The Chair

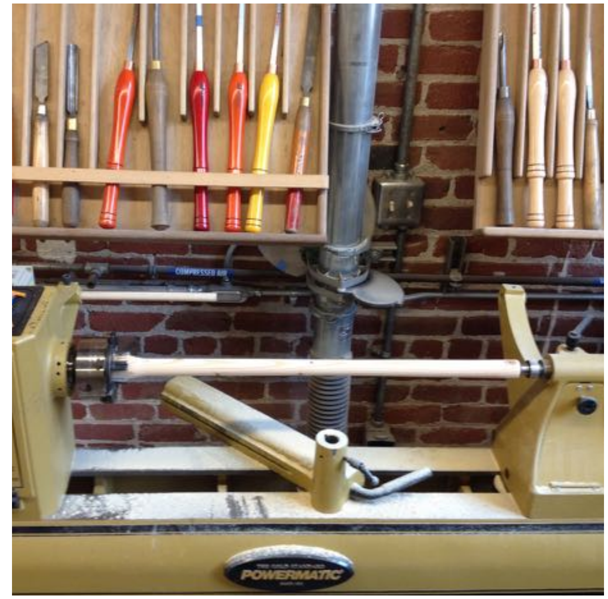
Antonio X Cerruto

2016

Chair-In-A-Week

Process


POWERMATIC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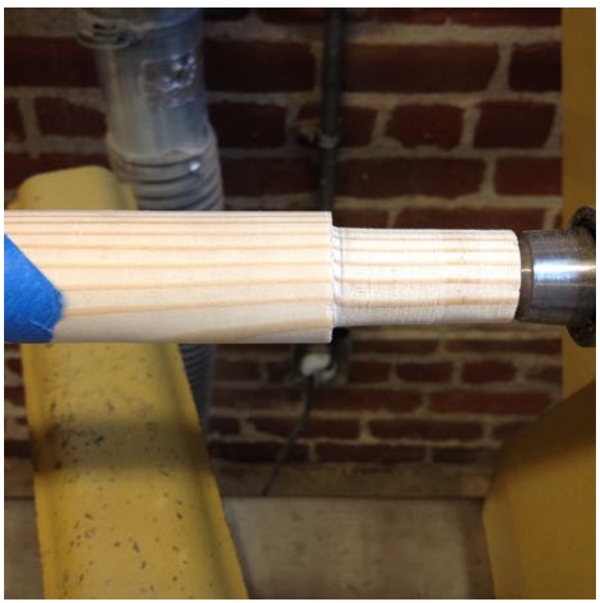
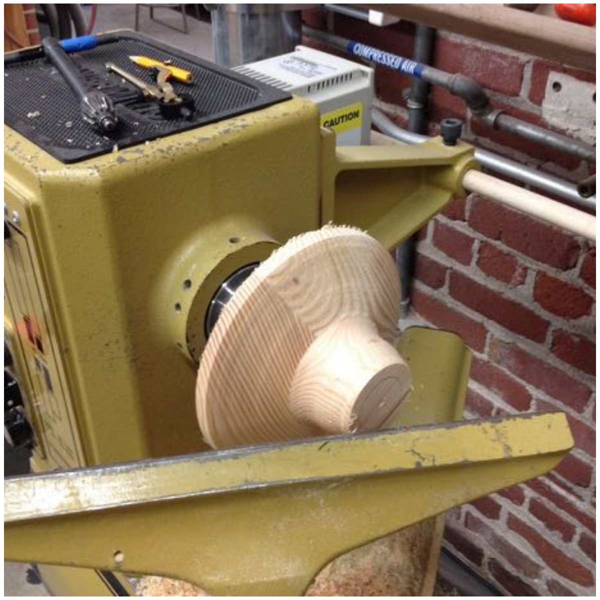
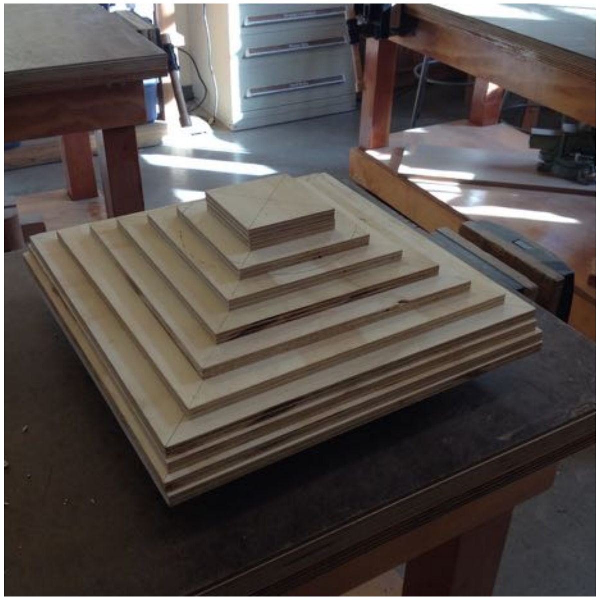
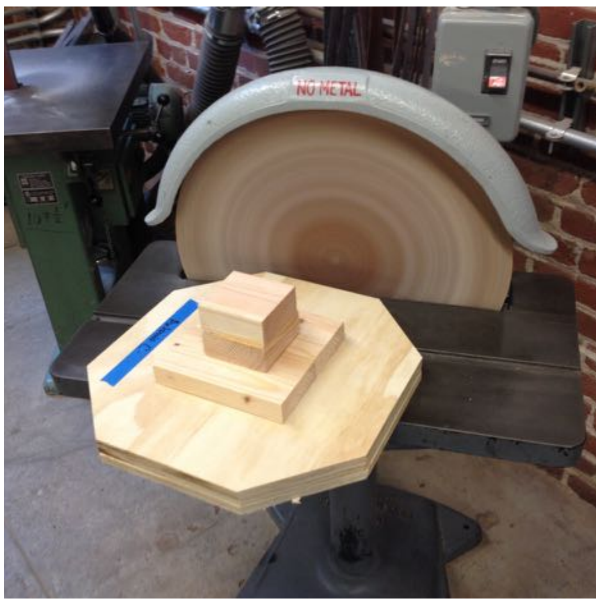



