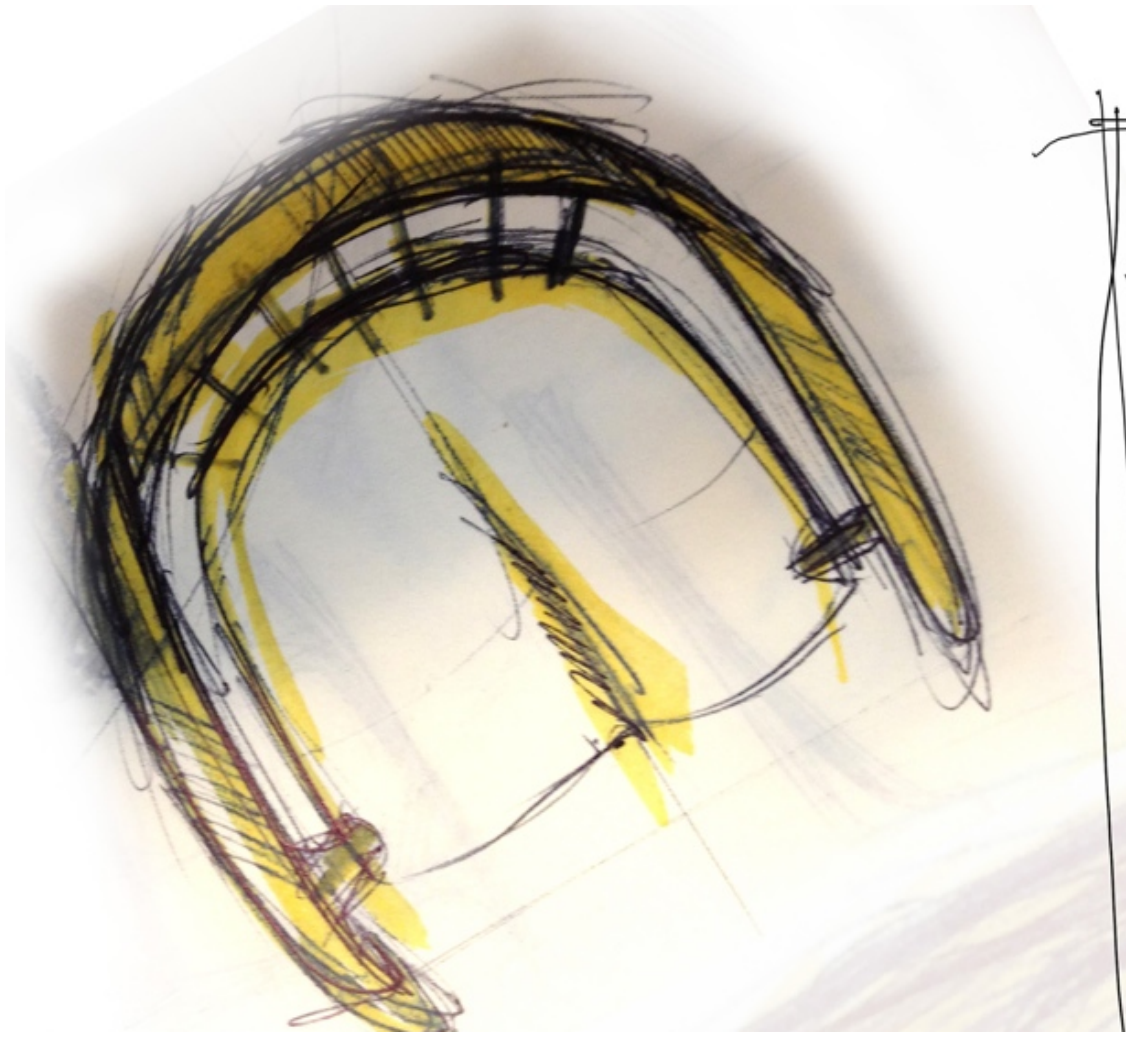
A Chair in the making..

