

The Crest Chair



Alex Key

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Me in the Crest chair
Photography: Alex Key

Project outline:

This project seeks to push Ash to its limits as a material, by exploring hand and digital methods of making within furniture design.

I will be researching practical processes such as steam bending, glue laminating in the workshop, alongside CNC 3-axis milling & digital model making on the computer. These are new areas of my skill set I am developing for this project, which will see the outcome of furniture showcasing the unity of these techniques and methods of making.



Guy's Hospital exterior - Thomas Heatherwick
Photography: Alex Key
Date: Aug '19

Research - 1.1 Primary: London Visit

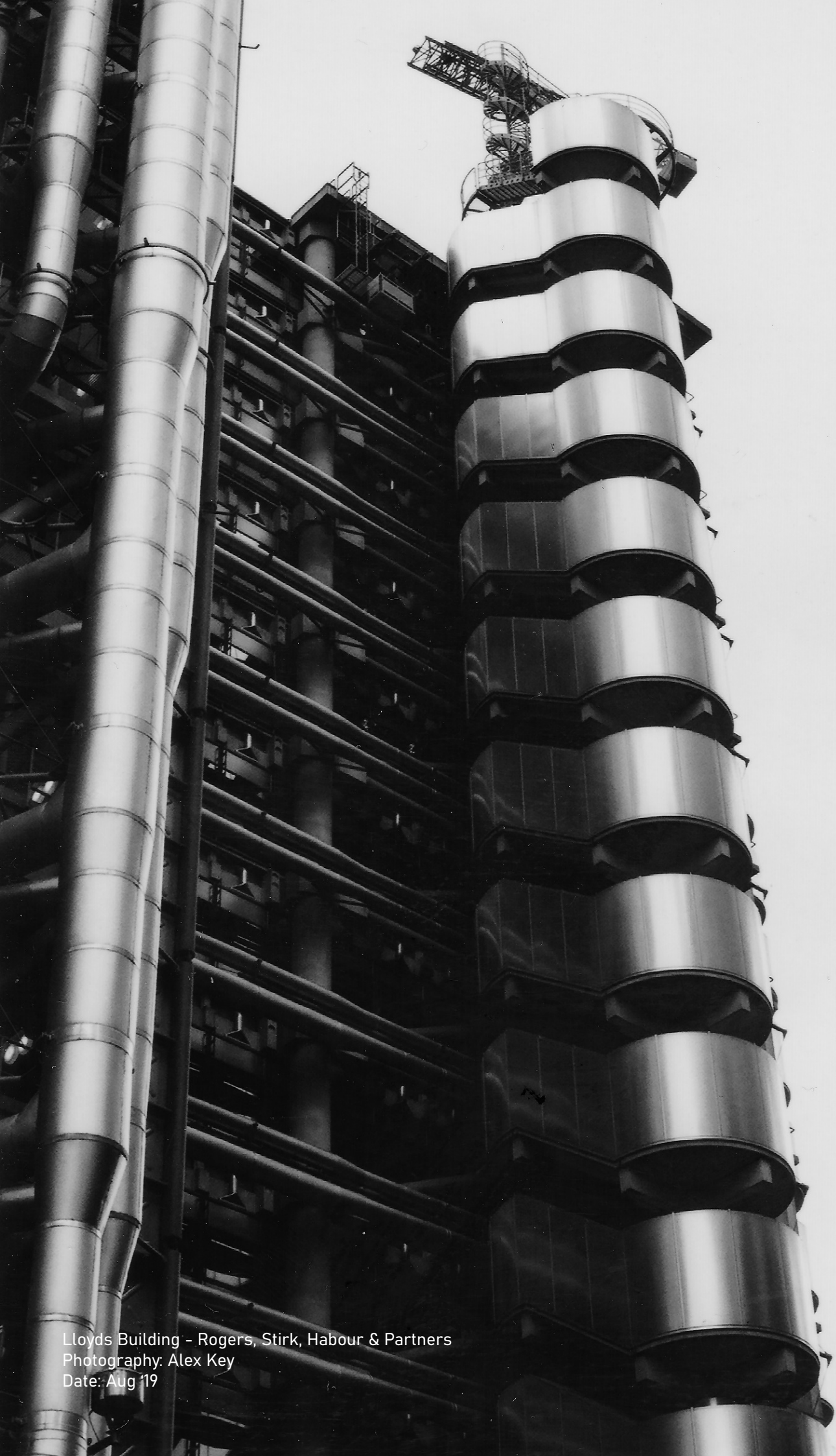
One of the first things I did for this project was conduct a research trip in London, this was where I walked to various landmarks such as the Lloyds building, Guy's hospital, The Gherkin and more. The reason I chose these buildings was to gain visual inspiration for the project by looking at flowing and repetitive shapes in architectural buildings throughout the city.

The building which really stood out the most and made an impact on me visually was the Guy's hospital exterior by Thomas Heatherwick. This exterior was made out of steel mesh squares which had been joined together and moulded into a free-flowing shape. The addition of square cut outs for the doors and windows created a dynamic contrast between the free and structured aesthetics within the building. This is an aspect which I found interesting and is something I would like to transfer into my own work in some form or another.

Overall, I found this trip useful as it helped me start to find the visual identity for this project as well as allowing me to view some interesting architectural marvels.



London map marking architectural site visits
Source: Unknown
Date: Aug '19



Lloyds Building - Rogers, Stirk, Harbour & Partners
Photography: Alex Key
Date: Aug '19



London Bridge Station exterior - Mark Middleton
Photography: Alex Key
Date: Aug '19

English Woodlands Timber Visit

Later on, in this project I conducted another research trip, this time to English Woodlands Timber just outside Chichester, with the intention of gaining knowledge about Ash and timber in general. This was because I was going to use Ash as the primary material for this project, to demonstrate the versatility and strength through the processes it can be used in to construct a chair from steam bending to milling.

I learnt a lot of technical research from this trip, including where the timber was sourced from, as well as how it is manufactured for purchase. Overall, this was a valuable trip which also saw me sourcing Ash from this sawmill for use in my project, which created a nice local connection for the piece.



Air drying timber log stacks
Photography: Alex Key
Date: Jan '20



Scotch Elm close up
Photography: Alex Key
Date: Jan '20



Ash close up
Photography: Alex Key
Date: Jan '20



Planned wood rack - Chesnut, Elm, French Walnut
Photography: Alex Key
Date: Jan '20

1.2 Secondary: Designers

Hans J. Wegner



Wishbone Chair - Hans J. Wegner
Source: Carl Hansen & Son
Date: 12/04/2020



CH008 - Coffee Table
Source: Carl Hansen & Son
Date: 12/04/2020

Ercol Furniture



Butterfly Chair - Ash
Source: Ercol
Date: 12/04/2020



Love seat - Ash
Source: Ercol
Date: 12/04/2020

As I continued my research, I turned to exploring other designers within the field of furniture design. A big influence on me as a designer is Hans Wegner who is a heavy weight from the Danish & Scandinavian furniture design movement. The reason he is a big influence on me as a designer is because he creates furniture which is minimalist as well as elegant, the favourite of mine being the Wishbone chair.

The reason I like this chair is because of the one piece back legs which curve up to meet the front of the backrest, this combines strength and aesthetical finesse in a great way. This chair comes in a variety of colours and woods from Walnut & Oak to Ebony, but I really like it in Ash (Depicted above) as it really accentuates the natural shapes as well as the simplicity of the design. These are all aspects I would like to explore in my own designs, from the elegant shapes and structural rigidity to the timeless shapes.

