

**Thomas  
Ward**



**Designer's  
Stand/Sit desk**

A level Design 2020

**Centre number: 51537**

**Candidate number: 5493**

**Grid 1**

**Identification of a  
Design Possibility**



## Establishing a Client and Design Opportunity

### Russell Pinch

#### Client Profile

Russell Pinch graduated from Ravensbourne College of Design, London. After graduating he worked as Sir Terence Conran's design assistant where he designed everything from furniture and tabletop accessories to interiors for the Concorde jet. In 1995 he became a Senior Product Designer for the Conran Group. After 5 years with Conran, Russell co-founded a brand design agency with clients including British Airways, WHSmith, Rip Curl and Selfridges. In 2004 Russell and his wife Oona founded PINCH, a furniture, product and interior design company. Pinch's studio is distinguished by its simplicity, quality and elegance. Pinch was founded with a focus on permanence. Russell and Oona firmly believe that pieces should be built to last. Russell is 46 and when he isn't working in his studio in Clapham, he enjoys spending time with his family in Devon.

#### Situation

Russell owns a studio in Clapham, He spends time here Sketching, modelling and working on the computer. He also spends time working in Devon. However, he complains that his working space is cluttered and messy and as a result work is less productive. The studio space in Clapham is constantly being adapted and they have bought three separate units and joined them all. The mezzanine is the area in which most work gets done. All the designers sit here and will often be sketching or working at their computers. There is a separate workshop in which all the modelling takes place. However, employees will often be refining their models at their desks. As a result, all these work spaces are extremely messy. The rest of the studio serves as a space to both show off pieces and to test prototypes.



#### Primary Client Interview:

##### What is your working process like?

I suppose my work can be split into three sections. Obviously there is a large amount of sketching involved. I also find myself with a scalpel in my hand a lot of the time, there is a lot of modelling to do. Thirdly I spend time on my computer. I suppose my job is a bit strange in that sometimes I'm an artist, sometimes I'm a sculptor and sometimes I'm a business man. As a result my desks look a bit like a bomb site. I wish I had the time to design myself a desk fitted to my working needs but I will never get the time.

##### I'm starting to see a design possibility already, is it only you who uses this desk?

Yes its only me but I think that its really important that if you were to take this on as a design problem then I would keen that you consider this desk in the context of rented work spaces such as WeWork. There are a lot of buildings now where companies are able to hire spaces to create completely different and quite refreshing working environments. There is a huge emphasis on creativity and teams of artists, designers, and engineers build every space to maximise comfort and inspiration.

##### In terms of your own needs when you're working, what do you consider important and what would you like to introduce into the way you work?

In Scandinavia stand-sit working is commonplace and offering employees a height adjustable workstation is now mandatory in Denmark. So in terms of reducing back pains and creating a better working environment for myself I think that I definitely consider this to be important. I also think that in rented workspaces this will become more and more common. I use these thick marker pens that come beautifully arranged in their box but after a couple of days they get scattered messily across my desk. I charge everything on my desk too and get wires tangles everywhere which is a nightmare. I also find it really frustrating when my laptop screen isnt at eye level and it often encourages me to slouch in my chair when its lower than my eye level. The desk also needs to be able to provide a flat surface so that I have lots of space to sketch and model.

##### Being a designer yourself what do you value highly in your own design process?

Yes - I think that sustainability is extremely important. However, since PINCH doesn't send pieces for mass production, the best way to do our bit to help is to ensure that products are really well made and built to last.



## Design Opportunity 1

### Primary Brief:

*"To design and manufacture an adaptable workspace suitable for Sketching, Modelling and computer based work."*

### Situation

Russell Pinch has a studio in Clapham as well as a house in Devon, in both of his current working environments he complains about mess and the fact that the desk that he currently owns doesn't allow for efficient changing between working on sketches and then models and then computer work. Below shows the current situation with a summary of the problems of the current space.

### Identification of Client Problems



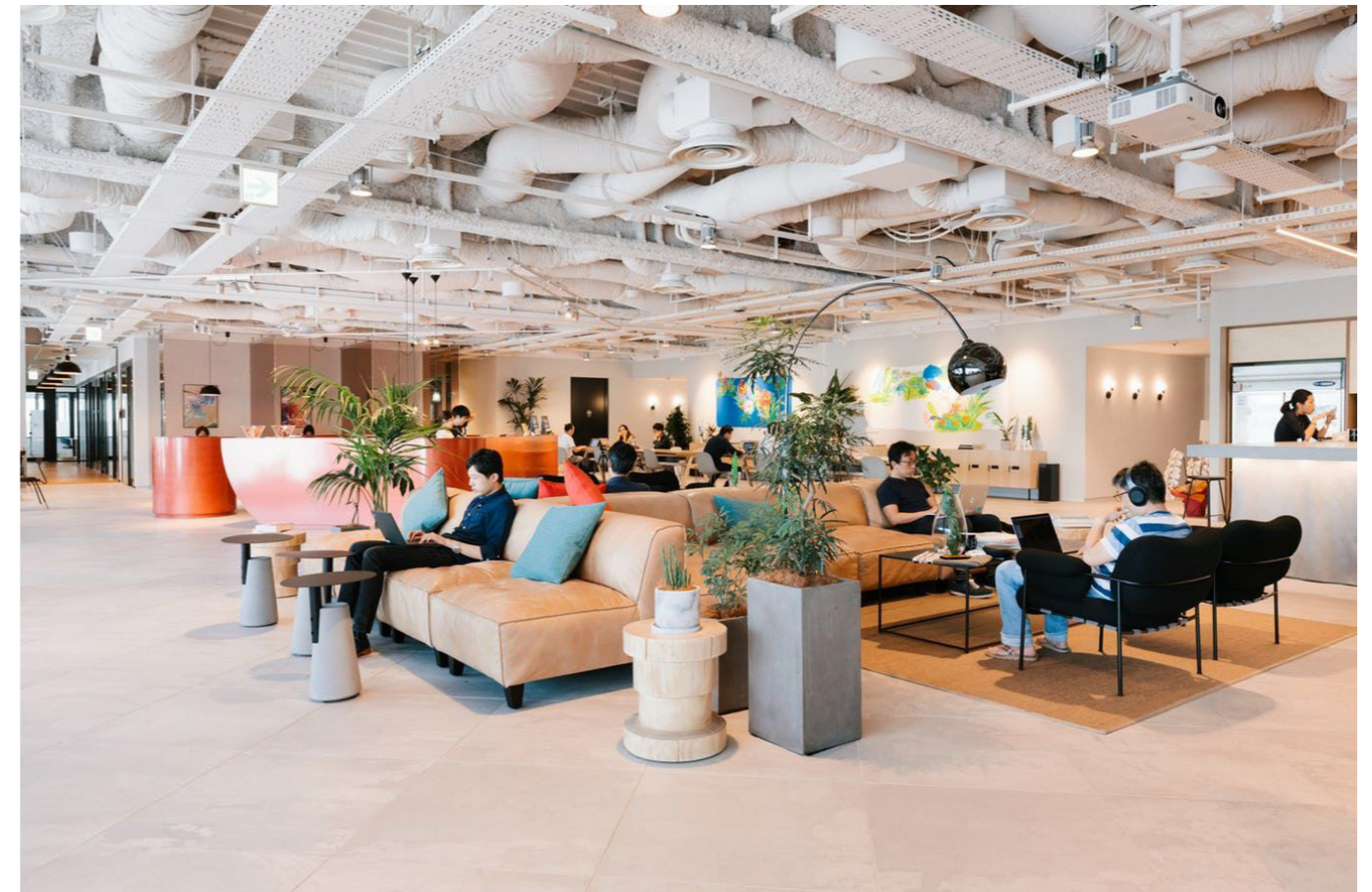
### Summary of Client Problems

- Lack of drawer space
- No order/regularity in terms of placement of tools
- Wires run up to the desk from the floor and have to be weighted down to stay on the table.
- Material samples are randomly placed and difficult to find.
- Not particularly adaptable workspace. i.e. difficult to switch between tasks
- Risk of spilling glue with cluttered workspace.
- Keyboard takes up sketching/modelling space.
- Books and papers look unorganised and at risk of falling.
- Postural problems as a result of working at one height only
- There is no way of hiding clutter.
- Mess is transferred to display space above. e.g. ping pong balls

## Establishing a Client and Design Opportunity

### Wider Context and User Group

Although this design problem points towards the specific needs and wants of Russell, he himself is a designer and he is keen that that this design task can be considered in the wider context of adaptable work environments for rented work spaces. I have added a picture of one of WeWork's facilities in Ginza below. These rented workspaces are becoming increasingly popular and especially in more creative industries. There is a strong emphasis on design and creativity already in terms of the art and furniture they display in their offices. Russell and I agree that an adaptable desk that could be used for many professions in a rented office space would be extremely beneficial to these companies. As a result the potential user group would consist of a wide variety of people, mainly young workers aged 20-35 but of many professions.



In addition to this, partly as a result of Russell's needs but also as a factor that may be attractive to people using rented workspaces, the idea of a standing/sitting workspace might be a sensible idea. The idea is becoming more and more popular especially in Scandinavia and as a result I believe that it would be particularly attractive to companies such as WeWork who might want to introduce this into their working environments. Companies are becoming concerned with creating a pleasant working environment for all of their employees and clients. There has been so much research into the idea that sitting in the same position repeatedly is bad for your body, many companies are keen to redefine office working routines and a standing sitting desk would do exactly this.



## Design Opportunity 2

### Primary Brief:

*"To design and manufacture an alternative method of reaching the workshop without compromising space in the kitchen."*

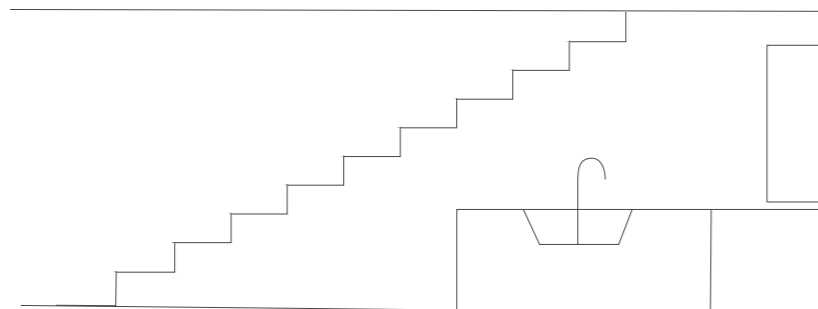
### Situation

During the time that I visited Russell's studio space, he showed me the workshop that he uses on a daily basis to make models. The workshop is small but consists of all the necessary tools and machinery he needs. Access to the workshop is through the roof of the kitchen. During work breaks, the kitchen is usually packed since everyone gathers to make coffee and food. The space is extremely limited and as a result there are often dangerous situations where Russell and his employees are carrying dangerous tools or fragile models through the crowded kitchen.

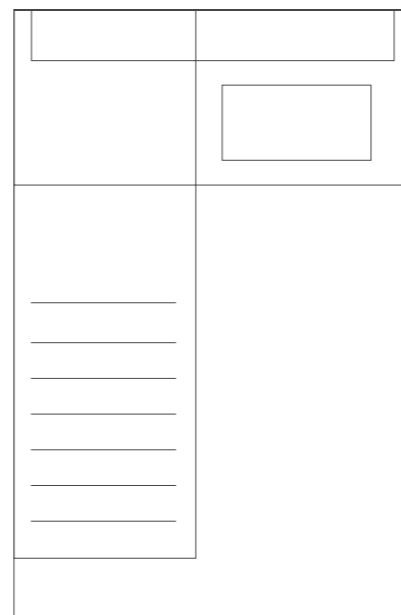
### Identification of Client Problems

The below sketches aim to show the room in its current state. Kitchen sideboards run in an L shape along the back and side of the room. The stairs take up a large amount of space at the moment which is particularly frustrating since there is very limited kitchen space.

This drawing shows a bird's eye view of the small kitchen. The stairs are on the left hand side with kitchen units at the top.



This drawing shows the kitchen from the view of the door - it is evident how much space the staircase takes up.



### Summary of Client Problems

- The current staircase takes up far too much space.
- The hatch at the top is unfriendly to unlock and open.
- The staircase is unattractive and takes away from the aesthetic of the room
- It is difficult to open the hatch with a cup of coffee in hand
- The stairs are sometimes slippery when people come in with wet shoes. This leads to a dangerous environment especially with hazardous tools around
- When the hatch is closed and someone is working in the workshop above, opening it may startle them or even not be possible since they could be standing on it. It is very difficult to get someone's attention in this situation.

## Establishing a Client and Design Opportunity

### User Group

Russell is actually the primary user of this staircase however, If a solution was created, then many of the rest of the team would benefit as a result of the gained space in the kitchen. Russell and his employees move around the studio a huge amount during the course of a standard working day. This includes walking up and down these stairs to the workshop a lot.

### Product Research

Below shows an existing product which addresses a similar problem to the one that Russell and his employees experience. I have annotated some of the Pros and Cons of the product.



### Pros

- Takes up little floorspace
- Handle to ensure easy manoeuvre
- Sustainable materials use
- Damped padding at the base to make sure no damage done to the floor
- Detachable to accommodate for various heights.

### Cons

- Very steep climb
- Steps are very thin
- No handle in the lower areas
- Heavy to lift up and down
- Blocks the doorway.

### Conclusion

This Design Opportunity has the potential to help PINCH in a number of ways. It would create a better working environment since more space would be gained within the kitchen. It would reduce the risk of a dangerous accident since more space would be created in the kitchen. If done cleverly there would be potential to create a system where people working downstairs would be able to communicate with those in the workshop without distracting them and be able to gain their attention which loud machinery is turned on.

## Design Opportunity 3

### Primary Brief:

“To design and manufacture a compact system capable of transporting furniture around the studio.”

### Situation

I came across this problem myself because when I visited Russell’s studio space, he was trying to move a large two seater sofa from one studio space into the other on his own. Since the downstairs areas of the showroom consist mainly of display furniture and areas for prototyping, Russell and other designers will often have to move large pieces of furniture around the studio. The studio is already lacking storage space and the display areas are very attractive with little clutter as a place for clients to view the products

### Identification of Client Problems



### Summary of Client Problems

- Items of furniture are heavy and difficult to move
- Pieces are often damaged moving them around the studio
- The walls get scratched whilst these pieces are moved around
- There is no room for a trolley to help move these pieces
- The display rooms are uncluttered and contain many beautiful pieces
- There is a step by the door which makes moving furniture between studios even harder
- Often this task may be left to one person making it very time consuming if not impossible.

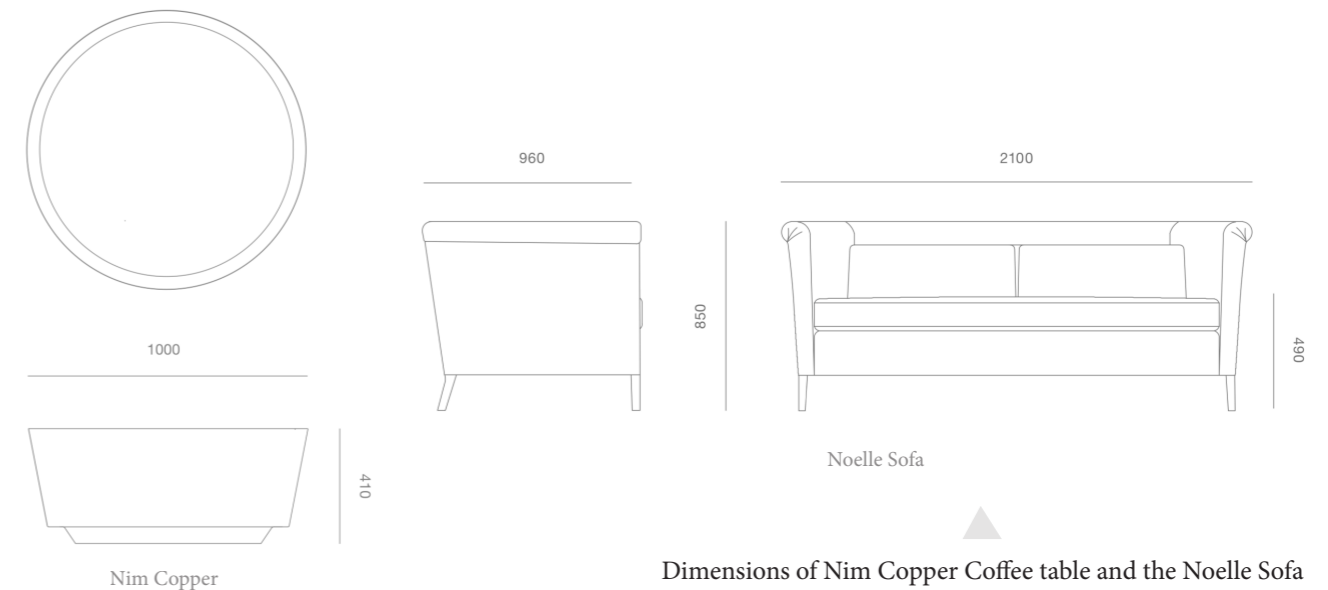
## Establishing a Client and Design Opportunity

### User Group

Russell’s team consists of three other designers and a couple of members of the sales team. All of whom are younger than Russell. They are extremely busy and often moving this furniture about is not what they need to be doing. They would be much better off spending this time talking to clients. The job often falls to the hands of Peter who would probably benefit the most from a solution.

### Environment and Other Considerations

The floor of the studio is timber as seen in the image to the left, It is very smooth and wheels would easily run over the surface. However, a small path separates the studio spaces and this is concrete. It isn't particularly smooth and therefore, large wheels would be preferable on any system used to move the furniture. The heaviest item that needs moving within the studio spaces is the Nim Copper (dimensions below) and the Largest piece is the Noelle Sofa (dimensions below.) An additional problem is the fact that since the display areas themselves are uncluttered and consist only of PINCH furniture. Any system that might help transport the furniture would need to blend in with the aesthetic of the furniture in order not to detract from the room.



◀ This Photo shows the doorway between one studio and the path. You can see how there is a problem lifting furniture over the step. It also shows the nature of the concrete in the bottom of the photo.

### Conclusion

This Design Opportunity has arisen out of problems my client faces daily. Solving these problems would result in more efficient work with more time being given to areas of importance. It would also lower the risk of injury since carrying many of these heavy pieces of furniture daily may result in damage to the lower back. In addition, if the furniture was at less risk of being dropped/damaged during transport around the studio, This would save the company money. Many of the pieces are very expensive and although manufactured extremely well, they are at risk of breaking. If the system were to be designed well enough, it could even become a feature within the showroom.



# Establishing Client's Needs, Wants and Values

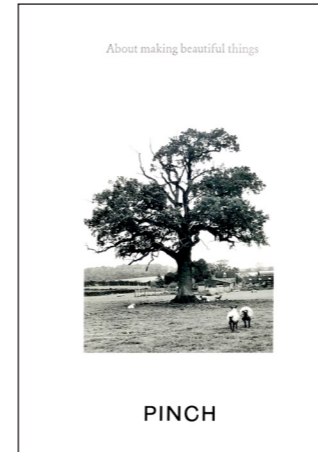
## Introduction

My primary interview helped me to some extent to establish the needs, wants and values of my client but I also decided to read a book given to me by my client describing how PINCH started and what it as a company deems important. This helped me in particular to explore the values of my client. All of these needs, wants and values are taken in the context of my primary identified design briefs which are as follows.

*“To design and manufacture an adaptable workspace suitable for Sketching, Modelling and computer based work.”*

*“To design and manufacture an alternative method of reaching the workshop without comprimising space in the kitchen.”*

*“To design and manufacture a compact system capable of transporting furniture around the studio.”*



At Pinch we believe in many things; in an emotional connection to the materials around us, that there are no short cuts when it comes to making something well, in the enduring beauty and appeal of a pure form. We live in a cluttered world and understand that any furniture or product must work hard to win its place.

How we *make* has always been incredibly important. There is a clear relationship between us, our lives, our design studio, the people we work with, and Pinch products.

Our commitment is to work in the best way we can.

## Client Needs:

### Design Opportunity 1

My Client would need a system where changing between his different stages of work is quick, efficient and leaves little clutter around his desk. He would also need a way of accessing cables quickly and easily but also so that they wouldn't fall off the desk. The desk would need to have 2 or more possible heights that align with ergonomic research. The desk needs to be able to fit A3 sheets of paper and A4 sizes folders.

### Design Opportunity 2

The design needs to be compact in order to save space in the kitchen. The design needs to be safe and secure in order to eliminate risk of injury. The design also needs to be very simple to operate and also to use since users will be carrying dangerous equipment from the kitchen into the workshop. The design must take up less space when not in use than when it is being operated. The design must be sturdy enough to last for many years.

### Design Opportunity 3

The system must be strong enough to lift the heaviest piece of PINCH furniture which is the Nim Copper Coffee table. In addition, it must be able to efficiently support the largest piece of PINCH furniture which is the Noelle sofa. It must be easy to operate to avoid damaging any of the furniture. The system must be able to navigate the furniture over a 1ft step in the doorway, it must also fold up in order to maximize storage space.

## Client Wants:

### Design Opportunity 1

My client wants large pen pots to be able to efficiently store thick marker pens without clutter. He wants to be able to store and charge his phone and laptop within the desk so that they remain easily accessible. He wants pencils and pens to remain neatly arranged within a drawer. He also wants the desk to change between standing and sitting heights as quickly as possible and for his keyboard to sit lower than his laptop screen

### Design Opportunity 2

My Client wants a way of transporting coffee upstairs to someone working there without having to walk upstairs yourself. He is keen for the design to remain in keeping with the style of the kitchen since this is a showspace for clients, he also wants a way of communicating with people in the workshop without distracting them whilst working with dangerous and noisy machinery.

### Design Opportunity 3

My client wants the system to fit in the boot of his car so that he can use it in his stores and in other situations outside of the studio. He wants the system to be easy enough to use such that only one person is consumed by the task of moving the furniture. He also wants the furniture to be strapped or attached in some way to the system in case of an accident so that the furniture is at less risk of damage.

## Client Values:

### Relevant to all Design Opportunities

#### - Sustainability :

The designs must be well built, they do not necessarily need to be made entirely from 100% sustainable materials however, all materials must be sustainably sourced and considerations should be made such that the life cycle of the product has as little impact on the planet as possible. The easiest way of doing this however is assuring that the product is well manufactured and futureproofed such that it lasts for as long as possible with the customer before they decide to get rid of it.

#### - Materials :

Russell believes that the materials of the product have an enormous significance on the user's relationship with the product. Materials must be chosen primarily because of their function but also to help the user to better understand the product and instill confidence during use.

#### - Aesthetics and Function :

My client also believes that any product no matter its function must be designed to look beautiful. In order to create an attractive environment, each product must earn its place in the room. Reducing clutter and any unnecessary elements is hugely important in creating efficiency in not only work but any other environment.

# Selection of Final Design Opportunity

<p><b>Design Opportunity 1</b></p> <p><i>“To design and manufacture an adaptable workspace suitable for Sketching, Modelling and computer based work.”</i></p>	<p><b>Pros</b></p> <p>This Design Opportunity would aim help increase Russell’s productivity and efficiency around work. However, it would be designed with consideration of a wider design brief. This would be in large rented office spaces to help create a more attractive working environment whereby the desk may revolutionise the way that many large companies encourage their employees to work (especially in creative industries.) The desk would have health benefits in that it would be designed with the consideration of ergonomic data such that it remains comfortable to work at without the risks much discussed with repetitive office work.</p>	<p><b>Cons</b></p> <p>The specific needs of my Client will conflict with the needs of the extended user group. The prototype will need to be a compromise between the needs of my client and the needs of the potential user group. This could mean that the design itself suffers. In addition, the Design Opportunity offers little in terms of bettering the wider world, It purely serves to make work more efficient and less unpleasant. Although this is important, I believe that Design Opportunities with a goal of environmental or societal improvement carry more weight. However, the desk should still be designed with addressing both of these aims even if in a small way.</p>
<p><b>Design Opportunity 2</b></p> <p><i>“To design and manufacture an alternative method of reaching the workshop without compromising space in the kitchen.”</i></p>	<p><b>Pros</b></p> <p>This Design Opportunity would decrease the risk of danger since frequently PINCH employees end up carrying sharp tools through the crowded kitchen, It would create a more attractive working environment where employees could enjoy a more comfortable break in the kitchen. It would also have the potential to address the problems with communicating with people working in the workshop. It would be extremely tailored to the very specific needs of PINCH however, this would be of huge benefit to them. The prototype would also consider commercial manufacturing processes in order to at least think about how this product might be tailored to other situations.</p>	<p><b>Cons</b></p> <p>This Design Opportunity addresses only the needs of one very specific user group at PINCH, there are already systems that exist to make staircases more compact (however, I have already discussed the issues with these). The design although it would serve to help PINCH employees and perhaps customers too, would not have wider applications outside of their studio due to the specific needs of the workspace.</p>
<p><b>Design Opportunity 3</b></p> <p><i>“To design and manufacture a compact system capable of transporting furniture around the studio.”</i></p>	<p><b>Pros</b></p> <p>This Design Opportunity has great potential to be of use outside of PINCH. There are many potential users of such a system involving a heavy lifting system that needs to compact and also visually unobtrusive. The Design also would help in working environments where time is vital and the working force is small. It would also reduce the risk of injury due to heavy lifting and aim to save money for the company in keeping the furniture safe since some of it is particularly fragile and at risk of breaking during transport.</p>	<p><b>Cons</b></p> <p>The Design Opportunity although it would greatly help the user group’s time, would have no wider societal and environmental benefits. Also given the limited manufacturing techniques I would be able to explore in the school’s workshop, I am not fully confident that I would be able to design a well enough developed prototype that would solve the problems discussed previously.</p>

## Justification

Design Opportunity 1 which I have decided to run with affords me the potential to consider a very real and promising emerging design situation and environment. It solves real life problems that are felt by many people and companies. I also believe that it is the design opportunity that I can develop and prototype to the greatest extent within my school’s workshop. The strong emphasis on ergonomics and anthropometrics is something that interests me greatly too.

## Client Feedback

*I completely agree, although selfishly there might be more benefit for me in either of the other possibilities. The one you have chosen has the potential to help a really vast user group. It's also a really exciting Design Brief.*

## Primary Design Brief

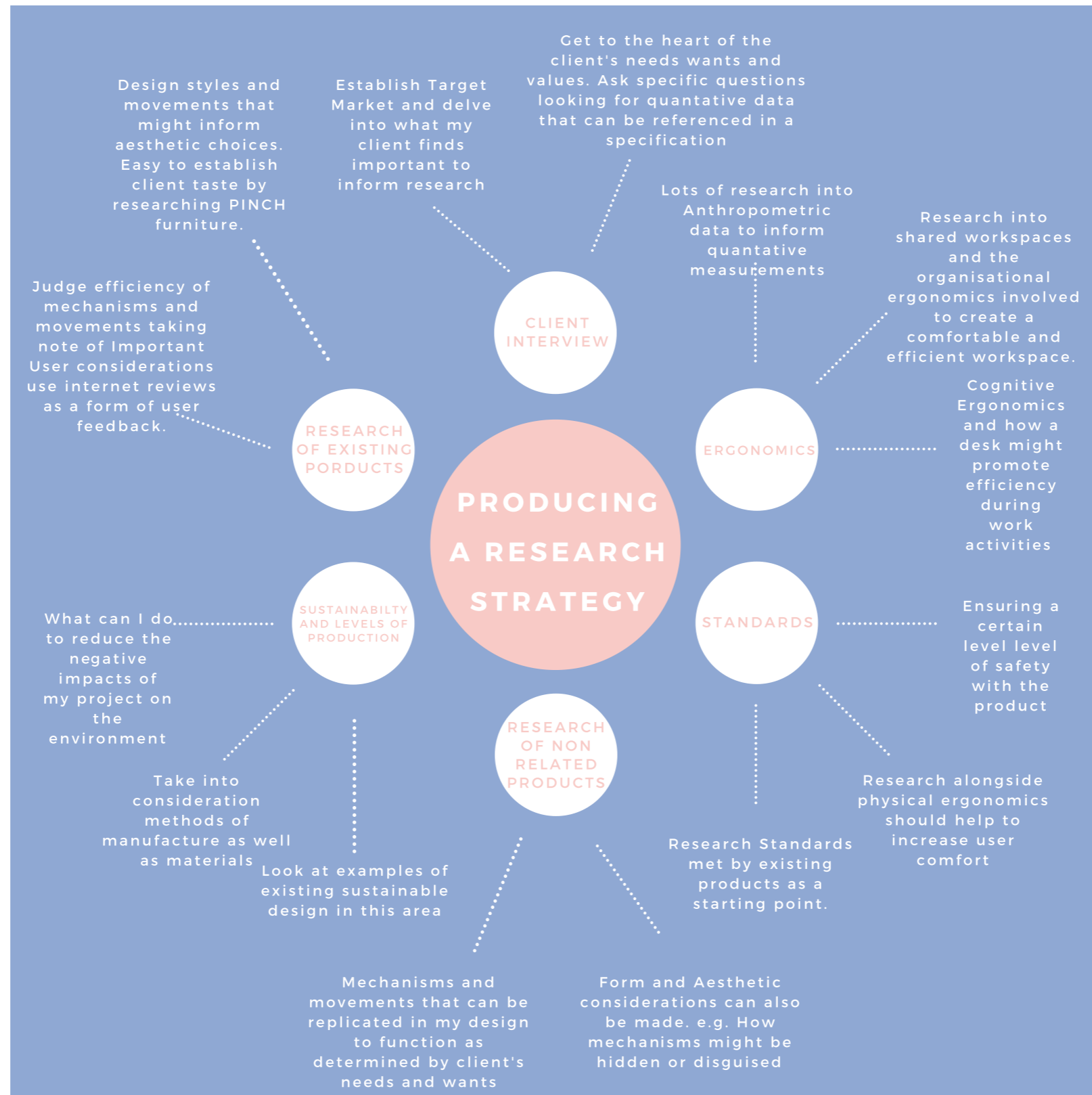
To Design and Manufacture a prototype for a desk. The desk must have 2 or more heights and consider ways of efficiently switching between stages of work (i.e. Sketching, Computed based or Modelling.) The desk must reduce clutter in order to create a more productive working environment. It must make charging more efficient and save time in both finding and putting away tools. It must fit A3 sheets of paper and A4 folders. There must be space within the desk for a phone and laptop to charge whilst remaining readily accessible. Pens and Pencils must be easy to access and lifting and lowering the desk between heights must be quick and easy. A keyboard should also be able to fit under a laptop screen.

**Grid 2**

**Investigation of  
Needs & Research**

## Research Strategy informed by Client Interview

It is very that my research stems from my client's needs wants and values. My client has already mentioned in his primary interview that Sustainability is something that is considered very important. In addition, he has mentioned that the organisational ergonomics of shared workspaces be researched to maximise working efficiency, comfort and working satisfaction. As a result these points shall be at the forefront of my research



## Primary Design Brief

To Design and Manufacture a prototype for a desk. The desk must have 2 or more heights and consider ways of efficiently switching between stages of work (i.e. Sketching, Computed based or Modelling.) The desk must reduce clutter in order to create a more productive working environment. It must make charging more efficient and save time in both finding and putting away tools. It must fit A3 sheets of paper and A4 folders. There must be space within the desk for a phone and laptop to charge whilst remaining readily accessible. Pens and Pencils must be easy to access and lifting and lowering the desk between heights must be quick and easy. A keyboard should also be able to fit under a laptop screen.

## How Design Brief and User Needs and Wants should inform Research.

The Design Brief mentions "2 or more heights" of the desk. In depth research of both Standards and Anthropometric data should take place to inform quantitative data to be referenced in the specifications. The "efficient switching between stages of work" suggests that organisational ergonomics need to be researched in order to create a productive working environment. This also goes for the reduction of clutter on the desk and charging efficiency where secondary research of existing products would also be useful. Primary research can take place in measuring A4 folders and A3 sheets of paper as well as dimensions of standard mobile phones and laptops to again inform quantitative measurements to be referenced in the specifications. There is a lot of research into correct working posture and collecting this research alongside anthropometric data will also help inform quantitative measurements on heights, distances, reaches and other important measurements to ensure user comfort.



# Further Assessment of User Needs and Wants

## Secondary Client Interview

### What do you have on/around your desk at the moment that makes it so cluttered? and what would solve this?

Cables take up a large amount of space on my desk at the moment and they are always tangled up creating a huge mess so some sort of **cable management is essential**. I also find that when I am doing my modelling I use a lot of card and all the little bits I cut up end up on my desk and this just gets really annoying I would love to find some way of solving this. I actually have this really useful board at the back of my current desk which had hooks so I can hang things like scissors off. This is a really handy solution because It really doesnt take much effort to put things away there but it still looks tidy. I have my laptop on my desk which I think is a 13” macbook pro. It sits on my laptop stand with a keyboard and a mouse in front. I have a big lamp on my desk too and sometimes I keep a fan on my desk. Something I really need is some **drawers to keep paper and card**. They can't be too big but I definitely need them, whether they are a separate unit or part of the desk is up to you but they also need to be to one side.

### Can you tell me a bit more about your sketching needs?

Sure, I actually dont need a desk which can tilt like some of those artist's desks. I just need a flat surface. Although I am quite specific that the **tabletop itself is timber**. I dont mind it the structure underneath is metal just so long as the tabletop itself is timber. I also already mentioned those large markers that I use, I need **big pots to keep those organised** so that they dont get left out on my desk.

### What about when you are modelling?

The desk needs a back so that firstly things dont fall off but also so that I can store things there. I also use a cutting matt and that needs getting rid of when I'm sketching.

### Have you got any idea about how big this needs to be?

Yes - It needs to be smaller than 1.5 x 0.8m

### What about a budget?

For me, you can have as large a budget as you wish however, you might want to take into consideration the rented workspace situation and consider cheaper materials and processes that are more suited to mass production. You obviously don't have to use them since you are making the desk for me but i suppose you should at least think about them and perhaps write them up.

### From a sustainability point of view do you have any other specific needs?

I suppose the main thing to do with sustainability is that this is built well but also that any sort of technology integrated solutions are upgradable, you might want to consider wireless charging although I dont have a phone that supports it at the moment.

### What is wrong with the standing sitting desks that are available?

Well a lot of the mechanisms dont work too well but the main thing is that they arent suited to my specific needs. Like I said I need to be able to efficiently switch between sketching, modelling and working on my computer and these desks are all very basic in that they are just flat surfaces with nothing in terms of pots or laptop stands or cable management.



## Summary of Client Needs and Wants

- Place to store paper and card (not too big)
- Way of getting rid of waste card easily
- Timber tabletop
- Big Pots
- Needs a Back
- Smaller than 1.5x0.8m
- Consider alternative materials/methods of construction
- Well built
- Consider Wireless charging
- System where changing between his different stages of work is quick, efficient and leaves little clutter around his desk.
- A way of accessing cables quickly and easily but also so that they wouldn't fall off the desk.
- 2 or more possible heights
- Store and charge phone and laptop within the desk so that they remain easily accessible.
- Pencils and pens to remain neatly arranged within a drawer
- To change between standing and sitting heights as quickly as possible
- Keyboard to sit lower than his laptop screen

## Client Values

### - Sustainability :

The designs must be well built, they do not necessarily need to be made entirely from 100% sustainable materials however, all materials must be sustainably sourced and considerations should be made such that the life cycle of the product has as little impact on the planet as possible. The easiest way of doing this however is assuring that the product is well manufactured and futureproofed such that it lasts for as long as possible with the customer before they decide to get rid of it.

### - Materials :

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### - Aesthetics and Function :

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## Relevant methods of research

- Existing product research + primary research of sizes
- Existing product research
- Materials research weighing up sustainability
- Physical ergonomics + existing product research
- Existing product research
- Specific point that can go straight to specifications
- Research of different Target audiences + Sustainability
- Existing product analysis
- Research related products and systems
- Organisational Ergonomics and research into other non related products that aim to solve similar problems
- Ergonomic research and primary research with measurements of cables etc.
- Anthropometric data to inform heights.
- Primary research and measurements of cables and typical phones and laptops.
- Organisational Ergonomics
- Research into non existing products with efficient methods of raising and lowering.
- Anthropometric data and physical ergonomics

## Relevant method of research

### - Sustainability :

Research should specifically target sustainably sourced materials. An LCA of a typical desk might be carried out to analyse improvements to be made. In addition, any research in existing products should look into durability to help improve product lifetime. Researching wireless charging would be a way to introduce futureproofing into the design.

### - Materials :

During Ergonomic research materials should be considered and how humans interact with them. i.e. materials/colours that influence comfort and productivity. Sketching on different surfaces produces different results and this should be researched.

### - Aesthetics and Function :

Research into Organisational Ergonomics will help determine an efficient workspace reducing clutter and creating efficiency whilst aspects relating to form can be researched using existing products, PINCH furniture and design movements.



# Ergonomic Research

## Aims of Ergonomic Research informed by Client Interview

- Establish quantitative data for the two (or more) heights that the desk should reach
- Research organisational ergonomics to inform ways of switching efficiently between stages of work, reducing clutter in the workspace and managing electronics efficiently
- Anthropometric Research regarding reaches and relevant human dimensions that could be needed.
- Research workplace ergonomics and increasing productivity.
- Anthropometric data to inform height of laptop screen above desk.

## Research of workplace ergonomics to improve posture

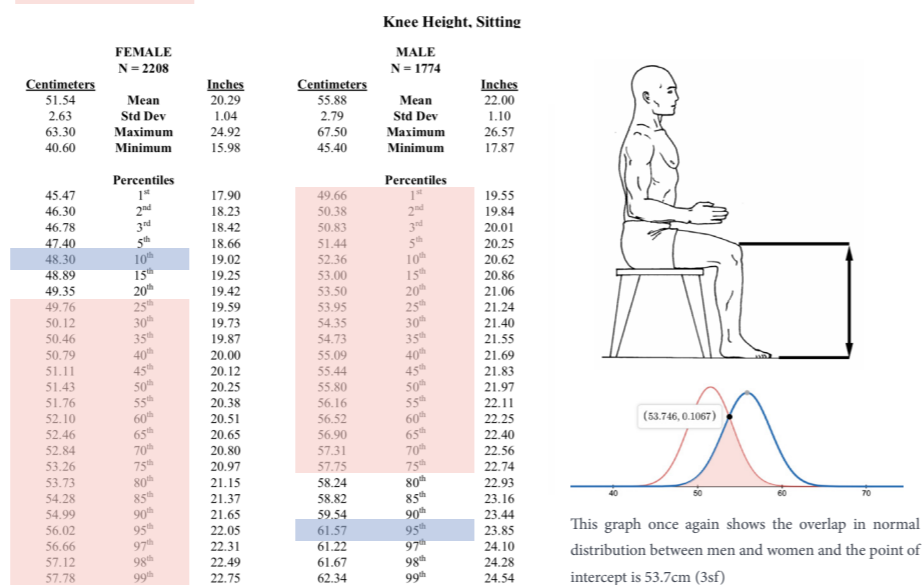
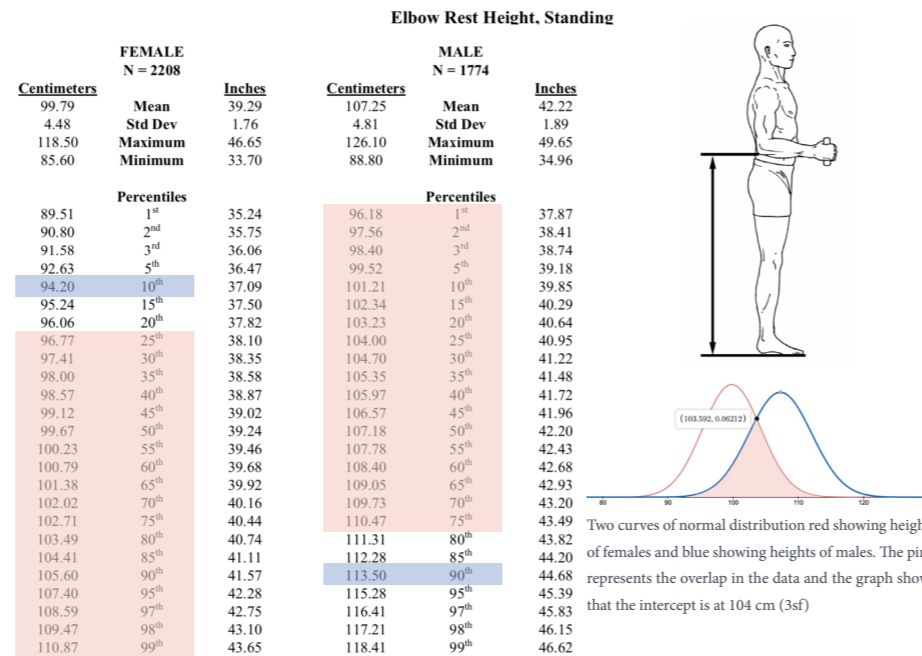
I read Anita Addlesberger's Article on "How to Create a Healthy Workplace" to help inform my research on workplace ergonomics. I learnt the following things.