1. Beginnings of a chair

The germ of an idea for this chair was plated long ago when I saw Sam Maloof's chairs. I had known very little about him or his designs then. My interest was in wood turning at that time. I thought to myself, that one day I am going to have the joy of carving those joints.

My Ideation sketches were based on the fact that, I will be using the 'maloof' joints. (will be illustrated soon). The joint is complex, but lends itself for carving, high strength and forming a rigid structure with minimal screws or dowels.

Sam Maloof's Rocker



The initial form of the chair evolved on paper. It was developed alongside with the process of development.

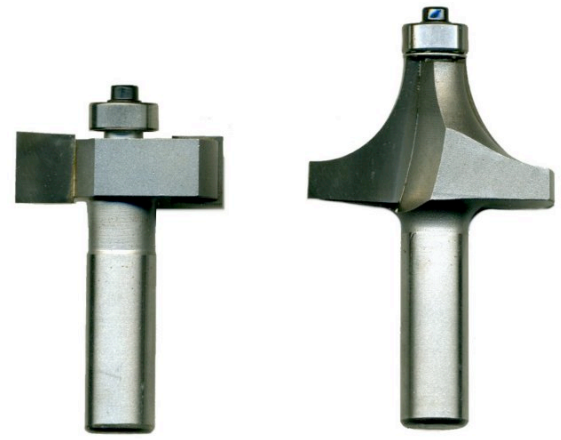
I divided the process as below,

1. Develop ergo buck and take measurements
2. Develop CAD curves for legs, arms, seat, backs and curves required for templates and jigs.
3. Procure the wood. Saw, Joint and plane the wood required for the seat, legs, arms and back
4. Prototype carving, joints, sculpting and template making. Try the tools.
5. Research and procure tools, screws, dowels, finishing materials, etc.
6. Prepare the seat block
7. Make the male joints on the seat and carve the seat
8. Cut the pattern for the front and rear legs. Route the female maloof joint on the legs. (Jigs are prepared to maintain symmetry)

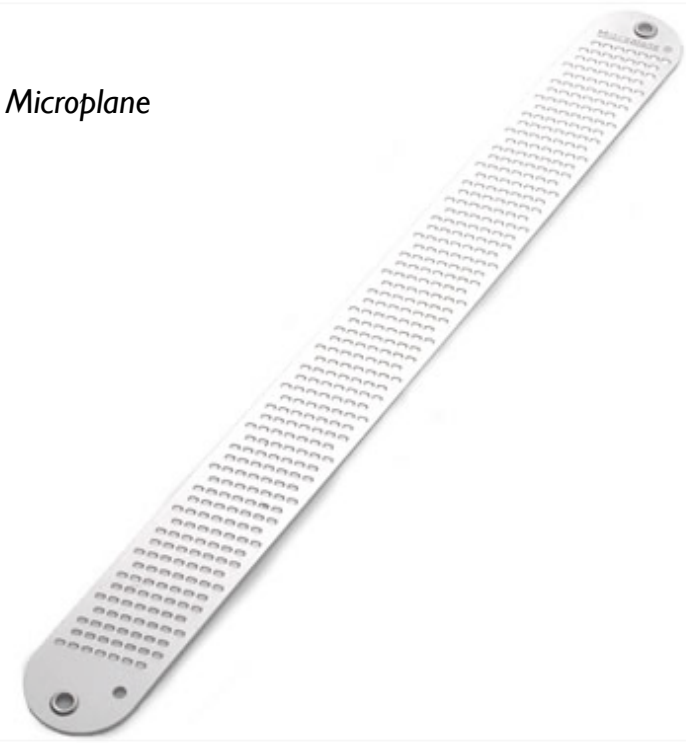
9. Join the legs to the seat and prepare the arms to length
10. Measure and cut the back to size and join using dowels.
11. The entire chair is now done and ready to carve. This is where all the surfaces come together.
12. Sand the entire surface down to 3200 grit.
13. Finish with tripoli(abrasive), white diamond(abrasive) and then wax and buff wax. More details of this process can be seen in '*bealle finishing kits*'

2. Tools of the trade

The design of the joint demanded a compatible sized router bit pair. Rabbet and round-over bit.