For the second designer I decided to look at a company, Ercol, rather than an individual. Ercol are a UK based furniture design company which create pieces inspired by traditional English furniture. The reason I decided to research them was because of the variety of processes they use, such as steam bending, glue laminating and milling to create a variety of chairs and tables.

One of the pieces which I find most visually interesting is the Love seat, I like this piece because it combines simplicity with structural strength. This is evident in the back of the chair which has a slightly curved styling, this visual aspect psychologically draws the users together. This combined with the simple underframe structure makes an understated yet visually engaging piece. The curved back, which subconsciously connects to the user is something which I think is very interesting and could be something which I explore and try to emulate within my own pieces.

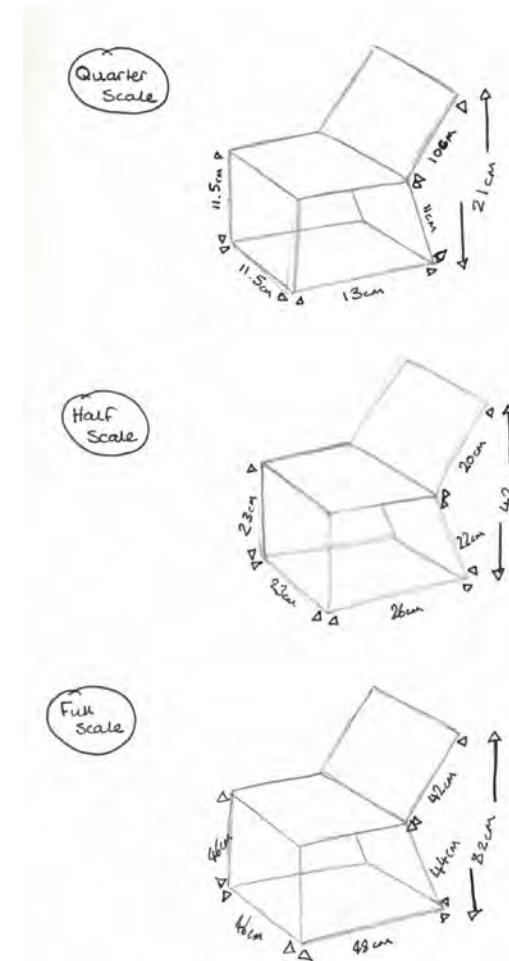
Ergonomics & Dimentions

As I continued through this project, I quickly discovered that if I wanted to make an appropriately sized chair, I needed some guide measurements. So, I decided to take measurements from a mass-produced single person chair, which was around at University. The thinking behind using this specific chair was that because it was mass produced that the sizes and ergonomics would be to cater the most amount of people. This would prove exceptionally useful if I was to take the piece into production via myself or a company.

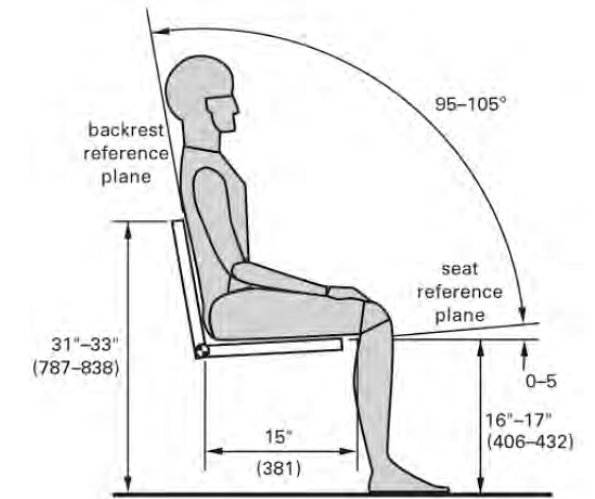
Once measured I then wrote them down and used them to create a useful chair sizing guide, this gave me the sizes for full, half and quarter scale models. This would be beneficial as the project progressed as in combination with secondary diagrams I would be able to make accurate models and drawings which could effectively convey my ideas.



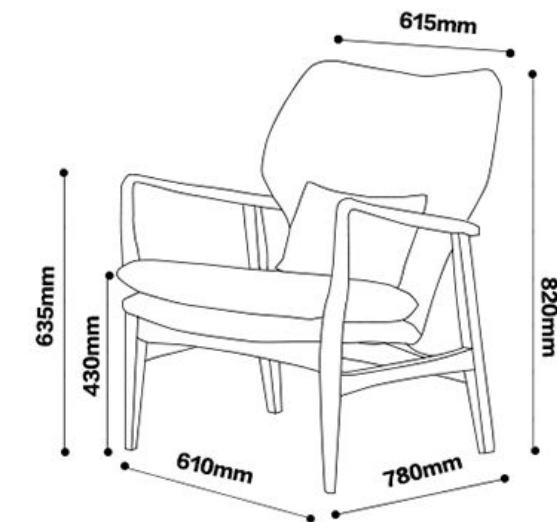
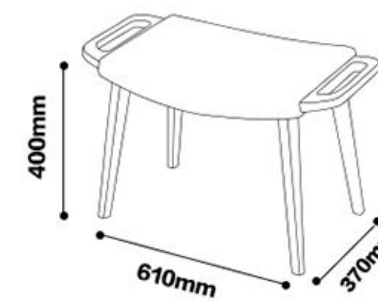
Original chair which I measured for scales
Source: Alex Key



Measurements & scale guide
Source: Alex Key



Measurements & angle guide
Source: Urbanologydesigns.com



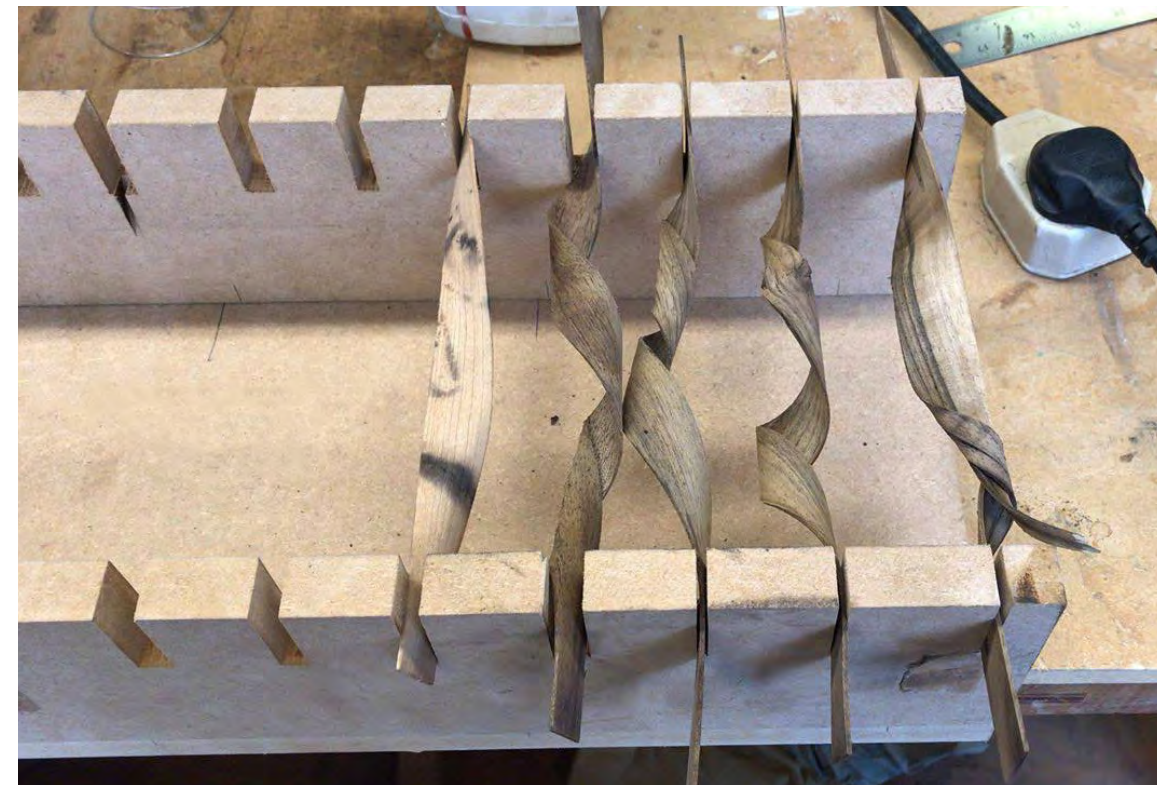
Chaise lounge dimensions
Source: Chaiseloungedimensions.net



