circles in the buck to clamp the bundles to one side, but after a while I needed to make curved pieces faster and so I cut the same curve into the other side and clamped bundles on both sides
- Don't use more glue than you need, otherwise you might have seams and you risk gluing your piece to the buck

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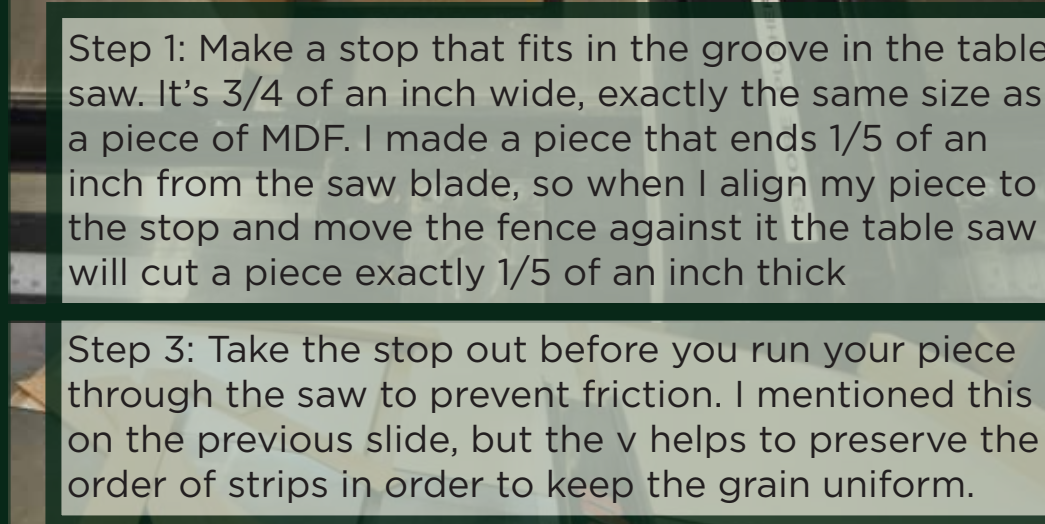
Construction: Back and Seat



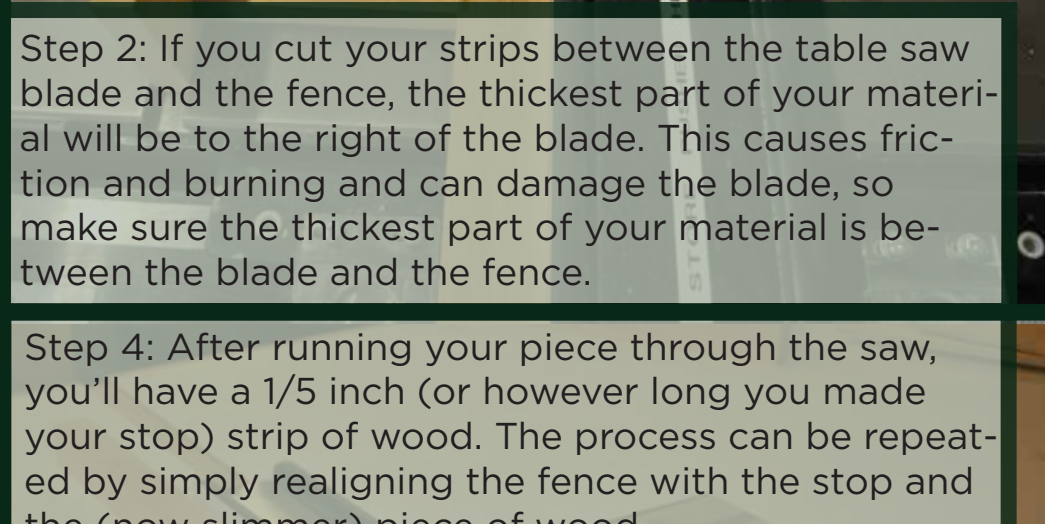
Step 1: Make a stop that fits in the groove in the table saw. It's $\frac{3}{4}$ of an inch wide, exactly the same size as a piece of MDF. I made a piece that ends $\frac{1}{5}$ of an inch from the saw blade, so when I align my piece to the stop and move the fence against it the table saw will cut a piece exactly $\frac{1}{5}$ of an inch thick