Rabbet and round over bit



Microplane

This is a microplane which is useful to sculpt fillets and smooth transitions in joinery. It is mounted on to a regular hacksaw frame. Changing the tension can allow you to control the fillet radius with a bit of practice.

Carbide abrasive discs is an essential tool to sculpt. It allows to remove shavings of wood instead of dust. Caution should be used as it is had to control an accurate line. Strongly recommend carving curved lines on scrap wood.

Carbide abrasive disc

Chisel set

A good set of sharpened cabinet chisels are valuable in shaving the joints to achieve that perfect fit.

2. Procuring and preparing the wood

One of the first things I estimated was the amount of wood and the minimum sizes I will need. I made a decision to go with 8/4 thick walnut (8/4 is slight thicker than 2"). When planed and jointed one usually ends up with a thickness of 1 7/8th inch. I made a note of minimum width requirement, erring on the higher side, for each component of the chair.

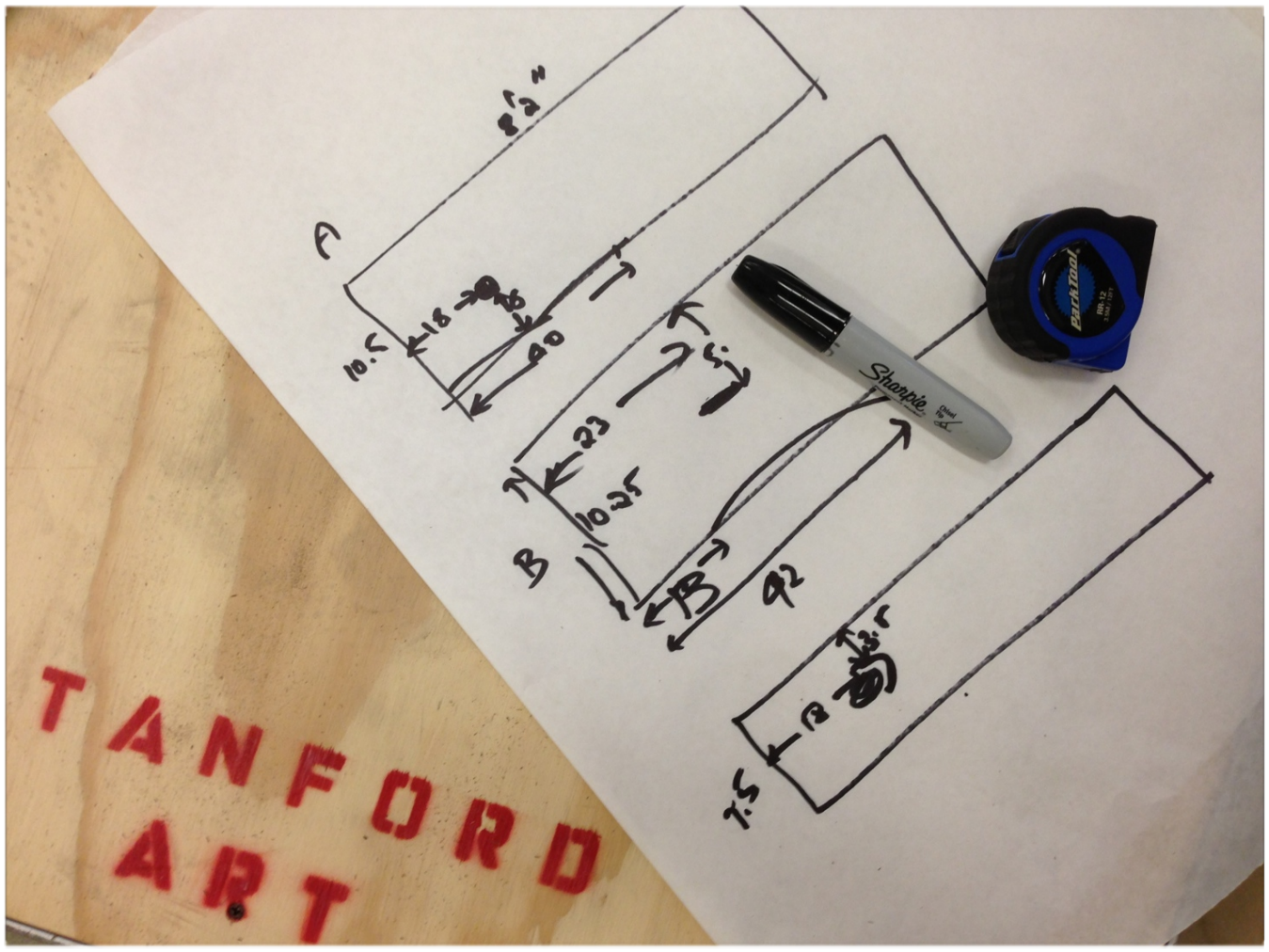
Ex:
Seat: 5 pieces of 23" X >6": 10bf
Arm: 2 pieces of 23" X >6": 4 bf
front leg: 2 pieces of 30" X >3" : 2bf
Rear leg: 2 pieces of 30" X 8-10" (to accommodate the curve of the rear leg): 9bf
Back: 1 piece of 30" X 8-10" (I did not have a definite idea of this shape. wanted to have extra length to have an option for steam bending a moderate curve): 4bf