1.3 Workshop: Steam Bending

The first process I explored in the practical portion of this project was steam bending, this was with the aim of learning the process and how I could use it to manipulate wood samples. My initial experiments were to twist the wood at various thicknesses to see how that affected it in conjunction with steaming lengths, the species of woods I tried were Walnut, Ash, Sycamore and Oak. The outcome of this research led me to find that thinner strips bent best, around 1-2mm, and that Walnut and Ash were the most malleable species.

I then continued onto explore what other visual results I could get out of steam bending; this was done by intertwining and twisting multiple Walnut strips to create flowing shapes. This gave me a variety of visually dynamic outcomes, which all explored steam bending in a more fluid and uncontrolled way. Manipulating wood in this way was very valuable for the project as it not only deepened my understanding of the process of steam bending, but also inspired the visuals.



Initial steam bending tests in the workshop
Photography: Alex Key
Date: Oct '19



Free-hand walnut steam bending in the workshop
Photography: Alex Key
Date: Nov '19



Free-hand Walnut steam bending outcome
Photography: Alex Key
Date: Dec '19



Free-hand Walnut steam bending outcome close-up
Photography: Alex Key
Date: Dec '19

Glue laminating



Series of shapes extracted and outlined from primary photos taken in London (See p6-9)
Photography: Alex Key
Date: Dec '19



Series of shapes extracted and outlined from primary photos taken in London (See p6-9)
Photography: Alex Key
Date: Dec '19

As I progressed through the practical for this project I soon realised that in order for the fluid shapes I was exploring to be functional, I would have to add structural strength and rigidity. This is when I decided to explore glue laminating, which is the process of gluing a series of strips in layers together in a JIG to achieve a complex shape.

The initial shapes and JIGs that I created were sourced from outline drawings taken from the photos which I took in London (See p6-9). This was a great way to link the primary research to the workshop exploration, as they gave me unique and interesting results as well as a further understand of glue laminating. I learnt a lot from these JIGs which I can apply to my final design later on, such as PVA working times, clamping pressure and how to spread it as well as how accuracy of the JIG can affect your results.



2-part compression JIG C
Photography: Alex Key
Date: Dec '19



2-part compression JIG C - Walnut strips
Photography: Alex Key
Date: Dec '19



2-part compression JIG D - Oak strips
Photography: Alex Key
Date: Dec '19



2-part compression JIG B - Oak strips
Photography: Alex Key
Date: Dec '19



2-part compression JIG A
Photography: Alex Key
Date: Dec '19



2-part compression JIG F outcome - (Ash)
Photography: Alex Key
Date: Dec '19



2-part compression JIG B
Photography: Alex Key
Date: Dec '19



2-part compression JIG B outcome - (Oak)
Photography: Alex Key
Date: Dec '19



Example 1 of a 2-part compression JIG C
Photography: Alex Key
Date: Dec '19



2-part compression JIG C outcome - (Walnut)
Photography: Alex Key
Date: Dec '19



Variety of 2-part compression JIG outcomes - (Oak, Walnut, Ash, Mahogany)
Photography: Alex Key
Date: Dec '19

2.1 Design Ideas: Initial Models

As I continued through this project, I started to develop how my process research could be applied to chair design. I started by thinking how I could implement steam bending into the framework of the chair by using wire to simulate the malleability of steam bending. I also was experimenting with my glue lamination tests by seeing how they could be implemented into chairs to.

This lead me down the path of combining multiple laminated tests together to create the skeleton of a chair. While this outcome wasn't the neatest or most accurate in the world, I found that it helped me in refining my design and process. This was a great starting idea for design development section of the project which I could improve upon and refine.



Initial chair model 1 - Wire
Photography: Alex Key
Date: Dec '19



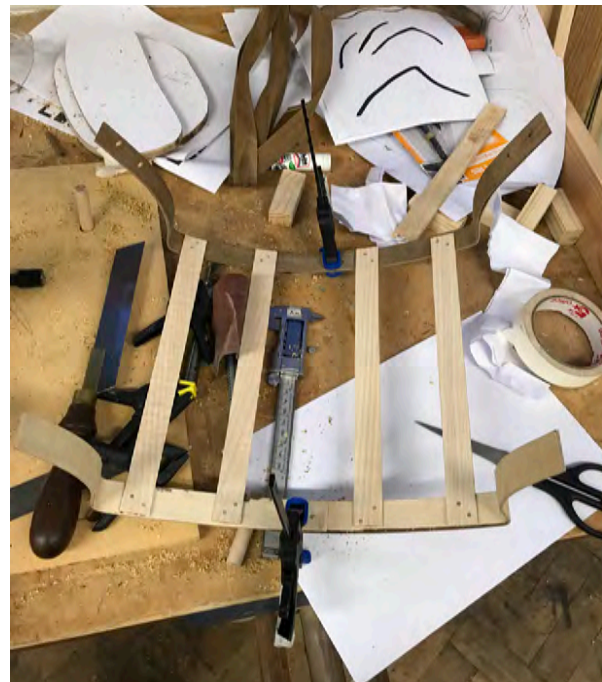
Initial bench model 1 - Glue lamination tests
Photography: Alex Key
Date: Dec '19



Initial bench model - Glue lamination tests
Photography: Alex Key
Date: Dec '19



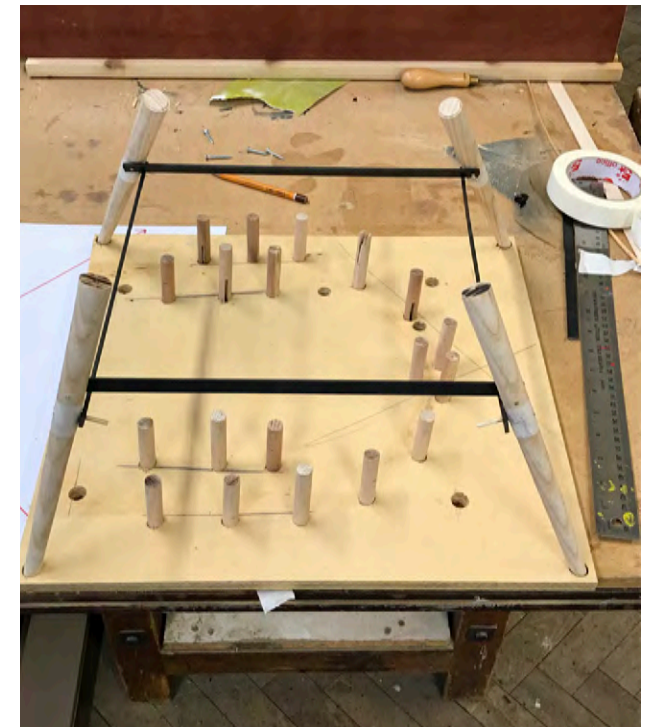
Glue laminations for initial chair model seat
Photography: Alex Key
Date: Dec '19