- Wrists should be at the same level as your elbows whilst typing.
- Your mouse should be within easy reach and on the same level as your keyboard
- Your monitor should be placed so that the top of the screen is at or slightly below eye level. The monitor should also be approximately an arms length away.

- Key objects such as your telephone, stapler and writing utensils should be kept close to your body to reduce reaching and straining

The article also details the importance of breaking the routine of long-term sitting. It recommends walking, standing during phone calls and stretching at your desk. It once again is another pointer that a standing/sitting desk will help mitigate the dangers of long term sitting which include an increase in blood sugar levels, brain function to slow and a drop in good cholesterol.

## Establishing quantitative data for the two (or more) heights that the desk should reach.

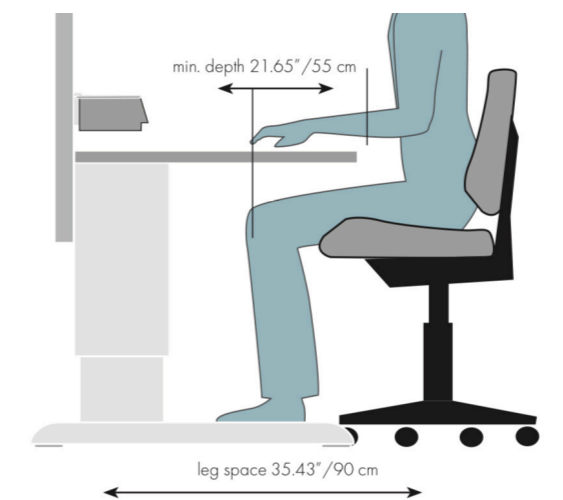
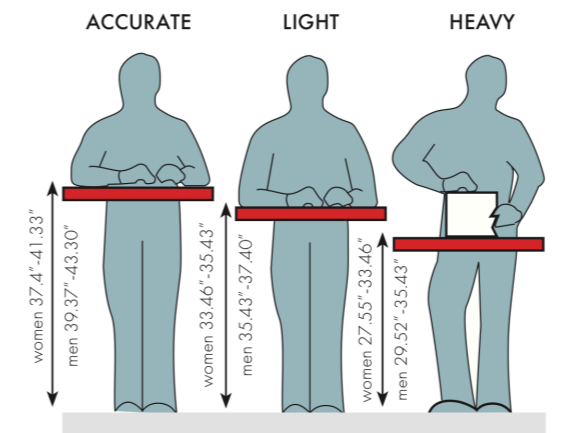


## Choosing a Sitting Height.

The second data set for Knee Height, Sitting should give a good representation of the lowest the desk should reach. For me it is more important that even people with really long legs should be able to fit comfortably. As a result, I think that its less important the intercept point is chosen, I think that it is more important that since your legs either fit under the desk or they don't, a height must be chosen such that as many people's legs fit under the desk as possible. As a result I am going to take forward the value of 62cm (2sf) which accomodates for 95% of men and 100% of women fitting under the desk. The standard deviation for this data set is much smaller than for the "Elbow rest height, Standing" which suggests that chosing a height that is accomodating for taller people by using the 95th percentile limit doesn't run the risk of making the desk as uncomfortable for shorter users since the spread of the data is smaller and the 95th percentile value still rests close to the mean.

## Choosing a Standing Height

With reference to my research of workplace ergonomics which suggests that "Wrists should be at the same level as your elbows whilst typing." I have selected two sets of appropriate data from the "Anthropometric Survey of U.S. Personnel" I want my desk to accomodate for the 5th - 95th percentiles I want to use data from the 10th percentile of Females to the 90th percentile of males. However, this provides quite a large range of heights from 94.2cm to 113.5cm. I noticed that there was a large overlap of the male and female data between 96cm - 110cm, this is shown by the pink highlighting on the data. I then decided to use the mean and standard deviation from the data to draw two curves of normal distribution to find the most common height of both men and women. The pink area beneath the curves represents the same pink area shown on the data set and I used computer software to map the intercept which shows that 104cm is the most common height for both men and women. I will take this specific value into my specifications



## Research into Organisational Ergonomics to Improve productivity

My fact finding involed reading research from **Treston** an industry innovator in workspace development, with a unique expertise in manufacturing ergonomic workspace solutions for changing environments. The piece of research was called "Increasing productivity with proper ergonomics."

The main lesson that it taught me was that workplaces have to be so much more adaptable than I has initially anticipated. Not only are no two users going to have the same physical dimensions but they are also not going to have the same eyesight, habits or even reaches and strengths.

In addition, the research suggested that even the standing heights of desks should have a degree of flexibility because the height you might want to be working at with a heavy object might be very different to an appropriate height for modelling where a high degree of accuracy is needed with a scalpel. The diagram to the left outlines this.

This applies to my project too. The prefered sketching or modelling heights for a desk will not be the same for any two people and therefore it is important that in my specifications it is detailed that a high degree of customisation is needed.

The research also gave indication of other key measurements of importance. It is clear from the research that productivity and comfort are correlated and that to maximize comfort it is vital that the depth of a desk isn't too great but also the minimum depth of the desk shouldn't be smaller than 55cm as detailed in the diagram to the left.

In addition I learnt that leg space is also vital for comfort and it i understandable that not having adequate legspace would decrease productivity.

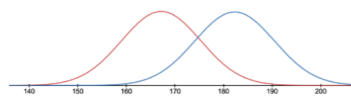
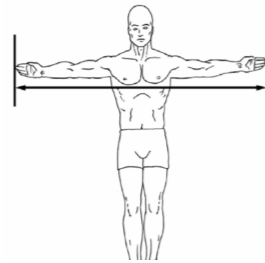
90cm is given by Treston's research and this should accomodate all the way upto the 95th percentile. This is definitely a vaule that I will take forward into my specifications.

I have learnt from my research into organisational ergonomics that improving productivity isnt as simple as sticking to a few measurements. It involves creating an adaptable workspace where each specific user feels comfortable in their working environment. Therefore I will also take forward to my specifications that the desk must accomodater for an adaptable workspace to suit the specific needs of individual users.

# Further Ergonomic Research

## Anthropometric data to inform height of laptop screen above desk

FEMALE N = 2208			MALE N = 1774		
Centimeters	Mean	Inches	Centimeters	Mean	Inches
167.19	65.82	182.31	71.77		
8.13	3.20	8.19	3.23		
196.80	77.48	215.90	85.00		
135.60	53.39	147.40	58.03		
Percentiles			Percentiles		
148.81	58.89	164.79	64.88		
151.02	59.46	166.53	65.56		
152.38	59.99	167.68	66.02		
154.21	60.71	169.31	66.66		
157.00	61.81	171.94	67.69		
158.88	62.55	173.78	68.42		
160.37	63.14	175.28	69.01		
161.67	63.65	176.60	69.53		
162.85	64.11	177.80	70.00		
163.94	64.54	178.92	70.44		
164.98	64.95	179.99	70.86		
166.00	65.36	181.04	71.28		
167.02	65.76	182.09	71.69		
168.04	66.16	183.14	72.10		
169.09	66.57	184.21	72.52		
170.18	67.00	185.32	72.96		
171.33	67.45	186.50	73.42		
172.60	67.95	187.77	73.93		
174.02	68.51	189.21	74.49		
175.67	69.16	190.86	75.14		
177.76	69.99	192.96	75.97		
180.86	71.20	196.03	77.18		
182.84	71.98	197.99	77.95		
184.27	72.55	199.42	78.51		
186.45	73.41	201.62	79.38		



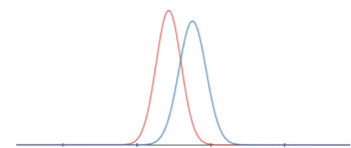
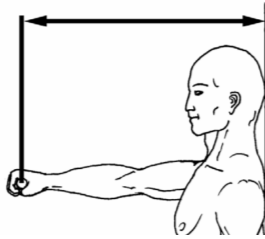
Intercept at 175cm

## Anthropometric data regarding reaches and relevant human dimensions that could be needed

### Span.

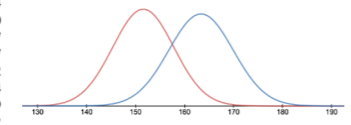
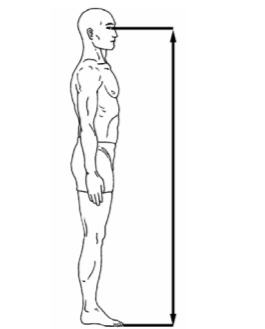
This measurement is important for the width of the desk. It seems nonsensical to have a desk that is so wide that it isn't possible to reach objects on both sides of the desk without actually straining the rest of your body. The intercept of the normal distribution curves for both men and women is at 175cm (3sf). Therefore this seems a sensible guideline to take forward into the specifications. The likely desired width of the desk will be smaller than this as my client has already mentioned in his secondary interview that he would prefer a desk to fit within the dimensions of 1.5m x 0.8m. However, this research still may well be useful when taken forwards to initial ideas.

FEMALE N = 2208			MALE N = 1774		
Centimeters	Mean	Inches	Centimeters	Mean	Inches
68.61	27.01	75.07	29.55		
3.39	1.33	3.68	1.45		
83.20	32.76	92.10	36.26		
57.50	22.64	62.60	24.65		
Percentiles			Percentiles		
61.51	24.22	67.26	26.48		
62.12	24.46	68.04	26.79		
62.55	24.63	68.55	26.99		
63.19	24.88	69.28	27.28		
64.26	25.30	70.45	27.74		
65.03	25.60	71.27	28.06		
65.66	25.85	71.93	28.32		
66.22	26.07	72.52	28.55		
66.72	26.27	73.05	28.76		
67.19	26.45	73.54	28.95		
67.64	26.63	74.02	29.14		
68.08	26.80	74.49	29.33		
68.51	26.97	74.95	29.51		
68.95	27.15	75.42	29.69		
69.40	27.32	75.90	29.88		
69.86	27.50	76.40	30.08		
70.34	27.69	76.92	30.29		
70.87	27.90	77.50	30.51		
71.46	28.14	78.15	30.77		
72.15	28.41	78.91	31.07		
73.03	28.75	79.87	31.45		
74.36	29.27	81.31	32.01		
75.24	29.62	82.25	32.38		
75.90	29.88	82.94	32.65		
76.97	30.30	84.03	33.08		



Intercept at 72cm

FEMALE N = 2208			MALE N = 1774		
Centimeters	Mean	Inches	Centimeters	Mean	Inches
151.61	59.69	163.39	64.32		
6.25	2.46	6.57	2.59		
175.30	69.02	191.20	75.28		
132.50	52.17	138.10	54.37		
Percentiles			Percentiles		
137.39	54.09	148.40	58.43		
139.07	54.75	150.22	59.14		
140.11	55.16	151.33	59.14		
141.52	55.72	152.82	59.58		
143.67	56.56	155.08	60.17		
145.13	57.14	156.60	61.05		
146.29	57.59	157.82	61.65		
147.30	57.99	158.88	62.13		
148.21	58.35	159.84	62.55		
149.06	58.68	160.73	62.93		
149.87	59.00	161.59	63.62		
150.66	59.32	162.42	63.95		
151.45	59.63	163.26	64.28		
152.24	59.94	164.10	64.61		
153.05	60.26	164.96	64.94		
153.90	60.59	165.85	65.30		
154.79	60.94	166.79	65.67		
155.77	61.33	167.82	66.07		
156.86	61.76	168.97	66.52		
158.14	62.26	170.29	67.04		
159.75	62.90	171.29	67.69		
162.13	63.83	174.29	68.62		
163.35	64.43	175.73	69.18		
164.75	64.86	176.72	69.57		
166.43	65.52	178.15	70.14		



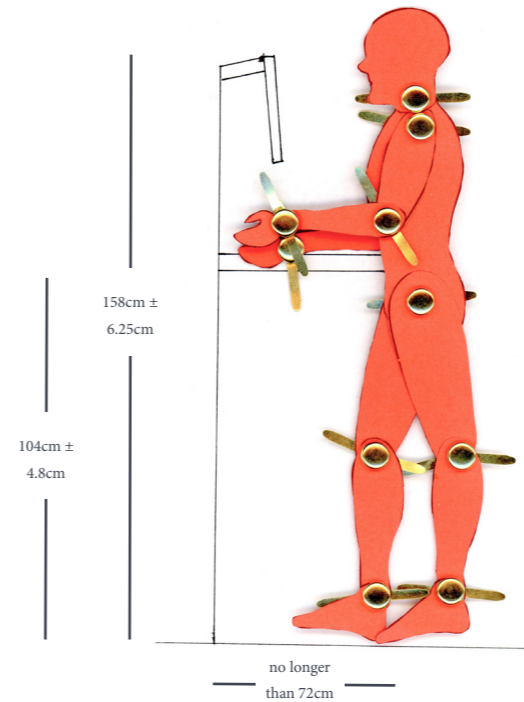
Intercept at 158cm

### Functional Grip Reach.

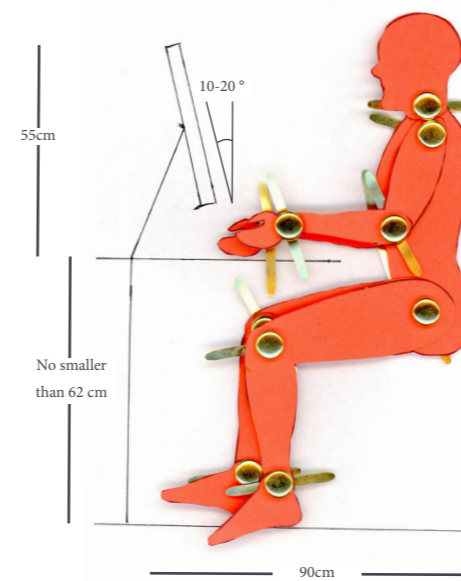
Functional grip reach will help me to determine the depth of the desk. It is important to me having researched workplace ergonomics that the user doesn't need to ever strain in order to reach something on the desk. Therefore, the desk should not be deeper than 72cm. This should help mitigate a situation where the user is able to place objects too far away to reach comfortably. By maximising comfort we will hopefully increase productivity. This also agrees with my client's request that the desk is no deeper than 80cm. This functional grip measurement can also be considered in a second dimension and should certainly be carried forwards into the initial ideas stage as well as development.

### Eye height to determine height of laptop screen.

As my research of workplace ergonomics informed me, it is essential that the top of the monitor screen is aligned with eye height. My anthropometric research concludes that the intercept of the normal curves for male and female is at 158 cm however as informed by my research into increasing productivity in the workspace it is important that there is scope for adjustability. As a result I suggest 158cm is used in my specifications as a guideline for eye height however and adjustability of one standard deviation (7cm) is considered to ensure an element of adaptability which my research has proven to be very important.



I have scanned these ergonomics in to give a visual representation of the dimensions that have been influenced by my research.



All of the above measurements shall be taken forwards to my design specifications.

## Brief Conclusion of Ergonomic Research to be taken forwards to Specifications:

Research of workplace ergonomics to improve posture

- Wrists should be at the same level as your elbows whilst typing.

- Your mouse should be within easy reach and on the same level as your keyboard

- Your monitor should be placed so that the top of the screen is at or slightly below eye level. The monitor should also be approximately an arms length away.

- Key objects such as your telephone, stapler and writing utensils should be kept close to your body to reduce reaching and straining

### Choosing a Sitting Height.

- 62cm

### Choosing a Standing Height

- 104cm

## Research into Organisational Ergonomics to Improve productivity

- High degree of adjustability

- Depth of desk should be no smaller than 55cm

- Leg room to be greater than 90cm

## Anthropometric data regarding reaches and relevant human dimensions that could be needed

- Span - desk no wider than 1.5m

- Functional Grip Reach
- Desk no deeper than 72cm

## Anthropometric data to inform height of laptop screen above desk

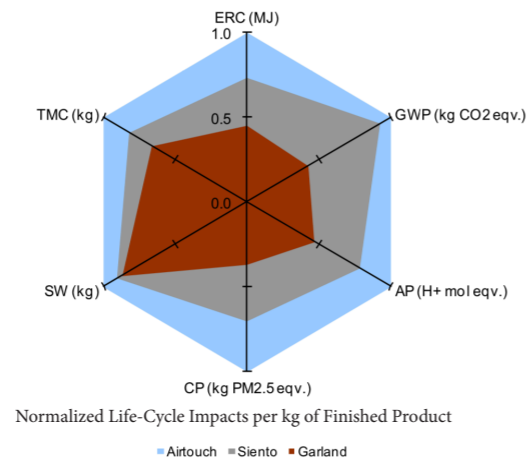
- Eye height
- standing height of top of monitor screen should be 158cm ± 7cm



# Research into Sustainability and Levels of production .

## Aims of Research

- Learn from Life Cycle Analysis of typical desk
- Research the impacts of different methods of manufacture and determine a suitable outcome to minimize impact on the environment
- Consider relevant level of production were the prototype to become commercially available.
- Consider Alternative Materials and Methods of manufacture for different Target Markets
- Research specific Materials and levels of sustainability.



## Life Cycle Analysis

In order to see how materials impact the Life Cycle of Office furniture I looked at a study done by the University of Michigan. It compares the material composition of three pieces of office furniture and their energy resource consumption, global warming potential, acidification potential, criteria pollutants, solid waste, and total material consumption.

### Siento Chair

Material	Weight (lb)
Steel	32.3
Plastic	14.6
Non-ferrous metals	13.4
Leather	2.6
Other	1.7
<b>Total Product Weight</b>	<b>64.7</b>

### AirTouch Table

Material	Weight (lb)
Steel (inc. iron and stainless)	50.4
Particleboard	33.1
Aluminum	28.0
Laminate	3.2
Adhesive and Plastics	1.1
<b>Total Product Weight</b>	<b>116</b>

### Garland Desk

Material	Weight (lb)
Particleboard	159.3
Steel	52.9
Plywood	40.2
Cherry	8.6
Other Wood/Paper	3.1
Adhesives and Finishes	1.9
Backing Material	1.6
Plastics	1.5
<b>Total Product Weight</b>	<b>269</b>

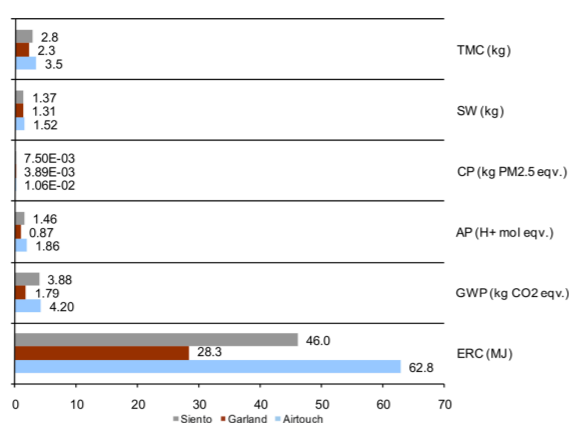
SW - Solid Waste  
 TMC - Total Material Consumption  
 ERC - Energy Resource Consumption  
 GWP - Global Warming Potential  
 AP - Acidification Potential  
 CP - Criteria Pollutants

By comparing the above and below graphs with the Material composition of each product we can determine which materials have the least impact on the environment. The above graph shows that the Garland desk has the least impact on the environment per kg and the AirTouch Table has the greatest impact on the environment per kg.

The Charts to the left show that the Garland desk is comprised of 79% wood, wood composite or paper. Whereas the AirTouch table by comparison is comprised of 28% wood composite.

It is clear that the Life-Cycle Impacts of products that contain high proportions of wood are far lower in comparison with the Life-Cycle Impacts of products that contain high proportions by mass of Steel and other metals.

In terms of the application of this within my project. In order to reduce the impact that my desk has on the environment I will take forward to my specifications that my desk should aim to improve upon the percentage composition of wood of the Garland desk. Therefore my 80% of my desk by mass must be wood, wood composite or paper.



## Methods of Manufacture and Levels of Production.

Given that the Life Cycle analysis just completed has resulted in the decision that this desk is going to comprise highly of timber this is going to impact the methods of manufacture in some way.

A decision needs to be made on whether it is most sensible to employ One-off production, Batch production or Mass production were the product to become commercially available.

Since in this instance I am producing a prototype which will need to be tested, One-off production is the only commercially viable option however, this would be impossible to sustain if the desk needed to be produced in much more quantity.

If this were to happen the desk could either be batch produced or mass produced:

Batch production wouldn't be able to compete with Mass production in terms of rate of production. It would also require more skilled labour. The cost per unit for the customer would be higher as a result of the increased labour time and skill and also due to the fact that raw materials wouldn't be able to be bought in bulk.

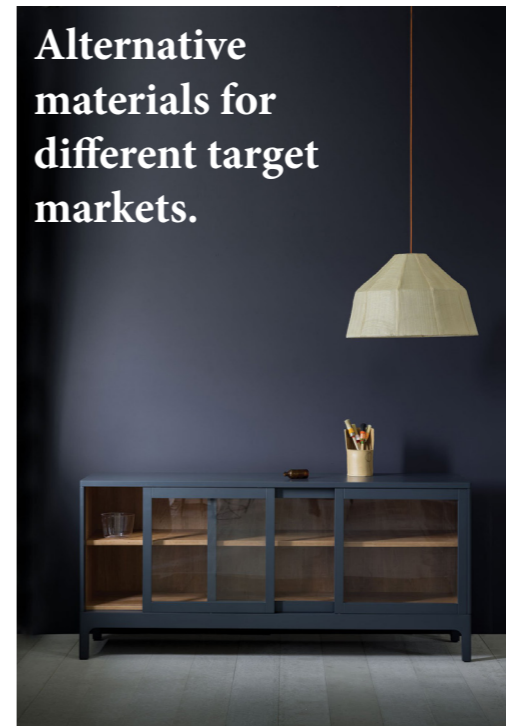
However, the setup costs of batch production are far lower than the setup costs of Mass production. There is more scope for flexible manufacture with batch production. For example if the design were to be refined after a year, it would be far less expensive to make new jigs and templates for batch production than it would be to redefine Methods of manufacture for mass production.

Therefore, even though I am only going to treat my project as a one off bespoke piece, considerations must be taken to try and mimick batch production.

It would be sensible to make templates and jigs where possible that would replicate the manufacturing process that might be used were the product to be batch produced.

Lastly, the environmental impacts of batch production are more favourable than mass production and this is another reason why it is more sensible to choose batch production as a level of production.

## Alternative materials for different target markets.



# PINCH

Following on from my research deciding to consider batch production, this will to some extent determine my choice of materials. Companies like PINCH whose core values I want to reflect in my own project place large emphasis on luxury materials such as high quality hardwoods. Batch production affords this to be possible.

However, choosing luxury materials drives up the price for the customer. The target audience is designers and creatives as well as shared workspaces that will value the adaptability of a desk like this.

Whilst users like Russell might be prepared to spend significant amounts of money on a high quality desk, there are plenty of younger designers and creatives that simply wouldn't be able to afford a desk made from luxury materials. In addition there would always be the fear or risk of spilling paint or glue on an expensive desk.

Therefore, since Russell is my client and this desk is for him specifically, I will use high quality materials that help improve aesthetics. However, throughout my portfolio I will continue to consider cheaper materials that would withstand the daily stains and knocks of a design studio.

## Conclusion:

### Research of Typical Life Cycle Analysis

- The desk must be comprised of at least 80% wood by mass
- Other general observations have been made about the environmental impact of materials. For example that the manufacture of steel is extremely energy intensive.

### Methods of Manufacture and Levels of Production.

- The prototype will be made as a one-off bespoke piece
- Should the desk become commercially available, It will be manufactured in batch production.

- Even though the prototype is a one off, the manufacturing processes should aim to reflect those of batch production. For example use of templates and Jigs.

### Alternative Materials for Different Target Markets

- The one off prototype should use high quality luxury materials and suit the specific needs of Russell Pinch.

- Consideration should be made throughout the portfolio in terms of choices that reduce the cost per unit. For example finding cheaper materials that make the product available to a wider user group.

Example of the High quality materials used in PINCH furniture. In this case Solid European Oak.





# Research of Relevant Standards.

## Relevant Standards:

### BS EN 527-1: 2011

European standard specified dimensions for office desks and tables

### BS 6396: 2008

Electrical Systems in Office Furniture and Educational Furniture

### BS EN 527-3:2003

Office furniture. Work tables and desks. Methods of test for the determination of the stability and the mechanical strength of the structure

### BS 3044:1990

Guide to ergonomics principles in the design and selection of office furniture

### BS 3962-1:1980

Methods of test for finishes for wooden furniture. Assessment of low angle glare by measurement of specular gloss at 85°.

### BS EN 527-1: 2011

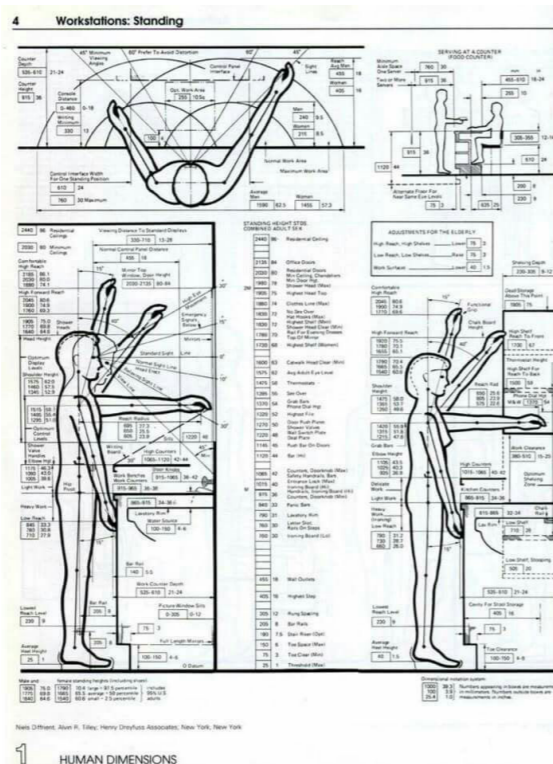
European standard specified dimensions for office desks and tables

- Fixed height desks should be 740mm ± 20 mm (increase of 20mm)
- Height adjustable or height selectable desks should adjust between 650mm and 850mm for sitting applications and between 650mm and 1250mm for sit/stand desks. The new heights are lower to suit short users and higher to suit tall users
- Legroom height at the front of the desk and at 500mm from the front edge has increased
- Desktops can not be thicker than 55mm at the front and 80mm at 500mm from the front edge
- Legroom depth on the floor and up to 120mm above the floor will now be 800mm (an increase of 200mm). This should allow tall people to be able to stretch their legs slightly without having to push themselves away from their desks and tap their keyboards with their arms at a stretch
- Legroom width has also increased to 850mm for fixed height desks and to 1200mm for height adjustable desks

### BS 6396: 2008

Electrical Systems in Office Furniture and Educational Furniture

- No more than six sockets allowed per supply
- The electrical system shall be rated for a total normal load of 13A
- No single item of equipment of a rated voltage higher than 250V or rated current higher than 5A shall be connected to the furniture.
- Power supply cords must not exceed 2m in visible length on exit from the desk clamp
- Cable must be clamped at point of entry to furniture and/ or at both ends where cables connect separate moving parts of furniture
- All extraneous metalwork should be earthed Items of office furniture intended to be earthed shall be provided with an earthing terminal that shall be connected to the earth terminal of the power module
- Provide the user with instructions concerning the safe installation and use of the furniture



### Ball Drop Impact Test

#### BS 3962: PART 6: 1980

Ball Drop Impact test (BS 3962: PART 6:1980) The resistance of wood finishes against impact can be determined using a ball drop impact test. This is done by using a steel ball of 19 mm diameter and weight of 28 g dropped on the finishing surface from a 2 m height. The quality of coating can be determined by evaluating the presence of crack or any defect on the surface area of the specimen.

### Adhesion Test

#### BS EN ISO 2409:2013

The adhesion for wood coating can be tested using two types of method namely cross-cut (BS EN ISO 2409:2013) and the pull-off test (BS EN ISO 4624:2003). Cross-cut test is the easiest method to determine the adhesion properties between wood and coating. A single-blade cutter is used to make lattice pattern on the surface. There are six cuts for each lattice pattern whereby the spacing between each cut is 2 mm. Twenty five squares boxes of 2 mm × 2 mm each at 90° angle are produced. An adhesive tape is then placed onto the lattice area and removed after 5 minutes. The area is examined for detachment of coating and rated based on the standard. For good adhesion properties, the detachment of small flakes at the intersections of the cut must not be greater than 5%

### Scratch Test

#### BS EN ISO 1518-1:2011

To ensure that the quality of finished wood products is prolonged, it is pertinent that the right finishing is used. For example, the type of coating used for dining table top must be more resilient than that used for chair. The strength of finishing material against scratching can be measured by using a scratch machine based on BS EN ISO 1518-1:2011. In this test, the finished panel is clamped onto the panel holder before a set of weight are placed on the stylus. The weight start with a minimum load of 1000 g until it reaches a maximum load of 2000 g. The effect of the stylus on the coating is then observed, and the amount of load is recorded.



Image showing Ball drop Impact Test ▲



Image showing Adhesion Test ▲

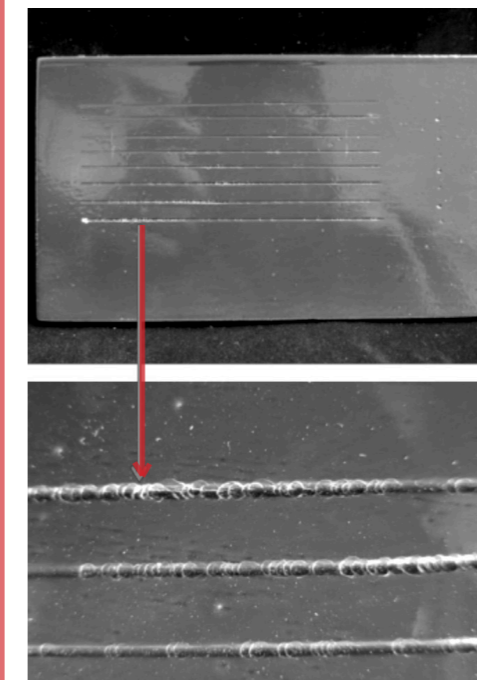


Image showing Scratch Test ▲

## Conclusion:

### Points to be taken forward to specifications

- Height adjustable or height selectable desks should adjust between 650mm and 850mm for sitting applications and between 650mm and 1250mm for sit/stand desks.
- Desktop can not be thicker than 55mm at the front and 80mm at 500mm from the front edge
- Legroom depth on the floor and up to 120mm above the floor should be 800mm
- Legroom width needs to be 850mm for fixed height desks and to 1200mm for height adjustable desks
- No more than six plug sockets allowed per supply
- Power supply cords must not exceed 2m in visible length on exit from the desk clamp
- Cable must be clamped at point of entry to furniture and/ or at both ends where cables connect separate moving parts of furniture.
- All extraneous metalwork should be earthed Items of office furniture intended to be earthed shall be provided with an earthing terminal that shall be connected to the earth terminal of the power module

- When a 19mm steel ball of mass 28g is dropped from 2m above the surface of the desk, the defect or crack must be no deeper than 5mm.

- When the Adhesion Test is carried out, the detachment of small flakes at the intersections of the cuts must not be greater than 5%

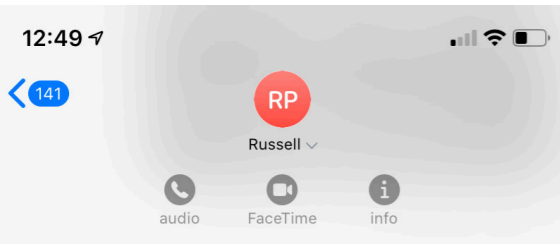
- The scratch test should be carried out using a scribe and different masses. The effects shouldn't appear visible until the mass reaches 800g.



# Primary Research and Research of Non-Related Products

## Aims of Research

- Evaluate Client's desires in terms of form and aesthetics.
- Research Mechanisms that can be replicated in a standing/sitting desk
- Primary research to inform sizes of objects that need to fit within the desk.
- Research efficient methods to charging electronics whilst reducing clutter
- Research adaptable workspaces.



Hi Russell,  
I hope you're well, I've been starting research for the desk and so far have looked at ergonomics, standards etc. I'm getting to the stage where I'm starting to think about what this is going to look like. Are there any particular design movements that I can look at to suit your taste?

Hi Thomas. Great to hear from you. How have you been? This desk is likely to sit around a lot of PINCH furniture so I think that it's important that it fits in nicely with the aesthetic of the office at the moment which as you know also serves a purpose as a showroom. Good Luck  
R

Thank you so much, this helps a lot. I might try and pop into the store next time come back from school.



## Evaluation of Form and Aesthetics

I wasn't exactly sure where to start in terms of aesthetic inspiration. So I sent a text to my client (bottom left) to see what his thoughts were and it became very obvious that my task was to design something that wouldn't look out of place amongst other PINCH pieces.

The Images to the left are extracted from a larger moodboard that I created to try and determine key themes that link the pieces of PINCH furniture. Here are the conclusions that I came to.

The first thing that is extremely obvious is the prevalence of natural materials. Natural timber forms the overwhelming majority of every single piece. Contrasting woods such as in picture 4 are also common.

I also noticed the natural looking tapers in the legs of most pieces for example in the tables in 2,3 and 9.

Contrast in paintwork and light colours of natural timber is also evident in 3 and 5.

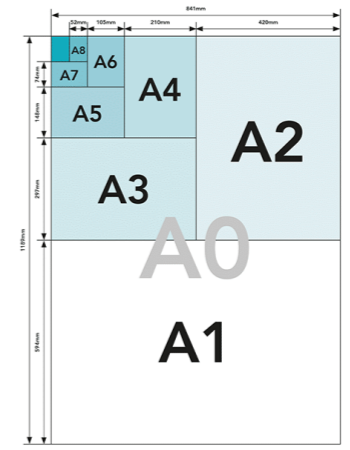
There are also elegant curves in many of the pieces for example the curve in the back legs of the chair in image 2 and the outline of the sidetable in image 7.

There is a strong emphasis on the natural grain of the wood. There are no images where woodgrain isn't significant.

Circles are fairly common such as the tables in images 1, 6 & 8. Joinery is also left visible in 4 and there is emphasis on the craftsmanship that has gone into manufacturing many of these pieces.

Woodturning could also be a way of replicating a similar aesthetic. Many of the legs appear to be turned but also the lamp in image 9 as well as the side table in image 7.

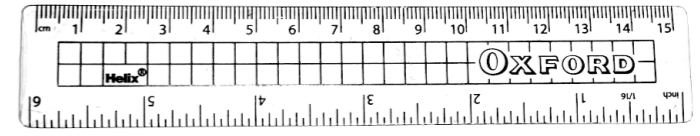
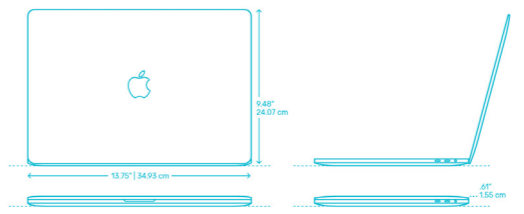
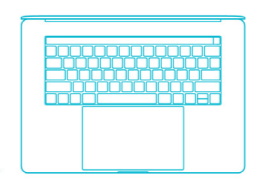
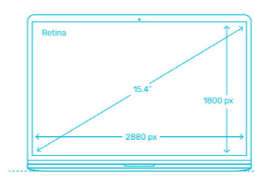
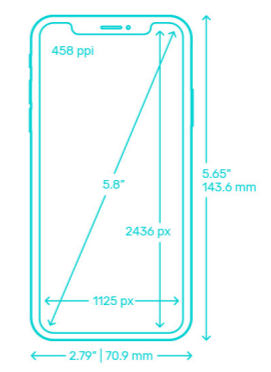
## Research to determine sizes of objects that need to fit within the desk.



The desk must have space to store both A3 and A4 paper for sketching on. This shows that the dimensions of A3 paper are 420mm x 297mm and the dimensions of A4 paper are 297mm x 210mm

Russell owns an iPhone X and has specified that he would like for it to fit within a drawer. My Ergonomics research also proved that it is important to keep frequently used objects close to the user therefore it is important that any drawer or opening is designed to fit an iPhone X with dimensions 143.6mm x 70.9mm.

Working must also be possible with a 13 inch macbook pro on the desk therefore the desktop must still provide enough room for a 34.93cm x 24.07cm to sit whilst also allowing for enough sketching or modelling space.



I measured my own copic markers which are identical to those which Russell uses. They are 145mm in length and 15mm in width and depth. Therefore pen pots must be at least 80mm deep to hold at least half the marker and must have a diameter of at least 90mm to store an adequate number of approximately 15 markers.



# Primary Research and Research of Non-Related Products

## Research Mechanisms that could have relevance.



### Ironing Board.

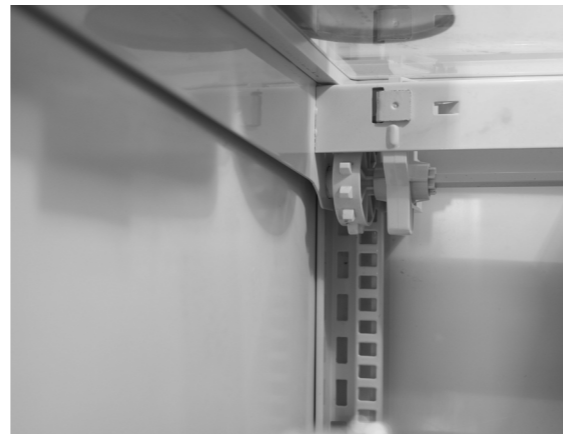
This is the Ironing board that we use at home. The mechanism that helps it to fold flat to reduce the space it takes up during storage could well be adapted in order to suit the specific needs of a standing sitting desk.

The piece of steel marked A has grooves along its length when the legs are extended to a steeper incline, piece B is allowed to slide over the grooved piece of steel.

Since the piece B is attached to a spring this prevents the board from falling back to a flat position however the lever shown in the photo below helps by releasing the spring so that the board can fold flat again.

This definitely has the potential to applied in some way to help transition between the standing and sitting positions of a desk.

I will take this idea forwards to Initial Ideas so that I can explore this mechanism in greater depth.



### Fridge Shelf Lift.

This Fridge Shelf lift helps move the top shelf of the fridge at home move up and down in order to accommodate for different sizes of foods that you might be putting on different shelves.

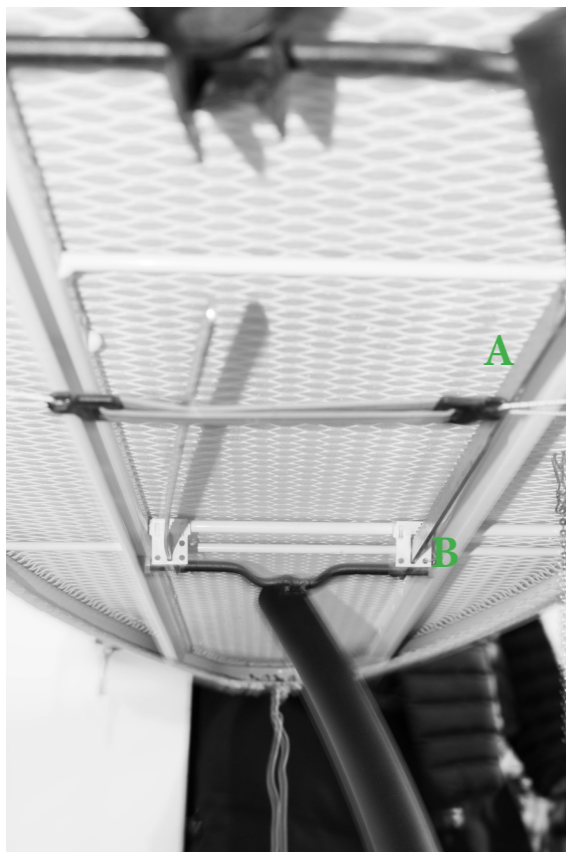
The handle is shown in the top picture and it extends outwards. The circled part rotates as you turn the handle so that you don't have to invert your wrist as you twist. This is a nice ergonomic feature.