COMPRESSED AIR
CAUTION





NO METAL



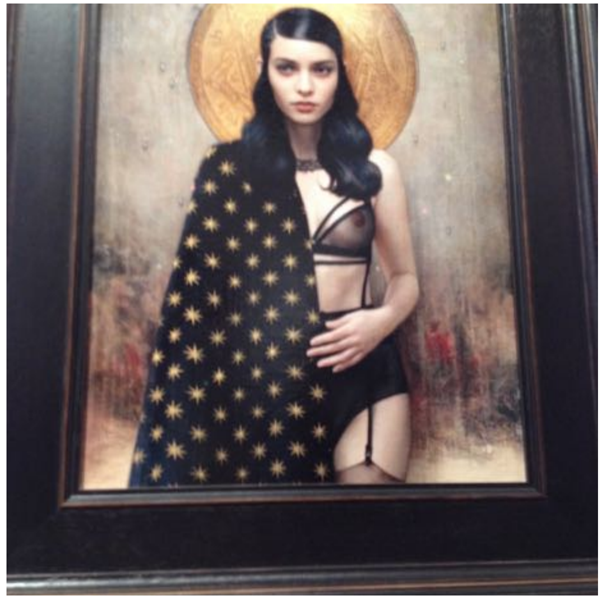






Stool
Inspiration & Research


ART
spoke
Sail - "Paint Me As A Dead Soul"
ink, acrylic, watercolor on paper




LX150











by Knoll

by Knoll

























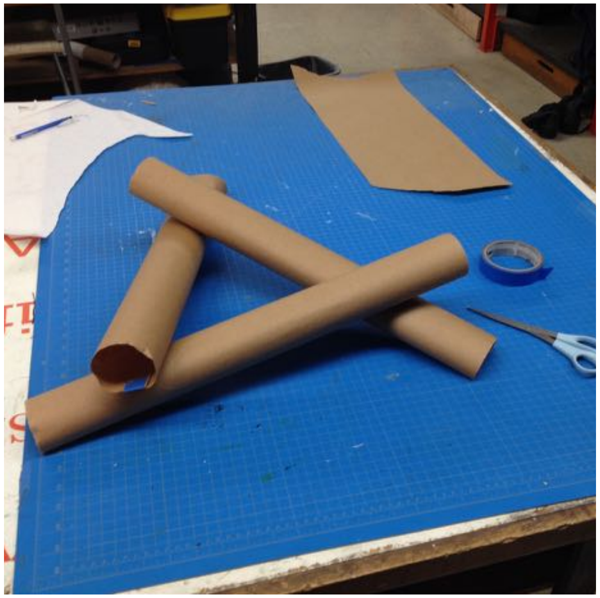

Stool
Focused Inspiration & Research

Aiming for a self-supporting stool made to be flat-packed, and assembled and disassembled without the use of screws, nails, or other joiner pieces, and without the use of any tools. There is to be no welding, brazing, etc. in the manufacturing process.