Glue laminations prototyping for initial chair design
Photography: Alex Key
Date: Dec '19



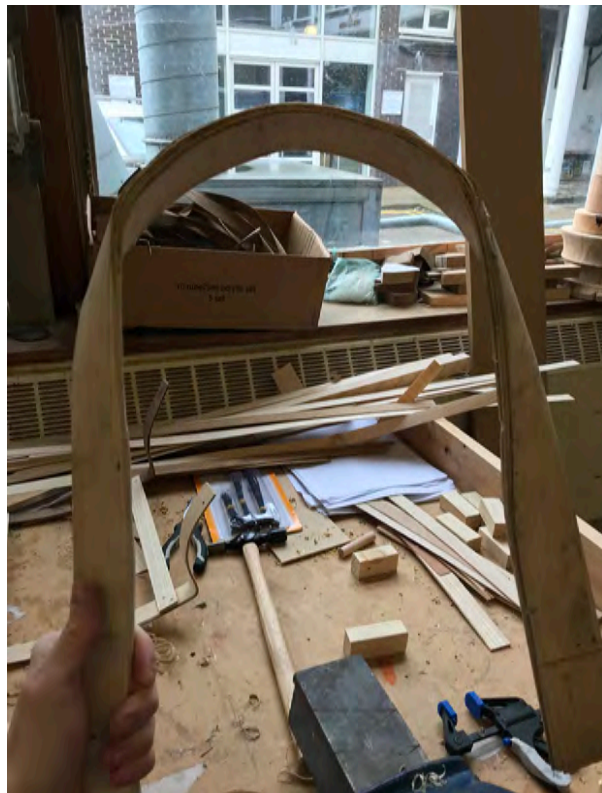
Fully assembly seat frame
Photography: Alex Key
Date: Dec '19



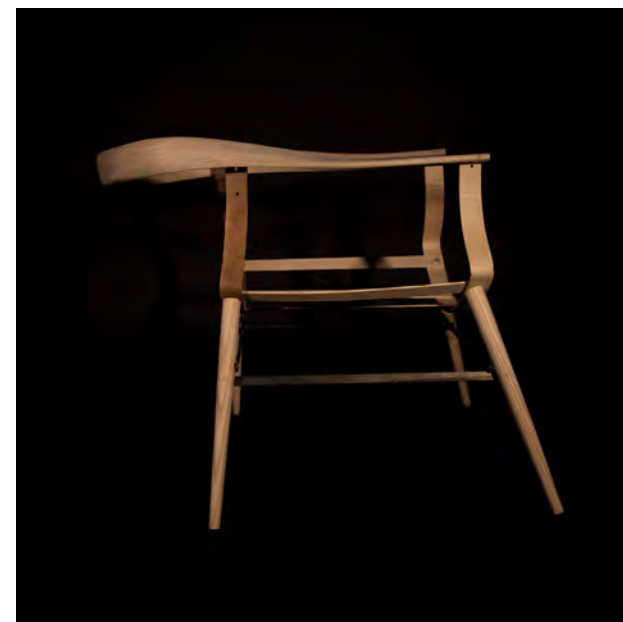
Leg spacing and frame assembly
Photography: Alex Key
Date: Dec '19