This handle drives an axle that runs along the middle of the shelf. This axle turns another that enters from the right hand side of the second image.

This in turn rotates the gear that locate in the runners that are positioned at the back of the fridge.

I can see an application of this where the runners might located in the legs of a desk and a handle might drive the desk up .

However a desktop is significantly heavier than a fridge shelf so it is very possible that the handle might have to be geared up.



## Charging Electronics and Adaptable Workspaces.

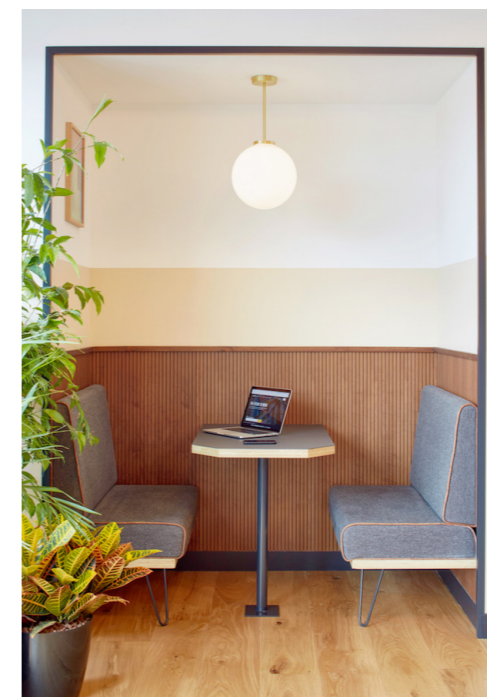


WeWork Tower Bridge, London.

It is really important to me that as in the example above, there is only one cable entering the desk from the powersource, As a result I think that it is essential that the desk is able to carry an extension pack within the body.

It is also essential as demonstrated well with the example above that the plug sockets are well hidden.

Having said this it is important that they are easily accessible and the user definitely shouldn't be crawling over the desk in order to plug a charger in as I can imagine could be the case with this desk.



## WeWork's Tips for Designing an Ideal Workspace.

### Allow Multiple Ways to Work

Think about creating a layout that has a gradient of high-energy public spaces down to private and focused spaces," says Devin Vermeulen, WeWork's creative director.

"Open and public spaces have great energy and promote community, but they can also be difficult places to do focused, heads-down work. Offsetting those spaces with nooks allow you to move around the space throughout the day to find an area that best suits the task at hand.

How might this be applied within my project? I think that it is important that this desk should be able to work efficiently and look attractive whether placed in a corner to increase privacy or whether it be in the middle of a busy room.



# Research of Existing Products.

## IKEA Bekant.

My friend owns the Ikea Bekant desk so I asked him if I could visit him and review the desk, here is what I found.

### Build

The desk is well built and sturdy. The legs are reassuringly heavy and the mechanism feels an industrial level of quality. On the desktop my friend has equipment totaling a weight of just under the 70kg limit I can hear the motors struggle a little when I move it up and down. At standing height there is a minor wobble, which is a slight problem however it could be to do with the uneven floor.

### Functionality

The functionality of the desk is pretty simple. You press the up button, and the desk raises, you press the down button, and it lowers. It's not a fast movement, but it's not particularly slow either.

The up and down controls could be a little more friendly, they require a decent push, and you have to hold them down for the duration of the motion (the buttons move with the desktop). A few times I accidentally let go as it was moving. It's an inconvenience.

It comes with a little plastic key that allows you to disable the movement buttons entirely.

The Bekant doesn't have any position memory functions that I've seen on other standing desks, but I don't think that my client would need them. However this might be something to consider for the situation in rented workspaces where a standard resting height may be needed

The range of heights it covers is huge, it goes from too-low-for-anyone (56cm) to unreasonably-high (122cm), I can't imagine there are many people that would need more range than it provides. Noise-wise the mechanism does have a distinct sound on raising and lowering, it's not loud by any means, but you can hear it in the next room.



There is a jolt that happens when you start lowering the desk. It's not too major, but my friend has spilt his drink a few times when moving the desk up.

### Design

I didn't realise until I saw it in the flesh, but the desk surface has quite rounded corners, more so than your average desk. I imagine this is to minimise injury should you bump into it. In a crowded, open plan office adjustable desks could create some hazard, and catching the corner of one with your hip would probably hurt quite a lot.

There are a handful of colour combinations to choose from and after much deliberation

The oak veneer surface looks really smart. It's got a slightly rough texture to it that might not be perfectly suited for sketching. I did run a cloth over it and it caught however.

### Things to take into consideration

The desk should be well built and sturdy, hopefully with no wobble at its top height. If there are controls a memory would be useful and it would be best if they didn't need to be held. The range doesn't need to be as large as with the Bekant. Noise should preferably be kept to a minimum. Rounded corners are a good idea to consider especially in the context of rented workspaces.

## Home Desk.

This is the most used at my home. It is used as a cabinet as well as a desk and to increase space the front folds up.

The ergonomics of the simple desk are not good. You can see from the photo to the right that angle A is not 90 degrees as my ergonomic research said it should be. It is clear that the desktop is slightly too high or that the chair is too low.

Angle B is far greater than 10-20 degrees which is what it should be. This is a result of eye level being significantly higher than the top of the laptop screen.



The Image to the left shows a steel insert in the wooden tabletop. This provides strength to the tabletop whilst also connecting it to the hinge so that it can turn through 90 degrees.

Another observation of note is that the unit weighs a significant amount and there is no chance of knocking the desk over whilst bumping into it.

We place heavy objects like books in the bottom drawers and its noticeable that this provides a lot of strength and stability to the unit. By loading the weight at the bottom of the desk it reduces the chance of falling over.

The simple drawers that are visible in the image to the left are extremely useful for organising specific things. For example batteries, Pens, Envelopes.

This could definitely be replicated in my project where different compartments could be used to house markers, pens, pencils etc

## Conclusion. Points to go toward Specification.

- There should be no visible or audible strain on the desk when 50kg is loaded onto the desktop.
- There should be no wobble at any of the heights of the desk.
- Heights should be able to be easily repeated so that a user doesn't have to fiddle to try and find the perfect height every time they adjust the desk.
- The noise of moving the desk up or down should not be able to be heard in a nextdoor room.
- Desk corners should not be able to be caught on clothing.
- The top surface must be sufficiently smooth in order that sketching is easy.
- The user must be able to keep elbows at 90 degrees.
- The top of the user's laptop must be able to be lifted to eye level.
- The user should not need to tilt a laptop screen to greater than 20 degrees.
- Using steel inserts is a good way of providing strength to the desktop.
- The desk should have its weight at the bottom to try and increase stability.
- The desk should provide sectioning in order to partition small objects that are used often. For example, pens, pencils, rulers, markers, scalpels and blades.



**Grid 3**

**Design Brief and  
Specification**

# Design Brief.

To Design and Manufacture a prototype for a desk. The desk must have 2 or more heights and consider ways of efficiently switching between stages of work (i.e. Sketching, Computed based or Modelling.) The desk must reduce clutter in order to create a more productive working environment. It must make charging more efficient and save time in both finding and putting away tools. It must fit A3 sheets of paper and A4 folders. There must be space within the desk for a phone and laptop to charge whilst remaining readily accessible. Pens and Pencils must be easy to access and lifting and lowering the desk between heights must be quick and easy. A keyboard should also be able to fit under a laptop screen.

The desk must be designed with Ergonomics and sustainability at the forefront. The effect of the desk on the environment during its lifetime should be minimal. This should be considered right from raw materials. Ergonomics should be considered at every stage in order to ensure maximum comfort and productivity during use. This involves using relevant anthropometric data.

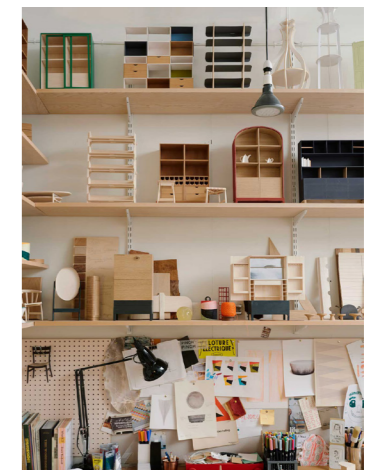
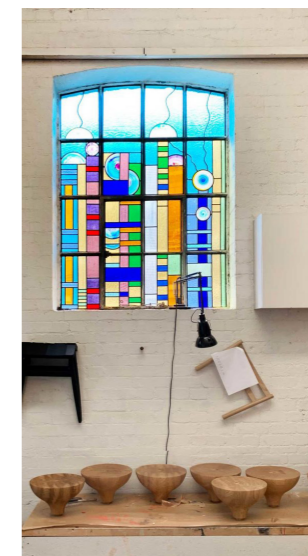
Durability and quality of manufacture are extremely important and the desk should also comprise mainly of timber due to its relatively minimal impact on the environment as well as its prominence in PINCH's furniture. The desk must fit aesthetically alongside pieces of pinch furniture which also explains the importance of wood within the design.

The desk must also conform to the relevant standards mentioned in research as well as the various tests. The desk is targeted at creative and in particular designers who might have to split their working day into multiple stages. Whilst this specific prototype should be tailored to the specific needs of my client, throughout the design process consideration should be made towards designing a product that is saleable to a wider target audience where cheaper materials might be needed and the desk itself may need to be more durable.

In addition, although this prototype is being manufactured as a one off piece, throughout the planning and manufacturing process, consideration towards batch production must be made at every stage. The desk must also fit with the ethos of a WeWork shared workspace where there are "Multiple ways to work."

Thomas Ward

Images show Russell Pinch's working process as well as the environment.





# Specifications.

Focus	Point	Justification
<b>Purpose</b>	<ul style="list-style-type: none"> <li>1.1 - Provide two or more heights for the user</li> <li>1.2 - Provide a space large enough for sketching work. (At least space for 3 A3 sheets)</li> <li>1.3 - Provide a suitable surface for modelling work</li> <li>1.4 - Be appropriate and comfortable for computer based work</li> <li>1.5 - Create a more productive and comfortable working environment for the user</li> <li>1.6 - Suit the needs of a rented workspace such as WeWork</li> <li>1.7 - Cater for a user group consisting of young creative who need to switch between multiple types of working.</li> <li>1.8 - Help reduce the reduce the health impacts of bad working postures</li> <li>1.9 - Efficiently switch between this different types of work. i.e. Sketching and modelling.</li> </ul>	<ul style="list-style-type: none"> <li>1.1 - This was specified by my user during the primary interview. It also is backed up by my ergonomic research which suggests that it is important for maintaining health working posture at your desk.</li> <li>1.2 - My client mentioned this in both the primary and secondary interviews. It is important to him that the desk is designed in a way that helps him work efficiently and productively whilst sketching.</li> <li>1.3 - This was also mentioned in both the primary and secondary interviews. Modelling makes up a large percentage of the the daily work that my client does and it is important that it is comfortable to do this.</li> <li>1.4 - This is probably the area of work that is associated with the negative postural and health impacts. As a result as mentioned in the client interview it is important that computer based work is comfortable.</li> <li>1.5 - Similarly to the last point this has been mentioned in my client interview however during ergonomic research it also grew increasingly obvious how important comfort is to increasing productivity at work.</li> <li>1.6 - My client mentioned WeWork and rented workspaces during the primary interview and we decided that this must be considered throughout the design process even if this prototype is to suit the needs of my client.</li> <li>1.7 - The desk is being designed to suit the specific needs of my client however in addition this represents the typical user group that might be found in rented workspaces. This group also needs to be considered.</li> <li>1.8 - Once again this was mentioned in a client interview by my client and my ergonomic research threw up how much of an issue this actually is. It is important that ergonomics are properly considered.</li> <li>1.9 - This is the crux of the design brief and is the first thing that my client mentioned that brought up the issue. It should help my client to become more productive and efficient in his working environment.</li> </ul>
<b>Function</b>	<ul style="list-style-type: none"> <li>2.1 - Reduce the amount of regular clutter on the user's desk by providing effective storage spaces of different sizes.</li> <li>2.2 - Create a productive work environment by sticking to ergonomic principles.</li> <li>2.3 - Make charging more efficient so that wires don't take up excess space on the desk but are also easy to access.</li> <li>2.4 - Save time in organising/tidying tools and equipment found on the desk on a day to day basis.</li> <li>2.5 - Store key objects (Phone, laptop and pens) within 40cm of the user when they are in the standing or sitting position.</li> <li>2.6 - Have a high degree of adjustability to make the desk suitable to the specific needs of a range of users.</li> <li>2.7 - The desk must adjust between 650mm and 1250mm</li> <li>2.8 - Legroom depth on the floor and up to 120mm above the floor should be 800mm</li> <li>2.9 - The desk must have space to store A3 paper for sketching on (420mm x 297mm)</li> <li>2.10 - The desk must also be able to store A4 writing paper (297mm x 210mm)</li> <li>2.11 - The drawer of the desk must have space of at least 143.6mm x 70.9mm to fit my client's iPhone.</li> <li>2.12 - The desktop must be able to sit a 34.93cm x 24.07cm macbook pro whilst also providing enough space for sketching</li> <li>2.13 - The desk must be able to fit in a wide number of different workplace layouts.</li> <li>2.14 - There must only be one cable entering the desk for charging purposes</li> <li>2.15 - The noise of moving the desk up or down should not be able to be heard in a nextdoor room.</li> <li>2.16 - The top surface must be sufficiently smooth in order that sketching is easy.</li> <li>2.17 - The user must be able to keep elbows at 90 degrees.</li> <li>2.18 - The user should not need to tilt a laptop screen to greater than 20 degrees.</li> <li>2.19 - The desk should provide sectioning in order to partition small objects that are used often.e.ge pens, pencils, rulers.</li> </ul>	<ul style="list-style-type: none"> <li>2.1 - This was mentioned by my client when talking about aesthetic considerations and it is important to him that the desk helps to make the surrounding area look tidier by reducing clutter and providing storage.</li> <li>2.2 - This is quite a general point that is mentioned in greater detail later on however, my ergonomic research proved how dimensions and principles can increase productivity which was mentioned as important.</li> <li>2.3 - My client mentioned the importance of reducing clutter in our secondary interview. Organising cables also increases productivity and should reduce time wasted in tidying or untangling wires.</li> <li>2.4 - My primary research of my own desk at home showed me the use of having multiple storage sections in order to increase productivity and reduce clutter. I've decided to replicate this with my own project.</li> <li>2.5 - My organisational ergonomics research concluded that it is important for efficiency that objects of regular use are kept in close proximity to the user to reduce strain whilst reaching for far away items.</li> <li>2.6 - My research into organisational ergonomics taught me that it is incredibly important that working spaces are extremely adjustable to suit the specific needs and comforts of each individual user.</li> <li>2.7 - This is taken directly from the British and European Standard BS EN 527-1: 2011. It is important to me and my client that the prototype is compliant with all relevant British and European standards.</li> <li>2.8 - Again this is taken directly from the British and European Standard BS EN 527-1: 2011. It is important to me and my client that the prototype is compliant with all relevant British and European standards.</li> <li>2.9 - Taken from my client's secondary interview. This lead to research into appropriate sizes. It accomodates for my user's sketching needs which is something that takes up a considerable amount of time.</li> <li>2.10 - Taken from my client's secondary interview. This lead to research into appropriate sizes. It accomodates for my user's sketching needs which is something that takes up a considerable amount of time.</li> <li>2.11 - The research into organisational ergonomics showed how important it was to keep objects of importance close to the user and primary research gave the exact dimensions of the user's iPhone.</li> <li>2.12 - Similarly to the point above, the research into ergonomics as well ad my client's keenness for charging compatability led to this specification point. It was also agreed that these shouldn't affect sketching needs.</li> <li>2.13 - My research into WeWork and the adaptability of office environments as well as the importance of both creative spaces as well as private area led to the conclusion that the desk should be able to suit both.</li> <li>2.14 - During research of non related products I came across a charging cable management system and was struck by the importance of the fact that only one cable enters the desk for neatness and aesthetics.</li> <li>2.15 - Research of existing products showed me that this is a frustrating problem for my friend who owns the IKEA Bekant desk and that my desk should also aim to avoid this problem if at all possible.</li> <li>2.16 - This is a direct request from my client. He is adamant that the desktop is made from timber since this is his preferred sketching surface. It is important therefore that the surface finish is of a high quality.</li> <li>2.17 - My research into workplace ergonomics and into organisational ergonomics showed me the importance of keeping elbows at 90 degrees to improve posture comfort and therefore hopefully productivity.</li> <li>2.18 - Again this is a requirement fed by Workplace ergonomics research and organisational ergonomics research. It should help to improve the user's comfort, posture and hopefully as a result efficiency.</li> <li>2.19 - My primary research of my own desk at home showed me the use of having multiple storage sections in order to increase productivity and reduce clutter. I've decided to replicate this with my own project.</li> </ul>
<b>Form &amp; Aesthetics</b>	<ul style="list-style-type: none"> <li>3.1 - The desk must fit alongside PINCH furniture and not look unattractive or out of place.</li> <li>3.2 - The desk must allow the natural grain of wood to be visible.</li> <li>3.3 - It must have some element of contrasting colours of wood or perhaps wood and metal.</li> <li>3.4 - The desk must also be equally attractive from all angles. It should be able to be placed in any position within a room</li> <li>3.5 - The legs of the desk should taper to fit with the aesthetic however this is not essential</li> <li>3.6 - Joinery techniques such as dowelling should be left visible to emphasise craftmanship.</li> <li>3.7 - If there is any paintwork, it must contrast in colour with the grain of the wood.</li> <li>3.8 - The desk must be simple and elegant and declutter the environment</li> <li>3.9 - The desk must look at home in a private focused space as well as a creative busy environment.</li> </ul>	<ul style="list-style-type: none"> <li>3.1 - The text shown in my primary research and research of existing products shows that my client feels that it is important that the desk is able to stick with the aesthetic of the products that surround the office.</li> <li>3.2 - During research I used a moodboard to analyse the aesthetics of PINCH products and determined that this was a key feature that needs to be replicated to some extent within my own project.</li> <li>3.3 - Once again whilst researching the aesthetics of PINCH furniture it became obvious that contrasting wood colours was a theme and this should aim to be applied during the initial ideas stage of my project.</li> <li>3.4 - Whilst researching WeWork's tips for designing an ideal workspace it became evident that the desk should be useful not only in private areas i.e. maybe against a wall but also in the middle of a room.</li> <li>3.5 - This was another thing that I noticed during research of PINCH products. The legs on the majority of table and chairs tapered naturally to the bottom of the piece and this could be replicated in my own design.</li> <li>3.6 - Again another thing that became obvious whilst researching PINCH products. There is an emphasis on high quality manufacture this is shown by leaving joinery visible to the user. This could help in my design.</li> <li>3.7 - Once again whilst researching the aesthetics of PINCH furniture it became obvious that contrasting paint and wood colours was a theme and this should be applied during the initial ideas stage of my project.</li> <li>3.8 - My client mentioned this during our secondary interview. I asked him about aesthetics and he mentioned that it is important that a product aims to earn its place in the room and declutter the environment.</li> <li>3.9 - Whilst researching WeWork's tips for designing an ideal workspace it became evident that the desk should be useful not only in private areas i.e. maybe against a wall but also in a creative space.</li> </ul>
<b>User Requirements</b>	<ul style="list-style-type: none"> <li>4.1 - Provide a place to store paper and card in a way that it is easily accessible and reduces clutter on the desk itself.</li> <li>4.2 - Provide a way of getting rid of waste card and modelling waste easily such that it doesn't acculate as mess.</li> <li>4.3 - Have a timber tabletop since it is an attractive surface to sketch on.</li> <li>4.4 - Include large pen pots of diameter greater than 90mm suited towards copic marker pens.</li> <li>4.5 - Be adaptable to future methods of charging such as wireless charging or new cable types and dimensions.</li> <li>4.6 - Provide a method of easily accessing and plugging in cables without any risk of them falling on the floor.</li> <li>4.7 - Arrange pens and pencils neatly within an easily accessible drawer.</li> <li>4.8 - The keyboard must be able to sit lower than a monitor or laptop screen when placed on the desk.</li> <li>4.9 - It must be possible to change from any one height to another within 15 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>4.1 - My client mentioned decluttering in his secondary interview. Storage helps declutter the environment which should increase working efficiency by reducing wasted time when the client might be tidying up.</li> <li>4.2 - Similarly to as mentioned above my client mentioned decluttering in his secondary interview as well as a way of getting rid of waste card and modelling scrap material storage too helps declutter the environment.</li> <li>4.3 - The reasons for this are due to the request of my client during a secondary interview but also by result of my research into sustainability which shows how increasing the mass of timber helps the environment</li> <li>4.4 - The secondary interview proved that its important to my client that pen pots exist and primary research of copic markers showed their dimensions to show that pots of 90mm would be appropriate.</li> <li>4.5 - Again this was mentioned in the secondary interview with my client and secondary research was carried out looking at examples of cable management which gave me an idea of how to go about this.</li> <li>4.6 - This is as a result of organisational ergonomics research and workplace ergonomics research which told of the importance of reducing strain and how the user should be comfortable at all times.</li> <li>4.7 - Organisational ergonomics and workplace ergonomics research showed that it is very important to keep regulary used items close to the user and by organising pens and pencils like this it becomes possible.</li> <li>4.8 - Again workplace ergonomics and organisational ergonomics research showed the importance of this on posture and therefore comfort and produtivity helping to create an enjoyable and efficient workspace.</li> <li>4.9 - During my client's secondary interview he mentioned the importance of the transition between standing and sitting heights being quick. This is also backed up by primary research of the IKEA Bekant.</li> </ul>
<b>Performance Requirements</b>	<ul style="list-style-type: none"> <li>5.1 - Be designed in a way such that wrists rest at the same level as elbows when typing.</li> <li>5.2 - Ensure that the user's mouse is within easy reach and on the same level as the user's keyboard.</li> <li>5.3 - Monitor or laptop screen must be aligned so that the top is level with the user's eyes in both standing/sitting positions.</li> <li>5.4 - Have at least one standing height of 105cm ± 5cm</li> <li>5.5 - Have at least one sitting height with bottom the desktop reaching 62cm ± 5cm above the ground.</li> <li>5.6 - There should be no visible or audible strain on the desk when 50kg is loaded onto the desktop.</li> <li>5.7 - Heights should be able to be easily repeated so that a user doesn't have to fiddle to try and find the perfect height every time they adjust the desk.</li> <li>5.8 - Be durable enough to withstand the user leaning or sitting on top surface (800N of force on top surface.)</li> </ul>	<ul style="list-style-type: none"> <li>5.1 - This is fed by my organisational ergonomics as well as workplace ergonomics. They proved that keeping elbows level with wrists helps with good posture and results in more productive working.</li> <li>5.2 - Again this has come about as a result of organisational ergonomics as well as workplace ergonomics which showed that to reduce repetitive strain the mouse should be within easy reach of the keyboard</li> <li>5.3 - This is shown by my organisational ergonomics as well as workplace ergonomics. They proved that aligning the laptop screen with the users eyes helps with good posture and results in more productive working.</li> <li>5.4 - My anthropometric research showed that this was a sensible height for the desk to come up to in order to cater for as much of the population as possible to ensure that they are comfortable whilst working.</li> <li>5.5 - My anthropometric research showed that this was a sensible height for the desk to come up to in order to cater for as much of the population as possible to ensure that they are comfortable whilst working.</li> <li>5.6 - My primary research of the IKEA Bekant desk showed that there was a bit of a struggle under the desk with this load and I think that it is important that this is improved upon with my own prototype.</li> <li>5.7 - This again was found to be important during primary research of the IKEA Bekant desk where I noticed that there was no memory and it was frustratingly difficult to get the desk back to the position that you know suited your own personal measurements. My desk should aim to have some sort of memory to that the same positions can be met time and time again without the user having to remember.</li> <li>5.8 - My client mentioned that the key to sustainability is something that is well built during his secondary interview and by making the desk sturdy enough to withstand this force this will go a long way to help.</li> </ul>

# Specifications.

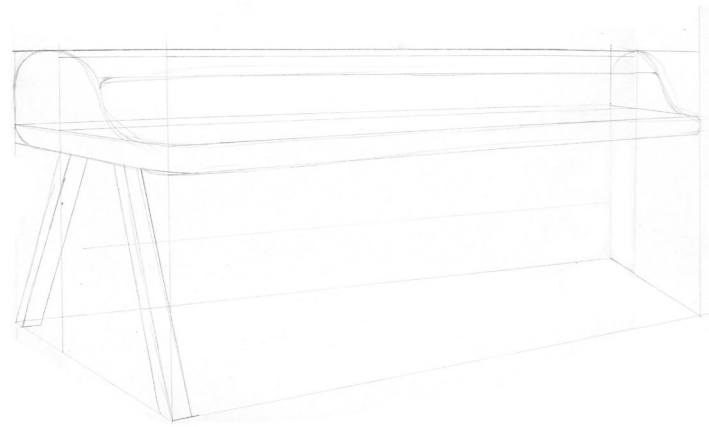
Focus	Point	Justification
<b>Materials</b>	<p>6.1 - Materials should be of high quality and fit the aesthetic of other PINCH furniture.</p> <p>6.2 - Have a timber tabletop at the request of my client.</p> <p>6.3 - Make considerations to other cheaper materials that may help widen the target market.</p> <p>6.4 - Use wood composites in place of natural timber to reduce cost and increase the range of target market.</p>	<p>6.1 - My client mentioned the importance of materials in his secondary interview. Not only in terms of form but also function it is important that high quality materials are used to ensure durability and stability.</p> <p>6.2 - During the secondary Interview my client made this very clear due to having an easy surface to sketch on but research into sustainability also showed that this was a good idea to reduce the impact on the planet.</p> <p>6.3 - Since this prototype is being designed to suit the specific needs of my client it will use luxury materials but during the design process I should also consider materials that will cut costs of production.</p> <p>6.4 - Since this prototype is being designed to suit the specific needs of my client it will use luxury materials but during the design process I should also consider materials that will cut costs of production.</p>
<b>Size</b>	<p>7.1 - The depth of the desk must be no shorter than 55cm to allow enough space for arms to rest during typing.</p> <p>7.2 - The desk must also be no deeper than 72cm so that far objects are never out of reach.</p> <p>7.3 - The legroom that the desk provides must be at least 90cm for maximum comfort.</p> <p>7.4 - The desk must be no wider than 150cm by client request</p> <p>7.5 - The standing height of the top of the monitor screen must be 158cm ± 7cm</p> <p>7.6 - Desktop can not be thicker than 55mm at the front and 80mm at 500mm from the front edge</p>	<p>7.1 - This has come about as a result of research into organisational ergonomics and workplace ergonomics which shows that you need sufficient space at the front of the desk to maintain a good working posture.</p> <p>7.2 - My anthropometric research showed a mean functional grip of 72cm. This means that any objects placed further away would be a strain to reach for many users therefore the back should be closer than this.</p> <p>7.3 - This was not only found in the british standard for workplace furniture but also found in ergonomic researching suggesting that it is a very necessary comfort requirement for all users.</p> <p>7.4 - This was mentioned in the secondary client interview and also backed up by anthropometric research into span where the mean was found to be slightly greater than this therefore 1.5 is a sensible value.</p> <p>7.5 - Anthropometric research showed this to be the mean eye level of people and as other ergonomic research proved, its important that the top of the monitor or laptop is aligned with eye level.</p> <p>7.6 - This is so that my design complies with both the British and European standards for office furniture. These standards are designed to help users remain comfortable and safe in office environments.</p>
<b>Sustainability</b>	<p>8.1 - The desk must be comprised of at least 80% wood by mass</p> <p>8.2 - Components must be easily separated into their individual materials to help with recycling.</p> <p>8.3 - All materials must be sustainably sourced.</p> <p>8.4 - The desk must also use very little of materials that are extremely energy intensive to produce.</p> <p>8.5 - Any Jigs or templates used during manufacture must be made from sustainably sourced materials.</p>	<p>8.1 - My research into the lifecycle of a typical piece of office furniture showed me that materials have quite a large part to play and that by using a high percentage of timber I can reduce the impact on the environment.</p> <p>8.2 - This is important in ensuring that the materials used in the manufacture of the product can be easily recycled without energy intensive processes needed to separate the product into its constituent materials</p> <p>8.3 - My client mentioned in his secondary interview when we talked about his values that sustainability is very important to him and one way of making sure that the desk is sustainable is by doing this.</p> <p>8.4 - The research that I did into Life Cycles of office furniture showed that some materials like steel are incredibly energy intensive to produce and I want to avoid using these materials if it is at all possible.</p> <p>8.5 - Since this will be produced as a one off prototype it would be extremely wasteful and harmful to the environment to use unsustainable materials in the manufacture of single use jigs and templates.</p>
<b>Safety</b>	<p>9.1 - There must be no more than six plug sockets allowed per supply.</p> <p>9.2 - Power supply cords must not exceed 2m in visible length on exit from the desk clamp.</p> <p>9.3 - Cable must be clamped at point of entry to desk and/ or at both ends where cables connect separate moving parts.</p> <p>9.4 - All extraneous metalwork should be earthed.</p> <p>9.5 - The weight distribution of the desk should be towards the base in order to increase stability</p> <p>9.6 - There should be no wobble at any of the heights of the desk.</p> <p>9.7 - Desk corners should not be able to be caught on clothing.</p>	<p>9.1 - This is so that the desk complies with BS 6396: 2008 Electrical Systems in Office Furniture and Educational Furniture this will ensure an acceptable level of safety and reliability for the product.</p> <p>9.2 - This is so that the desk complies with BS 6396: 2008 Electrical Systems in Office Furniture and Educational Furniture this will ensure an acceptable level of safety and reliability for the product.</p> <p>9.3 - This is so that the desk complies with BS 6396: 2008 Electrical Systems in Office Furniture and Educational Furniture this will ensure an acceptable level of safety and reliability for the product.</p> <p>9.4 - This is so that the desk complies with BS 6396: 2008 Electrical Systems in Office Furniture and Educational Furniture this will ensure an acceptable level of safety and reliability for the product.</p> <p>9.5 - This was decided during my primary research of the desk that I have at home where I decided that the desk became significantly more stable by stacking books in the lower drawers of the desk.</p> <p>9.6 - My primary research of the IKEA Bekant desk showed that there was a slight wobble at the top position and this is something that I want to try and avoid at all costs with my own design.</p> <p>9.7 - Again this was picked up during the process of primary research of the IKEA Bekant desk where it was noted that the corners are rounded to avoid catching on clothing. I thought this was sensible.</p>
<b>Scale of Production</b>	<p>10.1 - The prototype will be made as a one-off bespoke piece</p> <p>10.2 - Should the desk become commercially available, it will be manufactured in batch production.</p> <p>10.3 - Even though the prototype is a one off, the manufacturing processes should aim to reflect those of batch production.</p>	<p>10.1 - This is because the aim is for it to suit the specific needs of my client however during the design process I will also make considerations for the wider usergroup that includes rented workspace users.</p> <p>10.2 - Having researched methods and levels of production I decided that this was the best option economically and also for the environment which is particularly important to my client and myself.</p> <p>10.3 - Like I have already mentioned it is important that although this prototype is suited to the specific needs of my client, considerations are also made for what would be the case if the desk were batch produced</p>
<b>Cost</b>	<p>11.1 - The budget for this project is £1,000</p>	<p>11.1 - This is a number discussed with my client, it includes material costs as well as the costs of testing and any other things that might pop up.</p>
<b>Quality</b>	<p>12.1 - When the Ashesion Test is carried out, the detachment of small flakes at the intersections of the cuts must not be greater than 5%</p> <p>12.2 - The scratch test should be carried out using a scribe and different masses. The effects shouldn't appear visible until the mass reaches 800g.</p> <p>12.3 -When a 19mm steel ball of mass 28g is dropped from 2m above the surface of the desk, the defect or crack must be no deeper than 5mm.</p>	<p>12.1 - This test should be carried out so that the desk complies with the BS EN ISO 2409:2013. This will ensure a high level of quality and reduce the likelihood of damage to the desk surface during use.</p> <p>12.2 - This test should be carried out so that the desk complies with the BS EN ISO 1518-1:2011. This will ensure a high level of quality and reduce the likelihood of damage to the desk surface during use.</p> <p>12.3 - This test should be carried out so that the desk complies with the BS 3962: PART 6: 1980. This will ensure a high level of quality and reduce the likelihood of damage to the desk surface during use.</p>

**Grid 4**

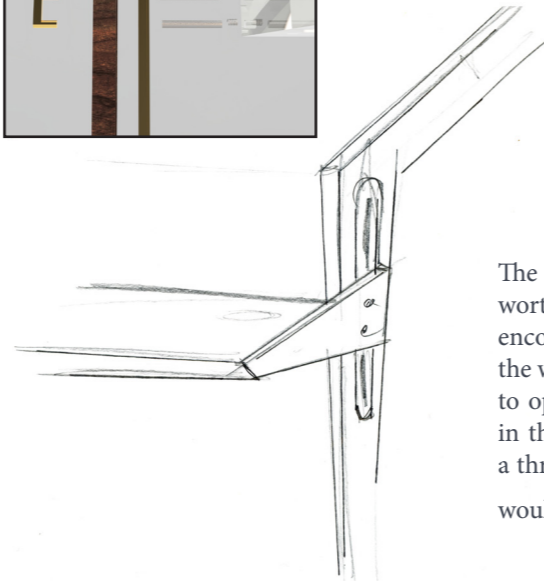
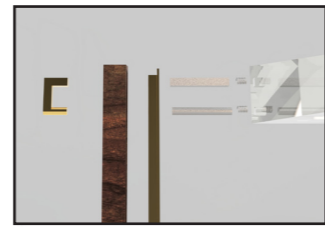
**Design Ideas**



# Design Idea Generation - Collage of Ideas



The Idea above is an exploration of form whereby inspiration came from PINCH furniture (SPEC 3.1) It also allows for joinery techniques to be left visible (SPEC 3.6) and for the sketching surface to be made from natural timber (SPEC 6.2) This was a useful exercise in exploring forms however this desk needs to be further developed in order to fit with more of the technical aspects of my specifications and Client needs/wants.

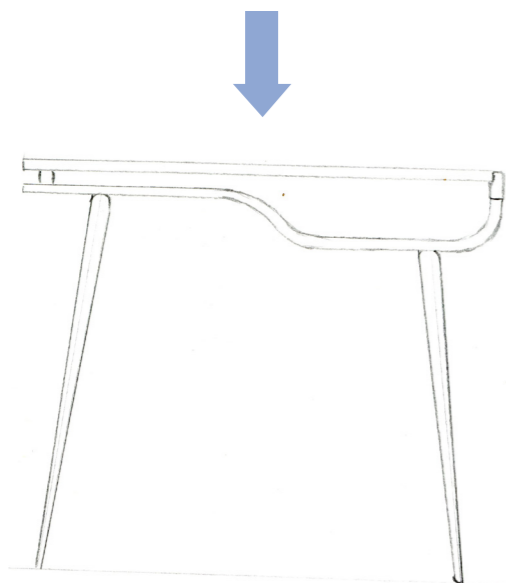
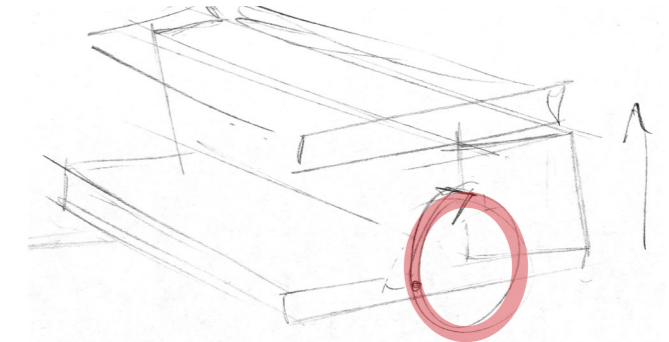


As a result of my client's comment I decided to look down the route of spring loading a mechanism so that it pops into a locked position. The exploded CAD view to the left shows one of my ideas where two pins are loaded into the desktop with springs behind so that when the desk reaches the top height, the pins locate into the top position such that they lock the desktop. The only way of unlocking the desk is by pressing the brass handle on the far left of the image which would compress the springs.

**I like this a lot. However, if the desk was to have more than two heights surely you would have to unlock the pins every time the desk passed through a middle position?**

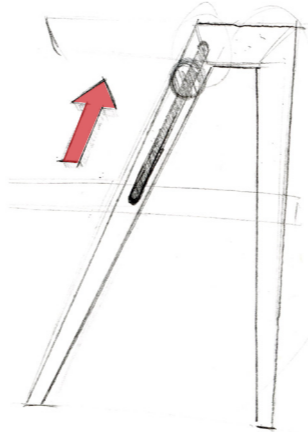
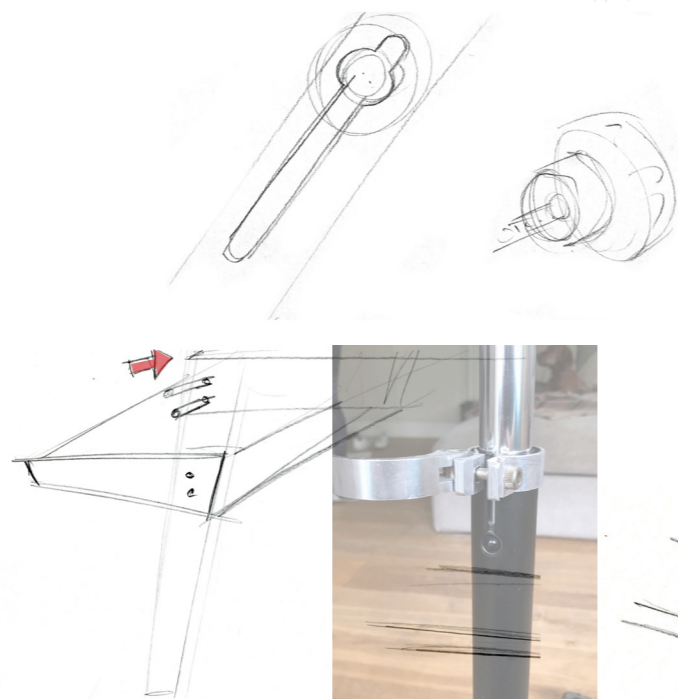
**Client Comment.**

The sketch to the left is an exploration to see whether it may be worth the leg being inside of the sliding mechanism since this would encourage the desk to stay level. However, this would also increase the width of the desk and therefore could make it harder for the user to operate. I also explored a screw mechanism to tighten the desk in the top position where the handle (below left) would tighten in a thread positioned in the desktop, this would lock it at the top and would potentially be a more stable solution (SPEC 5.8)



The idea above again explores form and similarities between the PINCH products (SPEC 3.1) This is particularly evident due to the use of tapered legs (SPEC 3.1) In addition, Unlike the example futher above, the desk considers more technical aspects of the specifications. For example (SPEC 2.5) Which says that key objects must be within 40cm of the user.

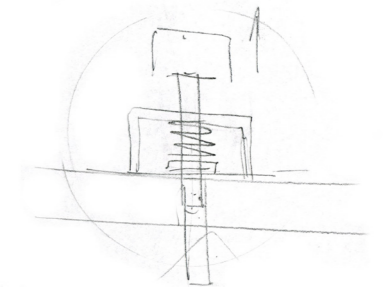
The lower part of the desk provides an easy way of accessing these things. Once again there is the potential for natural joinery techniques for example a mortise and tenon joint where the legs meet the tabletop and this could be an attractive feature. Having done these two sketched exploring form I decided that it was more important to explore the way the desk might move between heights.