Step 2: If you cut your strips between the table saw blade and the fence, the thickest part of your material will be to the right of the blade. This causes friction and burning and can damage the blade, so make sure the thickest part of your material is between the blade and the fence.



Step 3: Take the stop out before you run your piece through the saw to prevent friction. I mentioned this on the previous slide, but the v helps to preserve the order of strips in order to keep the grain uniform.



Step 4: After running your piece through the saw, you'll have a $\frac{1}{5}$ inch (or however long you made your stop) strip of wood. The process can be repeated by simply realigning the fence with the stop and the (now slimmer) piece of wood.



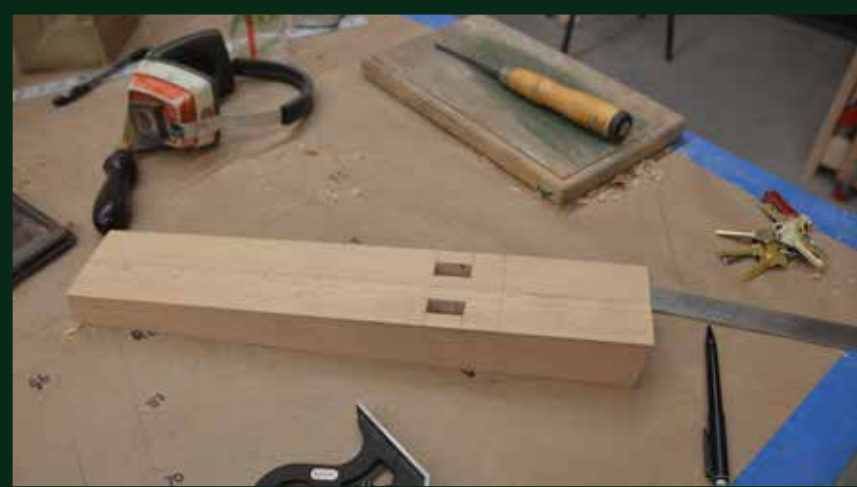
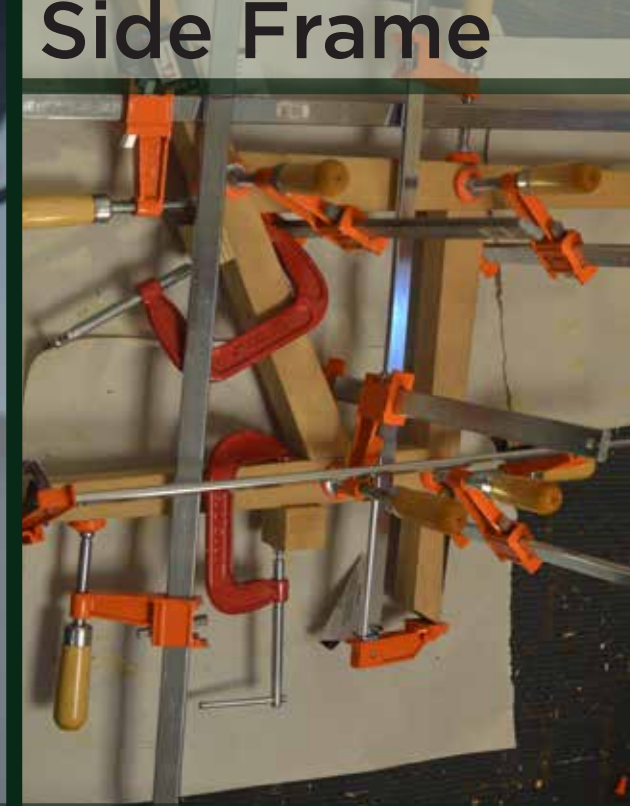
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Construction: Side Frame