First glue lamination back test - Clamp up
Photography: Alex Key
Date: Dec '19



Test back - Outcome
Photography: Alex Key
Date: Dec '19



Fully assembled initial seat 1
Photography: Alex Key
Date: Dec '19

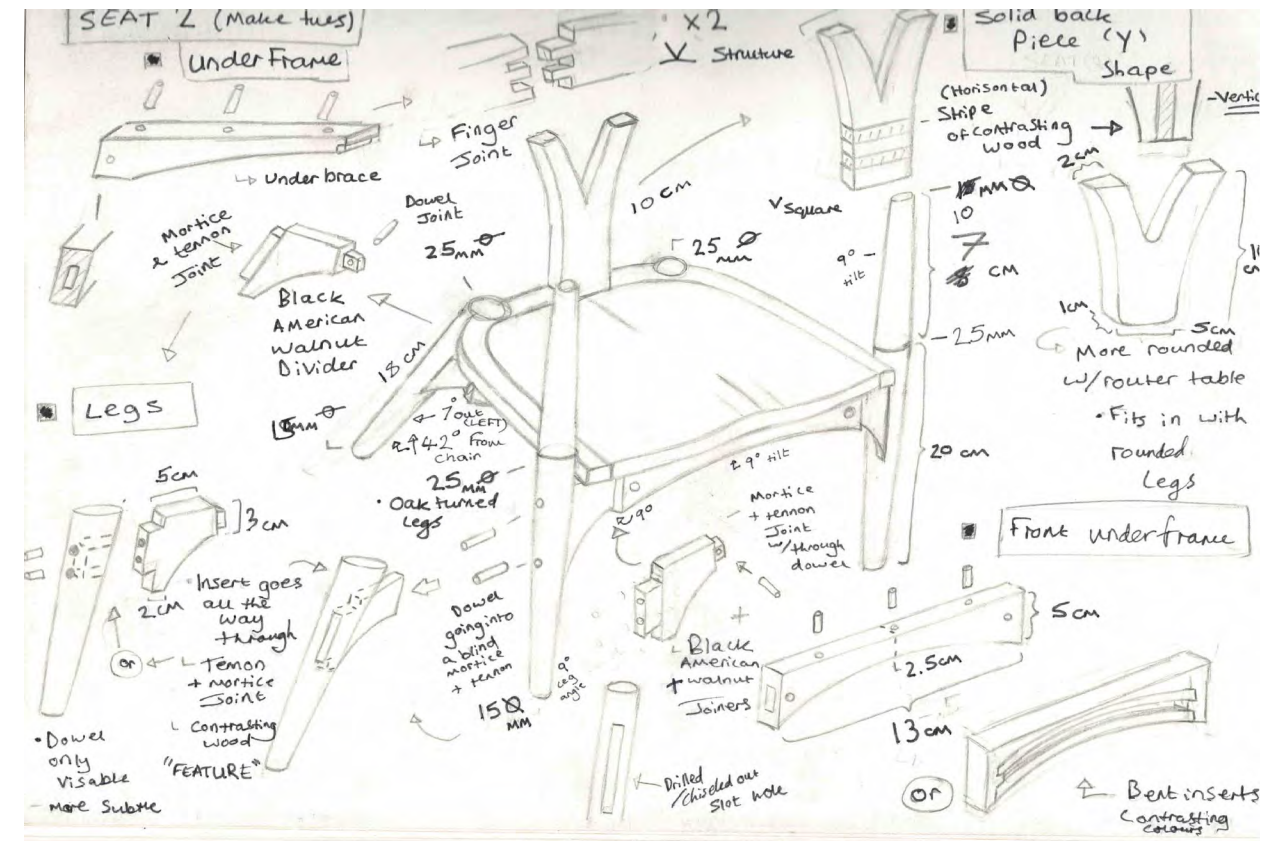


Fully assembled initial seat 2
Photography: Alex Key
Date: Dec '19

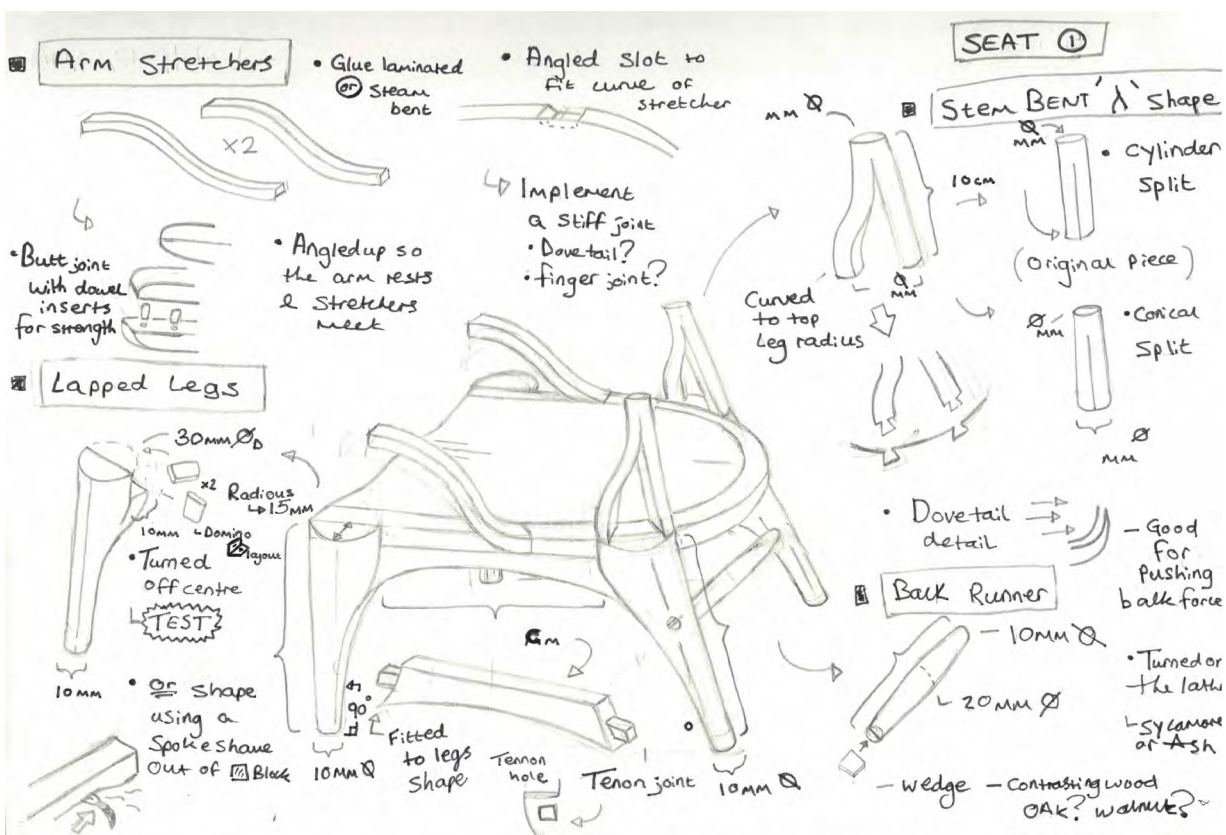
Drawings & CAD

Alongside model making I was also utilising my drawing and CAD skills to develop chair design ideas. I was developing aspects such as the legs, arms and back pieces by playing around with a variety of techniques such as turning on the lathe as well as steam bending more parts.

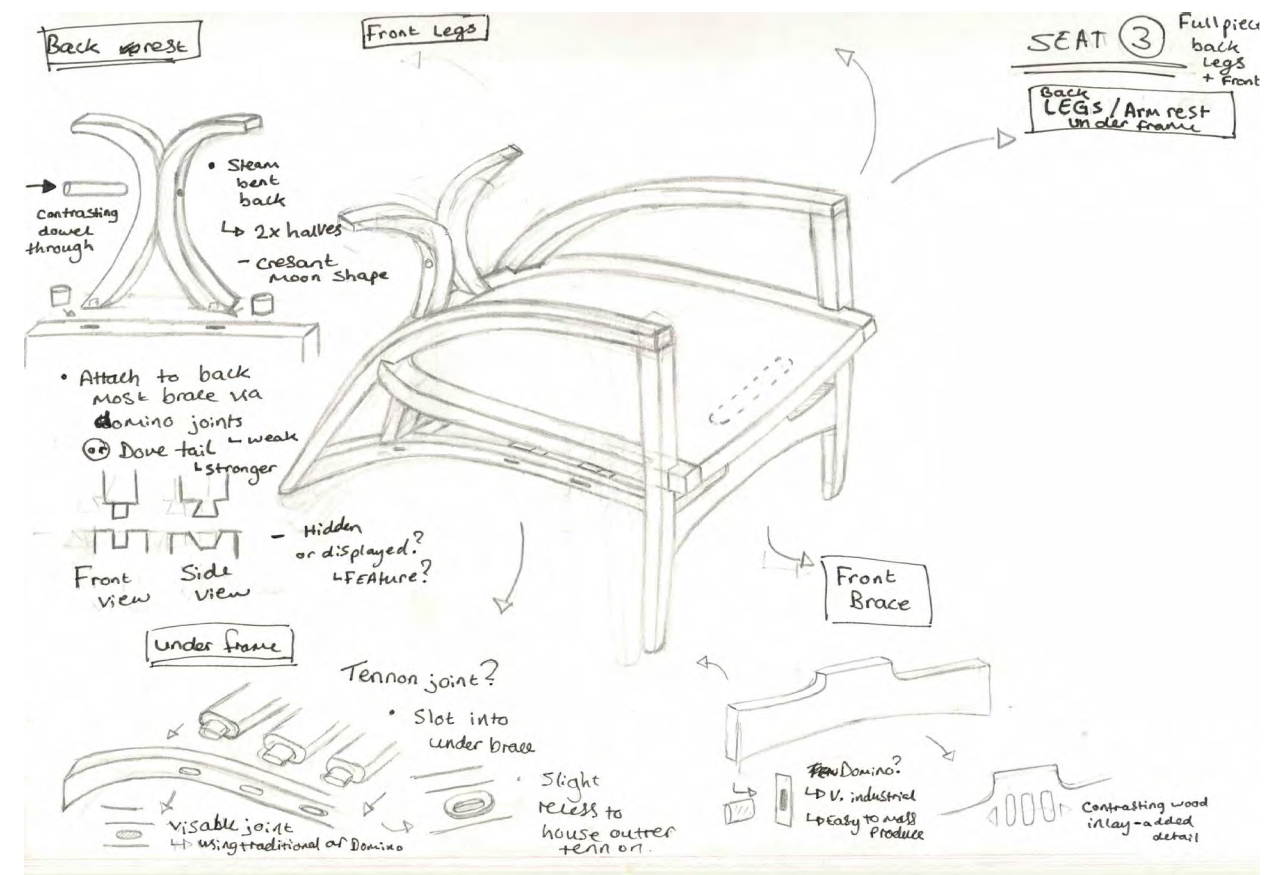
I worked on several designs which drew on inspiration from my initial shape exploration in the glue laminations process research, this being prominent in the arms of the 3rd drawn design. I was also exploring how I could implement a one piece body with the initial CAD sketch, however I found that my results left a lot to be desired as they were a little clunky and chunky, lacking the finesse that I strived for. Overall, I found the drawings to be a better way of idea development as it allowed me to be more creative with my initial designs as well as the shapes and parts which consisted within them.