The sketch below to the right shows a variation of the screw design however as a result of my client's coimment about spring loading to reduce user effort. In this sketch the pin is loaded in the desktop such that the pin is always pushing against the leg of the desk however there would be holes to locate the desk top within the leg and when the pin locates in the hole, the spring pushed the pin out to lock the desk in position, this is not unlike the scooter mechanism pictured to the left.



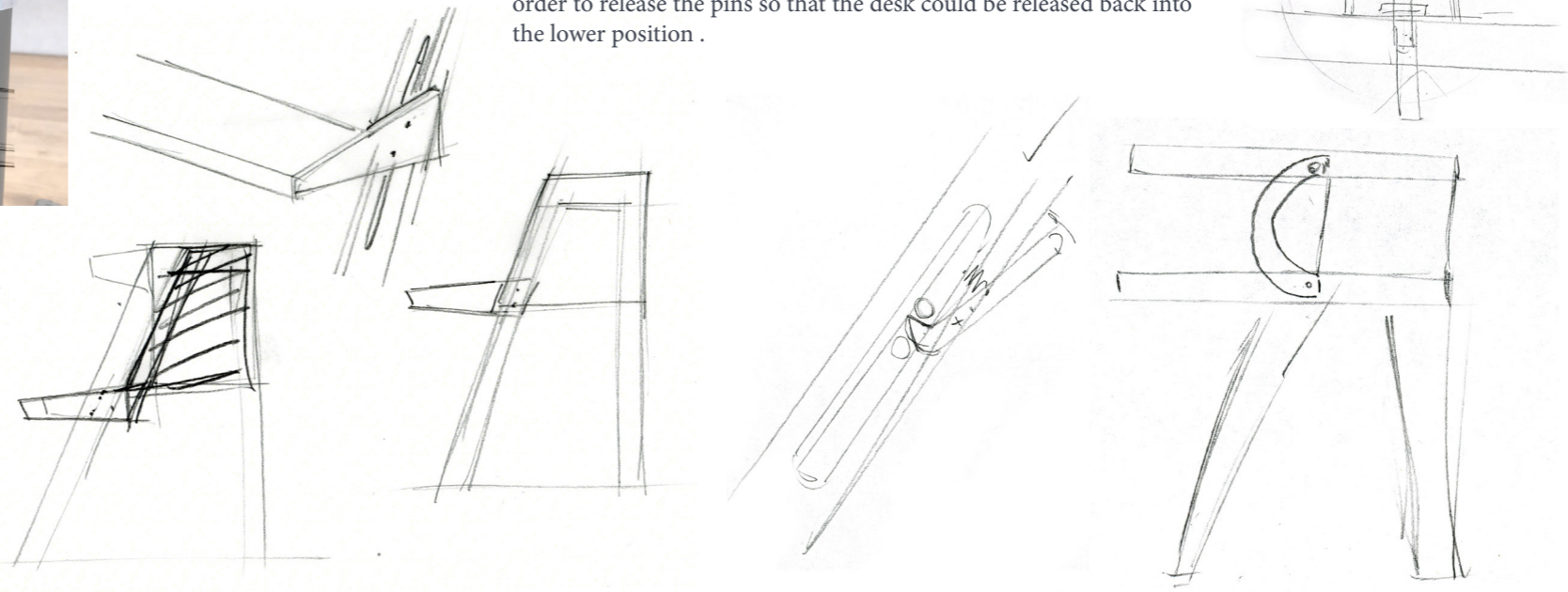
The sketch with the handle below is also as a result of my client's request to consider spring loading mechanisms. The shape of the handle would allow pins in the desktop to pass up past the handle but not back down and the handle would have to be depressed in order to release the pins so that the desk could be released back into the lower position .



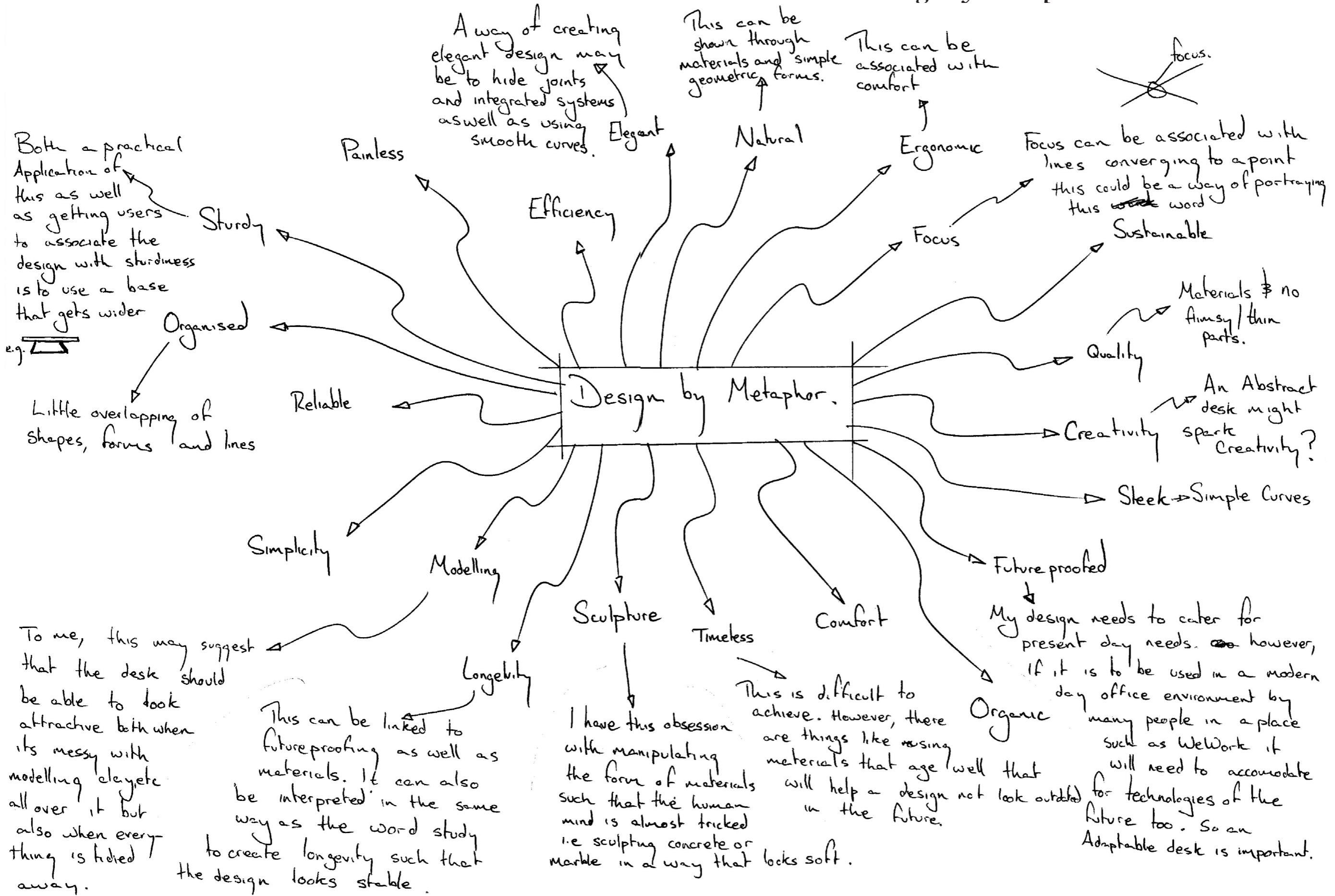
This is my first idea as to how the desk might move between heights and It was inspired by my sister's scooter at home. Pins support the desk in each position and they are pushed through the legs into the tabletop to lock the desk in each position

**Would this have to be at both sides? How would the user push all 4 pins in whilst holding a heavy desk? What about something spring loaded?**

**Client Comment.**



# Design by Metaphor





# Design by Metaphor

After having mind mapped to come up with words that my product should hopefully align itself with, I used these words and the strategy of design by Metaphor

‡ Analogy to come up with initial ideas.

This page shows ideas that have evolved by creating forms associated with the chosen words. In this case, I have

Focus Chosen the words: Organised, Sleek ‡ Simplicity.

- Creativity
- Comfort
- Sculpture
- Modelling
- Reliable
- Sturdy
- Efficiency
- Natural
- Sustainable
- Futureproofed
- Timeless
- Simplicity**
- Painless
- Organic
- Ergonomic
- Longevity
- Quality
- Elegant
- Sleek**
- Organised**

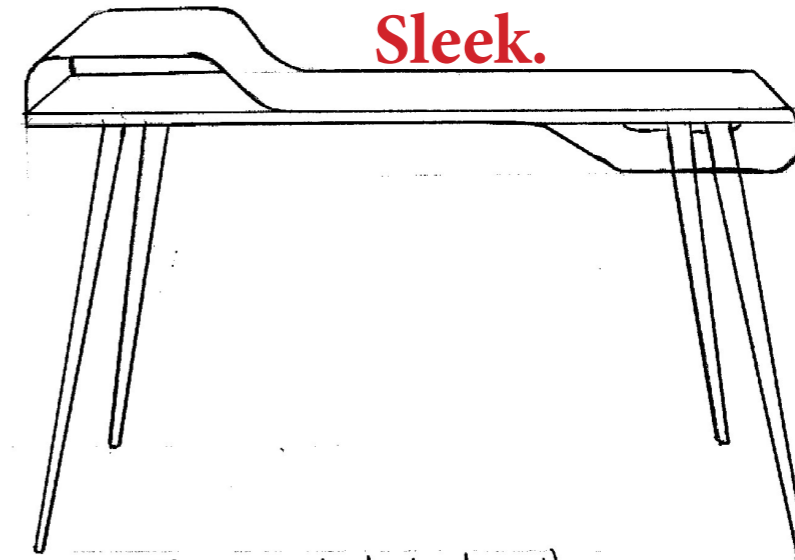
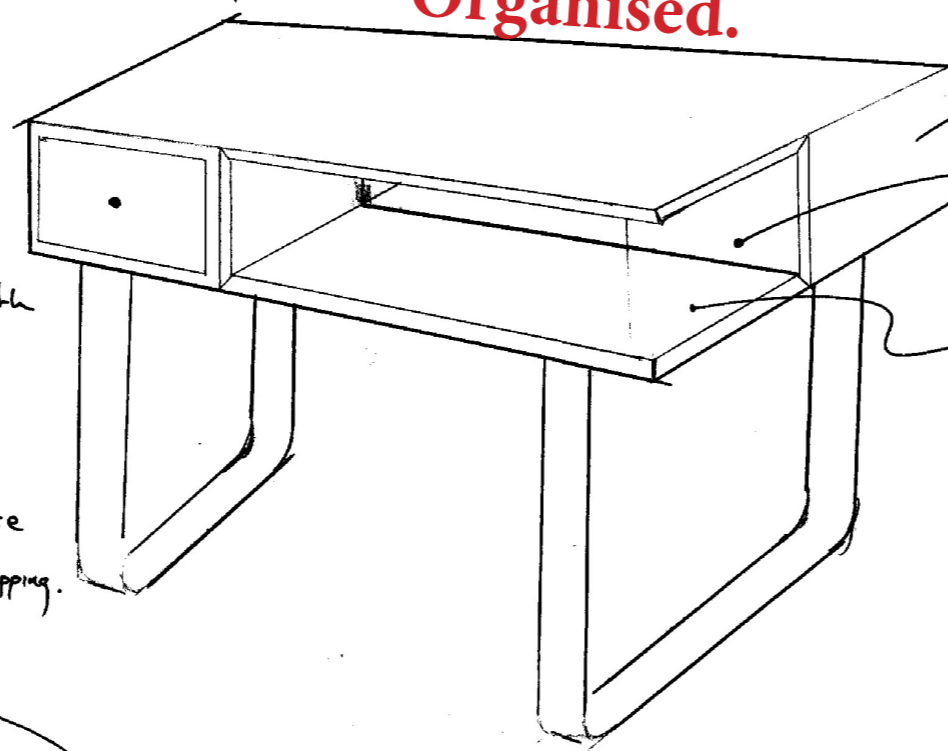
To me simple designs are powerful but tricky to come up with they should aim to conceal any integrated systems. As a result the form should include pure shapes with no busy overlapping.

To me, the word Organised is associated with simple design that is in no way over complicated. Rather than having lots of curves, I think it is better to stick with simple geometric forms.

This design inspired by the word sleek started with the smooth curve on the tabletop.

This shape was the basis of the design and the idea of the desk was inspired around it.

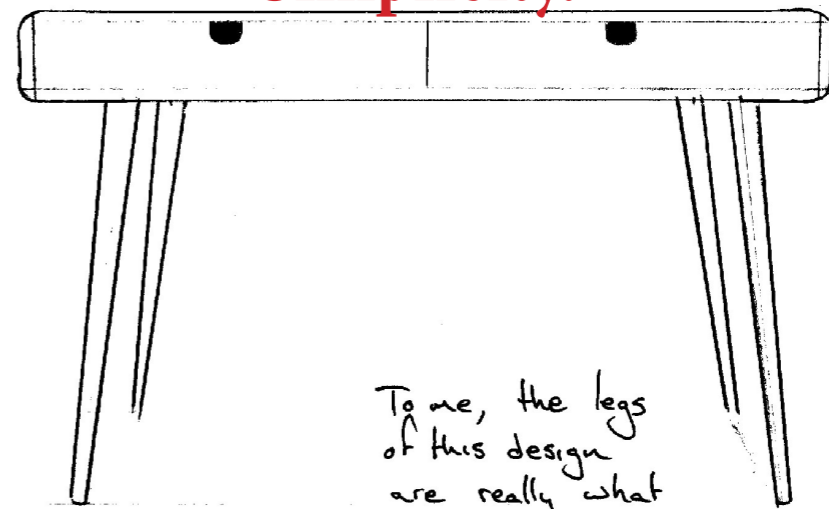
## Organised.



There is potential to add a cable management system into the back of the table. It would be possible to be modelling for example and then tidy your work into this section to clear the work surface for sketching.

This space here allows for quick and easy access of useful tools without them cluttering the work surface

## Simplicity.



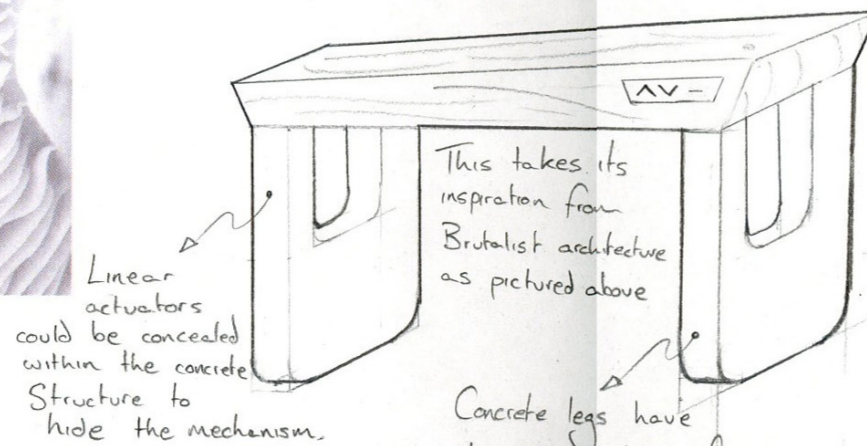
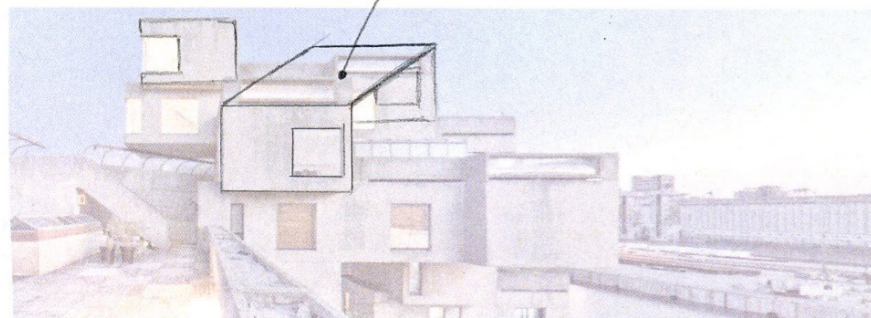
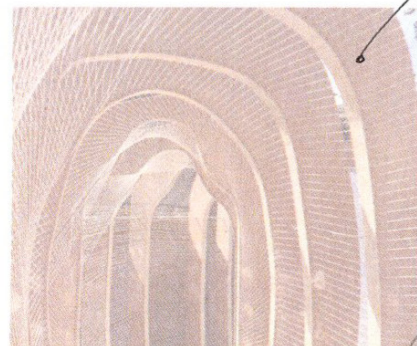
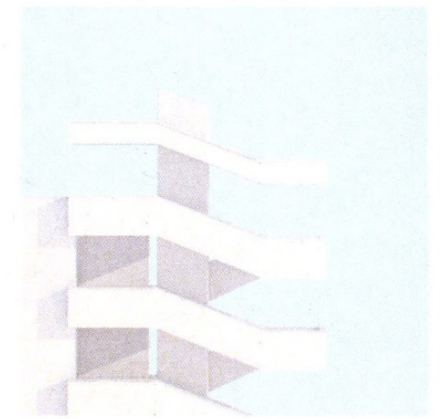
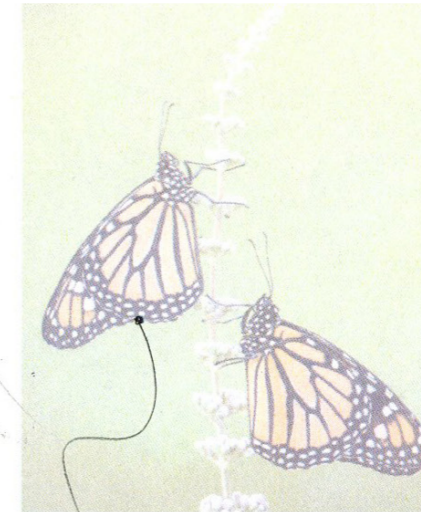
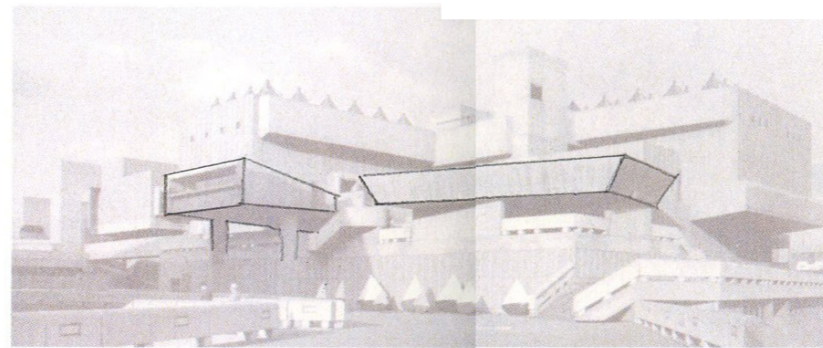
To me, the legs of this design are really what express simplicity. The taper especially.

In contrast to the word organised, the word sleek to me can be associated with smooth curves and flowing lines. However, similarly to the word organised, nothing should become busy or over complicated.



# Design by Analogy

This page is devoted to inspiring design by analogy, I have made the images more transparent in order to sketch over them. The idea is to trace the forms and use these as inspiration for my initial ideas. Some interpretations are more literal and others are more imaginative.



Linear actuators could be concealed within the concrete structure to hide the mechanism.

This takes its inspiration from Brutalist architecture as pictured above

Concrete legs have strong connotations of brutalist architecture. They are also very stable.

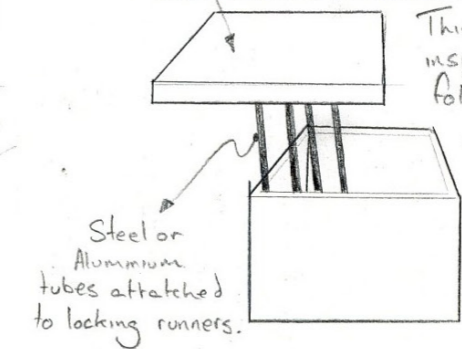
These elastic strings could have practical applications. They would be very useful to hang tools on and the way they are used in the example creates a very aesthetic flowing shape

This trace here suggests another form that the desk could take, I really like the contrast between the warm light and concrete. To imitate this perhaps LED strip lights and frosted acrylic could be used.

This provides a section for any books/pens etc to be stored whilst they are directly visible.

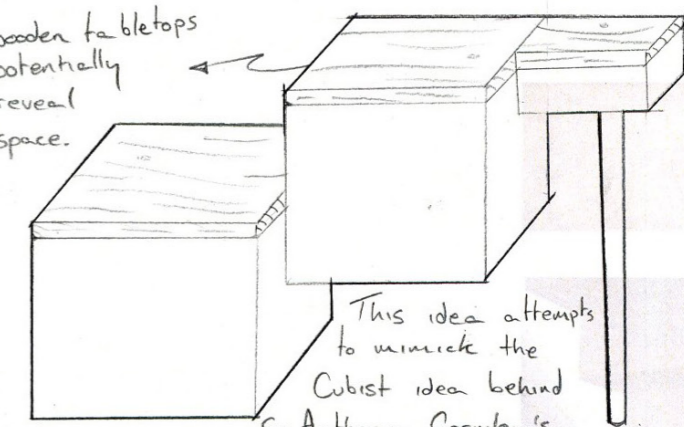
Glass tabletop to provide a smooth working surface whilst ensuring that the aesthetic curve remains visible to the user.

This idea has been inspired by an inverted wave shape. The sketch depicts the tabletop

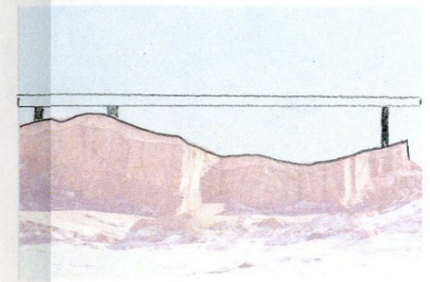
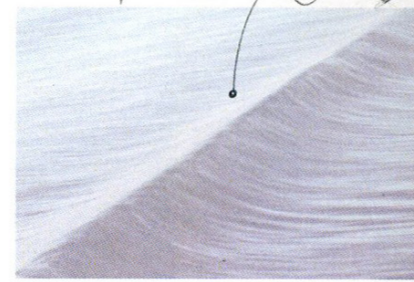
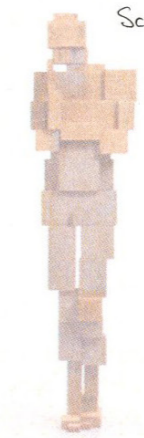


This idea has been inspired by the folding of a butterfly's wings. At sitting height the desk folds into a box.

The wooden tabletops could potentially open to reveal storage space.



This idea attempts to mimic the Cubist idea behind Sir Anthony Gormley's Sculpture.





# Initial Idea 1

## Materials Justification For Tabletop

By client request the tabletop must be timber however the variety isn't specified therefore I will explore this here,

**Walnut.**

- Fits PINCH Aesthetic
- Durable and Hard
- Resistant to chipping
- High density

**Pine.**

- Doesn't fit PINCH Aesthetic
- Knotty and unattractive
- Low relative density
- Splits easily

**MDF.**

- Doesn't fit PINCH Aesthetic
- Resistant to Warping
- Wont Chip
- Can be veneered

**Oak.**

- Fits PINCH Aesthetic
- Durable and Hard
- Resistant to chipping
- High density

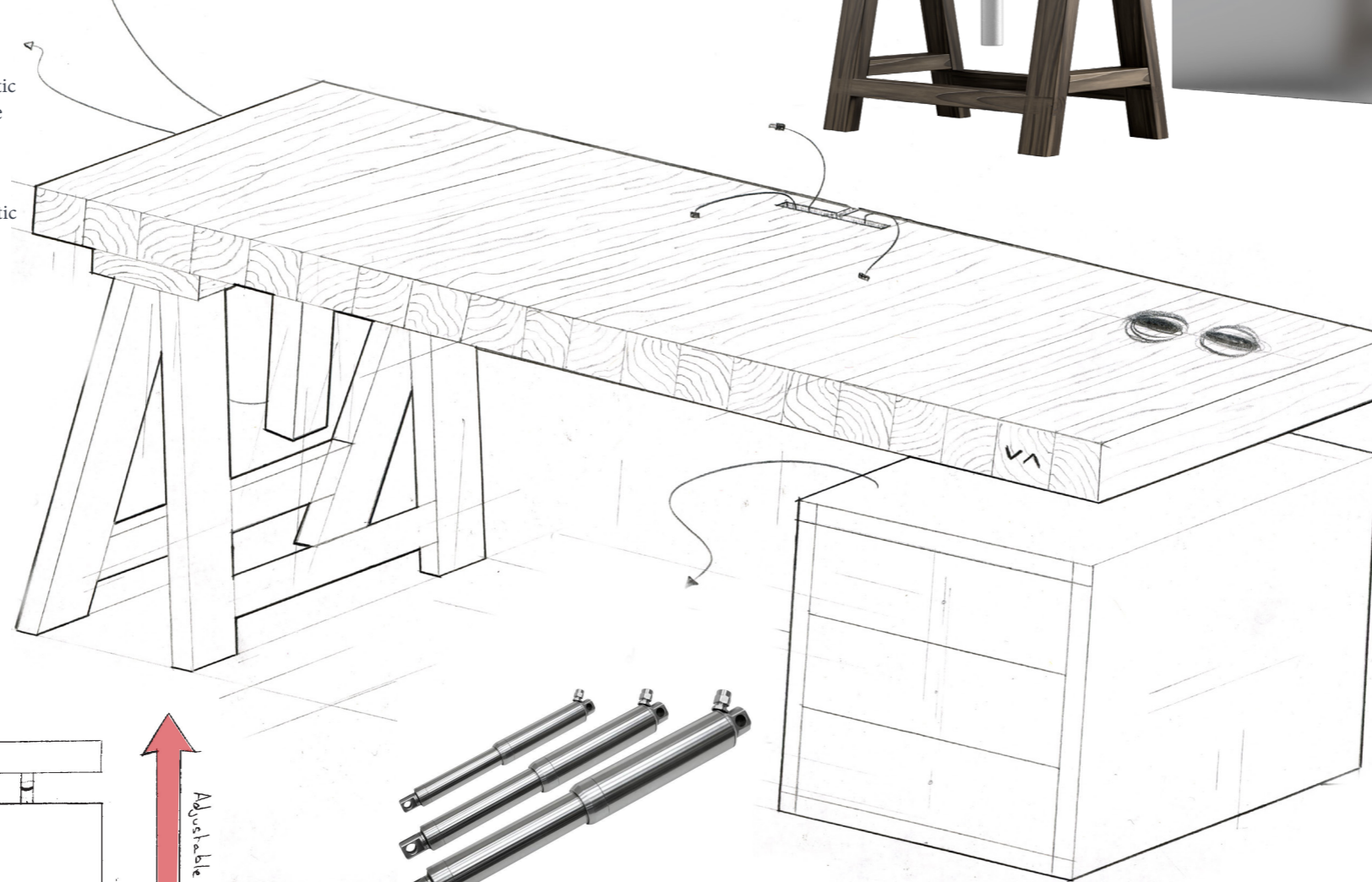
### Conclusion.

Oak and Walnut both seem like attractive options here therefore from completely an aesthetic standpoint I have chosen to go with Walnut since it contrasts more with the Aluminium. This helps the design to comply with (SPEC 3.3) which says that the design should have contrasting colours of wood and metal.

## Cable Management.

The back of the desk would house the cable management system where an extension cable would be screwed to the underside of the desk so that only one cable enters the desk (SPEC 9.1)

The cables enter directly from the middle of the desk so that they are within an arms reach (SPEC 2.3) The shape of the hole that the cables exit from are designed such that it is difficult but not impossible for the cables to fall to the floor (SPEC 4.6)



### Client Comment.

This looks like a very user friendly option and so long as the actuators don't fail under the mass of the tabletop then I think this is a very viable option.

### Dual Linear Actuator Controller

From Dakota Digital

The PAC-3200 is designed to control two linear motors at the same time. It is intended to be used to lift heavier trunk lids and toppers/bonnet covers that require more than one motor. The PAC-3200 has a safety auto reverse feature that will stop downward travel if something would block the trunk lid. If too much current draw is detected, indicating a blocked condition, the motors will reverse and return to the previous position before they started moving down. The system can learn three user programmable heights, so the trunk/cover will automatically move to a desired position with the push of a button. There is also an auto move to position feature that will open the trunk/cover when the key is turned off and close the cover when the key is turned on.



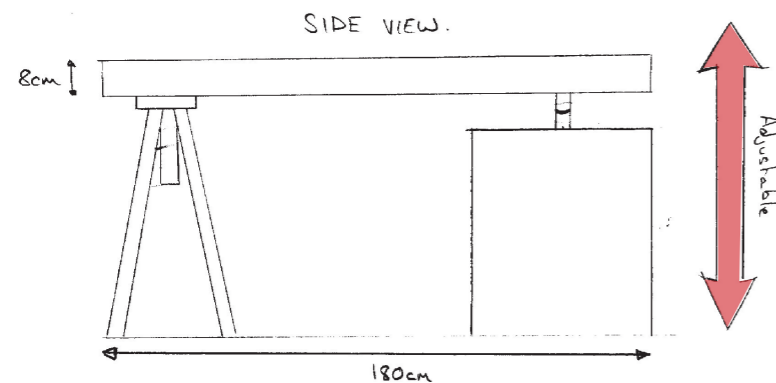
## Materials and Manufacturing Processes.

The majority of the desk would be manufactured from natural timber to fit with (SPEC 8.1) The timber rendered in this case is American black walnut since it fits nicely with the PINCH Aesthetic (SPEC 3.1)

The Aluminium cabinet would be brazed using separate sheets of 5mm Aluminium. Aluminium has been chosen because it has a high strength to weight ratio. (SPEC 5.8)

The movement of the desktop would be controlled using a dual linear actuator controller with two linear actuators situated in two telescopic legs marked A and B in the CAD render above. The controller would be wired in so that both actuators extend at the same time and rate so that the desk always remains flat.

A CNC Router would be used to cut the pen pots with radiused corners. These pieces of timber would then be attached to the others using dominos and then the whole piece would be put through the planer to ensure the same thickness and a smooth work surface (SPEC 1.2)



The Aluminium cabinet to the right hand side of the desk should provide easy access to key items (SPEC 2.5) They have the potential to store large objects such as A3 paper (SPEC 2.9) The linear actuators pictured above would be screwed into a plate in the top of the cabinet and all wires connecting both actuators to the controller would run along the underside of the desk such that it isn't visible.

### Client Comment.

I like this design. However, There isn't a lot of space for me to organise things. There are the sections to the right but I can just imagine shoving a load of things in there and it becoming very messy quickly.





# Initial Idea 2

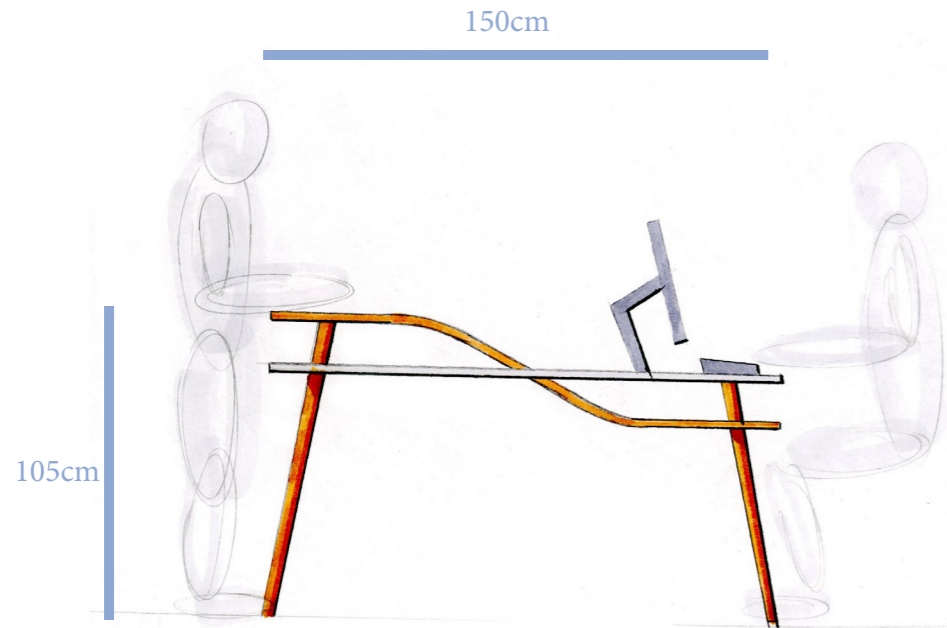
## Materials and Manufacturing Processes.

The majority of the desk would be manufactured from natural timber to fit with (SPEC 8.1) The timber rendered in this case is oak plywood sheets since it fits nicely with the PINCH Aesthetic (SPEC 3.1) and also makes it easier to manufacture the curve.

The table top has to be glass in order to maintain the aesthetic and also it helps to make sure that objects that are stored below are visible and therefore easier to access. (SPEC 2.5)

The legs of the table are made from American black walnut because of (SPEC 8.1) and they have a taper (SPEC 3.5) These would be manufactured on the wood turning lathe to maintain a smooth surface finish. The plywood top would be formed in a vacuum bag press pictured to the right, this would involve manufacturing a former which is a good method for batch production (SPEC 10.3)

The top of the legs would be notched so that the tabletop can rest however the glass will be held in place with pins so that it remains level. This is outlined on the bottom left of the page.

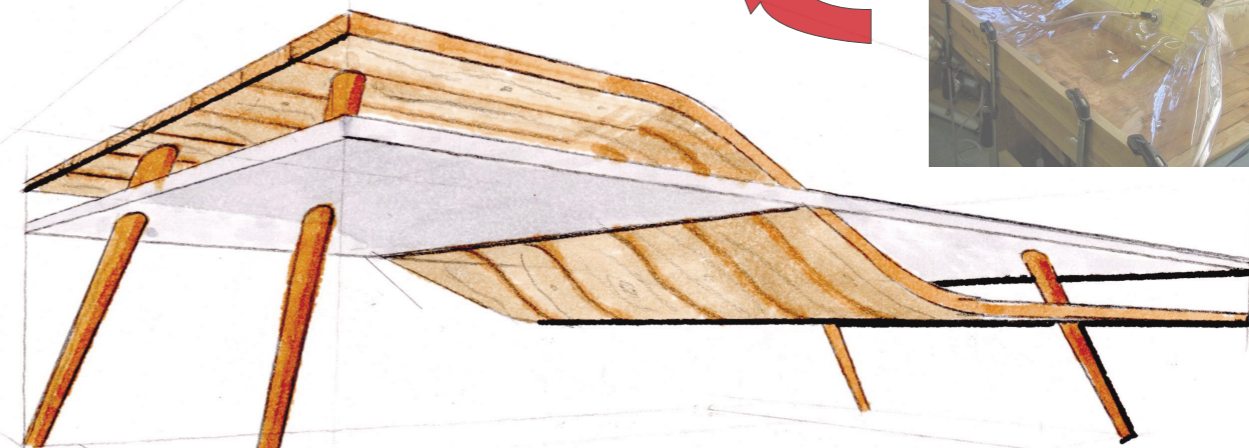


This desk aims to kill two birds with one stone, It aims to provide a standing and sitting height for the user whilst also providing storage space for paper, pens etc. The width is 150cm to fit to my client's request and the height of the standing position is 105cm to fit with ergonomic research. (SPEC 5.4)

As a result, A3 paper should be able to be stored both under the standing and sitting heights as well as any other key objects.

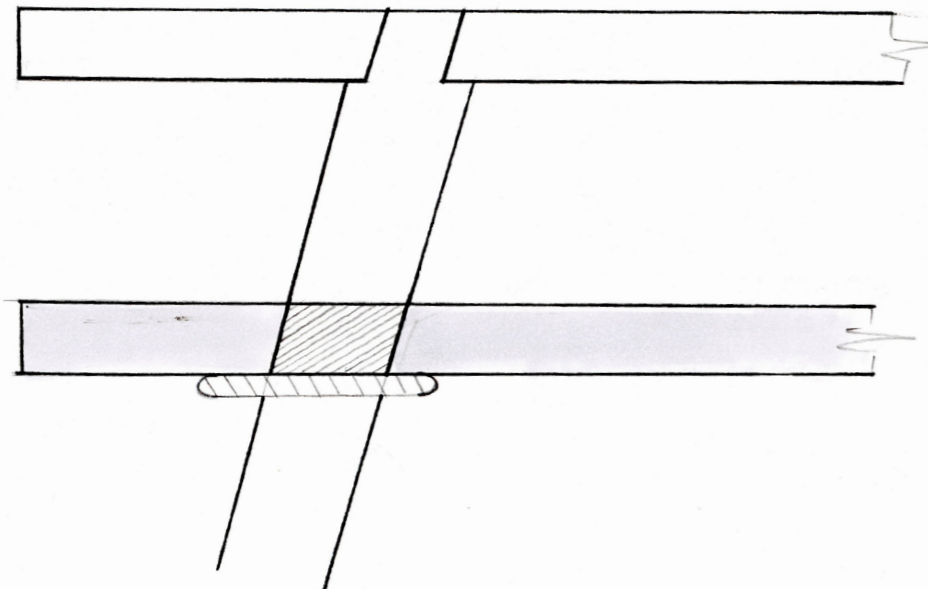
**Client Comment.**

I feel like it would be fairly frustrating if I was sketching on the top height of the desk and I had to walk all the way around to the shelf on the other side of the desk to pick up something I needed if I had left it there.



**Materials Justification.**

As with the other designs I must try to maximise the amount of natural timber in my design to comply with (SPEC 8.1) However, Oak plywood has been chosen since it is the most sensible choice of material to be formed in this curve since it is manufactured in thin sheets that will easily bend over a former. Glass has been chosen since it helps tools be located quickly and efficiently since it is transparent. Walnut has been chosen for the legs due to (SPEC 3.3) which says that woods must be of contrasting colours.



The glass sheet would be held in place by a piece of dowelling as shown in the cross section above, the top of the leg would be notched to fit the plywood in a mortise and tenon joint. A hole would be drilled in the leg at the correct angle such that the glass lies flat on the piece of dowelling. This should allow for both the top and bottom tabletops to remain stable however, this solution may still not support the weight of a human leaning on the desk. (SPEC 5.8)

CAD renderings of the design sent to my client alongside a brief explanation of manufacturing techniques.



**Client Comment.**

I feel like it would be fairly frustrating if I was sketching on the top height of the desk and I had to walk all the way around to the shelf on the other side of the desk to pick up something I needed if I had left it there.



# Initial Idea 3

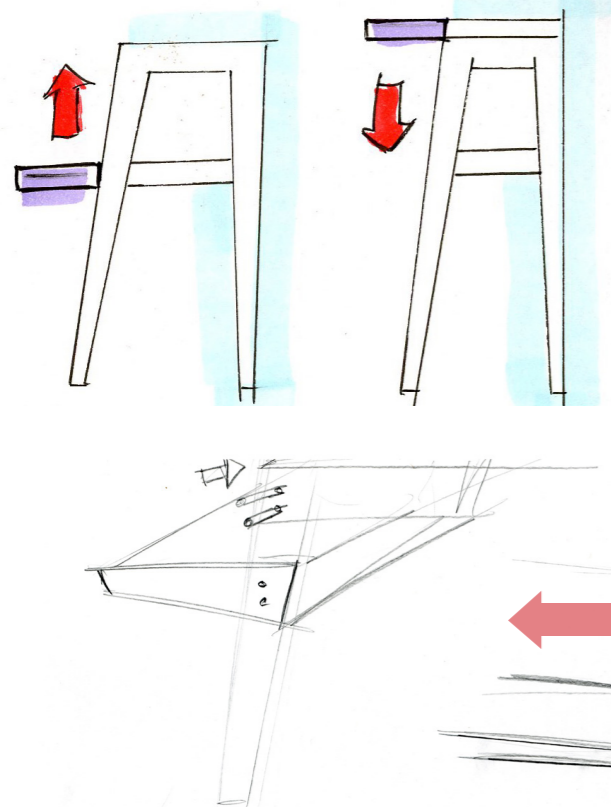


## Materials and Manufacturing Processes.

The desk will be made almost exclusively out of natural timber to fit with (SPEC 8.1) However, the above testing showed that not all of the desk could be made from natural timber for strength reasons

My test piece involved using the milling machine to route an 8mm channel in a test "leg" Then 8mm pieces of dowel were drilled into the test "tabletop." The top two left images show what happened when force was applied to the table, The wood gave and the tabletop was able to be pushed to an angle below parallel to the ground. As a result I have considered aluminium as an alternative for the pins with a plate to reinforce the legs.