To make the side frames, I measured out the pieces using Duron models I lasercut from a mockup I made in Illustrator. I cut the mortises on the mortiser in the wood shop and cleaned them up later with chisels. I cut the tenons using a combination of the table saw and chisels. If you're making identical pieces it's important to make sure your measurements and processes are as repeatable as possible. After cutting the mortises and tenons I did a significant amount of finishing work with a chisel, a rasp, and sandpaper to ensure a snug fit and seamless joints. There aren't any pictures showing this step but it was probably the most time-consuming of my whole chair construction. It took a ton of work to make sure that everything fit perfectly; the angled mortises and tenons were very difficult to perfect.

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Construction: Joinery



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Notes on the Joinery process:

- As you can see on the previous slide, I used a drill to remove some of the material for the mortises, then finished them off with a chisel
- Make sure you rough cut the mortises smaller than they need to be. It should go without saying, but you can always make a mortise bigger but not smaller
- The same goes for the tenons - I rough cut them on the bandsaw and chiseled them down to the size I needed, making sure to test fit multiple times during the process
- Another obvious but often forgotten fact - chisels are really, really sharp, and if you're tired or distracted and slip, they can do some serious damage to your fingers
- Make sure you're sharpening your chisels as often as possible
- If you need to use chisels to ensure fit, keep your pieces numbered and remember which tenon fits in which mortise. You can make sure all of your joints are of a reasonably similar size, but you need to match mortises and tenons to make sure they fit perfectly.
- Don't try to make the joints fit perfectly flush right away - It's a lot easier to sand a piece that's a little bit too big than plug a hole because of a piece you cut too small.
- I tested the fit of each mortise and tenon when my whole chair was clamped together. The wood will move and strain with the pressure required for the glue to dry, so it helps to recreate that when testing fit.
- As you can see in the bottom right corner, it helps to keep some sawdust from sanding to plug holes and make the joints look cleaner.

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Construction: Finishing



The finishing process is one of the most important steps in completing the chair. I had pre-sanded all of my slats, but after the tenons were cut I used a power sander to take down the edges and smooth out any rough spots. I sanded the frame after it had been cut and clamped, but before it had been glued, to ensure that I could fix any fit problems sanding might cause. It's important to remember that sanding will change the shape of the object, and that any joint with a precise fit needs to be handled with care. I decided not to use a stain and instead I used a finish that was a mix of boiled linseed oil, tung oil, and canuba wax. I was very happy with the color and grain of the wood and the waxy texture, and I highly recommend it to anyone who wants a smooth, natural finish.

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BOM

Materials, Tools, & Services	Standard Dimensions	Quantity	Cost
Beech @ MacBeath	2" x 8"	70 BF	\$280
TiteBond Wood Glue	8 Ounce Bottle	1 Bottle	\$8
West Systems Epoxy/Hardener	1.2 Qt (Hardener & Resin	1 Kit	\$70
Jorgensen Clamps	1ft, 2ft, 3ft (6" Clamp)	8 Clamps	\$130
Assorted Sandpaper	N/A	40 Sheets	\$20
Duron Sheets	3'x4'x1/4"	2 Sheets	\$16
Pine 2x4 from Home Depot	2"x4"x6'	10	\$50
Assorted Wood Screws	N/A	N/A	\$10
Respirator	N/A	1	\$35
Set of Narex Chisels	1/4", 1/2", 3/4", 1"	4	\$34
Diamond Sharpening Stone	800 Grit, 4000 Grit	1	\$55
Strop/ Stropping Compound	N/A	1	\$18
MDF	3/4" x 4'x4'	1	\$25
TOTAL			\$751

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