Stool
Concept Prototypes






Stool

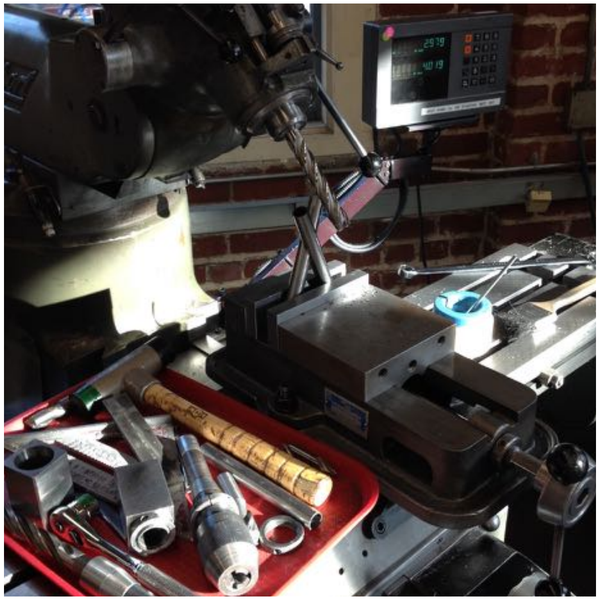
Process Prototypes

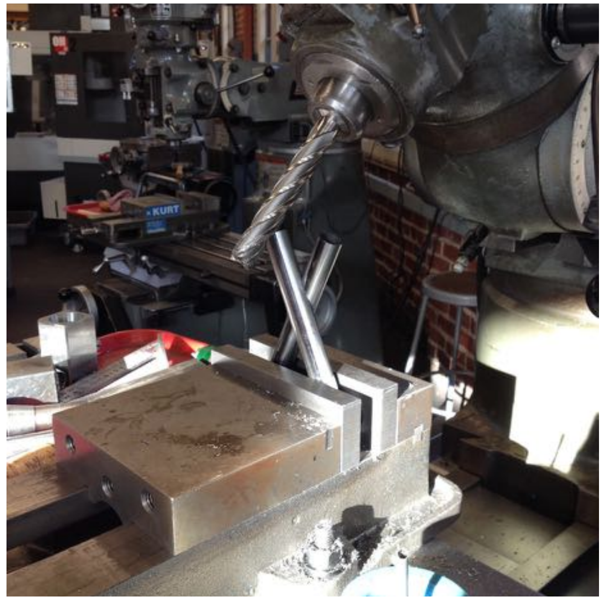
Stool

Legs: Small-scale Prototype

Initial prorotype of interlocking legs, using three tubes of steel of 3/4-inch diameter. The idea was that a notch on each leg would interlock with an adjacent leg, to form a self-supporting stool. Mill head was tilted at a 45-degree angle as shown in the following pictures.

Resulting notches did not provide good support for legs. Additionally, a tendency of the tubes to slip from the pictured set-up made it difficult to drill precisely.