I have considered a range of other methods of moving the tabletop up and down and am undecided and therefore will take many through to development, Below are a couple of sketches shgpowing how else this may be achieved.



### Client Comment.

Love the testing you've done, If it works with the metal then I definitely think It is a viable solution. Maybe make a full sized test piece so that you can load weight onto the tabletop.

The sketch to the right shows a metal plate that reinforces the leg adding strength but also preventing the tabletop from slipping as easily. It was shown in my tesing that timber gave too much give and wore down over time and under greater stresses hence the need for the metal plate and pins.

The sketch to the left shows pins locating the tabletop from the outside however my client has already suggested that this might make use difficult since it involves locating 4 pins, two on each side of a large and heavy desk.

Not only does the desk provide specific slots for A4 paper as well as a shelf (SPEC 2.10) It also has a separate drawer within the desk to store key items. They will be able to stay close to the user at all times since the drawer moves to both the standing and sitting heights. (SPEC 2.4)

### Client Comment.

This is brilliant - it will allow me to keep my laptop and phone near to me but they also wouldn't be in my face tempting me to check my emails.

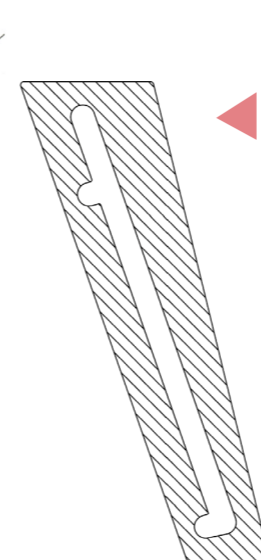
## Manufacturing Processes.

The position of the pins in the aluminium insert within the legs determines the height of the desk therefore high precision is needed in order to ensure that the desktop rests at the correct angle and height.

As a result I would use the milling machine to ensure a high degree of accuracy. The pins should fit in the aluminium groove with a certain tolerance in order to ensure that the desktop slides up and down with ease.

The majority of the desk would be constructed using domino joints or biscuit joints and there is a lot of scope to use large amounts of manufactured board to fit with (SPEC 6.4)

As a result of the client comments above considerations would need to be made into other materials but there is scope to add secondary woods.



This diagram to the left shows a cross section of the leg and where the pins would fit in the leg. They would slide up the leg and the bottom pin would locate in the two notches depending on whether the standing or sitting height were chosen. The aluminium insert would have the same groove milled into it.

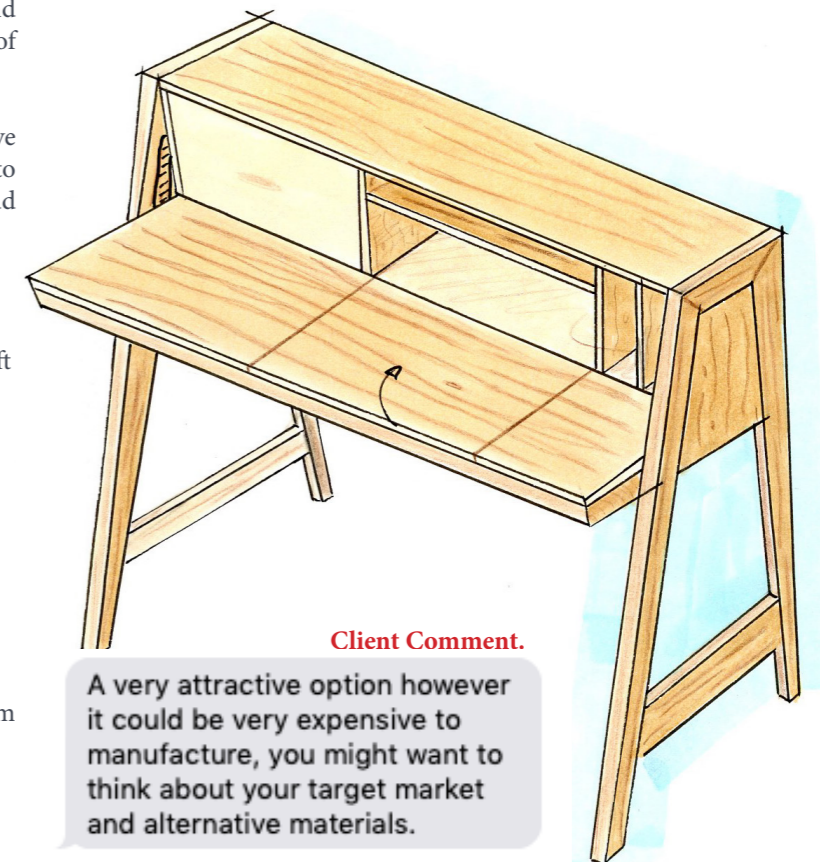


### Client Comment.

This could come in a range of colours, you might want to explore what other types of woods/materials you could use.



Render done as a result of client comment in walnut showing the potential for sectioning within the drawer to help organise pencils and phone.



### Client Comment.

A very attractive option however it could be very expensive to manufacture, you might want to think about your target market and alternative materials.



# Review of Initial Ideas

Focus	Point	Idea
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Representation of how well the Design Idea fits the specification points relative to the other designs with red representing poorly and green representing well.



## Purpose

- 1.1 - Provide two or more heights for the user
- 1.2 - Provide a space large enough for sketching work. (At least space for 3 A3 sheets)
- 1.3 - Provide a suitable surface for modelling work
- 1.4 - Be appropriate and comfortable for computer based work
- 1.5 - Create a more productive and comfortable working environment for the user
- 1.6 - Suit the needs of a rented workspace such as WeWork
- 1.7 - Cater for a user group consisting of young creative who need to switch between multiple types of working.
- 1.8 - Help reduce the reduce the health impacts of bad working postures
- 1.9 - Efficiently switch between this different types of work. i.e. Sketching and modelling.

- 1.1 - This desk would provide more than two heights for the user
- 1.2 - Yes - the tabletop is a very large surface
- 1.3 - Yes, the tabletop is large enough with space for storage
- 1.4 - No consideration for keyboard/monitor space
- 1.5 - Very similar environment to current situation
- 1.6 - Very adaptable due to simplicity of design.
- 1.7 - It would do this but only due to the simplicity of the design
- 1.8 - No active impact aside from benefits of standing and sitting.
- 1.9 - Simply a flat work surface with no innovative solution

- 1.1 - Yes - two heights provided for the user
- 1.2 - Only in the sitting position- minimal space when standing
- 1.3 - Again only in the sitting position
- 1.4 - Definitely, space for a keyboard under the desk
- 1.5 - Yes - ergonomics considered for typing with keyboard below
- 1.6 - Possibly, an attractive solution that wouldnt look out of place
- 1.7 - Yes, again an attractive solution that would suit this user group
- 1.8 - The ergonomics would help but not enough adjustability
- 1.9 - Only by the user moving around the desk and clearing space.

- 1.1 - Yes with the potential for more.
- 1.2 - Yes in both standing and sitting heights
- 1.3 - Yes in both standing and sitting heights
- 1.4 - Yes, front desk could be lowered to a keyboard height
- 1.5 - Electronics kept close but also tucked away
- 1.6 - Adaptable and scope for many more materials and colours
- 1.7 - Solution that keeps users moving and very adaptable.
- 1.8 - High degree of adjustability should cater for all
- 1.9 - yes, could have the top for sketching and bottom for computer.

## Function

- 2.1 - Reduce the amount of regular clutter on the user's desk by providing effective storage spaces of different sizes.
- 2.2 - Create a productive work environment by sticking to ergonomic principles.
- 2.3 - Make charging more efficient so that wires don't take up excess space on the desk but are also easy to access.
- 2.4 - Save time in organising/tidying tools and equipment found on the desk on a day to day basis.
- 2.5 - Store key objects (Phone, laptop and pens) within 40cm of the user when they are in the standing or sitting position.
- 2.6 - Have a high degree of adjustability to make the desk suitable to the specific needs of a range of users.
- 2.7 - The desk must adjust between 650mm and 1250mm
- 2.8 - Legroom depth on the floor and up to 120mm above the floor should be 800mm
- 2.9 - The desk must have space to store A3 paper for sketching on (420mm x 297mm)
- 2.10 - The desk must also be able to store A4 writing paper (297mm x 210mm)
- 2.11 - The drawer of the desk must have space of at least 143.6mm x 70.9mm to fit my client's iPhone.
- 2.12 - The desktop must be able to sit a 34.93cm x 24.07cm macbook pro whilst also providing enough space for sketching
- 2.13 - The desk must be able to fit in a wide number of different workplace layouts.
- 2.14 - There must only be one cable entering the desk for charging purposes
- 2.15 - The noise of moving the desk up or down should not be able to be heard in a nextdoor room.
- 2.16 - The top surface must be sufficiently smooth in order that sketching is easy.
- 2.17 - The user must be able to keep elbows at 90 degrees.
- 2.18 - The user should not need to tilt a laptop screen to greater than 20 degrees.
- 2.19 - The desk should provide sectioning in order to partition small objects that are used often.e.ge pens, pencils, rulers.

- 2.1 - Only one storage area of the same size
- 2.2 - High degree of adjustability however little more consideration
- 2.3 - Yes, efficient solution
- 2.4 - No, large open space with potential for mess
- 2.5 - No storage within comfortable reach of the user
- 2.6 - Yes - any height is possible with the actuators
- 2.7 - Yes - this is possible
- 2.8 - Yes - this is the case
- 2.9 - Yes but only in the side cabinet drawers with other things
- 2.10 - Again yes but in a large side drawer space.
- 2.11 - Yes
- 2.12 - Yes
- 2.13 - Would look good and work in many layouts
- 2.14 - This is the case
- 2.15 - Not possible to test until a later stage
- 2.16 - Not possible to test until a later stage but very possible
- 2.17 - Not possible to test until a later stage but very possible
- 2.18 - Not possible to test until a later stage but very possible
- 2.19 - No

- 2.1 - Clever storage area with things accessible from all angles
- 2.2 - Lots of ergonomic consideration such as lower keyboard
- 2.3 - No method of efficient charging
- 2.4 - Yes since objects are all visible under the glass
- 2.5 - No because storage areas are at opposite ends
- 2.6 - No adjustability
- 2.7 - Only two heights and top height isnt this high.
- 2.8 - Yes - there is sufficient leg room
- 2.9 - No, the legs get in the way of the storage space
- 2.10 - Yes, this is possible
- 2.11 - Yes
- 2.12 - Yes
- 2.13 - Wouldnt work as well against a wall
- 2.14 - Would likely be more than one due to no charging system
- 2.15 - There would be no noise
- 2.16 - Not possible to test until a later stage
- 2.17 - Not possible to test until a later stage
- 2.18 - Not possible to test until a later stage
- 2.19 - There isnt any partitioning.

- 2.1 - Yes - many different areas of different size for storage
- 2.2 - High degree of adjustability
- 2.3 - No current charging solution however could be developed
- 2.4 - Yes with specific areas for different objects
- 2.5 - Yes in both the standing and sitting heights
- 2.6 - More notches can be added for different heights
- 2.7 - Yes
- 2.8 - Yes
- 2.9 - Yes - specific area for this
- 2.10 - Yes - specific areas for this
- 2.11 - Yes
- 2.12 - Yes
- 2.13 - Accessible from all angles except with the side to a wall
- 2.14 - No current charging method
- 2.15 - Not possible to test until a later stage
- 2.16 - Not possible to test until a later stage
- 2.17 - Not possible to test until a later stage
- 2.18 - Not possible to test until a later stage
- 2.19 - Yes, many different sections within the desk to partition.

## Form & Aesthetics

- 3.1 - The desk must fit alongside PINCH furniture and not look unattractive or out of place.
- 3.2 - The desk must allow the natural grain of wood to be visible.
- 3.3 - It must have some element of contrasting colours of wood or perhaps wood and metal.
- 3.4 - The desk must also be equally attractive from all angles. It should be able to be placed in any position within a room
- 3.5 - The legs of the desk should taper to fit with the aesthetic however this is not essential
- 3.6 - Joinery techniques such as dowelling should be left visible to emphasise craftsmanship.
- 3.7 - If there is any paintwork, it must contrast in colour with the grain of the wood.
- 3.8 - The desk must be simple and elegant and declutter the environment
- 3.9 - The desk must look at home in a private focused space as well as a creative busy environment.

- 3.1 - Not in comparison the the other designs
- 3.2 - Yes very much so
- 3.3 - Yes, the walnut contrasts with the aluminium
- 3.4 - Yes, this is the case
- 3.5 - The legs dont taper
- 3.6 - Not possible to test until a later stage but this is likely
- 3.7 - No paintwork
- 3.8 - The desk is fairly chunky and might clutter a room
- 3.9 - This desk is more suited to a busy working environment

- 3.1 - Relatively it is good but not perfect
- 3.2 - Yes, grain is very visible
- 3.3 - Yes, oak contrasts with walnut nicely
- 3.4 - Yes, the desk would look good in the middle of a room
- 3.5 - Yes, the legs taper
- 3.6 - Mortise and tenon left visible at the top of the desk
- 3.7 - No paintwork
- 3.8 - Yes, very slim elegant design to reduce clutter
- 3.9 - More suited to a private workspace

- 3.1 - This fits the best out of the 3 ideas
- 3.2 - Grain is very visible from all angles
- 3.3 - No contrasting colours but potential for it
- 3.4 - Possibly less attractive from the back
- 3.5 - Yes - the legs taper
- 3.6 - This is very possible
- 3.7 - No paintwork in the design
- 3.8 - Very simple design with much space for storage
- 3.9 - Would work well in many environments

## User Requirements

- 4.1 - Provide a place to store paper and card in a way that it is easily accessible and reduces clutter on the desk itself.
- 4.2 - Provide a way of getting rid of waste card and modelling waste easily such that it doesn't accululate as mess.
- 4.3 - Have a timber tabletop since it is an attractive surface to sketch on.
- 4.4 - Include large pen pots of diameter greater than 90mm suited towards copic marker pens.
- 4.5 - Be adaptable to future methods of charging such as wireless charging or new cable types and dimensions.
- 4.6 - Provide a method of easily accessing and plugging in cables without any risk of them falling on the floor.
- 4.7 - Arrange pens and pencils neatly within an easily accessible drawer.
- 4.8 - The keyboard must be able to sit lower than a monitor or laptop screen when placed on the desk.
- 4.9 - It must be possible to change from any one height to another within 15 seconds.

- 4.1 - The drawer could easily become cluttered itself since it's large
- 4.2 - The desk doesnt do this
- 4.3 - Yes - the tabletop is timber
- 4.4 - Yes, these are included
- 4.5 - This could be added during development
- 4.6 - Easy to acces less easy to plug in.
- 4.7 - Pens would be accessible in the pen pots
- 4.8 - No - the desk is only one flat surface.
- 4.9 - Not possible to test until a later stage

- 4.1 - The space under the desk could store smaller pieces
- 4.2 - No way of doing this
- 4.3 - The majority of the tabletop is actually glass
- 4.4 - No pen pots
- 4.5 - No current charging solution
- 4.6 - No method at the moment, could be developed
- 4.7 - This isnt the cae
- 4.8 - Yes, the keyboard can sit lower
- 4.9 - Not possible to test until a later stage

- 4.1 - Lots of places to store card
- 4.2 - No way of doing this
- 4.3 - Yes, tabletop is timber
- 4.4 - Pen pots included
- 4.5 - No current methods of charging, could be developed
- 4.6 - No current cable management
- 4.7 - Neat drawer to organise pens and pencils
- 4.8 - This is possible id the front desktop can go lower
- 4.9 - Not possible to test until a later stage

## Performance Requirements

- 5.1 - Be designed in a way such that wrists rest at the same level as elbows when typing.
- 5.2 - Ensure that the user's mouse is within easy reach and on the same level as the user's keyboard.
- 5.3 - Monitor or laptop screen must be aligned so that the top is level with the user's eyes in both standing/sitting positions.
- 5.4 - Have at least one standing height of 105cm ± 5cm
- 5.5 - Have at least one sitting height with bottom the desktop reaching 62cm ± 5cm above the ground.
- 5.6 - There should be no visible or audible strain on the desk when 50kg is loaded onto the desktop.
- 5.7 - Heights should be able to be easily repeated so that a user doesn't have to fiddle to try and find the perfect height every time they adjust the desk.
- 5.8 - Be durable enough to withstand the user leaning or sitting on top surface (800N of force on top surface.)

- 5.1 - So long as the desk is adjustable to a range of heights which it is
- 5.2 - Mouse would definitely be on the same level as keyboard
- 5.3 - For this to happen the monitor has to be raised from the desk
- 5.4 - Yes
- 5.5 - Yes
- 5.6 - Not possible to test until a later stage
- 5.7 - Only if a controller is chosen with memory driving up cost
- 5.8 - Not possible to test until a later stage

- 5.1 - Not possible to test until a later stage
- 5.2 - Mouse may not have much room under desktop
- 5.3 - Very possible
- 5.4 - Yes
- 5.5 - Yes
- 5.6 - Yes
- 5.7 - The heights are fixed
- 5.8 - Not possible to test until a later stage

- 5.1 - Not possible to test until a later stage
- 5.2 - Very probably but not possible to test until a later stage
- 5.3 - Not possible to test until a later stage
- 5.4 - Yes
- 5.5 - Yes
- 5.6 - Not possible to test until a later stage
- 5.7 - Yes since the notches will be fixed.
- 5.8 - Not possible to test until a later stage

# Review of Initial Ideas

Focus	Point	Idea
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Representation of how well the Design Idea fits the specification points relative to the other designs with red representing poorly and green representing well.



<b>Materials</b>	<p>6.1 - Materials should be of high quality and fit the aesthetic of other PINCH furniture.</p> <p>6.2 - Have a timber tabletop at the request of my client.</p> <p>6.3 - Make considerations to other cheaper materials that may help widen the target market.</p> <p>6.4 - Use wood composites in place of natural timber to reduce cost and increase the range of target market.</p>	<p>6.1 - Aluminium is not a typical material used in PINCH</p> <p>6.2 - The tabletop is timber</p> <p>6.3 - Not possible to test until a later stage</p> <p>6.4 - Possible but would imoact aesthetics more than other designs</p>	<p>6.1 - Materials chosen fit aesthetic</p> <p>6.2 - Tabletop is predominantly glass</p> <p>6.3 - Not possible to test until a later stage</p> <p>6.4 - Not possible</p>	<p>6.1 - Chosen materials fit the aesthetic</p> <p>6.2 - Tabletop is timber</p> <p>6.3 - Not possible to test until a later stage</p> <p>6.4 - Very much possible</p>
<b>Size</b>	<p>7.1 - The depth of the desk must be no shorter than 55cm to allow enough space for arms to rest during typing.</p> <p>7.2 - The desk must also be no deeper than 72cm so that far objects are never out of reach.</p> <p>7.3 - The legroom that the desk provides must be at least 90cm for maximum comfort.</p> <p>7.4 - The desk must be no wider than 150cm by client request</p> <p>7.5 - The standing height of the top of the monitor screen must be 158cm ± 7cm</p> <p>7.6 - Desktop can not be thicker than 55mm at the front and 80mm at 500mm from the front edge</p>	<p>7.1 - Depth is larger than 55cm</p> <p>7.2 - Desk is no deeper than 72cm</p> <p>7.3 - Legroom is sufficient.</p> <p>7.4 - Desk is wider than 150cm</p> <p>7.5 - Not possible to test until a later stage but very likely</p> <p>7.6 - Desktop is thicker than 55mm</p>	<p>7.1 - Depth is larger than 55cm</p> <p>7.2 - Desk isnt deeper than 72cm</p> <p>7.3 - Legroom is large enough</p> <p>7.4 - Desk isn't wider than 150cm</p> <p>7.5 - This is the case</p> <p>7.6 - Not thicker than 55mm</p>	<p>7.1 - Depth is larger than 55cm</p> <p>7.2 - Desk isnt deeper than 72cm</p> <p>7.3 - Legroom is large enough</p> <p>7.4 - Desk isn't wider than 150cm</p> <p>7.5 - This is going to be possible</p> <p>7.6 - Not thicker than 55mm</p>
<b>Sustainability</b>	<p>8.1 - The desk must be comprised of at least 80% wood by mass</p> <p>8.2 - Components must be easily separated into their individual materials to help with recycling.</p> <p>8.3 - All materials must be sustainably sourced.</p> <p>8.4 - The desk must also use very little of materials that are extremely energy intensive to produce.</p> <p>8.5 - Any jigs or templates used during manufacture must be made from sustainably sourced materials.</p>	<p>8.1 - Not possible to test until a later stage</p> <p>8.2 - This would be possible with the excoption of the actuators</p> <p>8.3 - Not possible to test until a later stage</p> <p>8.4 - Relatively not as good as other designs</p> <p>8.5 - Not possible to test until a later stage</p>	<p>8.1 - Not possible to test until a later stage</p> <p>8.2 - Very easy to separate</p> <p>8.3 - Not possible to test until a later stage</p> <p>8.4 - Relatively not as good as other designs due to glass</p> <p>8.5 - Not possible to test until a later stage</p>	<p>8.1 - Not possible to test until a later stage but highly likely</p> <p>8.2 - Very easy to separate</p> <p>8.3 - Not possible to test until a later stage</p> <p>8.4 - Relatively better than all designs</p> <p>8.5 - Not possible to test until a later stage</p>
<b>Safety</b>	<p>9.1 - There must be no more than six plug sockets allowed per supply.</p> <p>9.2 - Power supply cords must not exceed 2m in visible length on exit from the desk clamp.</p> <p>9.3 - Cable must be clamped at point of entry to desk and/ or at both ends where cables connect separate moving parts.</p> <p>9.4 - All extraneous metalwork should be earthed.</p> <p>9.5 - The weight distribution of the desk should be towards the base in order to increase stability</p> <p>9.6 - There should be no wobble at any of the heights of the desk.</p> <p>9.7 - Desk corners should not be able to be caught on clothing.</p>	<p>9.1 - Not possible to test until a later stage</p> <p>9.2 - Not possible to test until a later stage</p> <p>9.3 - Yes, this would be the case</p> <p>9.4 - Would need to be added during development</p> <p>9.5 - Aluminim cabinet should ensure this</p> <p>9.6 - Not possible to test until a later stage</p> <p>9.7 - Not possible to test until a later stage</p>	<p>9.1 - Not possible to test until a later stage</p> <p>9.2 - Not possible to test until a later stage</p> <p>9.3 - Not with the current state of design</p> <p>9.4 - No metal work</p> <p>9.5 - Not the case</p> <p>9.6 - Not possible to test until a later stage</p> <p>9.7 - Not possible to test until a later stage</p>	<p>9.1 - Not possible to test until a later stage</p> <p>9.2 - Not possible to test until a later stage</p> <p>9.3 - Not with current design</p> <p>9.4 - Metalwork far from electronics</p> <p>9.5 - Not the case</p> <p>9.6 - Not possible to test until a later stage</p> <p>9.7 - Not possible to test until a later stage</p>
<b>Scale of Production</b>	<p>10.1 - The prototype will be made as a one-off bespoke piece</p> <p>10.2 - Should the desk become commercially available, it will be manufactured in batch production.</p> <p>10.3 - Even though the prototype is a one off, the manufacturing processes should aim to reflect those of batch production.</p>	<p>10.1 - This will happen</p> <p>10.2 - This will be able to happen</p> <p>10.3 - Not possible to test until a later stage</p>	<p>10.1 - This will happen</p> <p>10.2 - This will be able to happen</p> <p>10.3 - Not possible to test until a later stage</p>	<p>10.1 - This will happen</p> <p>10.2 - This will be able to happen</p> <p>10.3 - Not possible to test until a later stage</p>
<b>Cost</b>	<p>11.1 - The budget for this project is £1,000</p>	<p>11.1 - Materials should be below the budget</p>	<p>11.1 - Materials should be below the budget</p>	<p>11.1 - Materials should be below the budget</p>
<b>Quality</b>	<p>12.1 - When the Ashesion Test is carried out, the detachment of small flakes at the intersections of the cuts must not be greater than 5%</p> <p>12.2 - The scratch test should be carried out using a scribe and different masses. The effects shouldn't appear visible until the mass reaches 800g.</p> <p>12.3 - When a 19mm steel ball of mass 28g is dropped from 2m above the surface of the desk, the defect or crack must be no deeper than 5mm.</p>	<p>12.1 - Not possible to test until a later stage</p> <p>12.2 - Not possible to test until a later stage</p> <p>12.3 - Not possible to test until a later stage</p>	<p>12.1 - Not possible to test until a later stage</p> <p>12.2 - Not possible to test until a later stage</p> <p>12.3 - Not possible to test until a later stage</p>	<p>12.1 - Not possible to test until a later stage</p> <p>12.2 - Not possible to test until a later stage</p> <p>12.3 - Not possible to test until a later stage</p>

Chosen Idea

## Client Feedback

Definitely the most practical solution with sensible mechanical storage spaces. A clever way of lifting the desk up & down.

**Grid 5**

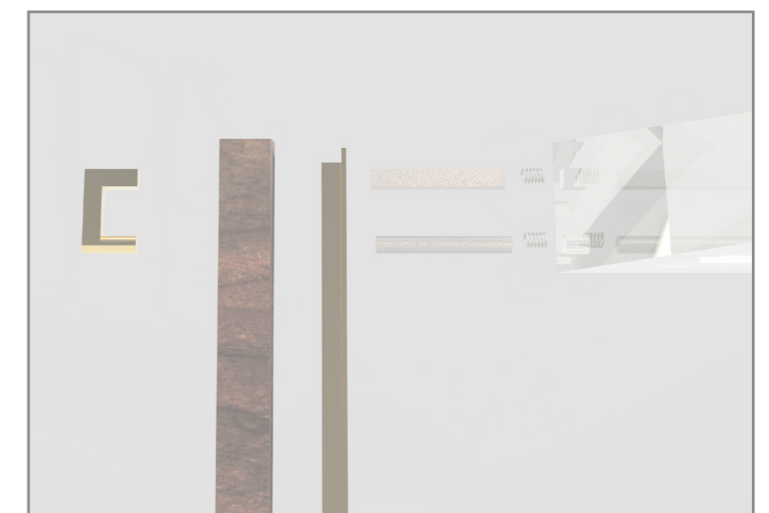
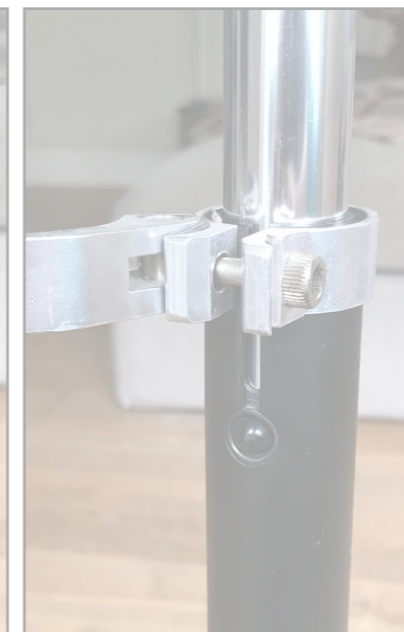
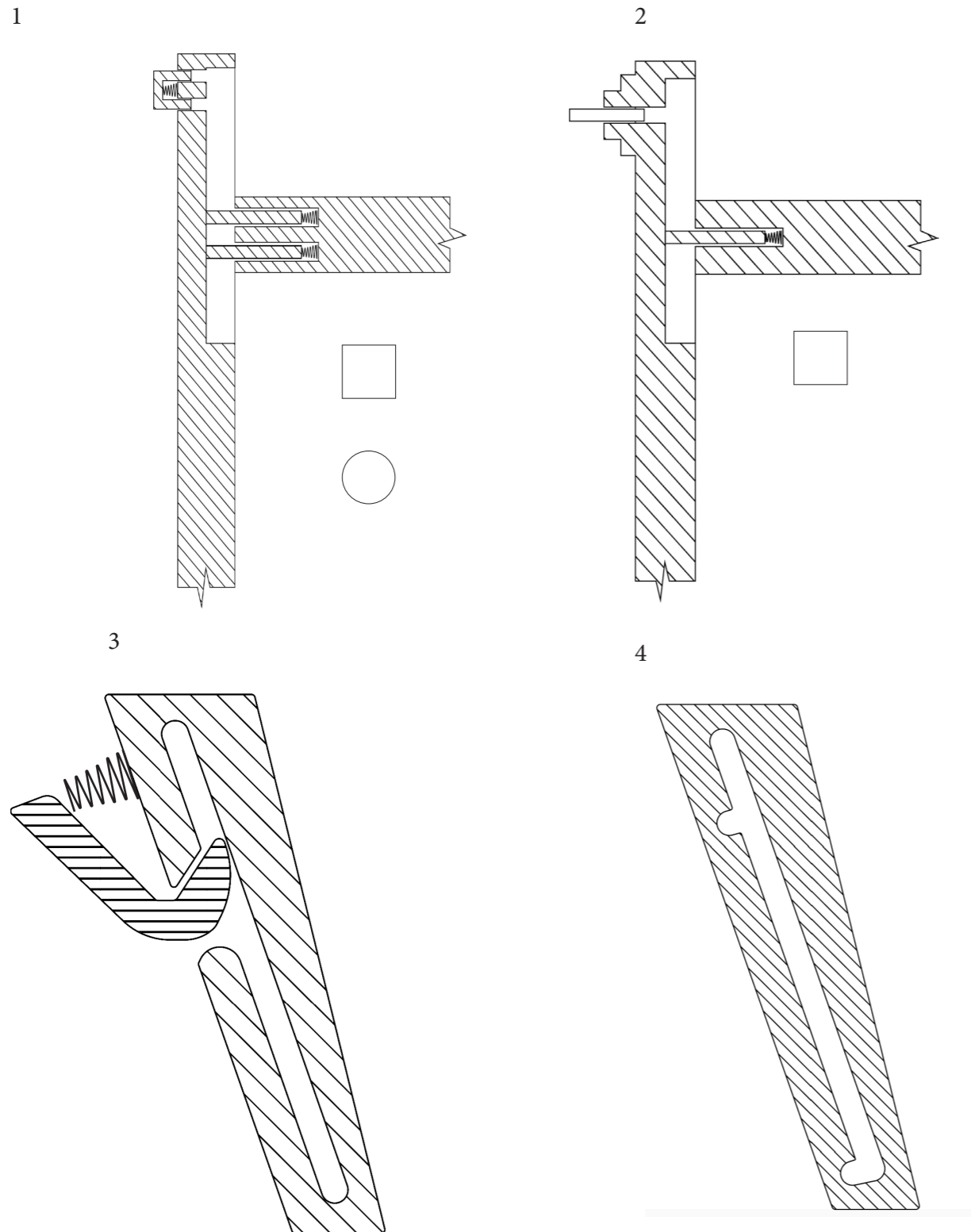
**Development of  
Design Ideas**

## Development of Desk Lift Mechanism

In order to develop the mechanism by which the front part of the desk would lift up and down and lock in both the top and bottom positions I used Adobe Illustrator to draw cross sections. I came up with four iterations each of which was an improvement on the last. I eventually settled on number 4 which I will take forwards to testing.

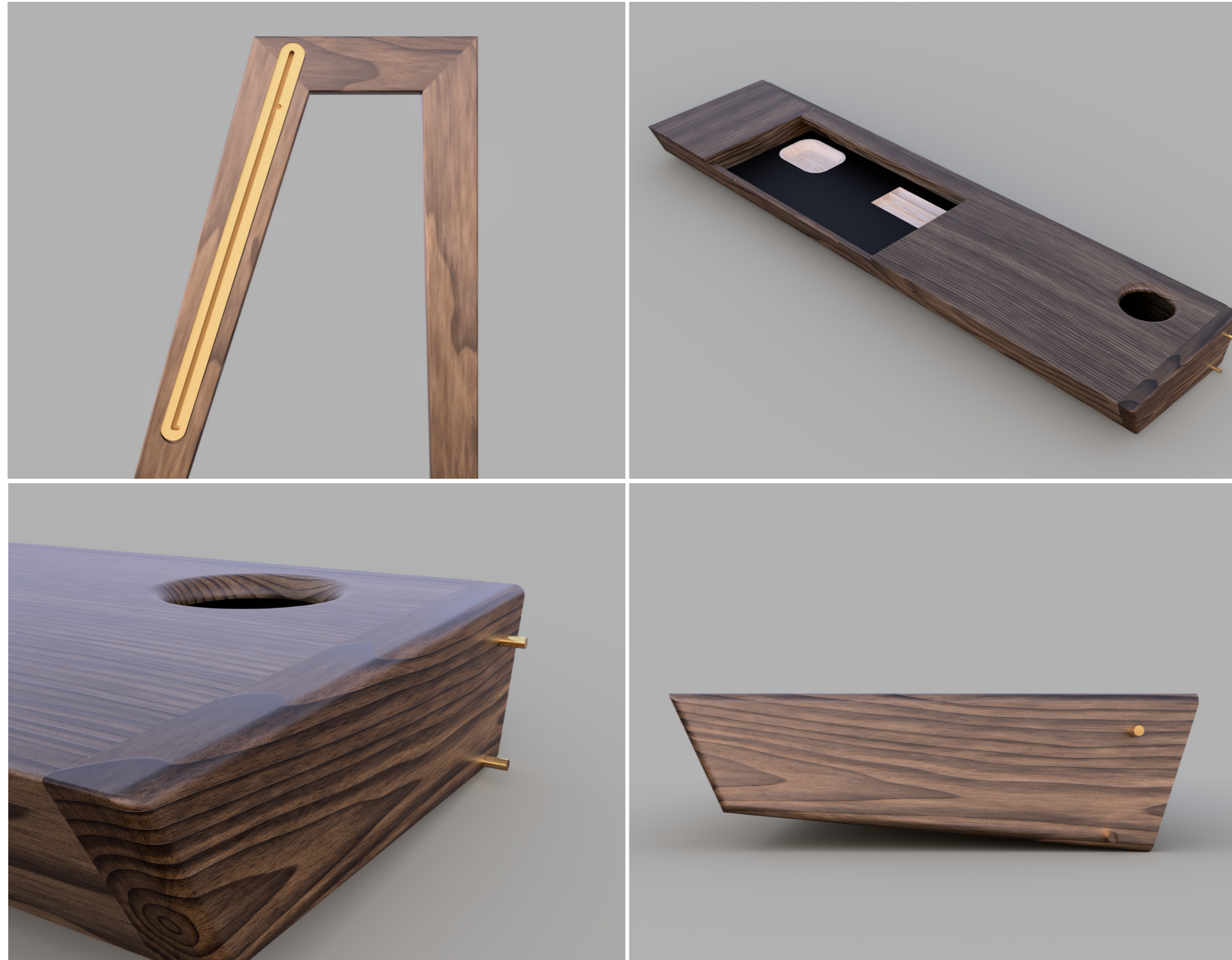
Justification

Unfortunately the annotated version of this page is at school - it should be in a black portfolio in the classroom. It has tracing paper stuck onto it and is probably one of the best pages in my portfolio. I am happy to try and recreate the page





## Final Desk Lift Mechanism Design



### Processes and Techniques:

The lift mechanism would consist of 4 main components. These would be: the main desktop (pictured left), the brass insert with the groove (pictured far left) The pins and finally the legs. Each component would be manufactured individually before being attached. I will use the milling machine to manufacture both the brass insert and the slot in the legs that the brass piece fits into. I will need to cut the groove in the leg before cutting the taper since this will make clamping it easier. I will also need to use scrap wood and paper to clamp the wood in order not to damage it. I will use the pillar drill to drill holes through the brass which will be countersunk so that the screws can sit flush.

For the main tabletop, each piece of wood will be cut individually using the table saw or band saw and I will use M10 sized biscuit joints to join each piece. Two 9mm holes will be drilled into the side pieces of the table top and the pins will be glued with Araldite

### Justification

The Milling machine gives a high degree of accuracy and it is also easy to get the rounded edges to the grooves since this is the same as the shape of the edge of the drill bit. With the Milling machine it is also possible to clamp the material very strongly.

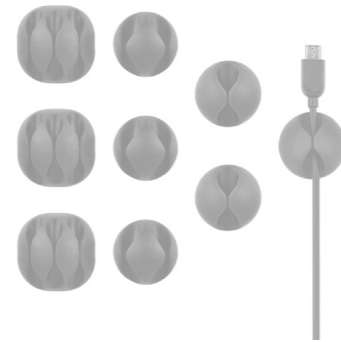
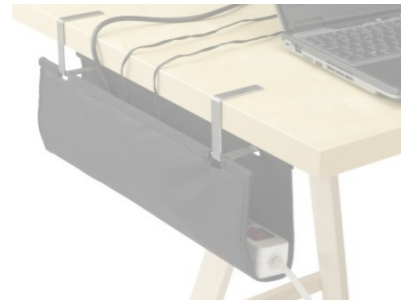
The table saw once again is a very accurate way of cutting however, I am not permitted to use it and therefore a technician will need to operate it for me. Biscuit joints are a personal preference since I feel that they give a small amount of tolerance such that if the cut isn't perfect, it is still possible to achieve a flush joint when clamping.

Araldite is an appropriate adhesive for this situation where we are joining metal to wood. It is a two part adhesive which comes as a resin and a hardener. This part may need to be clamped with a jig in order that the angle is perfect.