Pulling a 'line up' of planks to compare and choose

In terms of the grains, I was only particular for the pieces I plan to use for the rear leg. I wanted the grains to run along the curve to retain the strength and to avoid the end grain showing. The unique part of working with wood is that you make the best of what is available. We bought our wood at Macbeth. It took an entire afternoon to choose. We looked at richness in grain, bow in the plank, knots. One thing I wish I checked, was how close the plank was to the center of the tree. Generally, it is good to avoid the heart of the tree.

Don't be disappointed, if you don't find that perfect plank, with no knots, no bows. They never are. You can usually work around it to make the best of it.

Planing for ripping the wood to size, to avoid, knots, bows and get the best possible grain running where you want in the final design



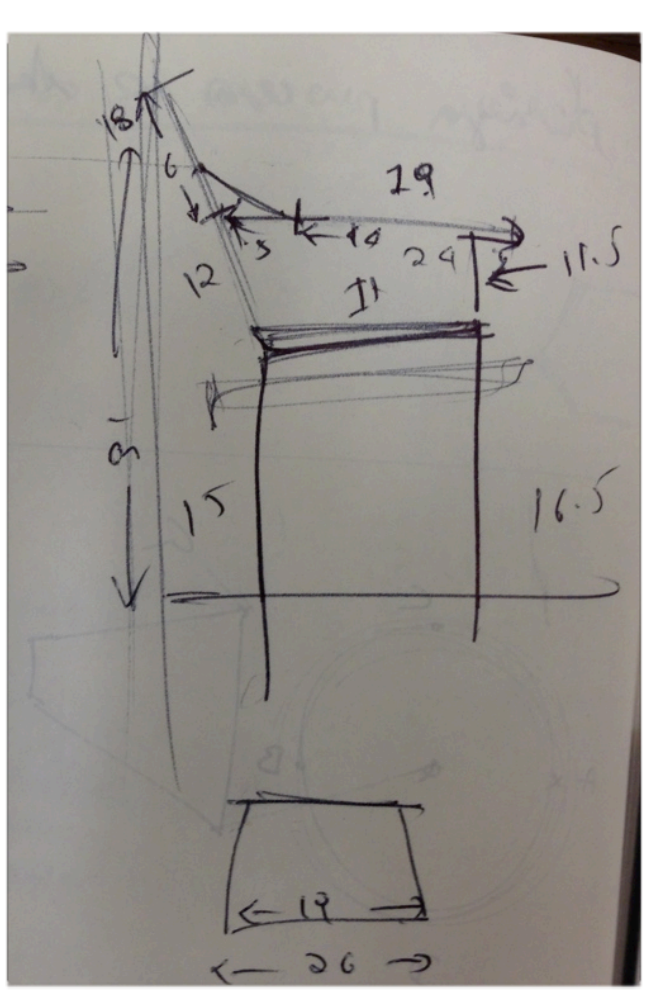
3. Ergo buck, Sculpting practice and experimental joints

It is very important to know the reasons why you are building a buck. For me, I wanted to make sure the ergonomics worked. I wanted to feel confident about the elbow room created due to the bend in the transition from back to the arm. I also wanted to freeze on the angle for the seat and the back.