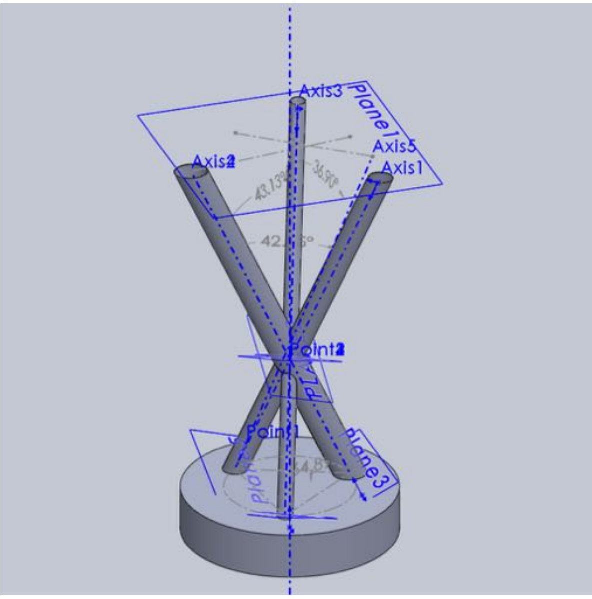

KURT

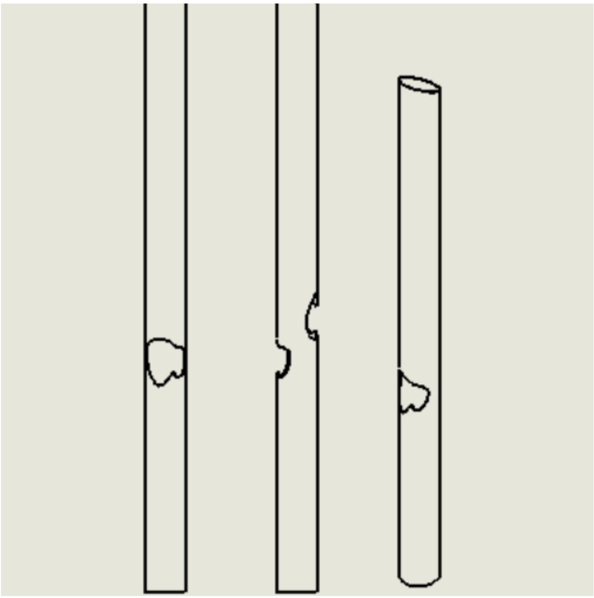
Stool

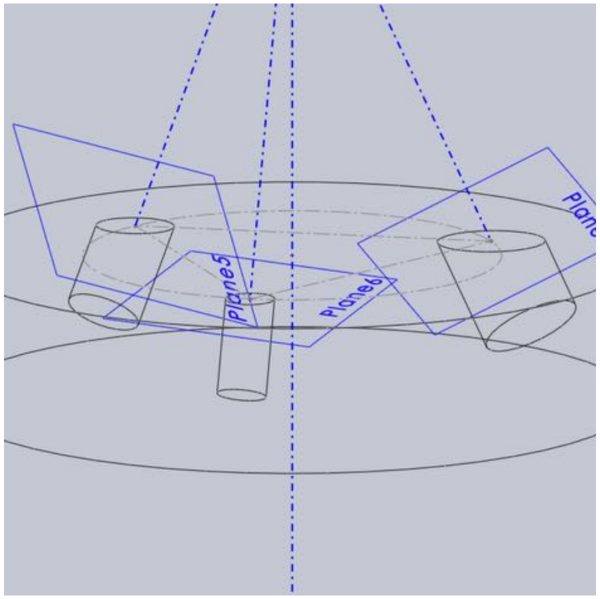
Legs: Design Adjustments

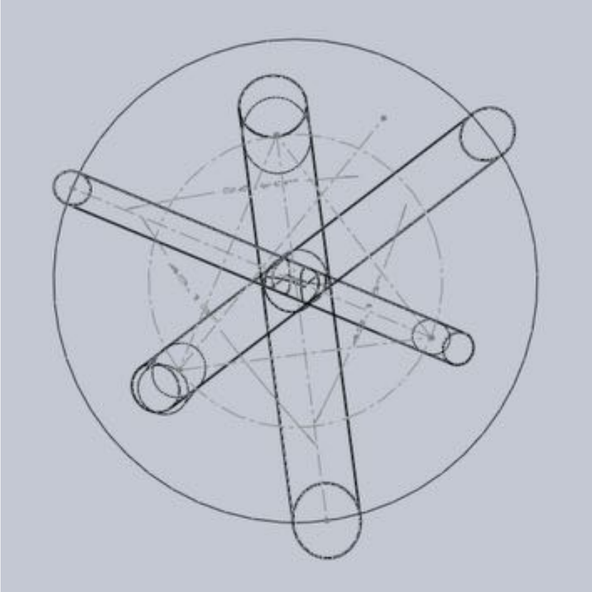
As a method to visualize the complex cuts of the stool's legs and seat, I created a 3D model of the stool in Solidworks. The height and angle between legs was adjusted to give a vertically slender aesthetic.

It turned out that the quality of the stool's vertical form was difficult to evaluate entirely in CAD. Legs at 45-degrees to each other resulted in a vertically unappealing form. This angle was later adjusted to 33.4-degrees to achieve the desired silhouette. Further, drawings generated in CAD were not useful in manufacturing, due to the extreme precision required of the cuts, and the difficulty of establishing drawing reference points for the complex cuts on the tubes.


Axis3
Plane1
Axis5
Axis1
Point1
Plane3




Plane5
Plane6



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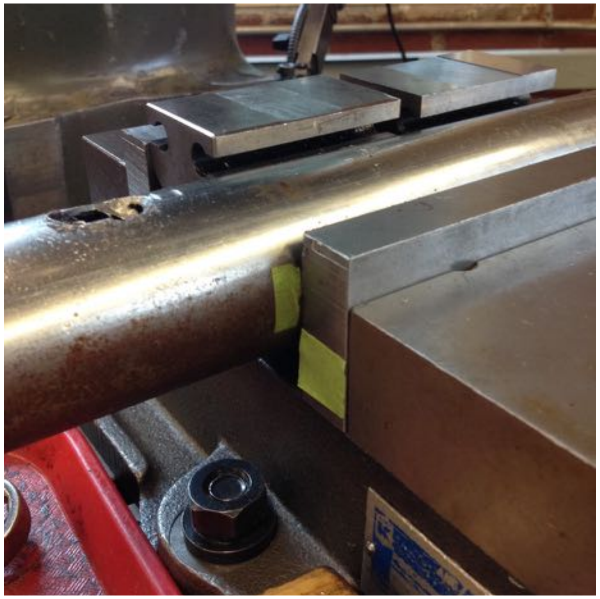
Legs: Process Prototype 1

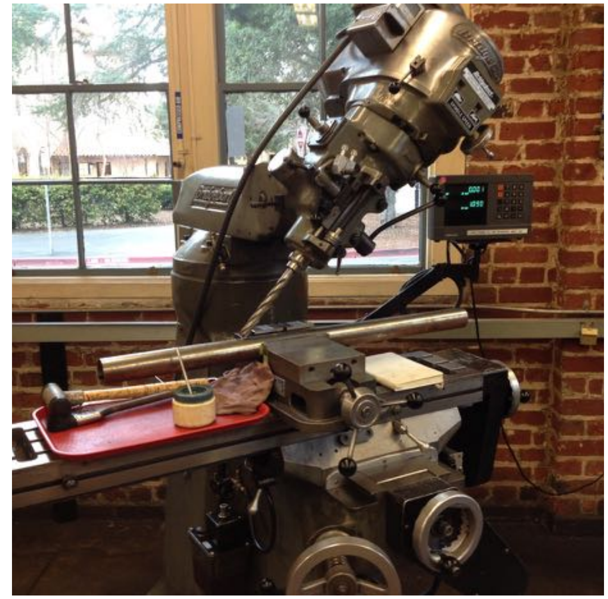
Initial full-scale prototype with steel legs that fit into each other. Tubes are of 35-inch length, with diameters of 2 inches, 1.5 inches, and 1 inch.