# Development of Cable Management System

Research

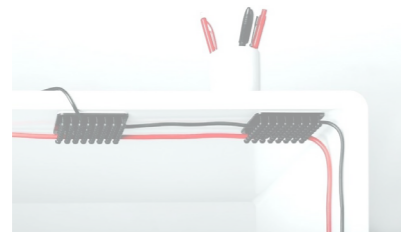
Client Feedback



1



2



3



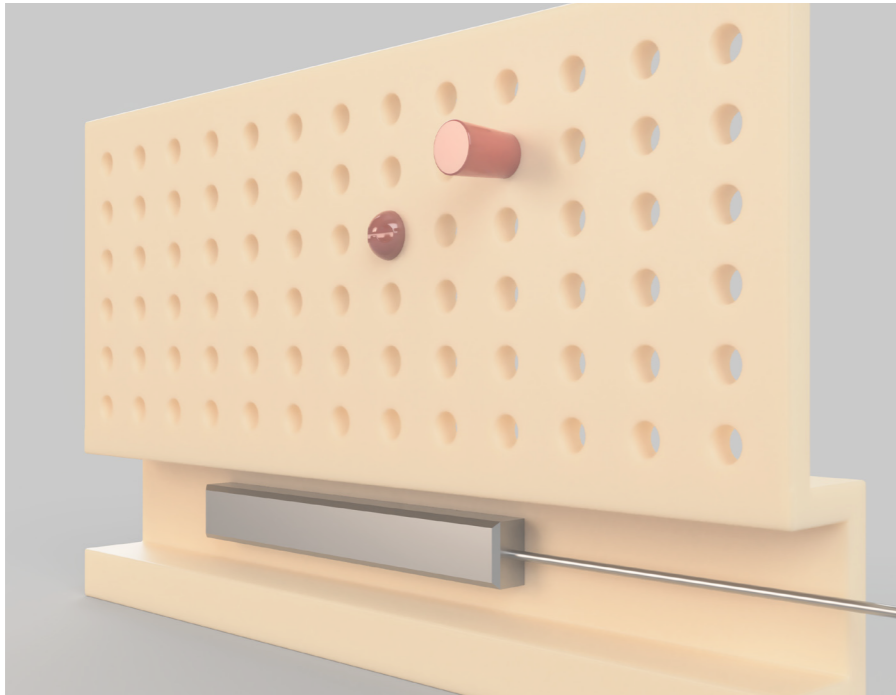
Conclusion

Justification of Final Idea

Unfortunately the annotated version of this page is at school - it should be in a black portfolio in the classroom. It has tracing paper stuck onto it and is probably one of the best pages in my portfolio. I am happy to try and recreate the page



# Final Cable Management Design



## Processes and Techniques:

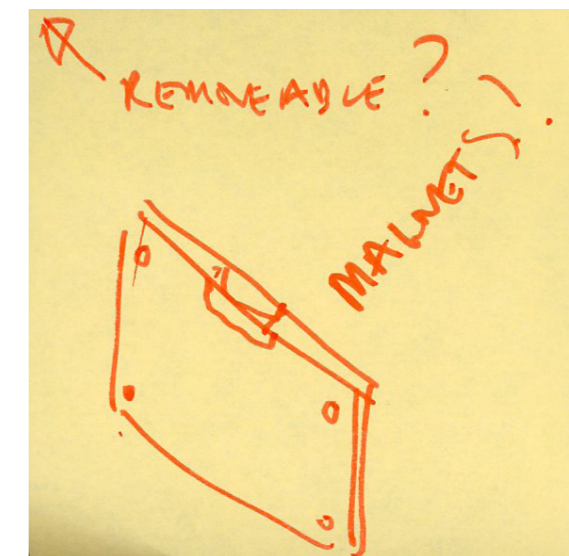
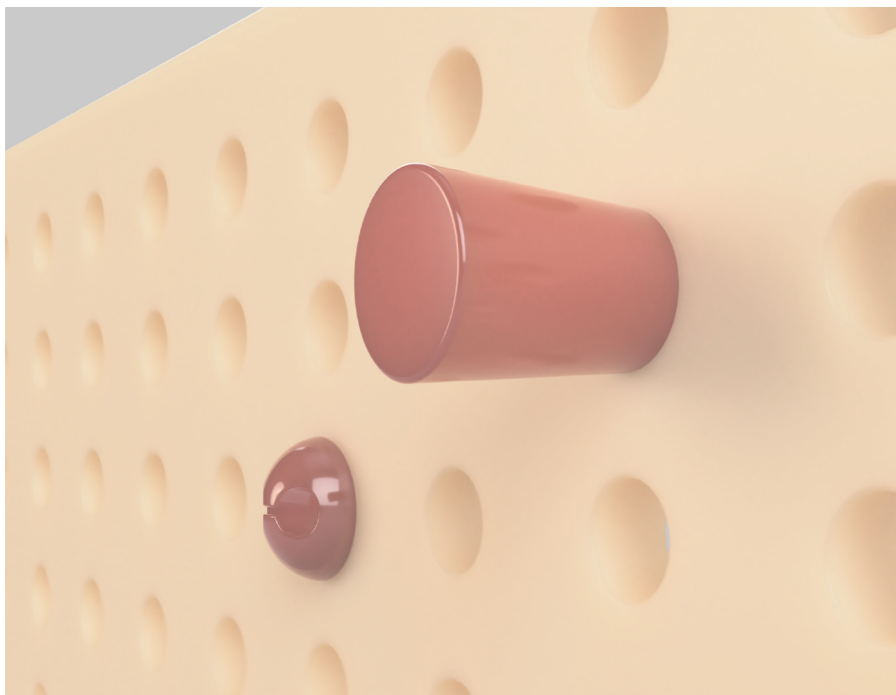
The most time efficient way to manufacture the backboard would probably be to use the CNC router given that I have already modelled the piece in CAD.. From here I would use biscuit joints to the other pieces of wood.

In order to manufacture the cable holders, I will use the 3D printer since I have already modelled the parts in CAD. this way I can get a very accurate fit.

I will use screws to attach the base of the cable management system to the desk itself.

## Client Comment.

I'm sorry to ruin all your hard work but I really don't see the benefit of having this big heavy piece at the back of the desk. I think it would be much better to use magnets to make the back panel detachable.



As a result of my client's comment in our most recent meeting. The system to the left has been scrapped and simplified to a removeable panel as shown by the renders on the right with three holes for cables to leave out of. The panel can be detached by magnets as per my client's request.

The post it note shows a drawing done by my client during our last meeting where he sketched his idea for the front panel with a small handle at the top and 4 magnets to attach the panel.

## In Depth Justification of Materials



### A *Metal Groove Insert - Brass*

#### *Justification:*

I have chosen brass for this component since it is a material that is wear resistant. It is also very easy to machine which is very helpful since this is a component that is relatively difficult to manufacture. I have also chosen it because of aesthetic reasons. Brass pairs very nicely with American Black Walnut and therefore this slot can actually become something that adds to the design rather than being visually obtrusive.

### B *Complementary Wood - Oak*

#### *Justification:*

Oak pairs extremely well with the American Black Walnut. The two colours contrast very nicely and this will add aesthetic interest. From a practical point of view, Oak is commonly used in furniture so is therefore less expensive. It is also durable and looks good with a range of different finishes.

### C *Hinges - Brass*

#### *Justification:*

In order to maintain continuity within the design, I think that it is important to use brass as the material for the hinges. Brass is corrosion resistant and won't rust so the hinges are unlikely to become stiff. Brass is also very durable.

### D *Pins - Hardened High Carbon Steel*

#### *Justification:*

I have learnt from testing that the pins wear very easily as therefore need to be made from metal as opposed to wood which splinters and wears down very easily. The pins are hidden and therefore there are no aesthetic considerations. However, the pins will be responsible for holding the considerable weight of the tabletop so they must be strong, they also need to be sufficiently hard to remain of consistent size and shape to fit well in the groove and slots. Therefore I have chosen to use High Carbon Steel that will be heat treated then quenched and tempered in order to increase hardness. This material should be sufficiently hard and strong not to cause any problems.

### E *The Body - American Black Walnut Veneered MDF*

#### *Justification:*

My specifications specifically mention the importance of using wood composites where possible to reduce cost. MDF also doesn't warp as natural timber does and therefore this should help increase the lifetime of the desk.

### F *Drawer lining - Felt*

#### *Justification:*

I have chosen felt because it is a very tactile material. To me it is important that the user is comfortable even when they are lifting pens or pencils out of the desk. Felt also has the ability to be stiffened which will create interesting shapes to organise my client's equipment.

### G *The Legs - American Black Walnut*

#### *Justification:*

Hardwoods are most commonly used for high end furniture and since my client has specifically requested the presence of a timber tabletop, I think that using a hardwood for the body is sensible. In addition, Hardwoods are the most prominent material to be featured in the collection of furniture manufactured by my client himself. I have decided to use American Black Walnut for the body for a number of reasons. Firstly, it is one of the most popular woods used in high end furniture. It is also dimensionally stable, shock resistant and is very strong.

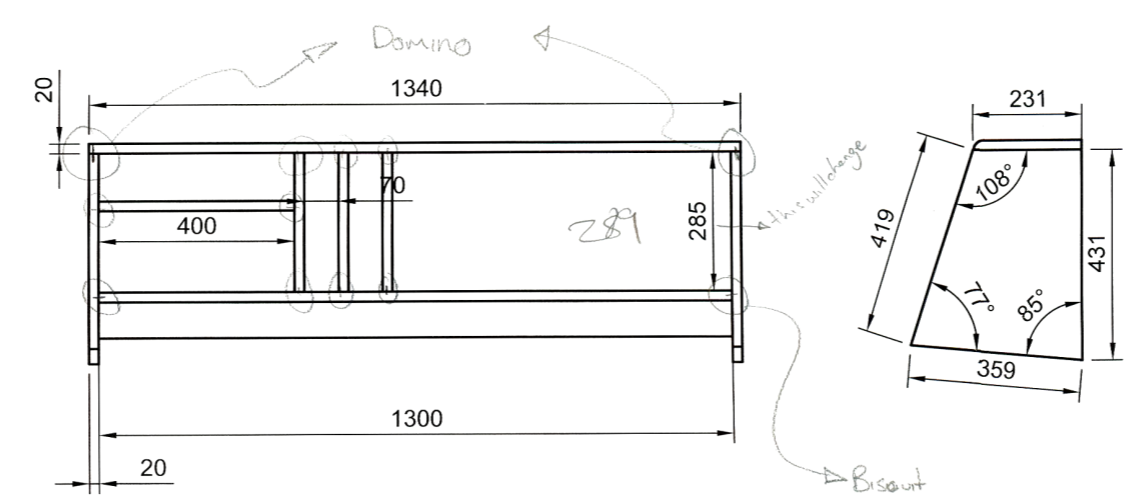
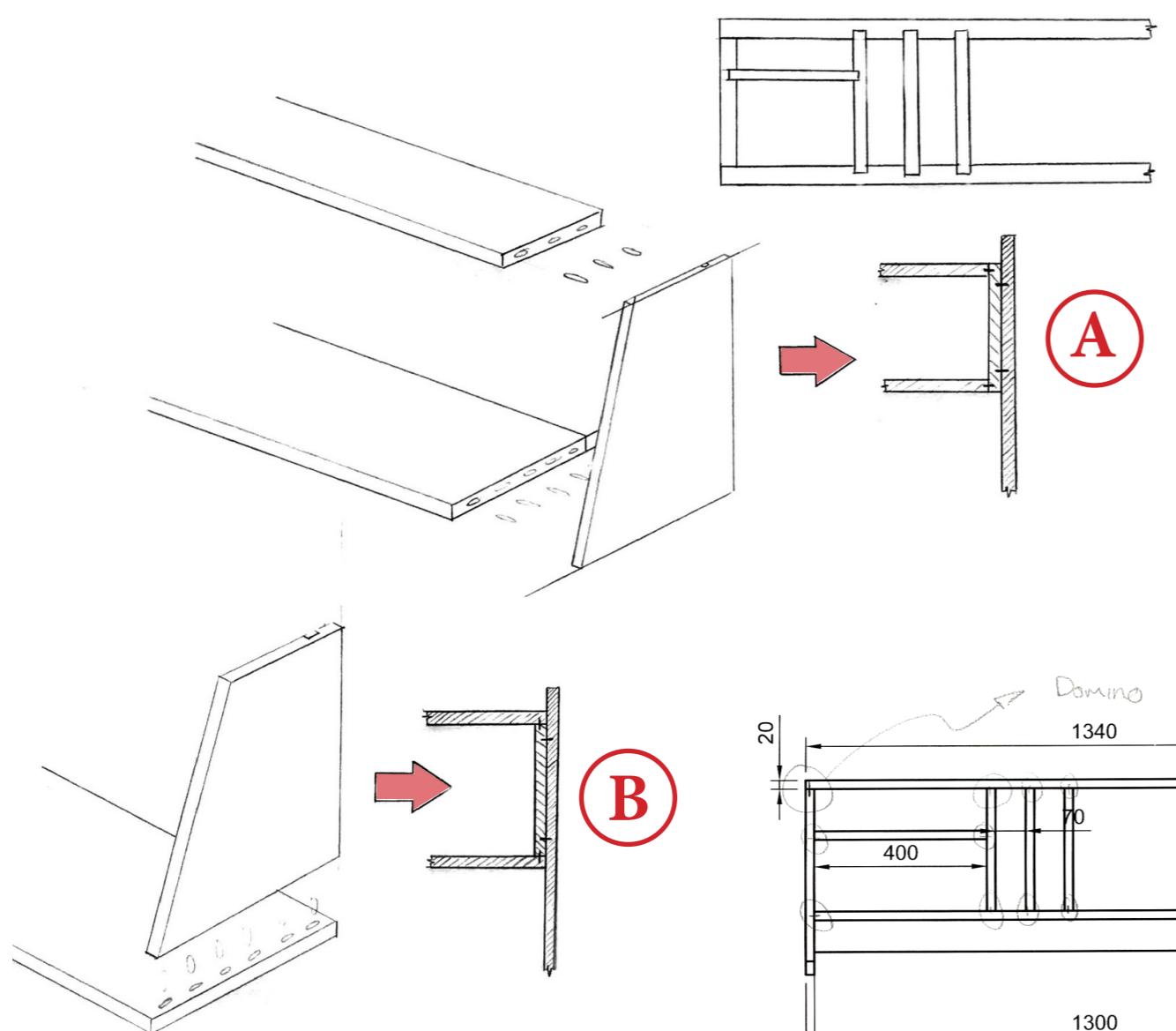
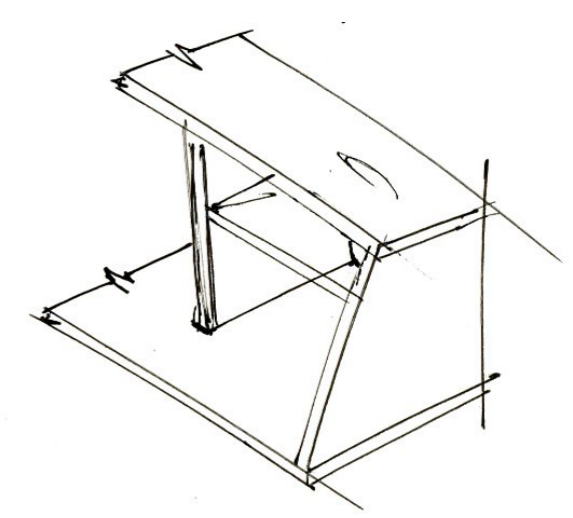


# Development of Main Body

## Using 16mm MDF instead of 20mm American Black Walnut

After my materials research which concluded that using 16mm MDF instead of 20mm ABW would dramatically reduce cost and increase stability I had to redesign the main body so that the dimensions were correct. Below shows the calculations that I did changing the widths from 20mm to 16mm so that I could put the correct measurements on my cutting list.

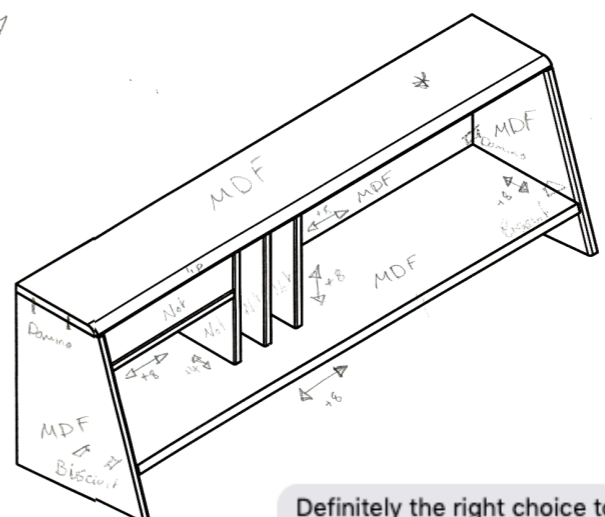
It was important that the top height didnt change and neither did the width or bottom height. Using 16mm MDF also meant that I had to use lipping to conceal the uncovered edges of the manufactured board and a separate cutting list was made drawing this up.



- 231 x 1340 x 20 → top \*
  - ~~38~~ 358 x 431 x 20 → ends x 2
  - 380 x 1308 x 20 → ~~the~~ back
  - 308 x 1308 x 20 → base
  - 231 x 285 x 20 → Folders x 3
- } MDF

Change from 16 → 20mm  
20mm → 16mm

- top → 1340 x ~~231~~ 231 x 16
- ends x 2 → 435 x 358 x 16
- back → ~~435~~ 435 x 1308 x 16
- base → 312 x 1308 x 16



### Deciding A or B?

I knew the shape of the main body but I needed to establish whether the outermost parts should be joined such as in drawing A or drawing B. Drawing A has the biscuits facing parallel to the ground and the bookend pieces outermost and drawing B has the biscuits facing perpendicular to the ground and the bookend pieces are below the top surface.

In both situations the main body will have to be attached to the legs with screws and domino joints. Drawing B allows for 32 mm more sketching space on the top surface since the top piece of the main body runs all the way to the legs. In addition, Method B allows for more stability since the biscuit joints are at 90 degrees to the screws and dominos attaching the main body to the legs which will give the desk extra strength in a different dimension.

### Client Comment.

Definitely the right choice to go with option A for stability and to get that extra space, plus it will look nicer. It would have been really nice for the desk to have been made entirely from natural timber but completely understandable why you've chosen to go with MDF.

# Modelling to Inform Manufacture

## Introduction

After visiting my client in his studio I realised the importance of modelling. My client uses balsa wood to model every design idea that he comes up with and it's a way of replicating manufacturing techniques and discovering weaknesses that would also come up in a full-sized model. Very often problems that are discovered in manufacturing a 1/5th sized model are problems that occur when the full-sized product is manufactured.

One of the difficulties that I came across when manufacturing the 1/5th scale model was that it was very difficult to keep the legs at 90 degrees to the top. As is shown by the model on the right I had to use blocks to clamp the legs at 90 degrees and doing this at full size would be even harder.

As a result I have decided that it is important that the main body is manufactured separately to the legs so that they can be attached as two separate components to ensure that the angle is kept much closer to 90 degrees to ensure stability of the desk.



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Another problem that I encountered was that the jointed mark with the arrow was very unstable. There were a few times where I dropped the model and this joint split.



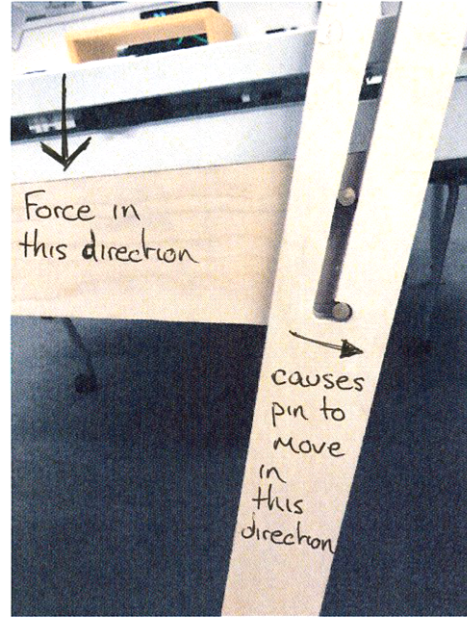


## Modelling to inform manufacture

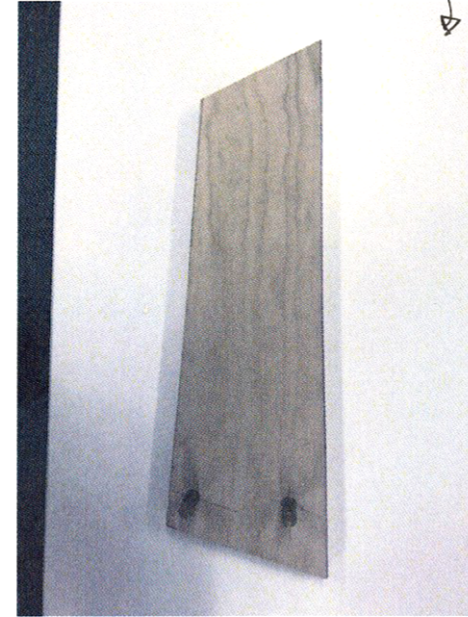
This photo shows the desk in its sitting position, you can see how the pins have moved into their lower position, the top pin remains in the groove whilst the bottom pin rotates

anti clockwise causing the tabletop to move so that it rests perpendicular to the ground.

During testing I established that I could put a lot of force on the tabletop without any damage to the groove or the pins.



I was previously worried that the force on the pins would cause them to become loose in their holes, I tested this by



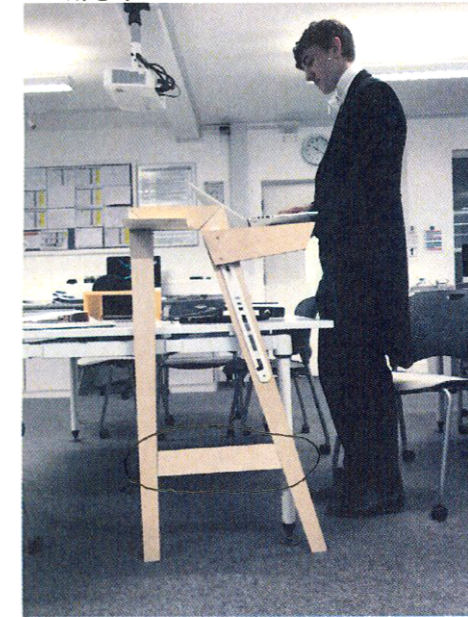
applying huge amounts of pressure to the tabletop over a period of 2 weeks and the pins still wouldn't budge.

In reality, the brass slot will be inset within the table leg so that it is less obtrusive, this will also mean that it retains more strength.



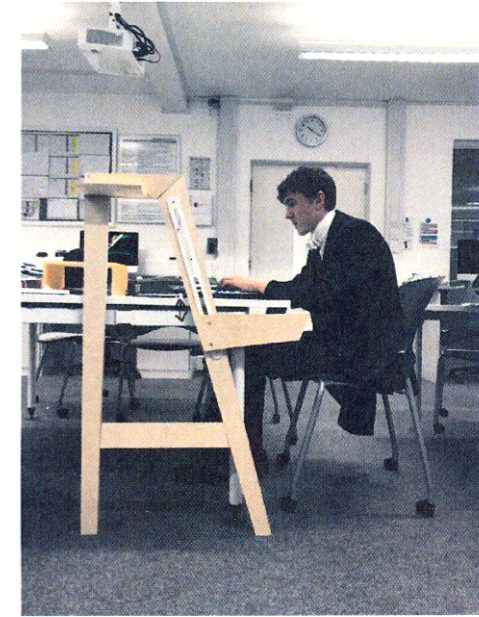
The labelled edge in the photo needs to be redused for the pin to fit more smoothly into the locking position.

I was surprised by the proportions of the desk and wanted the taper of the legs to be more obvious. Therefore, I will make the bottom brace thinner.



The standing position above is a comfortable height to work at.

This photo below shows ergonomic testing of the desk in the lowest position, you can tell that the position in which the desk rests at is too low because the user's

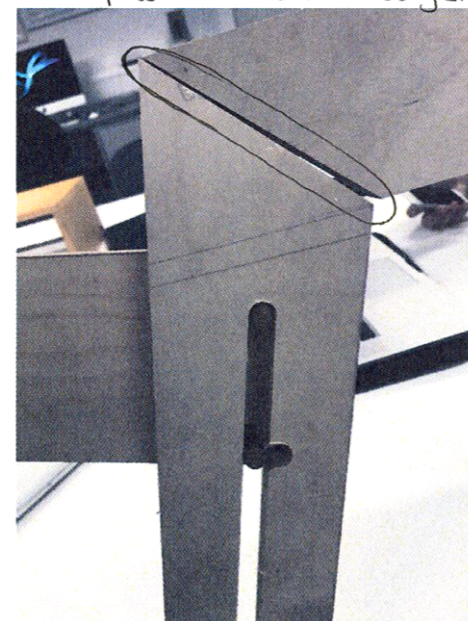


thighs would be in contact with the underside of the desk. I will make alterations such that the groove doesn't end as low.

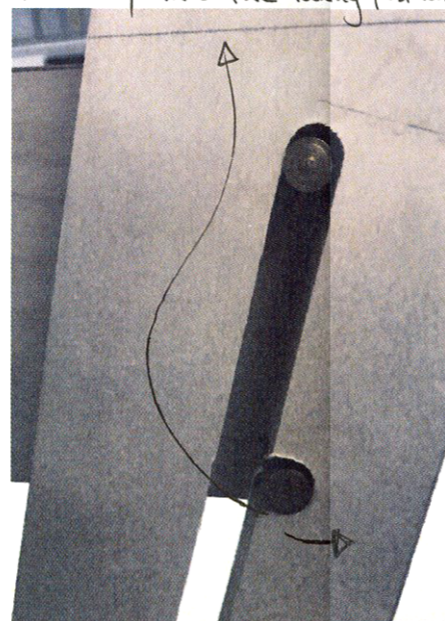
The pins run smoothly in the groove with a tolerance of  $\pm 0.5\text{mm}$  since the pins are 10mm in diameter and the groove is 11mm



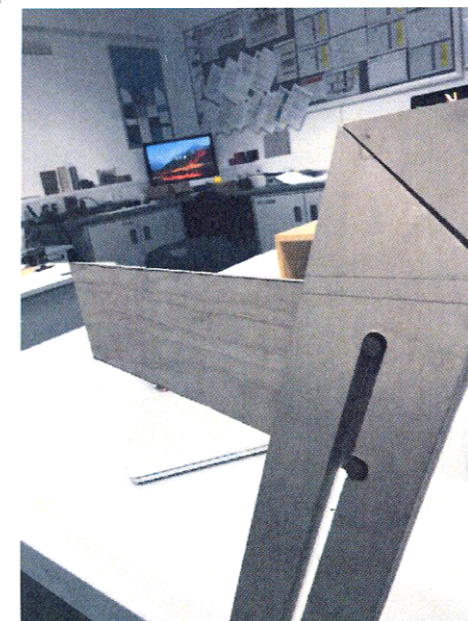
I have also marked the angle that you have to lift the tabletop by in order that the pins align parallel in the groove so it is possible for them to slide up and down.



When sanding, I used the belt sander which allowed a slight curve to the edges, this didn't allow for a strong fit when I glued them.

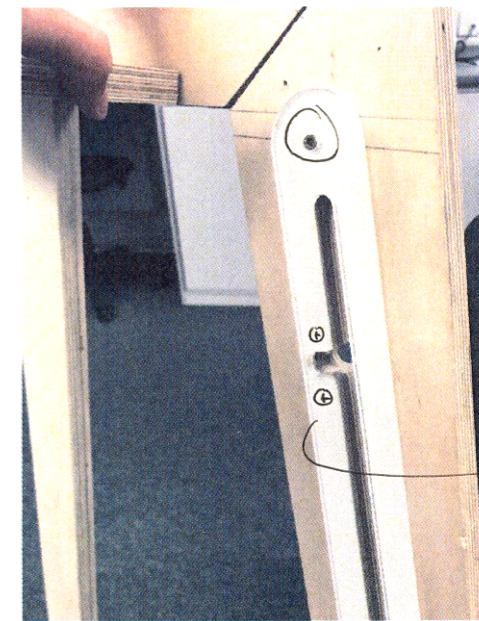


When locked at the top position, the bottom pin rotates anti clockwise locking the tabletop so that it can't slide down again.



I marked pencil lines on the wood to see whether the table lines are parallel to the ground and this proves that this is true.

In the image below, you can see how the brass slot will be screwed into the wooden (walnut) leg. In this case I have used acrylic since it is brittle and gives me a good idea of where the points of weakness are in the groove



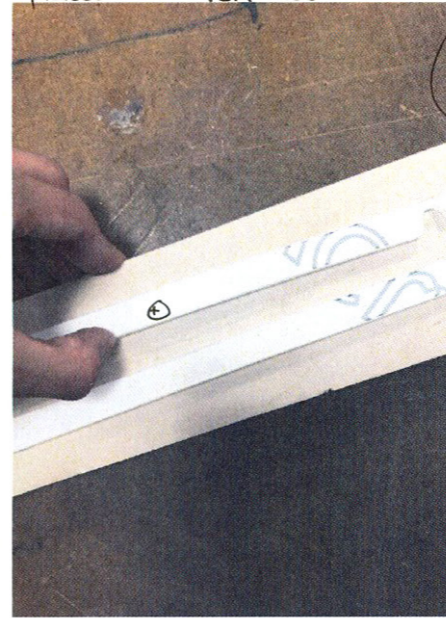
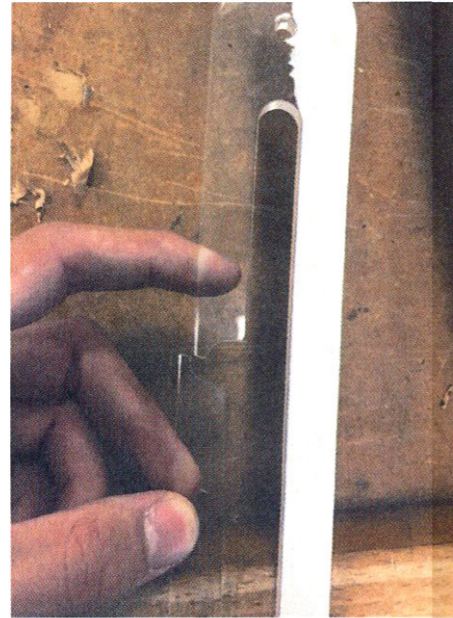
The slot bowed a lot in this area so I concluded

that I need to add extra fixtures in these positions to prevent the brass from deforming.



# Modelling to inform manufacture

Here acrylic bows when a force is applied to it, this can be mitigated if screws are placed to reinforce.

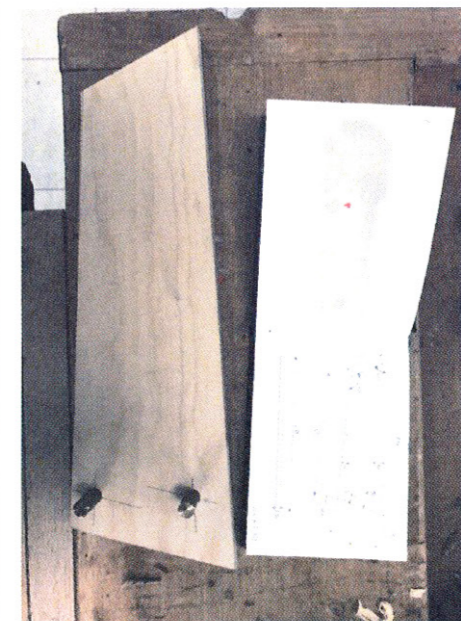
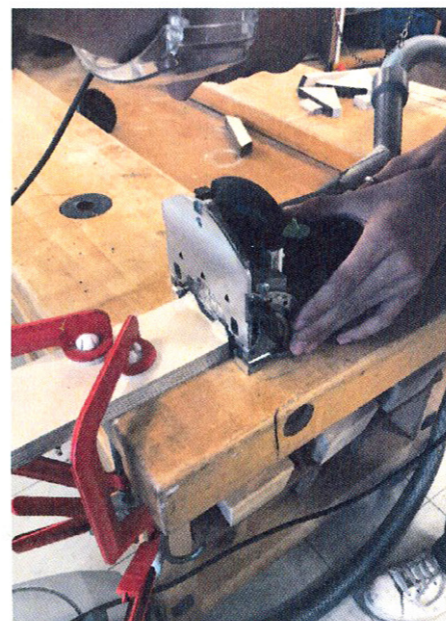
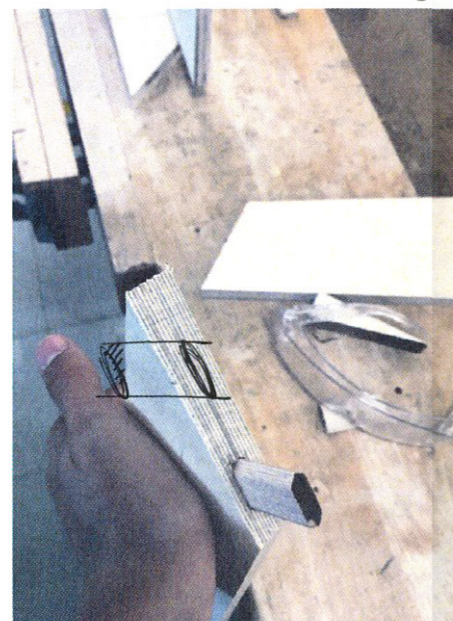


Scrap wood

This photo shows me milling the groove in the wood slot. Even plywood with a cross grain pattern splintered a fair amount so I learnt that the cutting rate cant be too fast and that the depth of each cut must be fairly shallow. This will ensure that the groove is as strong as possible with no areas of weakness.

During my testing I lasercut the slot in acrylic which will eventually be cut in brass. However I noticed that it took very little stress to snap the acrylic so I moved the slot to the right.

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This photo shows the end section of the desk alongside my sketchbook with a scaled drawing. I used a marking gauge to scribe paralalled lines.

In my testing I actually cutt all the way through the leg to avoid this, I need to move the dominos closer together

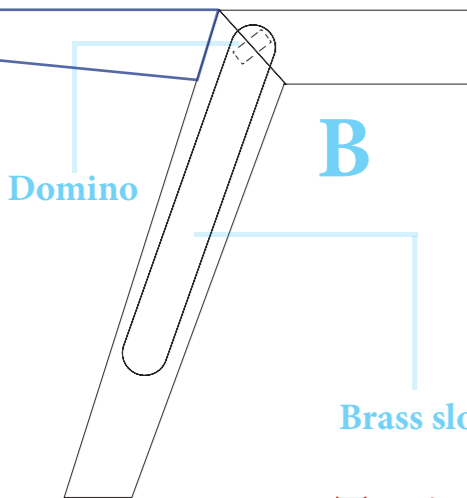


# Development of Mitre joint and Stability

## Introduction

The purpose of this page is to decide between two different top heights for the desk. Option A only allows the top position to be as high as bottom of the top brace of the legs as shown below. However, it will provide a more stable mitre joint allowing for 2 dominos to attach the front leg to the top brace. Option B allows the desktop to be as high as the very top of the legs which makes it possible to have a larger working area at the top height however it come at the sacrifice of a loss of stability of the front mitre joint.

Top height of desk level with top of Leg



Testing

The diagram to the left shows that with option B in order to get the top height level with the top of the legs the brass slot must cross over the mitre joint. This leaves less room for the dominos to fit in the joint and could result in a lack of strength.

There are significant aesthetic advantages to using method B as should be evident from the pictures below.

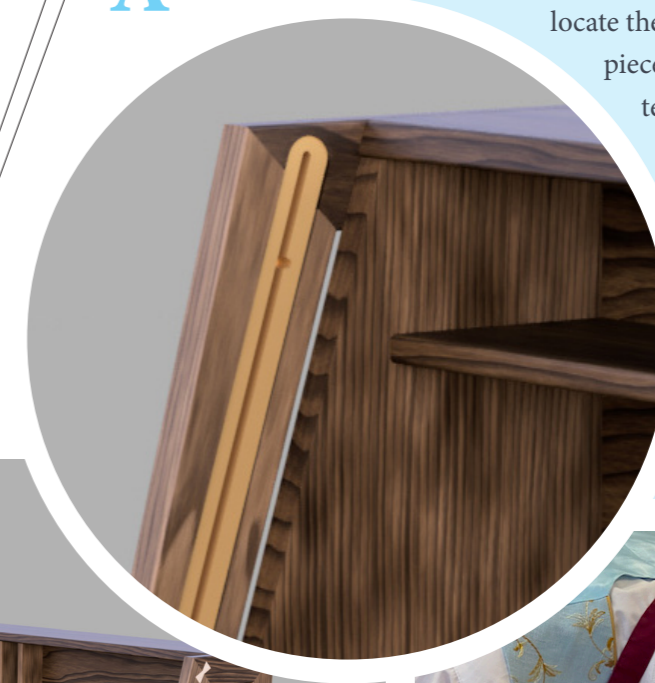
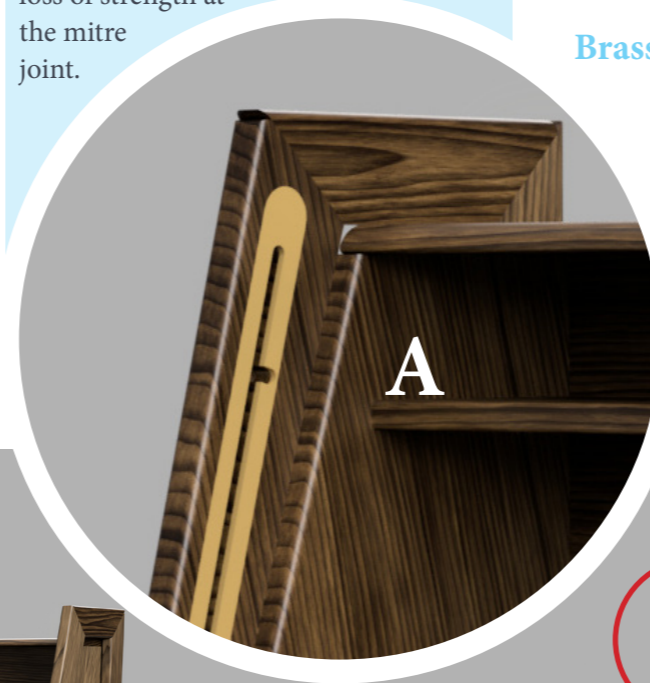
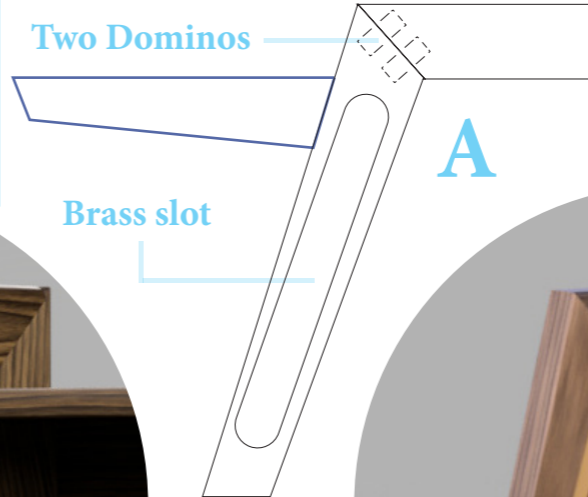
The photo below to the left shows a test piece made from plywood to determine the strength of the joint after having routed a groove for the brass slot to sit in. The strength was still surprisingly good.

There is also a significant downside to using method A. It is most easy to see this by looking at the circular pictures. The main body has to be attached to the legs and in order for the desk to be most stable this should be done in as many places as possible. Option B affords the main body to be screwed to the legs from both the back leg as well as the top central brace. However, with Option A, The main body is only able to be screwed to the legs from the back leg because the top central brace sits above the main body as you can see best in the image below. The loss in strength from not being able to screw the main body to the legs in this place would outweigh the loss of strength at the mitre joint.

## Client Comment.

Although the fact that the legs standing proud of the top in option A might have stopped me from knocking things off the side of my desk, I agree that option B appears to be much more sensible.

Top height of desk lower than height of leg.



## Lessons learnt from Testing.

In order to cut the groove for the the brass slot I had to laser cut a template that could then be used to guide the handheld router. This will be able to be used again during the manufacture of my product and is a great example of a template that might be used in Batch production (SPEC 10.3)

I learnt that the offset for the cutting blade from the edge of the template is 9mm. In addition, There needs to be a tolerance of 0.3mm in the width of the slot in order for the piece of brass to fit in comfortably. I used screws to locate the template onto the piece of plywood and in my template I added markers to line the template up with the corners of the wood so that in the future I knew that the groove was cut Identically on both of the front legs.





## *Client requested renders*



*These renders were asked for by my client since he wanted to see whether he preferred the desk in a day or night colour scheme. We talked about both and agreed that the walnut version with brass inserts shown on the left was more suited to user group with more money to spend on a fancy desk that might sit proud in a study. The Beech and Aluminium version might be better suited to a messy workspace environment and would be more a cost efficient alternative. Since my client would be keen for this desk to sit in his study at home, we decided that I will manufacture the Walnut and Brass version.*



## Comparing Two Desks

### Relative Cost of Manufacture

### Materials

### Durability

### User Group

### Environment



The cost for this desk would be far greater than for the beech and Aluminium desk. Primarily due to the cost of materials. Brass and Walnut are much more expensive materials than Aluminium and Beech. The manufacturing cost would actually be very similar but handcrafted elements such as the butterfly joint in the walnut and brass desk would add complexity and drive up the price of manufacturing.

Brass is a heavier choice of metal with a very attractive surface finish when polished correctly and should help create a luxury feel to the product. It pairs really nicely with the Walnut which due to its dark colour should conceal blemishes and stains a bit better than the beech. Veneered MDF will still be used to reduce cost but the lipping will be thicker than in the beech desk to increase quality and appearance.

The thicker lipping on the edges of the MDF will be 5mm instead of iron on which has the tendency to peel or split. The lipping will also be pinned into the MDF instead of ironed on and this will increase the durability. Higher quality oils will also help increase durability of the product with comparison to the beech that has a lower manufacturing cost.

The User group for this type of desk would likely be older people who have spent long enough working to save up for an attractive desk that they may want to use at home. They would be keen for this desk to be long lasting and a luxury piece to validate the amount of money spent on it. I imagine users would still have creative minds but would be very keen that the desk performed to a high standard functionally and ergonomically.

This is more likely to be found in a home environment perhaps in a study or maybe an office at work. The environment is likely to be less busy and messy. The user may prefer working from home and this piece may form the basis of a home office environment. The user is more likely to place this desk in a more private space where it is less likely to be damaged or knocked due to its higher price and more luxury feel.



There may be more potential for batch or mass production techniques with this desk. With few complex joints there could be more computer control and less high skill labour. The lower cost would allow for higher rates of production and different manufacturing techniques involving more Jigs, Templates and machines to increase accuracy and repeatability and reduce the time of manufacturing.