Half-scale chair design 2
Photography: Alex Key
Date: Jan '20



Half-scale chair design 1
Photography: Alex Key
Date: Jan '20



Half-scale chair design 3
Photography: Alex Key
Date: Jan '20



Initial chair CAD A
Photography: Alex Key
Date: Dec '19

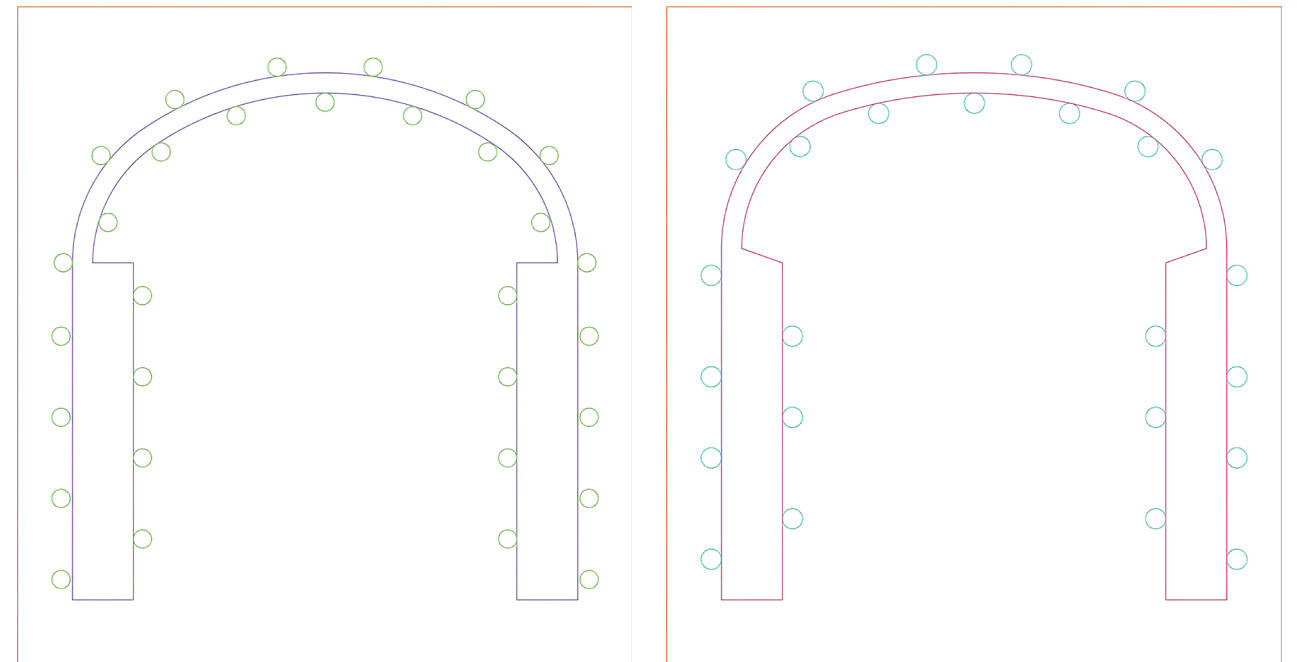


Initial chair CAD B
Photography: Alex Key
Date: Dec '19

2.2 Refinement: Half-scale model

Once I had developed my initial ideas through various methods, I then started to refine it into one accurate half scale design proposal. This was through initially developing some aspects on the computer such as the seats as well as the JIGs for steam bending and glue laminating the backs. Seeing the combination of digital processes and hand-skills was an aspect which I had been wanting to explore and unite throughout this project, this half scale model allowed me to achieve that.

The back JIGs were developed from the digital models of the seats in Rhino, which had two subtle variations, one being full curve and the other being a flattened curve. This was to experiment with how they would visually look as well as comfort, which once produce helped me decide to opt for the curved one as that was more appealing and was shaped to a person's back better.



Back JIGs outlines 1+2
Photography: Alex Key
Date: Jan '20



Sycamore back glue up B
 Photography: Alex Key
 Date: Jan '20



Sycamore back glue up A
 Photography: Alex Key
 Date: Jan '20

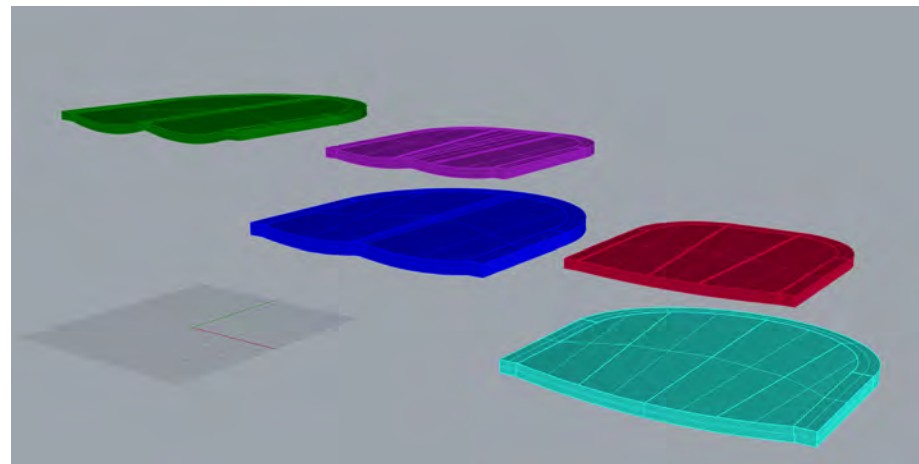


Sycamore back outcome A
 Photography: Alex Key
 Date: Jan '20



Walnut & Sycamore backs all laid out
 Photography: Alex Key
 Date: Jan '20

All of these half-scale seat models were developed on Rhino with the guide of the ergonomics and dimensions research I had conducted earlier. These tests were to explore the shapes of the seats which I was implementing for comfort and aesthetics. I did these tests in Sycamore & Oak as well as Oak with Walnut. The reason I decided to use these species of wood was to help create initial boards wide enough for the milling machine, however this addition of other woods created contrast between the lighter and darker colours adding to the visuals of the design.



All seat variations CAD - Rhino 6
Photography: Alex Key
Date: Jan '20



3-axis milling outcome varieties 2-5
Photography: Alex Key
Date: Feb '20

One of the more interesting aspects I found while exploring the CNC mill was that I could reduce the thickness of the seat and still have it structurally strong. This was an aspect which would help me to push Ash further in chair design, by allowing me to create a thin yet structural seat.



Sycamore back orientation test
Photography: Alex Key
Date: Jan '20



Back angle & spindles test
Photography: Alex Key
Date: Jan '20



Spindles glue up
Photography: Alex Key
Date: Jan '20



This was the outcome of my half scale model, which saw a CNC milled seat on top of turned legs and support spindles joined to a steam bent/ glue laminated back. Creating this half-scale model taught me a lot about my design, such as how to join the legs with wedge joints as they are structural as well as aesthetically pleasing, but also informed me of the JIGs that I would have to develop to achieve the design, all lessons I will take forward in this project.