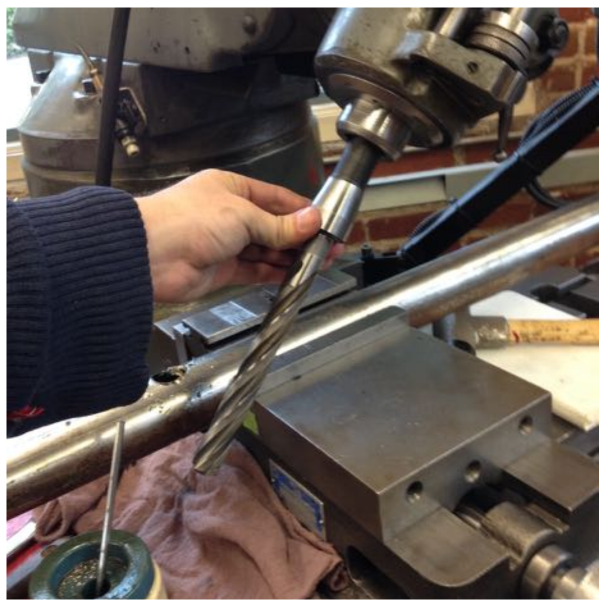
Cuts were made with drills, slowly increasing drill size in increments of 1/4-inch diameter until the desired hole size was reached.

Mill head was tilted at 45 degrees to normal of mill bed as shown in the following figures.

Cuts were made on each leg individually before assembly. The precision required of the cut locations yielded misalignments that made assembly impossible. At this point, the 1.5-inch diam. tube was inserted into the 1.5-inch wide hole on the 2-inch diam. tube, and a 1-inch wide hole was drillled into the two larger tubes simultaneously. Strap clamps held this set-up in place.







Bridgeport





Bridgeport


Stool

Legs: Process Prototype 2, 3

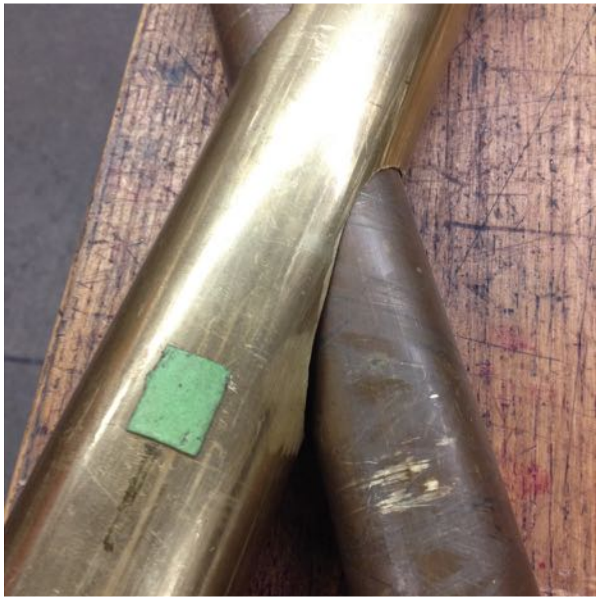
Drilling on bronze tubes was quite different from working with steel tubing of similar length, diameter, and wall thickness. The bronze tubes had a greater tendency to warp with the force of the vice clamp, as well as heat, flex, and move during the drilling process. Wall thickness was about 1/32-inch for all tubes.

An additional vice grip was used to hold the bronze tubing at two ends to minimize movement during drilling. Tubes were held via three-point contact by using V-blocks between the jaws of the vice grips.

Movement caused by an attempt at larger increments in drill size (1/2-inch) and fast drilling speed resulted in an unacceptably large gap between the interrelated 2-inch and 1.5-inch diameter tubes. Automatic feed was used from this point forward.