Aluminium has a very high strength to weight ratio so would be great in this application. It is more likely to scratch than the brass reducing the attractiveness of the surface finish. There will be a higher percentage of MDF in this design which will reduce warping. Lipping will be much thinner than the walnut desk and Iron on lipping will be more prominent to reduce the overall cost of the product.

This desk would be more likely to be used in busy creative studios and as a result it would not last as long as the walnut version. The thin lipping would likely peel or split after heavy use however the desk should remain functional for just as long as the walnut version since there isn't much difference in the strength of the materials and the manufacturing techniques are not significantly different.

The user group for this desk would be younger. They may be less keen to invest in something that they could easily ruin by spilling paint on or staining with a coffee mug. Users would be busy creative people who work a lot with their hands and have many different types of work perhaps a young artist who sketches, paints and works with clay. The desk would have to be able to withstand the demands of all these methods of work.

I imagine this desk sitting in a large open plan creative studio space. Lots of people around working together and doing many different things. I imagine a messy loud environment with many different creative people. It could fit well in a shared workspace where people of all sorts of methods of work gather. The environment is more likely to be open and active with many busy people and probably a lot more noise.



**Grid 6**

**Final Design  
Solution**



# Flow Chart

## Manufacture of Legs

Ask technician to cut blanks of hardwood from dimesions on cutting lists using circular saw 5

Using pencil, tape measure, steel rule and protractor to mark out the shapeof the leg on each blank. 5

Using a tape measure, steel rule and protractor. Check are dimen- sions within  $\pm 0.5\text{mm}$  and  $\pm 0.5^\circ$  2

Using the handsaw cut to the waste side of marked lines. 5

Ensure that guard is down to the correct height, the extraction is turned on, safety googlesare worn and someone is supervising. 2

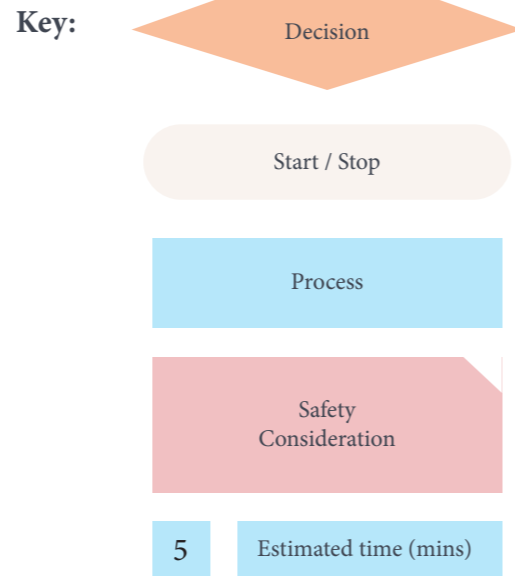
Use the disk sander and bell sander to ensure that edges are flat and accurate to marked lines. 5

Ensure extraction is turned on, safety googles are worn and loose clothing is tied back. 1

Place edge on flat workbenchwith light behind and check: does the light shine through meaning surface isn't flat? 1

Place pieces in position relative to each other on the workbench and using a sharp pencil, mark small dashes as a reference for the domino cutter 2

Clamp pieces to table individu- ally with the pencil mark on the upper side using a g clamp 2



## Manufacture of Brass slot

Ask technician to cut blanks according to sizes on the cutting list 1

Use scriber, dot punch, odd legged calipers, steel rule and di- viders to mark holes to be drilled and groove to be cut 10

Clamp to milling machine bed using scrap wood and place scrap wood beneath work 5

Select 10mm cutting bit and cut groove by passing over in increasing depths each time 60

Make sure work is securely clamped, correct cutting rate is chosen, eye protection is worn, guards are down and loose cloth- ing is tied up 2

Clamp work securely to the pillar drill and select 3mm cutting bit 2

Drill holes and countersink 5

Make sure the work is securely clamped, correct cutting speed is chosen, eye protection is worn, guards are down and loose cloth- ing is tied up 1

Use a half rounded file to de-burr the edges then use emery cloth to ensure that the edges are smooth 10

Align domino cutter to pencil marks and cut holes 1

Ensure extraction is turned on, safety goggles are worn, loose clothing is tied back. Make sure that cables are out of the way, the bag is attached to the cutter and thar ear protection is worn 2

Using screwdriver and 15mm screws screw the acrylic template onto the front leg 2

Clamp work to the bench and pass the router over the work cutting at 2mm increasing depths 15

Wear eye protection, ear protec- tion, tie back loose clothing and ensure that wires are out of the way. 1

Place brass slot in the routed groove then trace through the grooves in the brass as a template onto the wood below to mark out the position of the groove and the screws. 5

Remove brass from leg then us- ing 15mm screws and screwdriv- er, screw acrylic template onto the leg. 5

Using 9mm cutting bit pass over the wood at 2mm increasing depths until a depth of 16mm. 30

Wear eye protection, ear protec- tion, tie back loose clothing and ensure that wires are out of the way. 2

Clamp wood secured to the base of the pillar drill and drill 2mm pilot holes 5

Make sure work is securely clamped, correct cutting speed is chosen, eye protection is worn, guards are down and loose cloth- ing is tied up 2

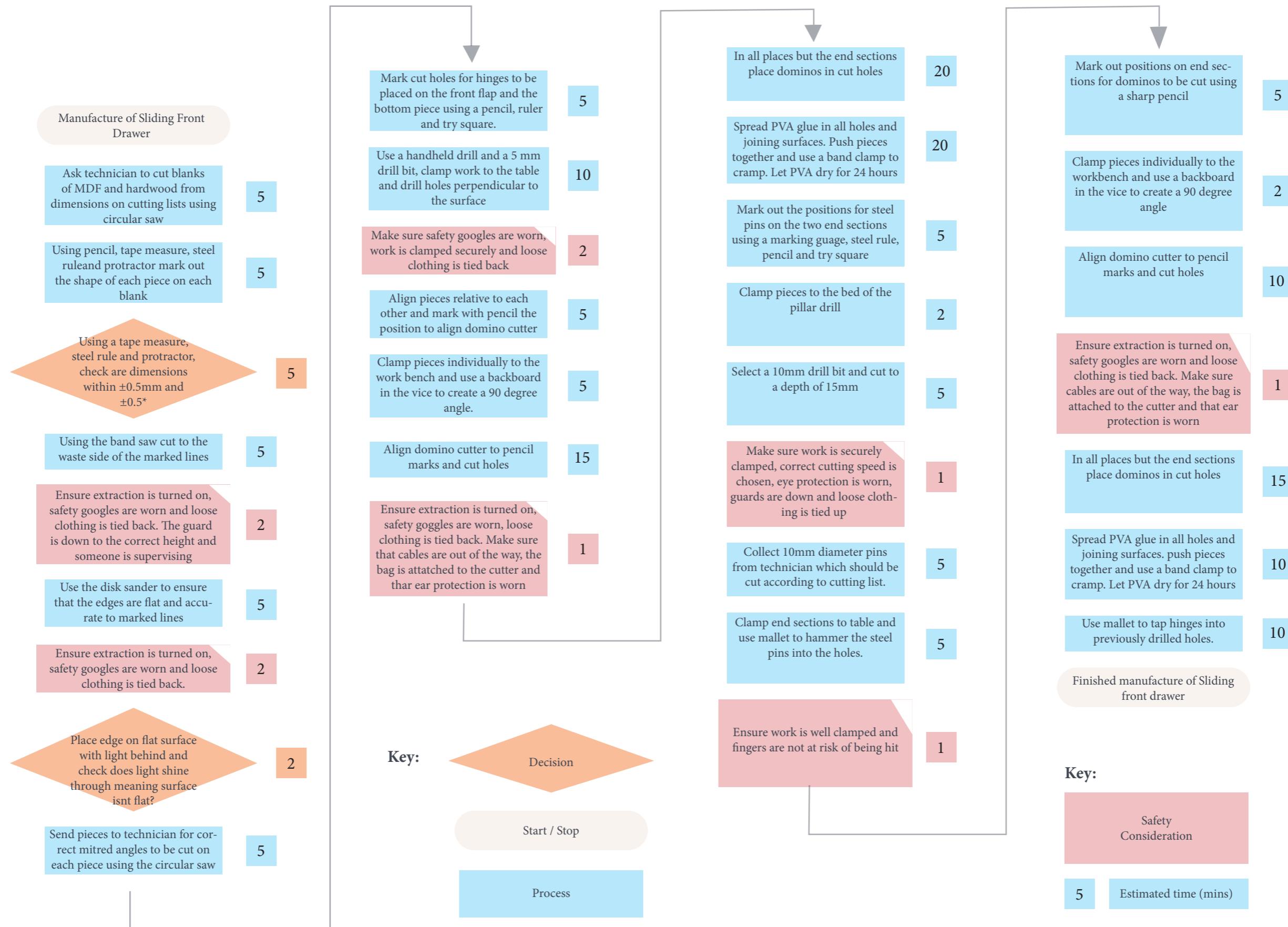
Screw brass slot into the routed groove using 3mm x 20mm screws 2

In both sets of legs place domi- nos in cut holes. 3

Spread PVA glue in all holes and joining surfaces push pieces together and use a band clamp to cramp. Let PVA dry for 24 hours 10

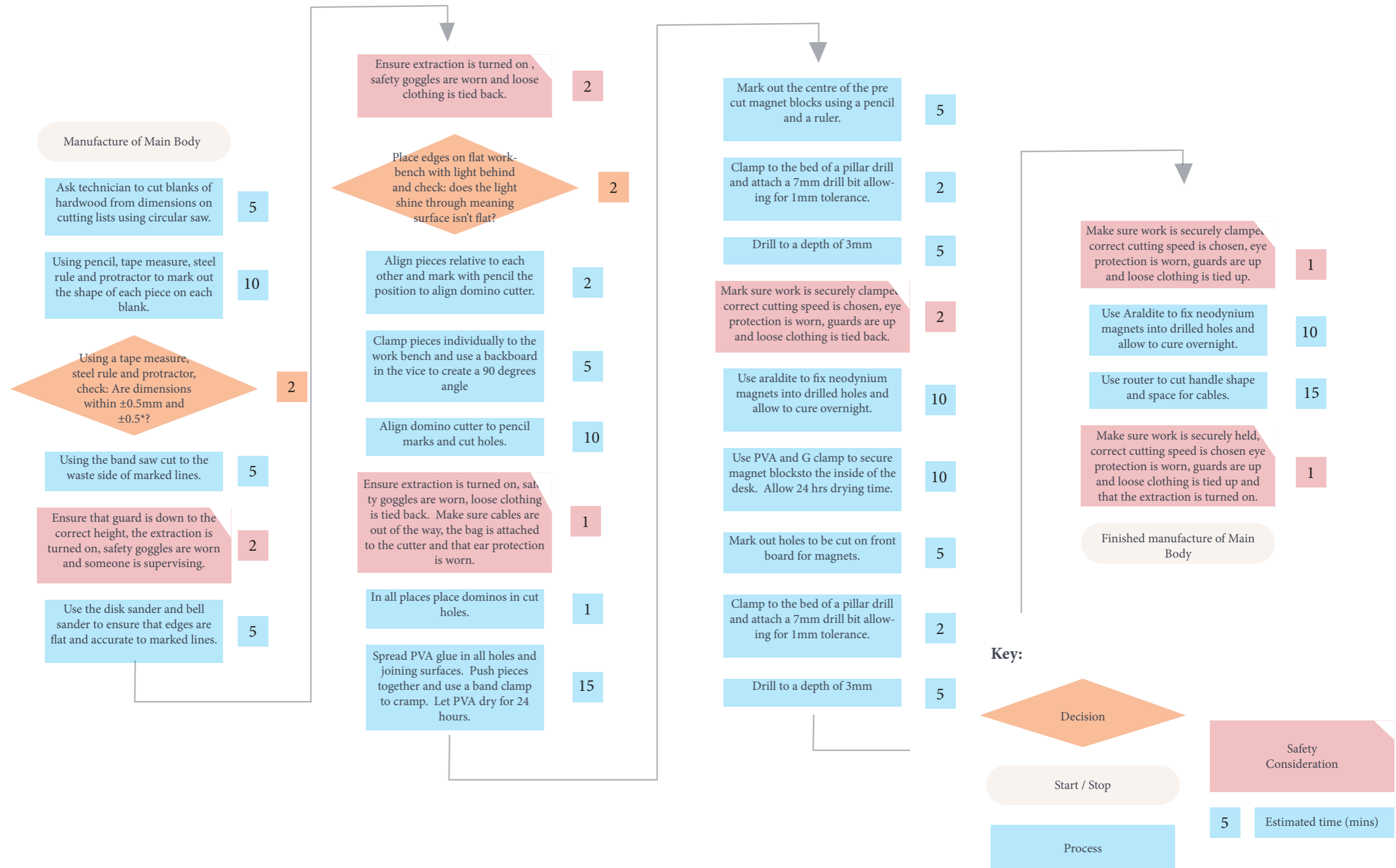
Finished manufacture of Legs

# Flow Chart

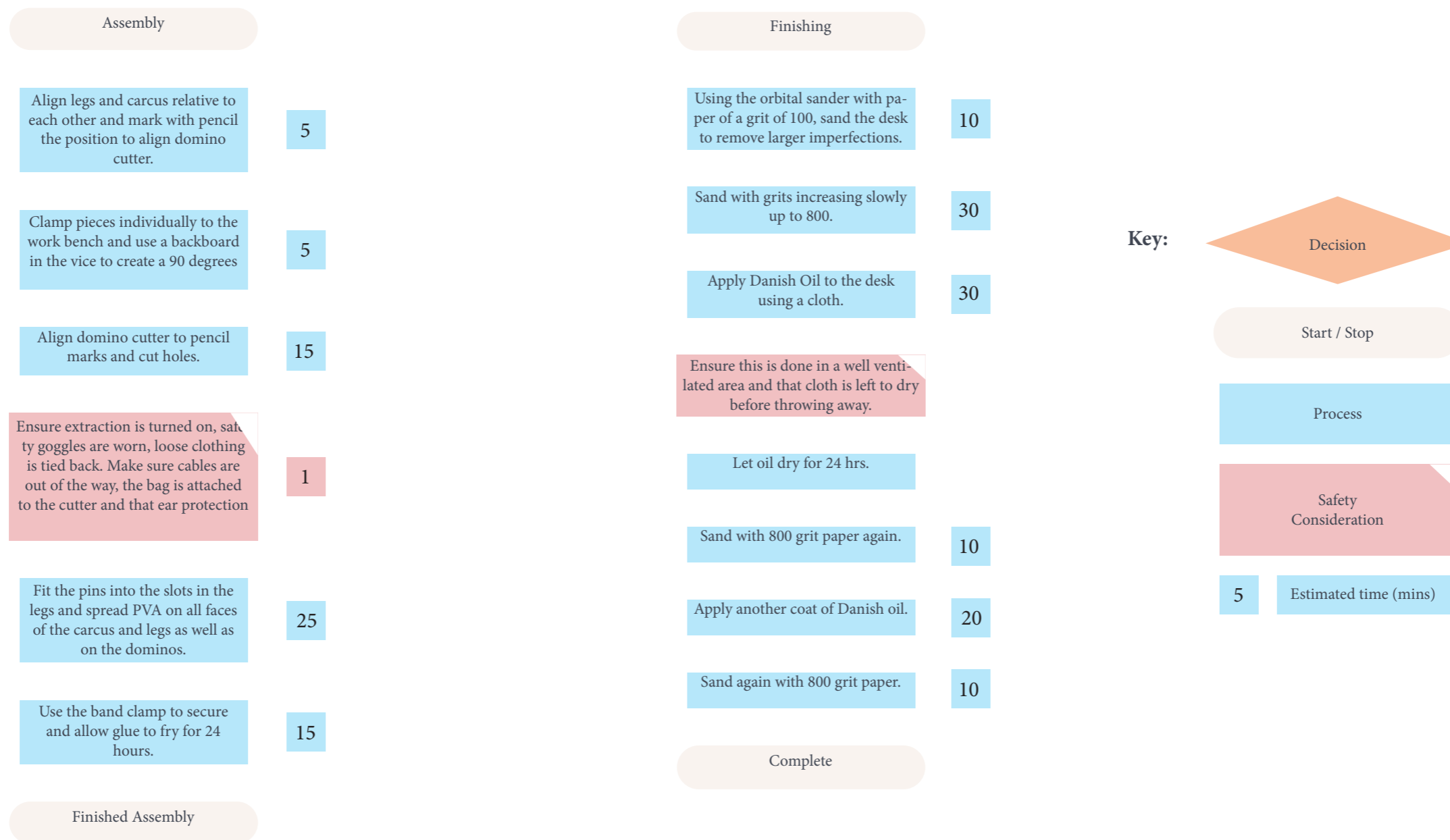




# Flow Chart



# Flow Chart





# Tolerances, Surface Finishes and Outsourced components

## Tolerances



This test piece shows an example of where I have needed to use a tolerance in order to ensure that the pins run smoothly within the groove. In the test piece I use a tolerance of 1.5mm between the diameter of the pins and the width of the groove. However, although this ensures that the pins and drawer run smoothly through the leg, it is also frustrating because the drawer is now too loose. After testing I have ensured that the tolerance is now 1mm which should hopefully be a happier alternative.

Elsewhere in my project I will aim for an accuracy of  $\pm 0.5\text{mm}$  or  $0.5^\circ$ . Due to the complex angles in the project, this high degree of accuracy should allow me to produce a fully working desk. I will detail in my flow chart how I will check the accuracy of each piece that is cut.

Another area of the project that needs tolerance consideration is around the hinges. When the 5mm diameter hinges are fitted into the wood they need to be a tight fit such that they can't move around once fitted. In this situation the wood will be drilled with holes of exactly 5mm diameter and the hinges will be hammered in. In this situation the lack of tolerance will ensure a better fit.

## Surface Finishes



For the surface finish of the brass I have decided that I want a brushed finish for aesthetic reasons. However, the brass plays an important role in the sliding up/down mechanism and therefore it is important that it is protected from any corrosion that might damage the performance of the desk. As a result I will use steel wool to achieve the brushed look of the brass but I will apply a lacquer afterwards to ensure that the brass is protected.

For the wood, I will use Danish oil. Other than its aesthetics, it is very easy to apply and it dries in 4-6 hours per coat. It is food safe when dry. It does not smell when dry. It does not leave a surface film or varnish and therefore will not chip, flake, crack or peel. It is also dirt resistant and resistant to stains.



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## Outsourced components



JOYKK 10 Pieces Copper Brass Wine Jewelry Box Hidden Invisible Concealed Barrel Hinge - Gold by JOYKK

Price: £2.95 FREE delivery.

Promotion Message Promotion Available. 1 promotion

1 new from £2.95

- **Durable Material:** Made of high quality Pure Copper, durable and practical
- **High Performance:** Convenient to carry and use, safe and durable for long term use, easy to use with simple instructions
- **Suitable For:** Perfect for making small cases or boxes
- **Versatile:** Widely used in hotels, wooden doors, counter doors, lightweight caravan worktop or table and other DIYs
- **Size:** 5x25mm/0.2x1"

I have outsourced both these magnets and hinges since they are not available in the school workshop. The important consideration with the hinges was that they remain invisible and as a result, the ones in the school department were not suited. Magnets aren't available in the school workshop so I have chosen to use these from Amazon. I have used them before and they are extremely strong therefore a good adhesive such as epoxy resin will be used to attach the magnets to the wood and will be allowed a long time to dry before testing.

I have also used an external source for my brass. I asked my teacher to order the correct dimensions from 1st Class Metals. Unfortunately the school department didn't have the correct dimensions. This metal will need to have 10 mm shaved off the sides in order to cut it down to the correct width of 40mm which will be done using the milling machine.



N52 Neodymium Cylinder Fridge Magnets (30 pcs) | 6mm x 3mm, 1/4" x 1/8" | Rare Earth Disc Magnets for Arts, Crafts, Hobbies, Home and Office Organization by Magnetron

£5 off your first Treasure Truck order

by Magnetron

★★★★★ 411 ratings | 3 answered questions

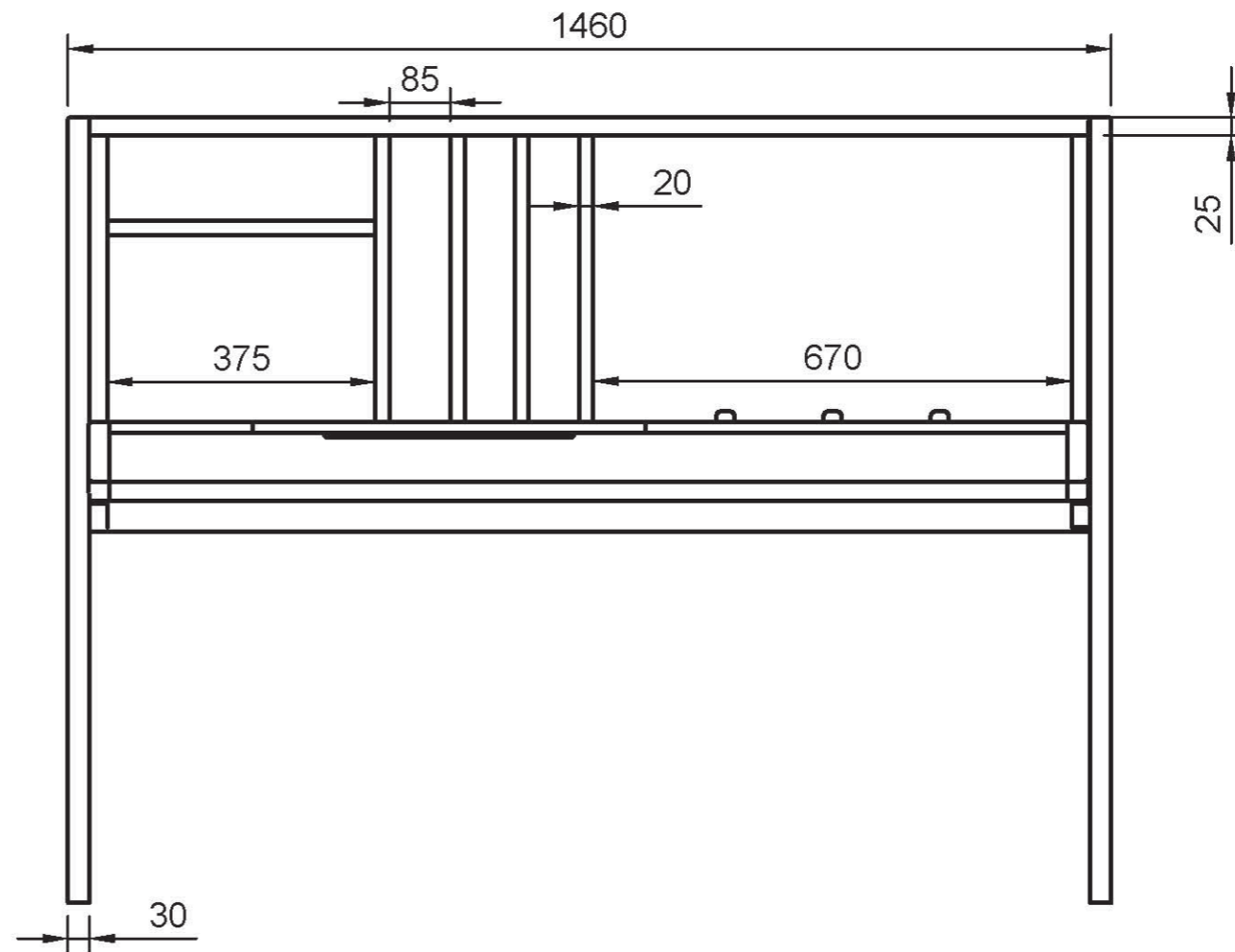
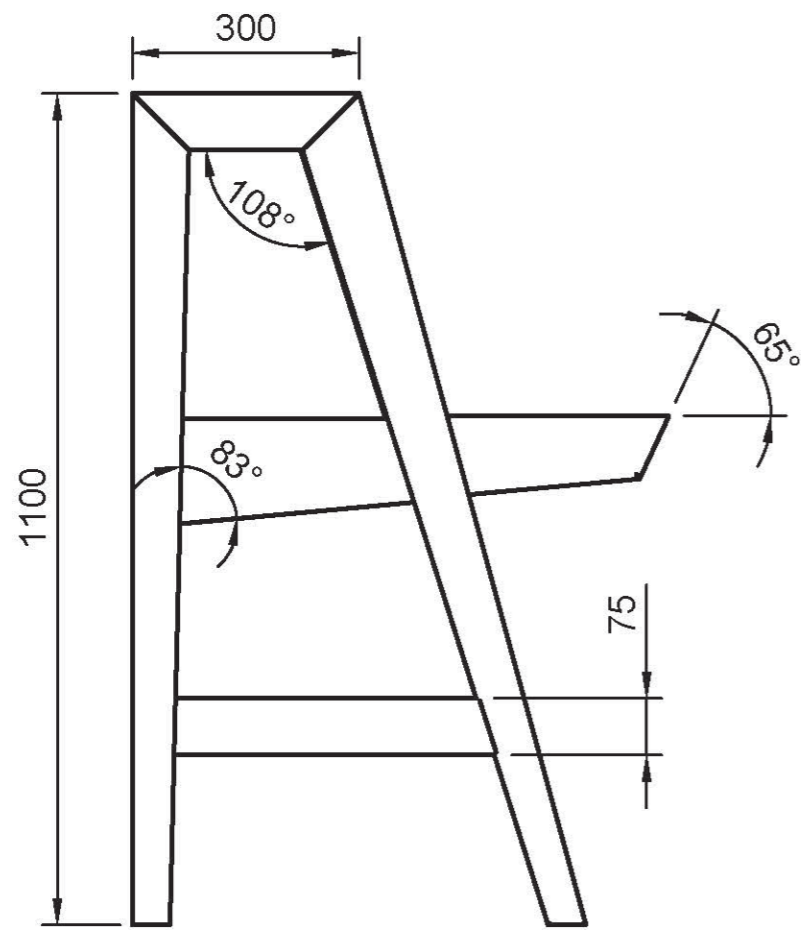
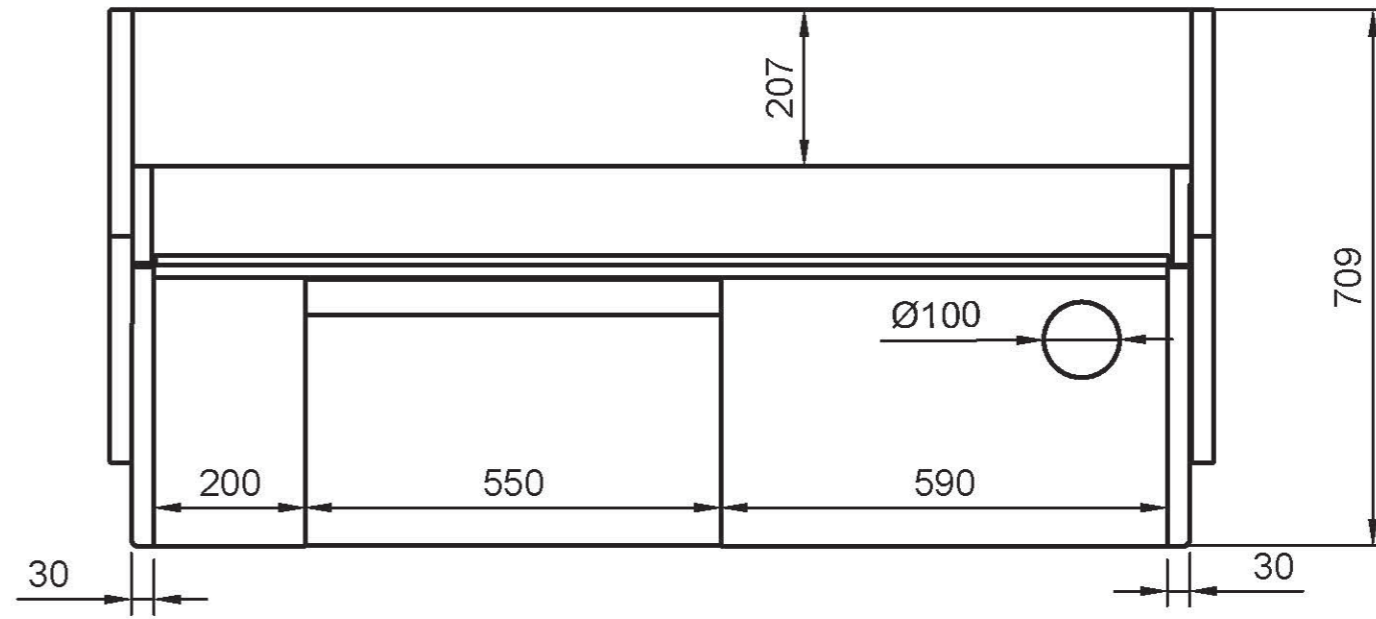
Amazon's Choice for "neodymium magnets"

Price: £4.99 (£1.66 / 10 items) & FREE UK Delivery on orders dispatched by Amazon over £20. Delivery Details

Note: This item is eligible for click and collect. Details

2 new from £4.99

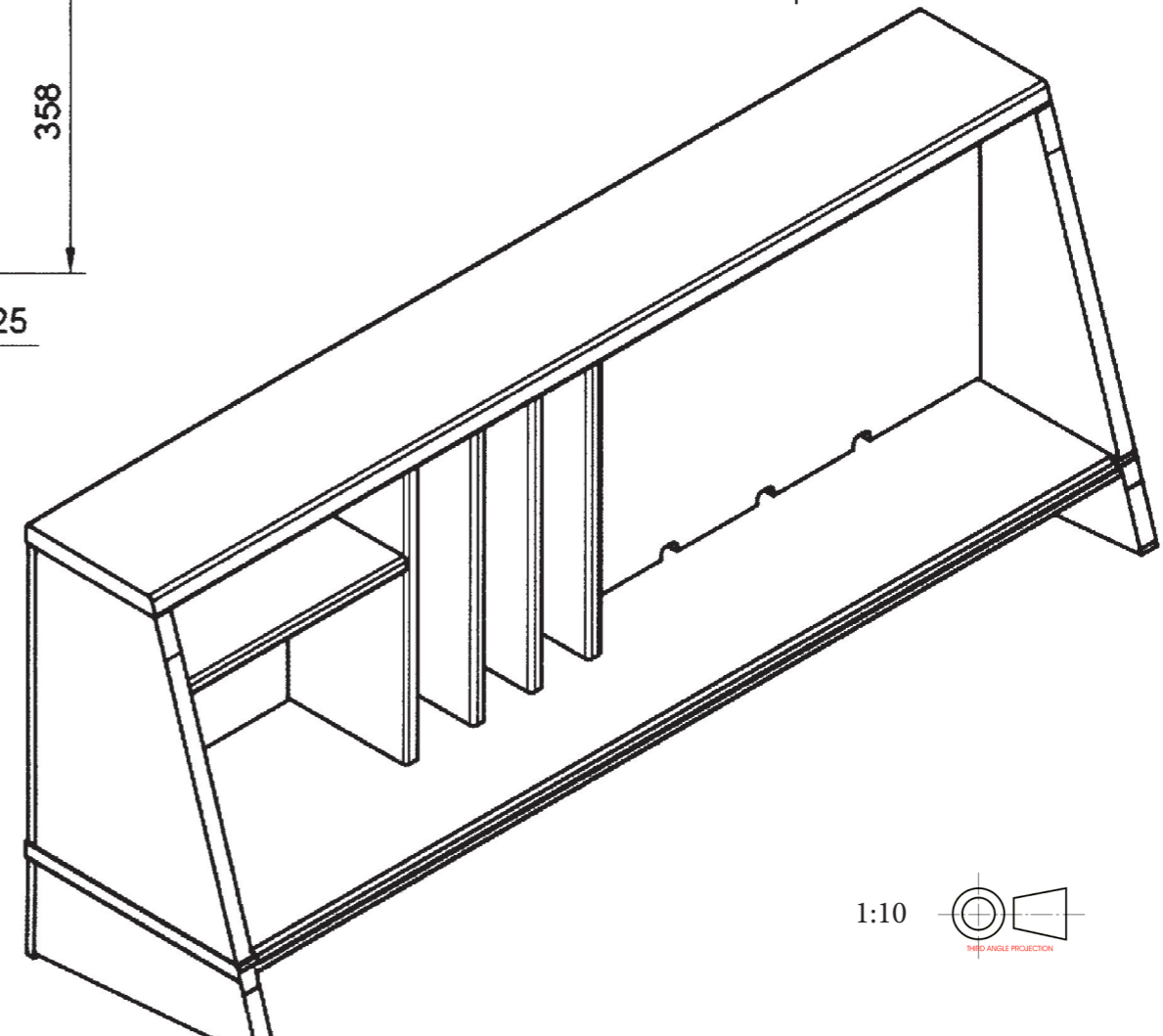
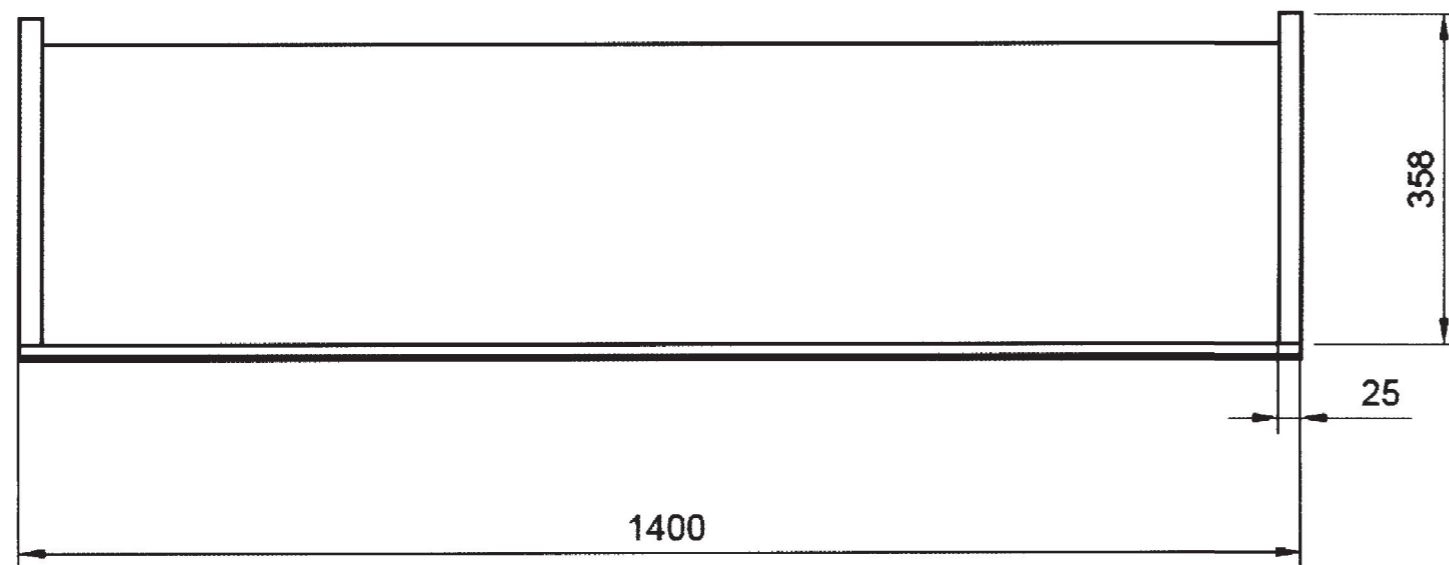
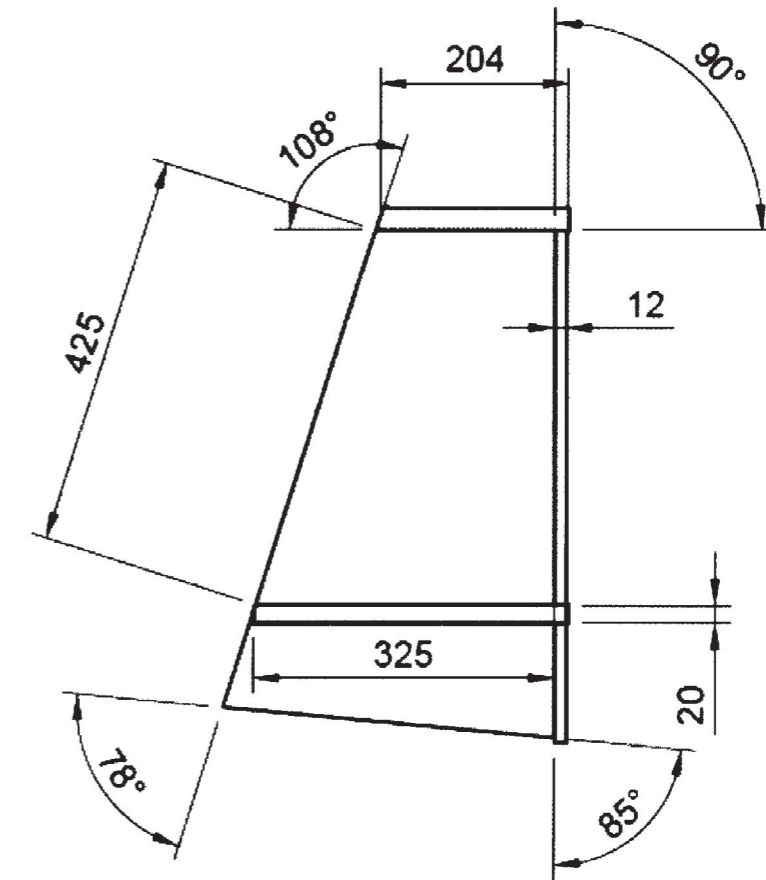
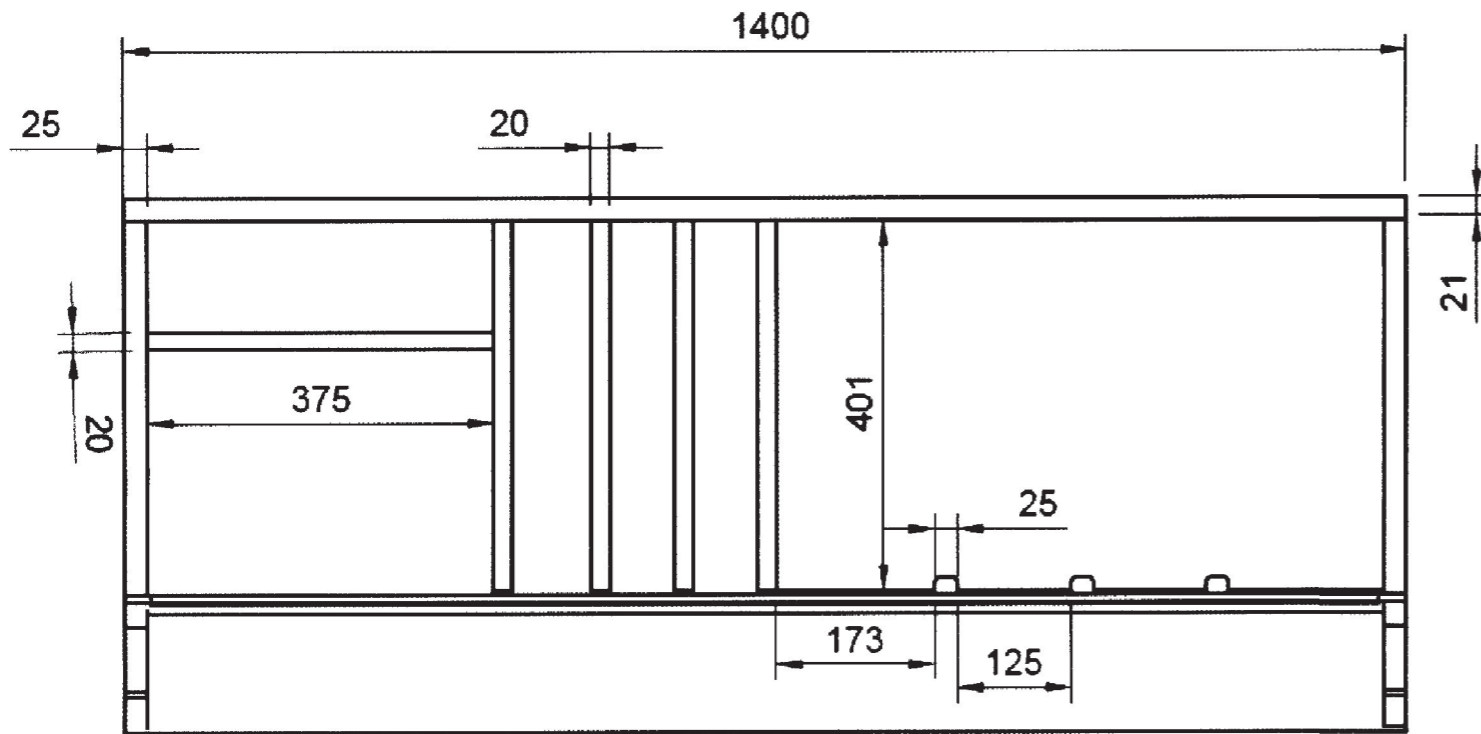
*Orthographic Drawing showing important dimensions*