All the measurements taken from the buck was transferred to the drawing and later to CAD to make the patterns. This made the whole process easier. On the downside, it took time to freeze everything.

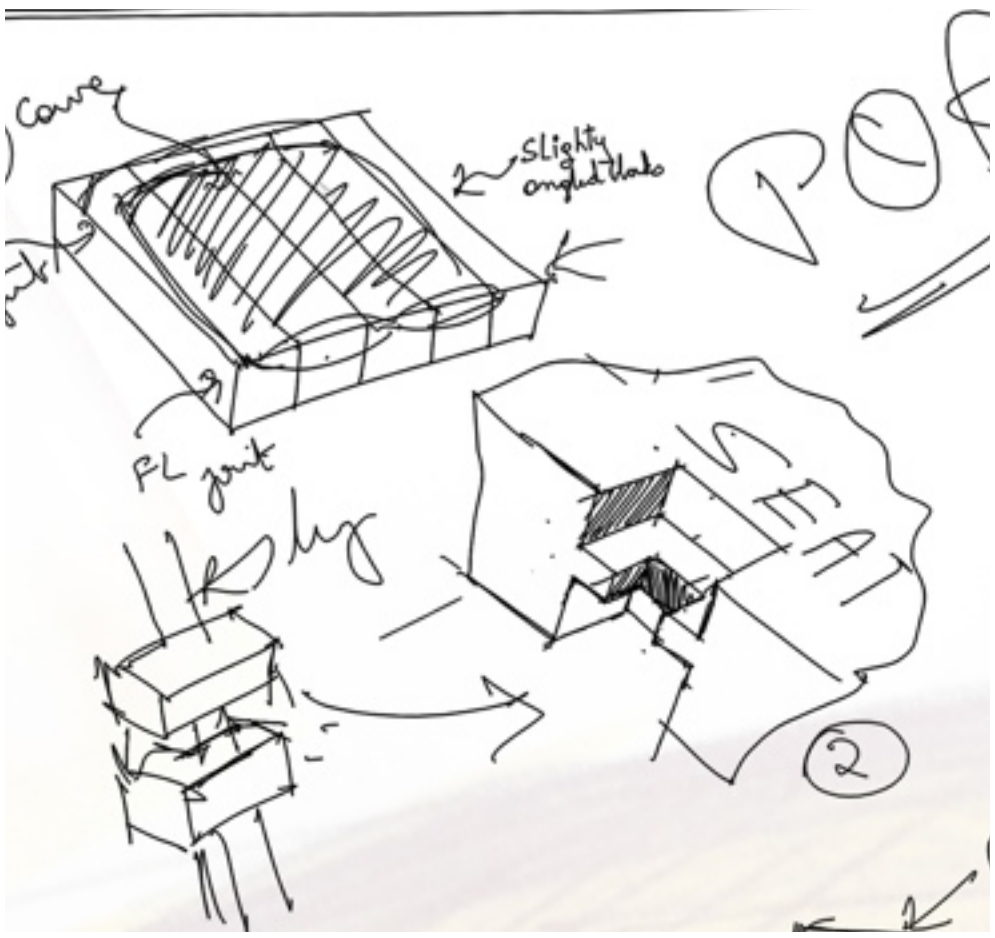
I added the buck to the lawn chair to get all these information. The angles was arrived at by moving the chair over the end on a ramp. Raising and lowering the legs using shims was also something that tried.

This worked amazing well.



One of the things I wanted to get hands on experience before committing to sculpting was my ability to actually sculpt. I tested this by gluing up and sculpting a piece of walnut to an intended shape. I learnt that I need to have a template to get accurate curves, especially to get symmetry. It also creates a lot of dust. The best parts was that using a rasp gave a better result, but it was limited to concave shapes and was way to slower.