Bridgeport



Stool

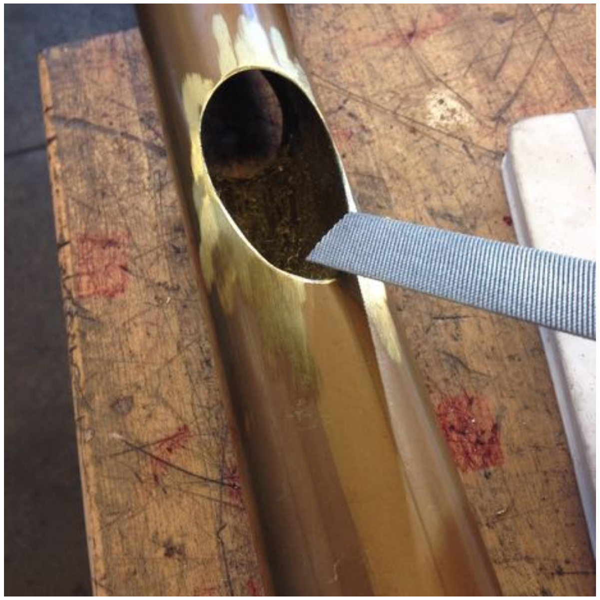
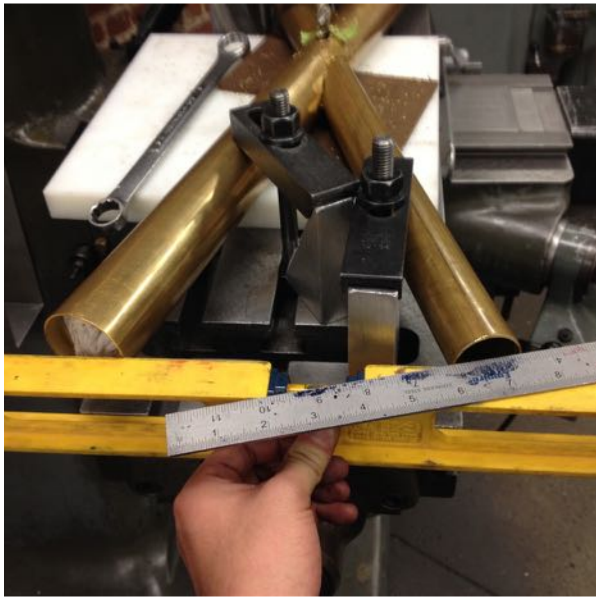
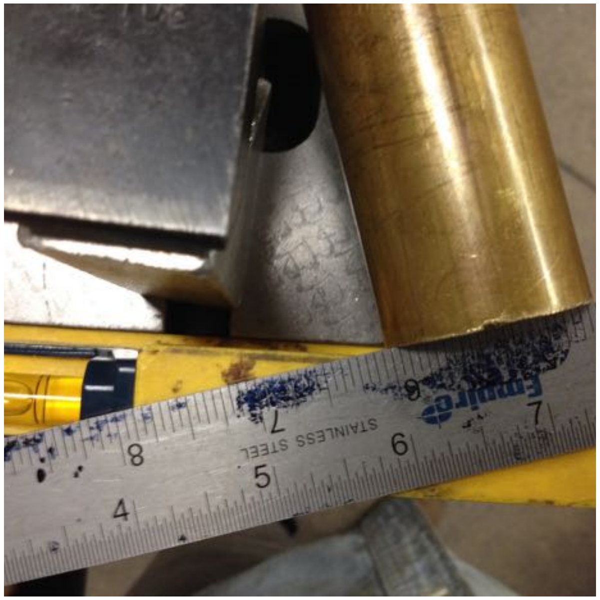
Legs: Process Prototype 4

Drilling left big burs that needed to be removed with careful filing, to maintain the shape of the holes.

The strap-clamp set-up shown in the following pictures used a single block of plastic as sacrificial material to drilling. Since the 1.5-inch diameter drill tip could not be seen as it traveled through this plastic and toward the mill bed, the set-up needed to be changed.

Perpendicular alignment of the two interconnected tubes to the mill bed was done by matching a ruler that touched the edge of the mill bed on one side, and both ends of the tubes on the other. The difference in tube diameters was taken into account by eyeball measurement.


Oil

Oil



Empire
STAINLESS STEEL

Oil

Stool

Legs: Process Prototype 5

Strap claming of tubes with two plastic plates. Two pieces of duron were placed under the smaller diameter tubes to prevent them from rocking.

The lack of three-point contact for the tubes and the relative ease with which the tube walls flexed with applied pressure resulted in a failure of the strap clamps. The tubes fell out of their arrangement and the drill damaged the tubing.



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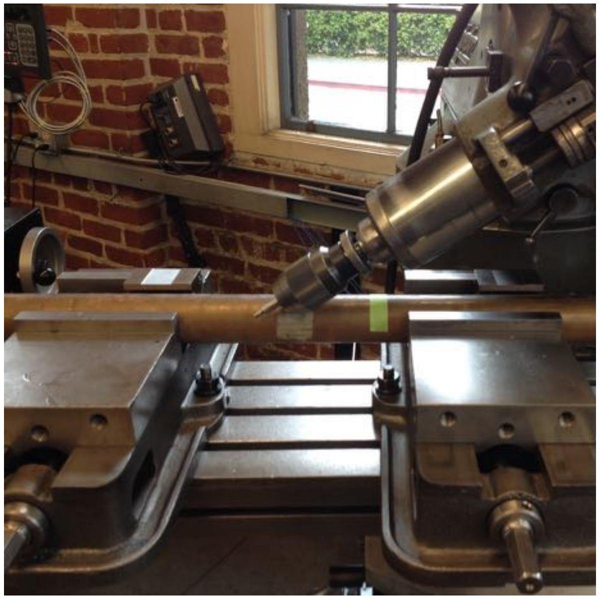
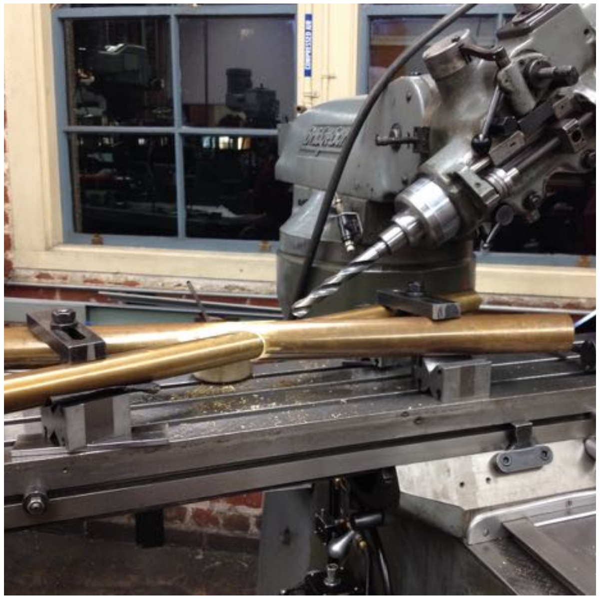
Legs: Process Prototype 6