Finalised Digital Model

Once I had a clear idea of what my final chair design was going to look like, I started to develop a full-scale model using Rhino. This is where I started to develop the underframe of the design to give it more structural strength. This was necessary as I had pushed the thickness of the seat to its limits, meaning that the wedge joints couldn't take a full persons body weight. Adding this underframe would increase the chairs overall strength, safety as well as making it a commercially viable piece.

Assembling the piece in Rhino also allowed me to create an orthographic and technical drawings for the piece. This aid me in the making process as it allowed me to have a deeper understanding of the piece and how I can construct it. Creating these drawings will also help me in presenting them to clients or companies for manufacture, as it will deepen their understanding and knowledge of the piece. Overall creating this digital model of the design was a great step in this project, as it not only allowed me to finalise the design but also allowed me to fix any structural issues which were evident in the half scale model.



Crest chair render 1
Source: Alex Key



Crest chair - Silhouette render
Source: Alex Key



Top View



Perspective View

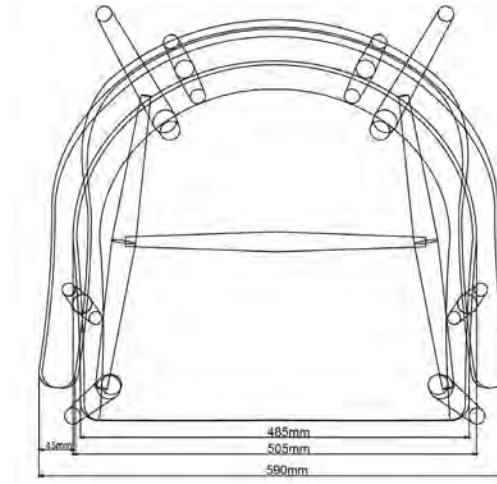


Front View



Right View

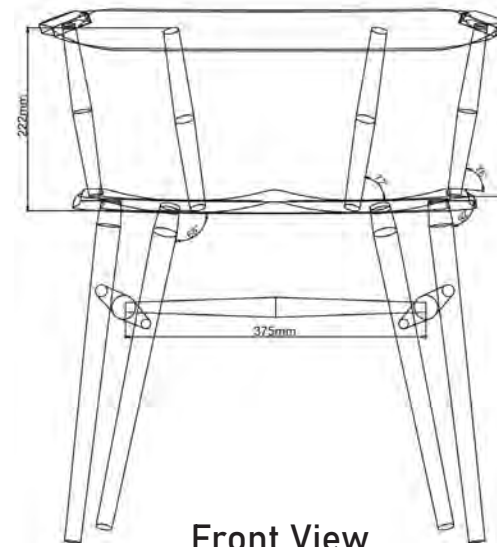
Orthographic Render - Crest chair
Source: Alex Key



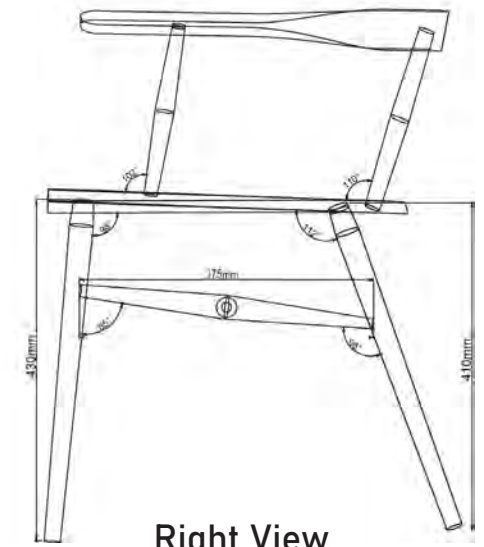
Top View



Perspective View



Front View



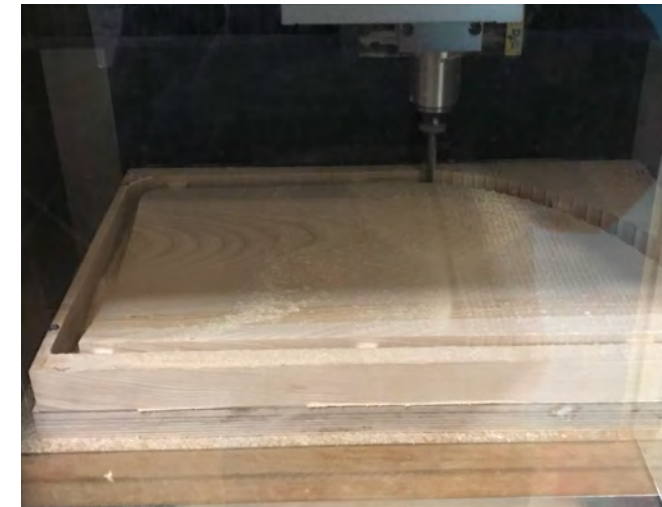
Right View

Orthographic technical drawing - Crest chair
Source: Alex Key

Construction - 3.1 Making: The Seat

One of the biggest aspects in the making of my chair was the seat, this is the piece which shows off the digital angle of my project. To make this I first split up the seat from the Rhino model into two halves and exported it as a STL file so that the CNC mill could read it.

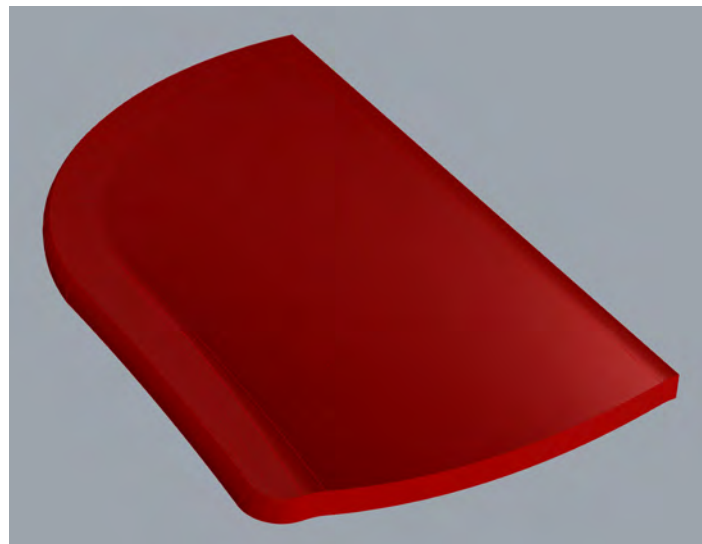
While the machine was getting ready I glued up the Ash and Oak blocks in the seat into one big slab which when dried I split in two. The reason I incorporated Oak strips was to get the blocks wide enough for the whole seat dimensions, but they also acted as an accented detail which I would carry over into other aspects of the chair such as the connecting dowels for the back and the wedges for the legs. Once dried these blocks then went to the 3-Axis CNC mill which cut out the profile over 3 hours and resulted in the seat being only 15mm thick.