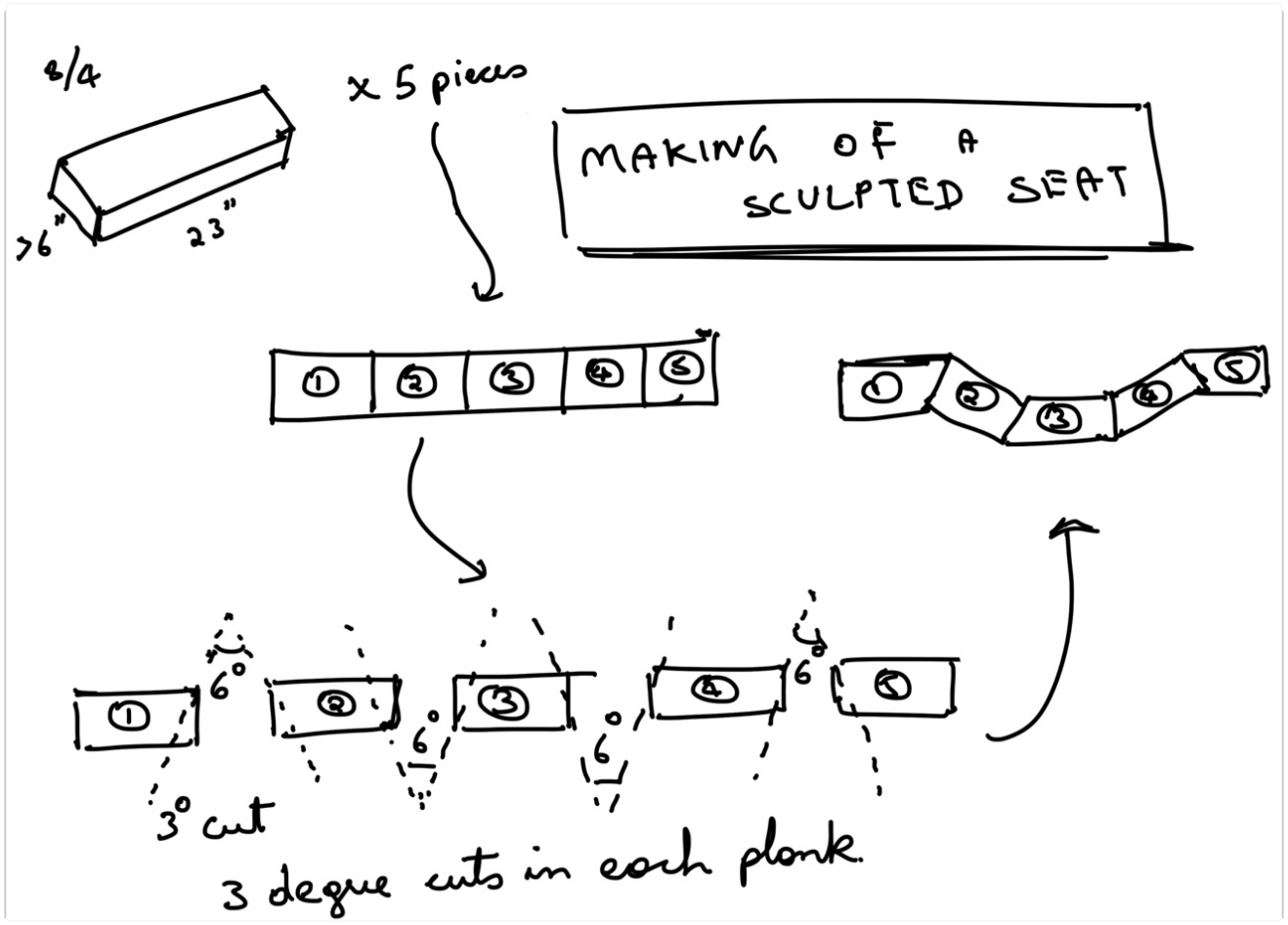
Carbide abrasive disc used to sculpt a trial piece of wood. Carving a curved line is quiet tricky. Its no work to be done when sleepy or alone late at night.