A two-vice set-up with V-blocks and automatic feed was consistently successfull in the set-up of an angled drill. The angle was at 56.6-degrees from the normal to the mill bed, with the center of the drill at a distance of 16.75 inches from the edge of the 35-inch tube. A 2-inch diameter tube was drilled with a 1.5-inch wide hole in this fashion.

A 1.5-inch diam. tube was then inserted into the hole of the 2-inch diam. tube, making sure that the length of tubing between tube edge and intersection was equal for both tubes. Tubes rested on V-blocks lined with 120-grit sandpaper, serving to increase friction between the tubes and the V-blocks. Pieces of duron were added beneath the blocks supporting the 1.5-inch diam. tube, in order to minimize rocking. Alignment of the tubes to be perpendicular to the mill-bed was done as shown in Process Prototype 4 above. Strap-clamps held the configuration securely in place. The center of the drill was placed 1.4826 inches from the intersection point of the two tubes.






Stool

Seat: Shaping

A large piece of mahogany was used as the material for the wood seat. Making use of the wood around a large crack, the wood was cut and jointed into pieces of roughly 15 x 5 x 3 inches. These pieces were glued together to form a rough 15 x 15 x 3 inch block, which was further cut, jointed, and planed to form a 14 x 14 x 2.75 inch block.

The block of mahogany was sanded into a rough circle of 13 inches in diameter. This was then turned on a wood lathe in order to form a bowled surface. The edges of the bowl were removed in favor of a smooth transition between the bowled surface and the edge of the seat. Seat was sanded up to 220 grit.

Sanding was used as a major material-removal process since this particular wood produced deep tears when cut with sharpened lathe tools.



DEWALT



GENERAL
DANGER
DANGER
DANGER



POWERMATIC
MODEL 4224
MATIC

Stool

Seat: Drilling

Flat-ended holes for the legs to fit into were drilled with forstner bits. A practice piece made of glued two-by-fours was used to gain confidence in the drilling process.

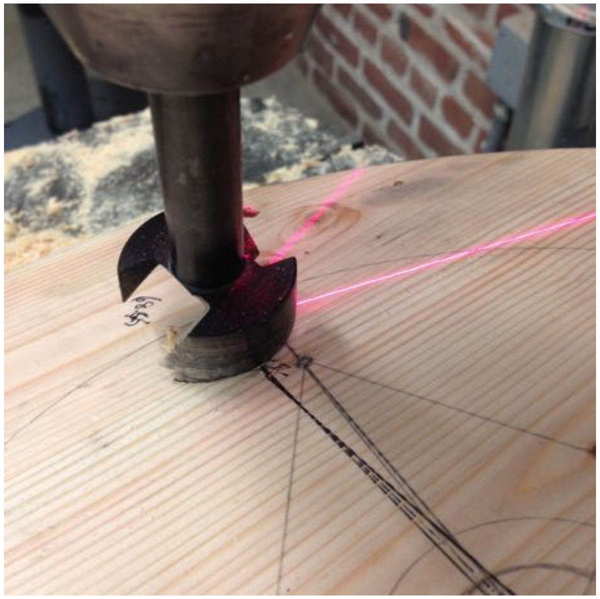
The assembled legs were centered on the bottom of the wooden seat, and the contour of each leg was clearly marked. Secondary markings 3/4 inch toward the direction of the center of the seat were made for each leg. These secondary markings were used to indicate the edges of the holes to be drilled.