Seat top 3-axis milling
Photography: Alex Key



Seat bottom 3-axis milling
Photography: Alex Key



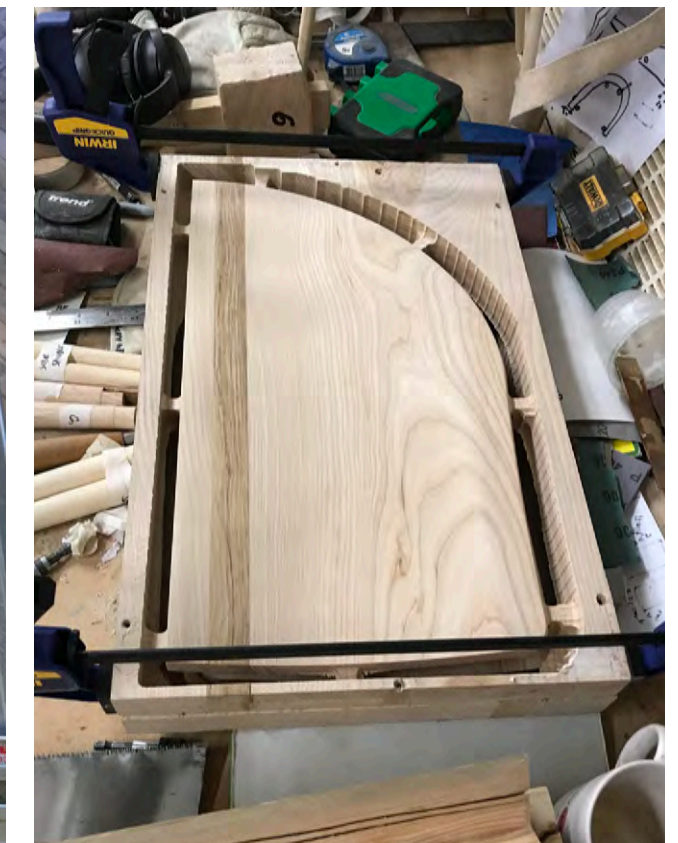
Seat half in Rhino
Source: Alex Key



Seat blocks glued up in sash clamps 2
Photography: Alex Key



Milled seat half 1
Photography: Alex Key



Milled seat half 2
Photography: Alex Key

Once both halves were milled I then joined them together using biscuit joints, the reason for which was because of their thin profile. Once all the holes were cut I then glued the two halves together to form a whole seat and turned to drilling the holes for the spindles and legs.



Milled seat halves 1 & 2
Photography: Alex Key



All the biscuit holes cut
Photography: Alex Key



Milled seat glued together
Photography: Alex Key

Overall, I was happy with the result of the milling, although it was expensive it was a necessary to push the Ash material for this project. However, if I was to do this again, I would seek doing it as one piece, which I couldn't as the bed was too small in the machine at University. I would also seek out a 5-axis machine to do the leg and spindle holes, making it more accurate as well as less prone to tear out.

The Back

One of the more time-consuming aspects of making my chair was the back, this was steam bent then glue laminated. It was steam bent to achieve the desired curve and twist as well as glue laminated for strength. This required a rather larger and complex JIG, which bent the Ash strips after steaming for around 30mins in the steamer.

I was happy with the results of this process once I had cleaned it up using a spokeshave and sandpaper. Although there are some improvements I would have made to the process, such as using a vacuum bag to aid in the glue lamination process. This would have allowed the layers to be under equally spread pressure making the bond tighter and neater as well as using less clamps overall.



Ash strips in steam bender
Photography: Alex Key



Ash strips in bending JIG 4
Photography: Alex Key



Ash back glue lamination clamp up
Photography: Alex Key



Ash back glue lamination outcome 2
Photography: Alex Key



Ash back glue lamination clean up with a spokeshave
Source: Alex Key

Finishing

Once the design had been fully assembled, I turned my attention to sanding down and applying a finish. I firstly sanded down the entire piece multiple times with various grits of sandpaper from 80 to 320. This was to remove any scratches, marks or dents occurred through assembly.



Sanding down - 80 to 320 grit
Photography: Alex Key

Alongside this I was testing finishes, these were Water-based lacquer, Danish oil and Wax. I tested them on plain Ash as well as Ash/Oak combinations to see how they would affect the wood. I found that the best finish was Water-based lacquer as it showed off the pale colour of the Ash beautifully as well as really brought out the grain.



Finishes sample board - Water based lacquer, danish oil & wax
Photography: Alex Key

3.2 Final outcome: Photos

The Crest chair was my final outcome for this project, constructed out of Ash combining both hand and digital skills. Overall, I was happy with this outcome, I really liked the back and how it transitioned into the arms. I was also glad that it was comfy and could withstand someone's weight, this was an aspect that I couldn't properly test on the computer or via models. This gave me valuable information which I took forward into the construction and design of further ideas.



Applying clear coat lacquer (Coat 1)
Photography: Alex Key



Applying clear coat lacquer (Coat 2)
Photography: Alex Key



Crest chair finish applied
Photography: Lauren Hurley

From my tests I decided to apply Water-based lacquer to my chair as it gave me the best result. I applied this in multiple coats sanding with 320 grit inbetween. I was happy with the result but if I was to take this chair to market I would have explored pressure-spray lacquering it, this would have resulted in a better finish over all as well as less sanding inbetween layers.



Crest chair final photo 1
Photography: Alex Key



Crest chair final photo 2
Photography: Alex Key

Size: 590x505x645mm
Material: Ash
Finish: Water-based lacquer



Crest chair final photo 3
Photography: Alex Key

Proposed Contexts

Unfortunately, due to unforeseen circumstances I could not set up the Crest chair in any formal context beyond the photography studio, so I decided to mock up some context renders in Rhino. While rough they serve the purpose of showing the potential contexts for this design, which would be domestic, from a modern living room to a more formal kitchen.

The only issue I could foresee these designs having in either of these contexts would be comfort during prolonged use, this would be countered by the addition of a small leather cushion for the seat and back. This could be in a contrasting colour like black or a more complimentary such as tan.



Crest chairs set in the Living Room
Photography: Alex Key



Crest chairs set in the Kitchen
Photography: Alex Key

Construction: 3.3 Further Designs: Crescent Chair

Alongside the Crest chair I was also designing another chair and a bench, these designs were to be different but visually connect to the previous. Unfortunately I didn't get to make them as I ran out of workshop time due to the Covid-19 pandemic.

The first chair I designed was the Crescent chair, which had three legs with an inverted back rest. This would have been made using a slightly altered JIG from the original back, as well as templates for the front legs. The main difference for this design would have been the split 'V' back leg, which would have been two routed round parts steam bent and joined together at the bottom using a contrasting oak dowel.

Overall I thought this design was strong as it is visually different from the last but looks as if it could fit in with the overarching family aesthetic, my only concern would be the back leg not being stable enough resulting in the design rocking or tilting.



Crescent chair - Perspective render
Source: Alex Key



Crescent chair - Silhouette render
Source: Alex Key



Top View



Perspective View



Front View



Right View

Crescent chair - Orthographic render
Source: Alex Key

Size: 590x545x664mm
Proposed Material: Ash
Proposed Finish: Water-based lacquer

Further Designs: Crescendo Bench

The next design that I made was the Crescendo bench, which saw the back being a longer version of the one in the original Crest chair. Although there was an alternate aspect in this design which was the curved underframe, which echoed the backrest. This design would have required a bigger JIG for the back, or alternatively would have required it to be made in two halves. Also, various parts would require long pieces of Ash wood, this would potentially be a problem to source in rough sawn lumber.

The length of the steam box would also be an issue as the one at University is 800mm long, this would require me to construct a new one. However, this presents another issue as the longer the box the lower level of pressure, meaning that the pieces would take longer to steam to become flexible. Overall, I like this design, however there would be some issues in the making which I would have to iron out if I was to make this design or outsource it.



Crescendo bench - Perspective render
Source: Alex Key



Crescendo bench - Silhouette render
Source: Alex Key



Top



Perspective



Front



Right

Crescendo bench - Orthographic render
Source: Alex Key

Size: 500x1025x670mm
Proposed Material: Ash
Proposed Finish: Water-based lacquer