Schematic of maloof joint.

4. Making of the seat

The seat is made from 5 pieces of wood. The schematics of the seat are shown below. The process is a bit involved and you will have to create your own jigs to achieve accuracy.



Step by step process:

1. Cut all planks to size. Plane and joint each plank to accurate right angles. Pass all of the together in the planer to get even thickness. Match the grain both on the top and bottom of the planks. Move knots and interesting features towards the center of the seat. Use a consistent marking system like traditional triangle system to keep track of orientation and assembly.

2. A angle of 3 degrees have to be cut in each of the planks as shown in the schematic. This creates a nice 1/2" scoop in the blank. The grains run better on the carved seat. Use all the tricks in the book, like canceling table saw errors by subsequent cuts, dry clamping to check for gaps, using a card scraper to get a tight fit, etc.

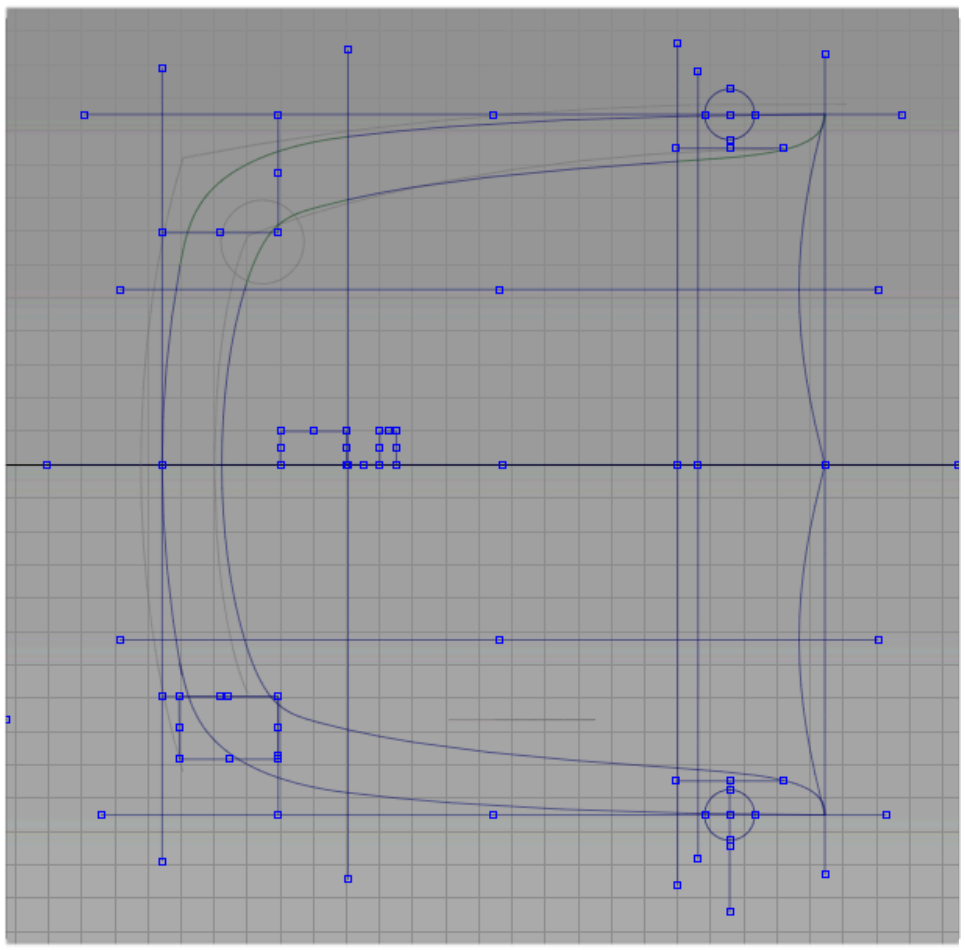
3. Dry clamp to check fit. Note that plank 1 and 5 are flat and have only one 3 degree angle cut in them. Plank 2, 3 and 4 has angles cut in both sides.