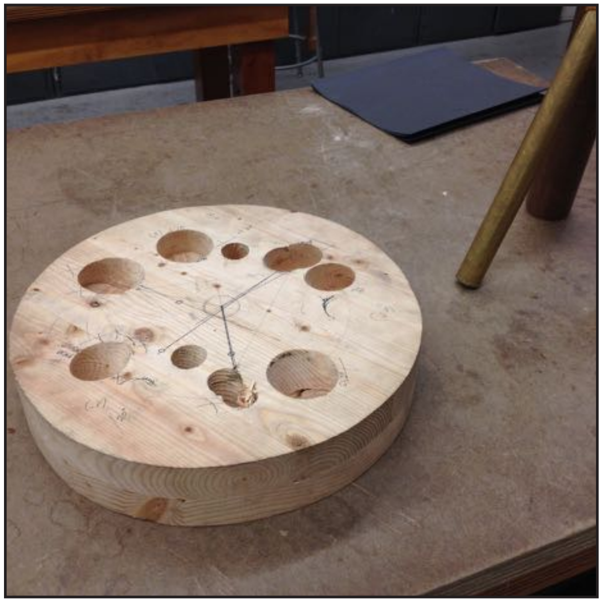
The first hole to be drilled was the 2-inch diam. hole. A digital angle gauge was used to determine the angle from the 2-inch diam. leg to the back of the wooden seat. The bed of the drill press was tilted to this desired angle, and the edge of a forstner bit of 1.5-inch diam. was aligned with the secondary marking for the 2-inch diam. leg, before drilling. A hole of 2.25-inch depth from initial contact with wood was drilled. From there, the 2-inch wide hole was filed by hand and the 2-inch diam. tube was inserted to the bottom of the hole.

The 1.5 inch diam. tube was then inserted into the corresponding hole on the 2-inch diam. tube, and the point at which the 1.5 inch diam. tube hit the seat was marked as the next hole edge for drilling. Previous markings on the seat were used simply as points of reference for accuracy of the hole orientations. A 1-5/8 diameter hole was drilled to a depth of 2.25 inches. The slightly larger hole size made it easier for the tube to fit into place.

The process was repeated for the 1-inch diam. tube, with a 1-1/8 diameter hole and 2.25-inch depth of cut.





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Final Touches

With the stool assembled, a final hole of 3/16 inch diameter was drilled into the side of the seat closest to the 1-inch leg, through and into the metal leg. A bronze pin is inserted into these holes in order to secure the legs from falling when the stool is picked up.

The ends of the legs touching the ground were cut and sanded at angles to be flush with the ground. Bronze tubes and pin were sanded to 400-grit and then buffed with a tripoli compound.

Wooden seat was finished with shellac. An initial attempt at finishing with linseed oil amplified small marks on the wood, and was discarded in favor of shellac.


Klean Strip
Boiled Linseed Oil
PROTECTS & SEALS WOOD

Stool
Glamour Shots

Antonio Cerruto

Stool
Bronze, Mahogany
14” L x 14” W x 29” H
Self-supporting stool made to be assembled
and disassembled using only five integral parts.

Stool
Material Sourcing

Mahogany wood sourced from Global Wood Source
376 Reed St
Santa Clara, CA 95050
Total cost of wood in final piece: $55
Total cost of wood in prototyping + final piece: $175

2 x 4 wood sourced from Home Depot
Total cost of wood in prototyping: $10

Bronze and steel sourced from Alan Steel
505 E Bayshore Rd
Redwood City, CA 94063
Total cost of metal in final piece: $100
Total cost of metal in prototyping + final piece: $475

Total cost of final piece materials: $155
Total cost of prototyping + final piece: $660

Both Global Wood Source and Alan Steel are highly recommended for their friendly staff and close proximity. I found it possible to get small student discounts from both of them.

Stool

Notes and Reflections

Choice of Materials
Mahogany and bronze were chosen for their complementary nature. They are two materials that celebrate each other when together. No other materials were considered for fabrication of the stool. In fact, these two materials inspired the creation of the stool.

What did you learn about yourself as a designer through this experience?
I need more basic visual training.
It was very inspiring to focus on the interaction between two different materials.
I had very big ups and downs throughout this project, probably because I form strong emotional attachments to concepts and ideas. I would benefit from more practice of "killing my babies."

What would you do differently if you could start all over from scratch?
The 1-inch diam. leg should be at a slightly smaller angle with repect to the plane of the other two legs, in order to form a perfect equilateral triangle between the center-points of the three legs on the floor. To achieve this in the future, adjust CAD model to fit "real" angles of cuts, etc. and use the information in this model to inform the next angle of drilling.

What were the biggest surprises (good or bad) you encountered?
Drilling into bronze with large drill bits was very different from drilling into steel, even when using the same exact set-up and similar length, diameter, and wall thickness of tubing. The bronze tubes had a greater tendency to warp with the force of the vice clamp, as well as heat, flex, and move during the drilling process.

Stool
Notes and Reflections

What advice would you offer to anyone taking the class in the future (regardless of their chair design)?
When looking for inspiration, take a break from looking at chairs and look at jewelry, sculpture, music (what would you be sitting on when listening to certain songs?), literature, theater, bugs, bacteria, animals, flowers, plants, food, simple geometric shapes, etc.. Think about your emotional reactions to the things around you, try to distill these emotions, understand their source, and try your hand at creating a similar effect in your own medium.

Final Note
I don't want to personify this chair or what it's 'doing'. It's not trying to slip into any background. It doesn't yearn for anything, and it doesn't want to be comfortable, or have clean lines, or be thoughtful, or be clever, or subtly show off a particularly sexy contour. It doesn't reflect something that I brought back from a revelatory trip to Japan. It doesn't particularly care about being in harmony with nature. Or being in harmony with anything, for that matter. There is no interpretation. Stop thinking so much. You see it or you don't.

The Chair

Antonio X Cerruto

2016