4. Plank 1 and 5 have the cutouts to accommodate for the leg joints. In the image you see the cutout for the rear leg. This is further used as a guide to rabbet a *maloof* joint.

5. The front cutout in the seat is checked with a trial piece for accuracy. Joint is achieved by rabbeting the cutout on both sides by setting the height of the rabbet to a accurate 1/2".

6. Rabbeting both the rear and front cutout has to be done before gluing the planks together. The depth of the cutout and the length is based on the thickness of the legs. The axis of the legs need to cross tangent to the seat edges for optimal strength.

7. Glueing of the planks is done one by one. Use clamps from both sides to avoid the planks moving (3 degree angle can make them slide easily)



8. CAD modeling helps in creating an accurate template with quality lines.

9. The front cutout in the seat is checked with a trial piece for accuracy. Joint is achieved by rabbeting the cutout on both sides by setting the height of the rabbet to a accurate 1/2".

10. A rasp, and microplane is used to shape and sculpt the seat. This is more of an art. It helps to feel the surface as you carve and see it in varying lights to judge the flow of the form.

5. Making of the front legs

In the image you see the blank front leg and the grove cut in the exact height where it meets the seat cutout. The round over matches the rabbeting bit used on the seat to make a tight joint. Notice that the round-over is one only in the vicinity of the joint.

The poplar piece is used as a trial piece to cut the grove. The trial piece is cut first to match the seat and then with the same settings on the table saw, the dado blades are used to cut the actual leg to get an accurate fit. Even with all the steps followed for accuracy, don't assume that the left and the right leg will have the same measurement. They won't.

The leg is finished by turing on the lathe. Both sides of the joint is turned to about 1 3/8".

Front leg joinery

6. Making of the arms

The curves for the arms were designed in CAD. This was later cut into templates on a laser cutter. The pattern making bit is used to shape the arms. The holes you see in the template are for easy reference of the leg center.

6. Prepare the seat block
7. Make the male joints on the seat and carve the seat
8. Cut the pattern for the front and rear legs. Route the female maloof joint on the legs.(Jigs are prepared to maintain symmetry)

7. Material and supplies cost

For a wooden chair made of sculpted walnut, the most expensive part of the expenditure is the wood itself. Total project cost: 1000$ and adding

1. California walnut @ 10$/bf: 430$
29bf is the exact calculated requirement. Considering waste and choice of grains, knots and bow 43bf of walnut was purchased.

2. Prototyping lumber: 60$
Poplar used to try joints and experiment for accuracy

3.Titebond 1 wood glue: 15$

4. Rabbeting and rounder bit: 79$
Procured from highland woodworking as a pair. Best in class router bits.

5. Microplane: 10$

6. Grizzly pneumatic drum sander: 85$
Not used yet. Useful in getting smooth transition in curves.

7. Pattern makers 2” router bit: (about 45 $)
Borrowed from Kevin. A sharp router bit is worth the investment.

8. 3M Respirator: 48$

9. Stanley Chisel set: 130$

Tools and consumables good to have, but available in PRL and sculpture lab:

Random orbit sander
Angle grinder with carbide abrasive disc(variable speed)
Industrial dremel
Wood sculpting Rasp set
Combination square
Vernier calipers
Sand paper in various grits (30, 60, 80, 120, 180, 320)
Steel wool (1000 grit)

8. Status

At this point the entire chair can be put together. To allow for easy sculpting none of the parts are permanently joined. I feel great about the form factor and the shape of the chair and how each of the parts flows into one another.

The further work will involve carving each of the joints. This will be done after resolving the fit of the arms. I imagine that each of the legs will join the seat as if it were two melted chocolate coming together.

The document will be updated in the future. If any of you reading this want to pursue a sculpted chair making, feel free to ask me any questions at *pare.raviraj@gmail.com*. The act of making a chair like this is about learning as you go and solving the micro problems with jigs, fixtures and sometimes by changing the design to suit the resources you have in hand.

I am thankful for John Edmark's support during this project. I am also indebt to Anja Ulfeldt, Daniel Tiffany, Craig Milroy, Kevin Mcelroy and rest of the class for supporting me.