1:10 FIRST ANGLE PROJECTION



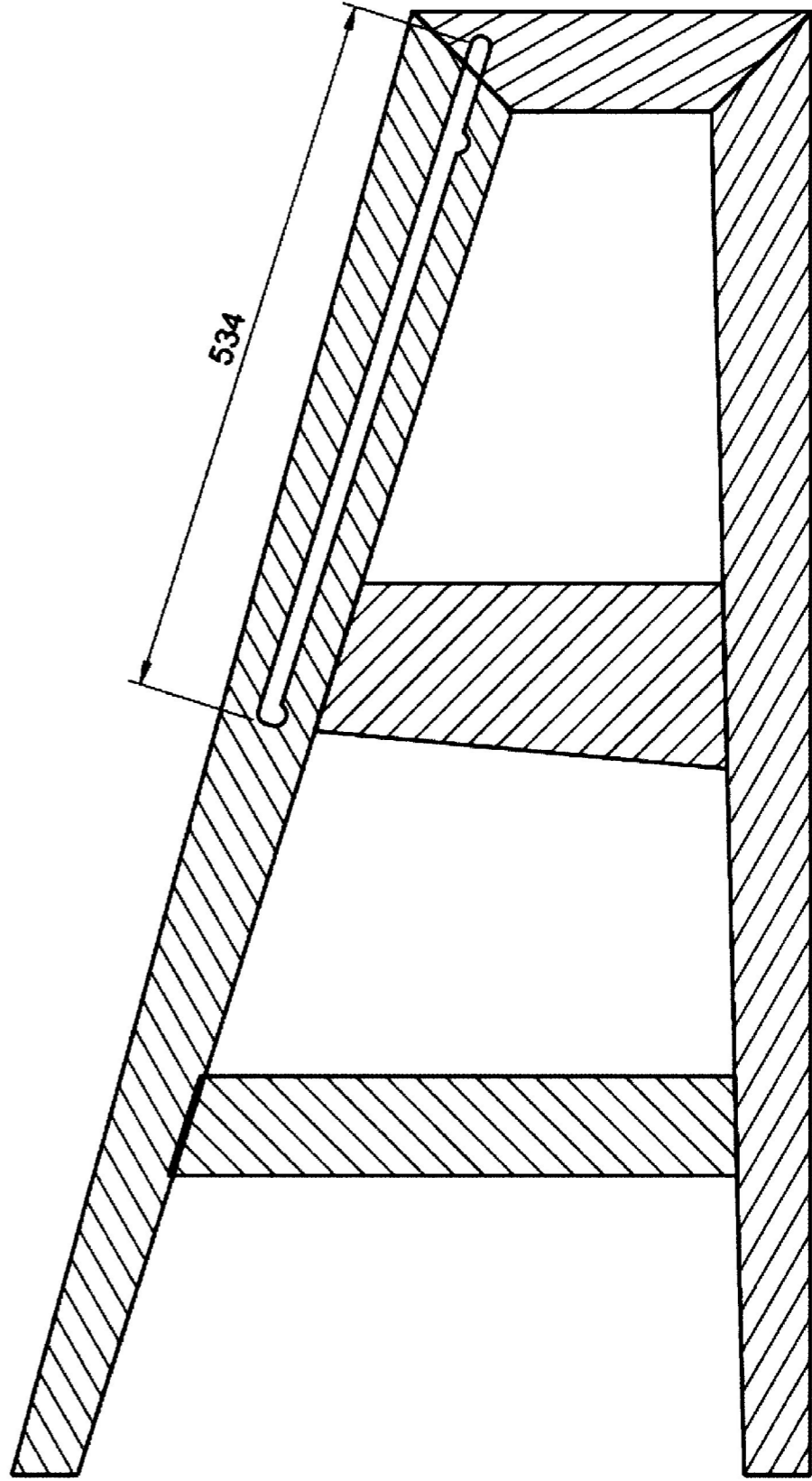
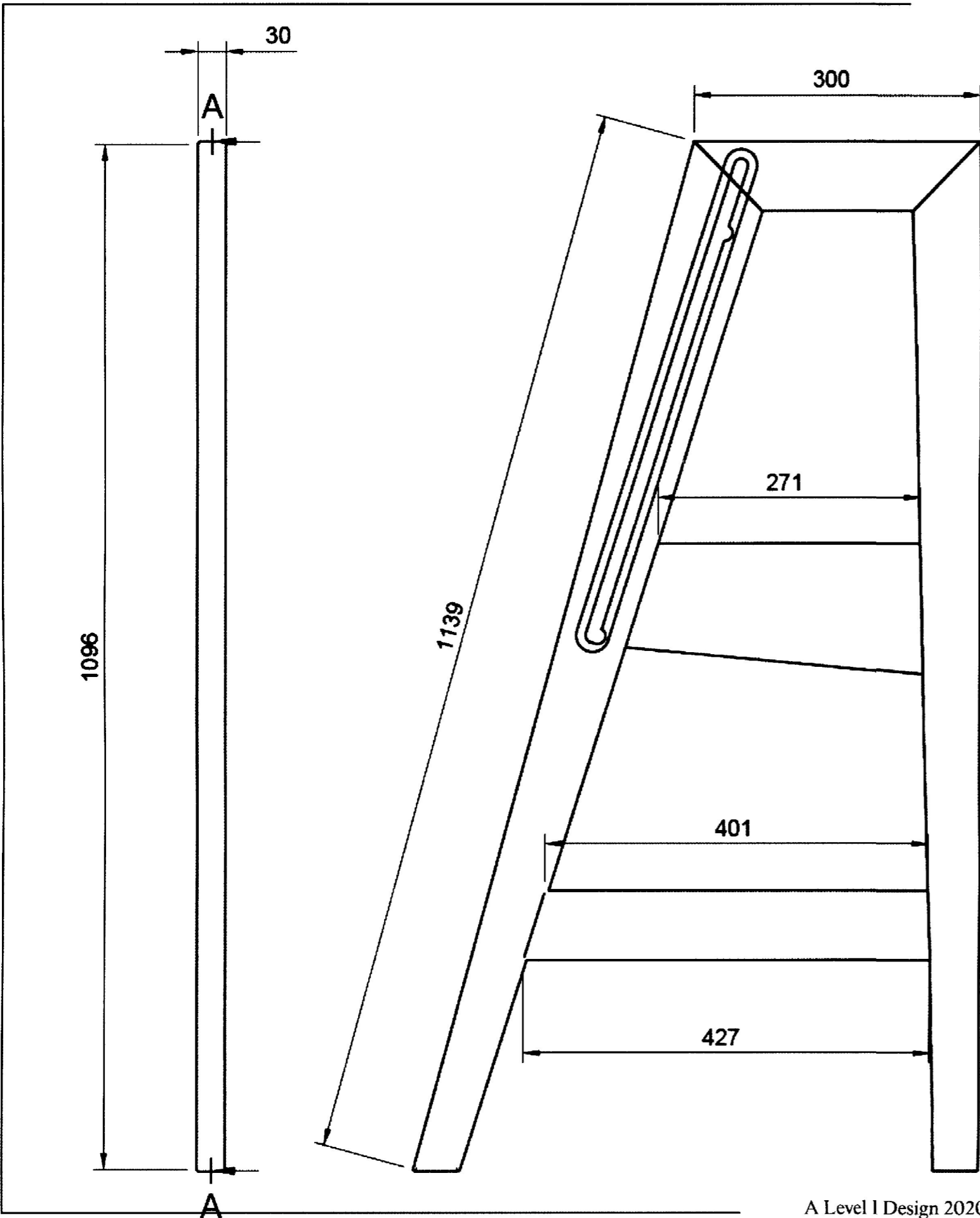
Orthographic drawing showing body dimensions



1:10 

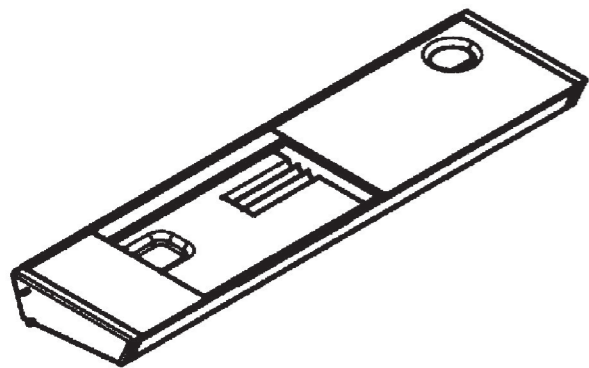
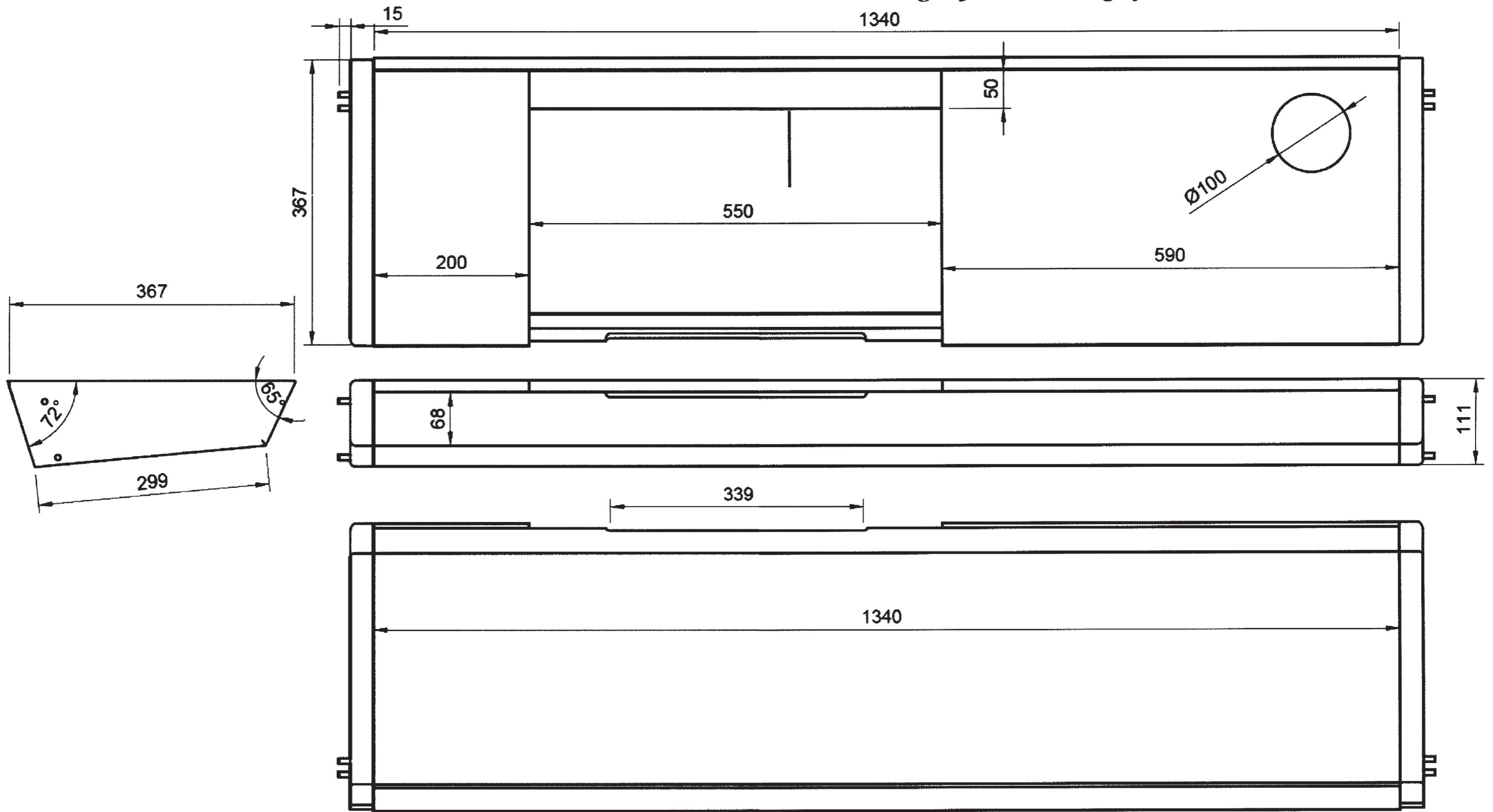
Orthographic drawing of legs

A-A (1:5)

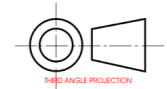




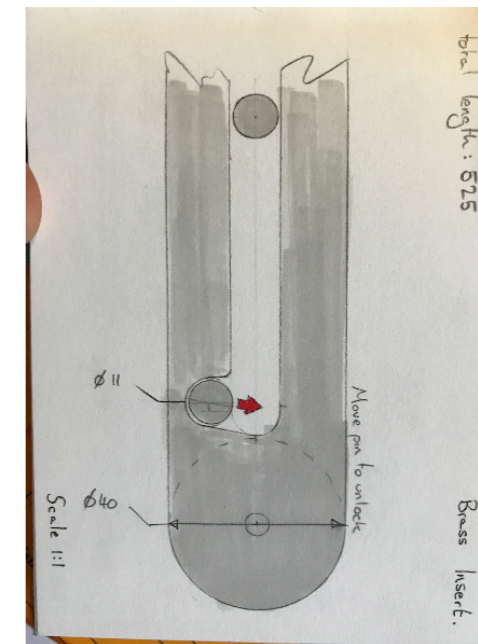
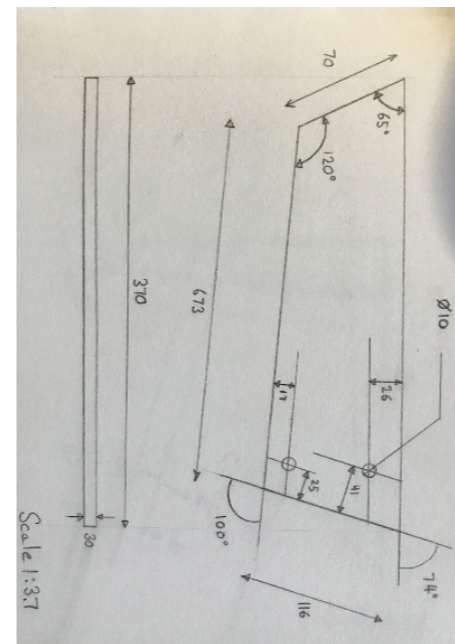
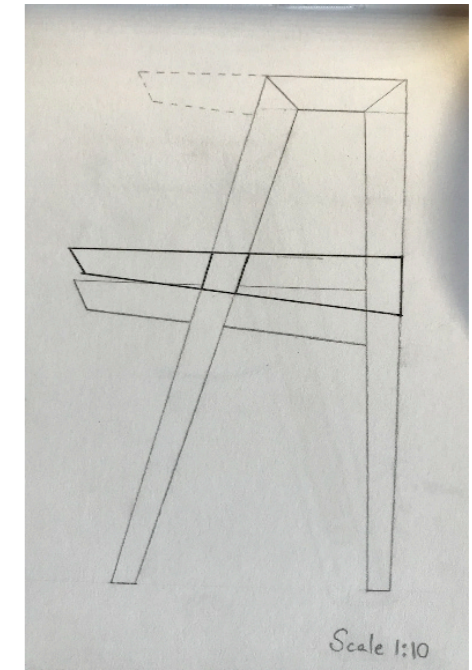
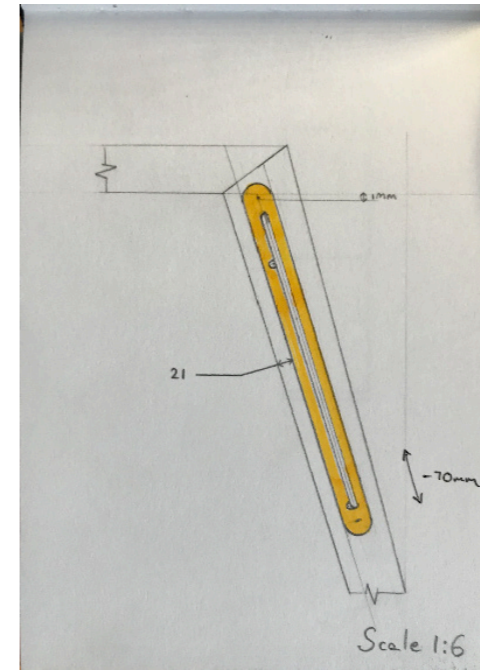
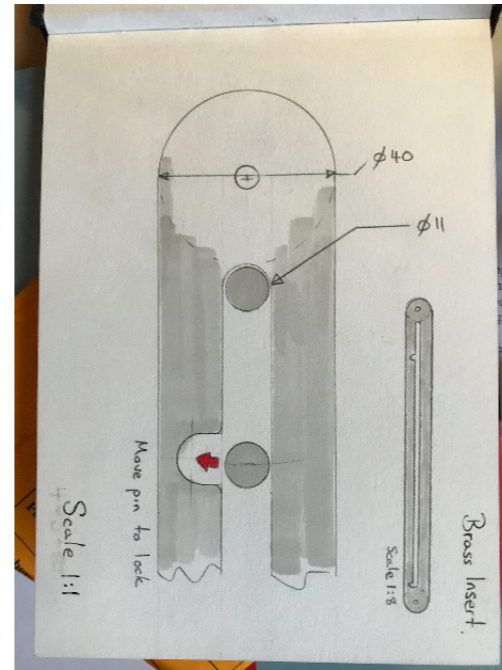
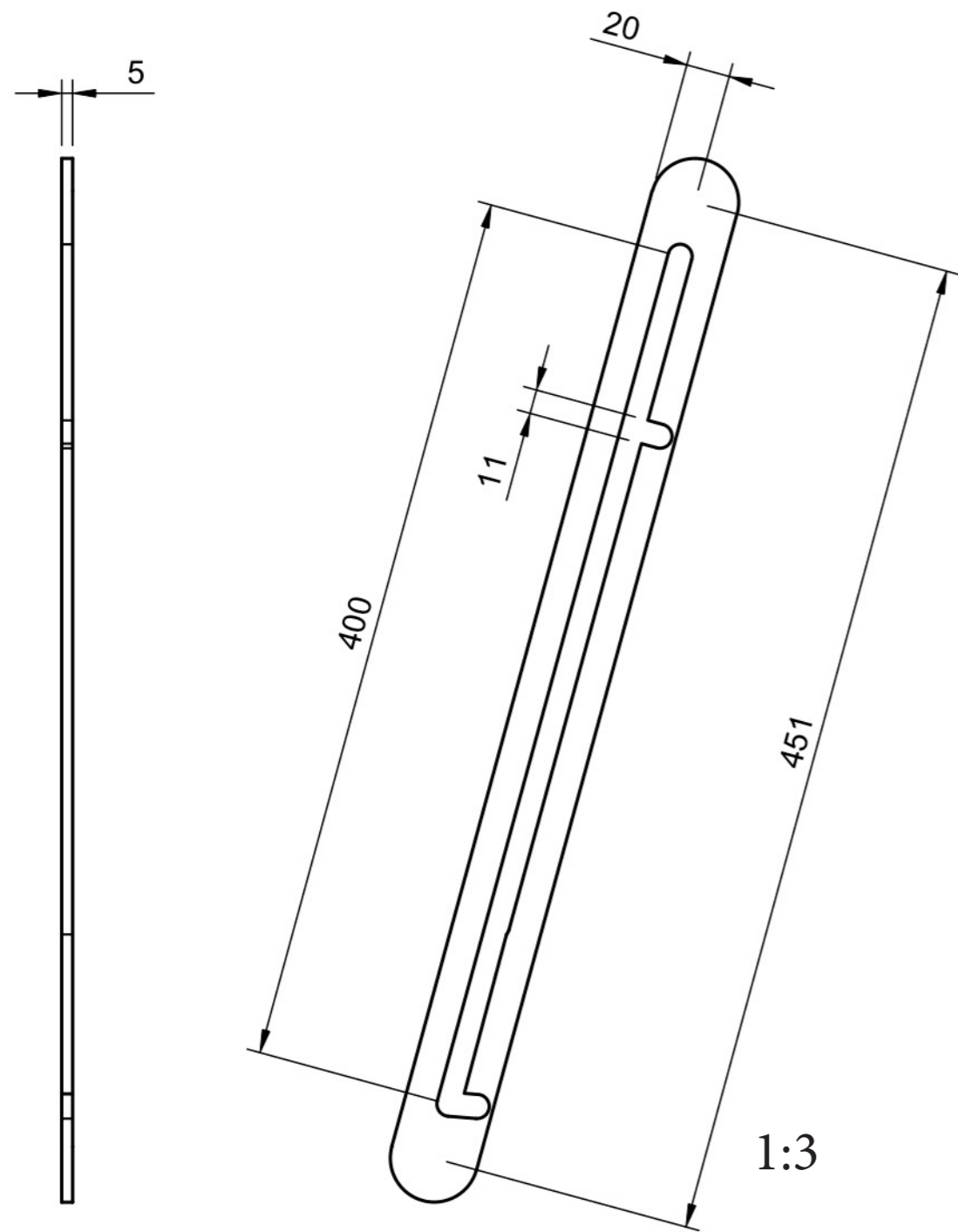
# Orthographic drawing of drawer



1:5



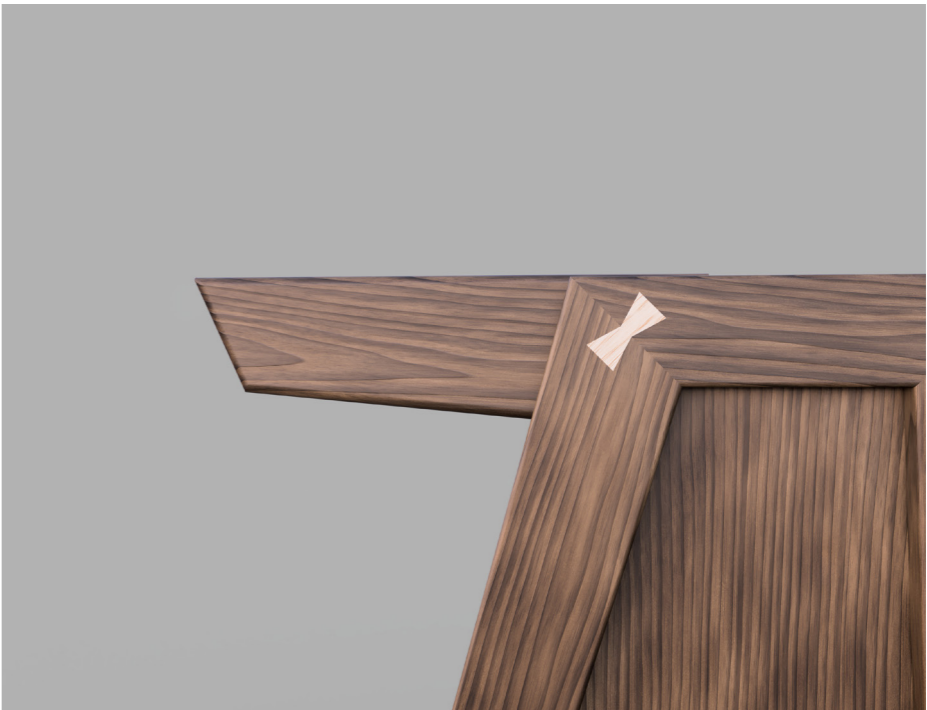
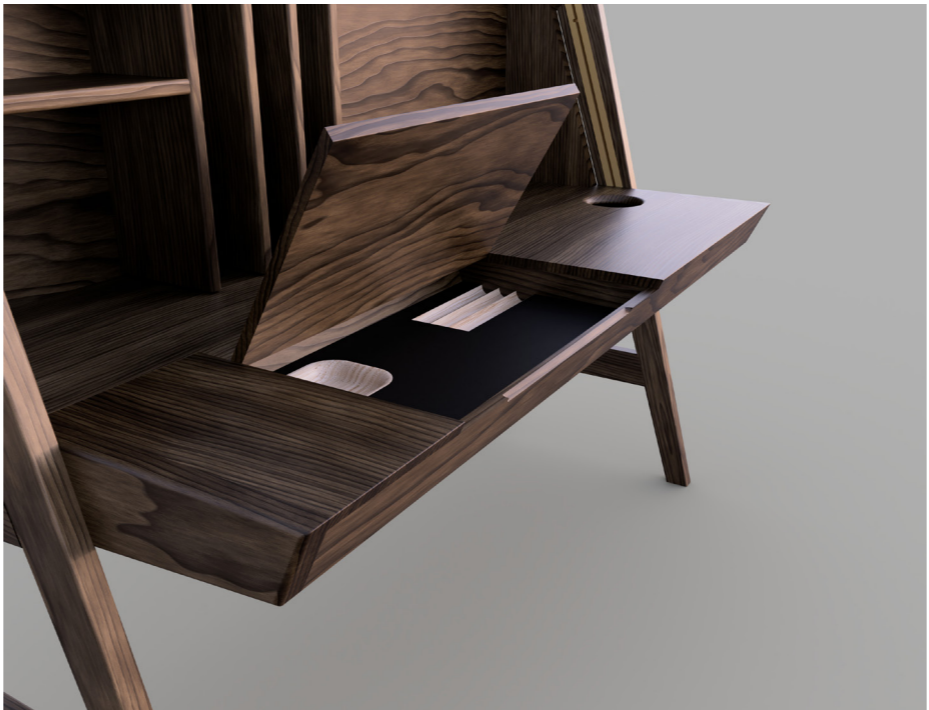
# Orthographic showing brass insert and other sketches



The Orthographic to the left shows the dimensions of the drawer runner which are also detailed in the drawings in my sketchbook above. The drawings in the sketchbook also show modifications that I have made to my design since modelling. For example. In the top right images I have sketched over a 1:10 scale drawing of my design after further ergonomic research to show the new sitting height of the desk.



*Final Renders*



**Grid 7**

**Review of Final  
Idea**



# Review of Development and Final Idea

Focus	Point
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**Introduction**

In order to establish how well my final design solution fits my design specifications I conducted an interview with my client over the phone where he had access to my CAD renders and had also been able to ask me questions the week before about the specifics of my design. I recorded his comments on how well the final design met each of the specification points. In addition, I judged the final design against each of the specification points myself.

**Purpose**

- 1.1 - Provide two or more heights for the user
- 1.2 - Provide a space large enough for sketching work. (At least space for 3 A3 sheets)
- 1.3 - Provide a suitable surface for modelling work
- 1.4 - Be appropriate and comfortable for computer based work
- 1.5 - Create a more productive and comfortable working environment for the user
- 1.6 - Suit the needs of a rented workspace such as WeWork
- 1.7 - Cater for a user group consisting of young creative who need to switch between multiple types of working.
- 1.8 - Help reduce the health impacts of bad working postures
- 1.9 - Efficiently switch between this different types of work. i.e. Sketching and modelling.

**Function**

- 2.1 - Reduce the amount of regular clutter on the user's desk by providing effective storage spaces of different sizes.
- 2.2 - Create a productive work environment by sticking to ergonomic principles.
- 2.3 - Make charging more efficient so that wires don't take up excess space on the desk but are also easy to access.
- 2.4 - Save time in organising/tidying tools and equipment found on the desk on a day to day basis.
- 2.5 - Store key objects (Phone, laptop and pens) within 40cm of the user when they are in the standing or sitting position.
- 2.6 - Have a high degree of adjustability to make the desk suitable to the specific needs of a range of users.
- 2.7 - The desk must adjust between 650mm and 1250mm
- 2.8 - Legroom depth on the floor and up to 120mm above the floor should be 800mm
- 2.9 - The desk must have space to store A3 paper for sketching on (420mm x 297mm)
- 2.10 - The desk must also be able to store A4 writing paper (297mm x 210mm)
- 2.11 - The drawer of the desk must have space of at least 143.6mm x 70.9mm to fit my client's iPhone.
- 2.12 - The desktop must be able to sit a 34.93cm x 24.07cm macbook pro whilst also providing enough space for sketching
- 2.13 - The desk must be able to fit in a wide number of different workplace layouts.
- 2.14 - There must only be one cable entering the desk for charging purposes
- 2.15 - The noise of moving the desk up or down should not be able to be heard in a nextdoor room.
- 2.16 - The top surface must be sufficiently smooth in order that sketching is easy.
- 2.17 - The user must be able to keep elbows at 90 degrees.
- 2.18 - The user should not need to tilt a laptop screen to greater than 20 degrees.
- 2.19 - The desk should provide sectioning in order to partition small objects that are used often.e.g pens, pencils, rulers.

**Form & Aesthetics**

- 3.1 - The desk must fit alongside PINCH furniture and not look unattractive or out of place.
- 3.2 - The desk must allow the natural grain of wood to be visible.
- 3.3 - It must have some element of contrasting colours of wood or perhaps wood and metal.
- 3.4 - The desk must also be equally attractive from all angles. It should be able to be placed in any position within a room
- 3.5 - The legs of the desk should taper to fit with the aesthetic however this is not essential
- 3.6 - Joinery techniques such as dowelling should be left visible to emphasise craftsmanship.
- 3.7 - If there is any paintwork, it must contrast in colour with the grain of the wood.
- 3.8 - The desk must be simple and elegant and declutter the environment
- 3.9 - The desk must look at home in a private focused space as well as a creative busy environment.

**User Requirements**

- 4.1 - Provide a place to store paper and card in a way that it is easily accessible and reduces clutter on the desk itself.
- 4.2 - Provide a way of getting rid of waste card and modelling waste easily such that it doesn't acculuate as mess.
- 4.3 - Have a timber tabletop since it is an attractive surface to sketch on.
- 4.4 - Include large pen pots of diameter greater than 90mm suited towards copic marker pens.
- 4.5 - Be adaptable to future methods of charging such as wireless charging or new cable types and dimensions.
- 4.6 - Provide a method of easily accessing and plugging in cables without any risk of them falling on the floor.
- 4.7 - Arrange pens and pencils neatly within an easily accessible drawer.
- 4.8 - The keyboard must be able to sit lower than a monitor or laptop screen when placed on the desk.
- 4.9 - It must be possible to change from any one height to another within 15 seconds.

**Performance Requirements**

- 5.1 - Be designed in a way such that wrists rest at the same level as elbows when typing.
- 5.2 - Ensure that the user's mouse is within easy reach and on the same level as the user's keyboard.
- 5.3 - Monitor or laptop screen must be aligned so that the top is level with the user's eyes in both standing/sitting positions.
- 5.4 - Have at least one standing height of 105cm ± 5cm
- 5.5 - Have at least one sitting height with bottom the desktop reaching 62cm ± 5cm above the ground.
- 5.6 - There should be no visible or audible strain on the desk when 50kg is loaded onto the desktop.
- 5.7 - Heights should be able to be easily repeated so that a user doesn't have to fiddle to try and find the perfect height every time they adjust the desk.
- 5.8 - Be durable enough to withstand the user leaning or sitting on top surface (800N of force on top surface.)

## My Evaluation

- 1.1 - The desk does this however only two heights are catered for in this specific prototype to suit my client
- 1.2 - This has been the case since initial ideas and is shown to be true in my orthographic drawings
- 1.3 - The space provided is certainly large enough with plenty of storage space for various tools
- 1.4 - The desk provides two comfortable heights changed during testing that suit computer based work
- 1.5 - This is highly subjected and would be better evaluated after manufacture
- 1.6 - The desk works in open spaces as well as against a wall and is also a very adaptable workspace.
- 1.7 - The desk makes it easy to switch between one form of work to the next by simply lifting the front.
- 1.8 - Research into ergonomics was carried out and in addition testing considered ergonomics highly
- 1.9 - Again by lifting the front section of the desk you can completely change your working layout.

- 2.1 - The storage space provided both within the moving tabletop and in the main body are sufficient
- 2.2 - The whole design process has been informed by my ergonomic research established early on
- 2.3 - Development involving secondary research and User centred design helped to find a great solution
- 2.4 - The drawer within the tabletop provides a great way of doing this.
- 2.5 - Again, the drawer uin the tabletop ensures that this is the case in both standing and sitting heights
- 2.6 - The desk is not as adjustable as I would have liked however it suits the specific needs of my client
- 2.7 - It doesn't do this but is designed to the heights needed by my client.
- 2.8 - This was the case before development and remains the case
- 2.9 - The spaces within the main body are designed to store A3 paper and they are easy to access.
- 2.10 - Again the vertical slots in the main body are designed to take A3 paper and make it accessible
- 2.11 - There is a specific compartment for the user's phone to keep it from distracting the user
- 2.12 - The desktop is 670mm x 1400mm which is plenty of space for the laptop and sketching space
- 2.13 - The only layout not possible is with the side against a wall because then the top desktop cant be lifted.
- 2.14 - One cable enters the desk through the back into the charging section.
- 2.15 - I wont be able to test this until later but with my model this is the case.
- 2.16 - Again I can't test this until after manufacture but it is highly likely that this is the case.
- 2.17 - My testing of my model proved that this was the case and this should be carried through.
- 2.18 - My testing of my model proved that this was the case and this should be carried through.
- 2.19 - Inside the drawer of the desk there are multiple sections for pens, pencils, rulers etc.

- 3.1 - Considerable research and specification points helped to make this possible.
- 3.2 - This has been the case since the idea was first drawn up.
- 3.3 - The butterfly joint contrasts with the walnut and the brass compliments the walnut nicely
- 3.4 - I think that this would be better judged by my client
- 3.5 - The legs do taper.
- 3.6 - The butterfly joint shows off craftsmanship even if it doesn't add strength to the joint.
- 3.7 - There is no paintwork in the design
- 3.8 - I think that this would be better judged by my client
- 3.9 - The development into the two types of desk show that both are possible with this form and design

- 4.1 - There is plenty of space to store card within the main body that keeps it neat and accessible
- 4.2 - This isn't the case and it hasn't been developed well enough.
- 4.3 - This has been the case right from when the idea was first drawn up.
- 4.4 - There is one pen pot with diameter 100mm to suit the need of the copic markers
- 4.5 - The spaces for the cables are larger than needed to allow for new types of charging cables.
- 4.6 - The cables won't be able to fall off the desk when they are trapped by the section they sit in
- 4.7 - Pens and pencils are arranged in the drawer that is located in the front desktop as well as the pen pots
- 4.8 - This will only be the case if my client uses the laptop stand that he currently uses
- 4.9 - This cant be tested until after manufacture.

- 5.1 - My development during testing changed the bottom height to allow for this.
- 5.2 - The keyboard and the mouse will both lie on the moveable desktop level.
- 5.3 - This should be possible as long as the client continues to use his laptop stand.
- 5.4 - The standing height is 110cm so this rests within the boundary set out in the specifications.
- 5.5 - The sitting height is at 66cm which is within the range set out in the specifications.
- 5.6 - This wont be able to be tested until after manufacture but I am optimistic after testing.
- 5.7 - The two heights of the desk can be repeated everytime because the notches in the groove remain in the same place.
- 5.8 - Development considered strength of joints in depth to help ensure this be the case after manufacture

## Client Evaluation

- 1.1 - Good that youve picked heights for me in this but with a public one other heights should be considered
- 1.2 - This is fantastic, something I was really happy with after initial ideas and you've kept it
- 1.3 - Plenty of space for my modelling but also lots of storage space, great.
- 1.4 - Yes brilliant and also space for me to sketch alongside too which I always seem to need to do.
- 1.5 - We will have to see about this won't we but I am optimistic
- 1.6 - I can imagine them liking this sort of thing that has postural benefits and is aimed at creatives
- 1.7 - Definitely aimed at more active people who would be creative work.
- 1.8 - Your ergonomic research looks sound so I have no doubt this will be the case
- 1.9 - Yes I love the way I could load my tools on the back of each height and just lift to change.

- 2.1 - Loads of storage space, I particularly like the drawer at the front.
- 2.2 - Like I said earlier, it looks like your ergonomic research is very thorough.
- 2.3 - You did a great job developing ideas but Im happy with our simple solution
- 2.4 - The pen pot and shelving should help a lot
- 2.5 - Yes - like I said that front drawer is perfect for this
- 2.6 - I'm glad that it is only suited to my needs, makes it easier for me
- 2.7 - As long as it reaches my heights I'm happy
- 2.8 -
- 2.9 - Looks great
- 2.10 - Perfect
- 2.11 -
- 2.12 -
- 2.13 - Yes but most likely with the back to a wall no?
- 2.14 -
- 2.15 - This isnt much of an issue for me anyway
- 2.16 - This will definitely be fine if it is manufactured well
- 2.17 -
- 2.18 -
- 2.19 - The work youve done on CAD showing that frint drawer is great.

- 3.1 - Yes, the materials that you have chosen are smart and the colour pairing of the brass and walnut
- 3.2 - Very important yes
- 3.3 - Yep like I said with the walnut and Brass
- 3.4 - Maybe less so from behind but thats my fault for asking for a back.
- 3.5 - They look great
- 3.6 - The butterfly joint is cool - good luck manufacturing
- 3.7 -
- 3.8 - The storage space is great and I think it looks elegant
- 3.9 - Yes - loved the renders you did of the two different desks too

- 4.1 - Definitely enough space at the back of the desk
- 4.2 - Yes maybe this could have been developed a bit better
- 4.3 - Yes- very important to me
- 4.4 - Brilliant - I really lack these at the moment
- 4.5 - That back charging is fairly versatile and will definitely work for all my needs
- 4.6 - Yes- a well developed solution
- 4.7 - Yes, a great solution within that front drawer.
- 4.8 - Shouldnt be a problem for me with my laptop stand
- 4.9 - We shall see

- 5.1 - Hopefully this is the case
- 5.2 -
- 5.3 - Should always be possible with the laptop stand that I've got
- 5.4 - Perfect for me
- 5.5 - Brilliant
- 5.6 -
- 5.7 -
- 5.8 - Your development looks solid in this area

# Review of Development and Final Idea

Focus	Point	My Evaluation	Client Evaluation
Materials	6.1 - Materials should be of high quality and fit the aesthetic of other PINCH furniture. 6.2 - Have a timber tabletop at the request of my client. 6.3 - Make considerations to other cheaper materials that may help widen the target market. 6.4 - Use wood composites in place of natural timber to reduce cost and increase the range of target market.	6.1 - Materials have been changed and still fit the PINCH aesthetic in my opinion. 6.2 - The tabletop is indeed timber 6.3 - My development mentions the Beech and Aluminium alternative in depth. 6.4 - MDF had been chosen to make up the main body as a result of development.	6.1 - Definitely, we have desks with that Walnut and Brass pairing. 6.2 - 6.3 - We talked in depth about a Beech and Aluminium alternative. 6.4 - As much as I'd prefer something entirely from natural timber it is a sensible solution
Size	7.1 - The depth of the desk must be no shorter than 55cm to allow enough space for arms to rest during typing. 7.2 - The desk must also be no deeper than 72cm so that far objects are never out of reach. 7.3 - The legroom that the desk provides must be at least 90cm for maximum comfort. 7.4 - The desk must be no wider than 150cm by client request 7.5 - The standing height of the top of the monitor screen must be 158cm ± 7cm 7.6 - Desktop can not be thicker than 55mm at the front and 80mm at 500mm from the front edge	7.1 - The desk is deeper than 55cm allowing for arms to rest properly 7.2 - The desk is 67cm deep at the deepest point so doesn't exceed this specification point 7.3 - The legroom is greater than 90cm 7.4 - The desk is 140cm wide 7.5 - The desk is 110cm tall so standing on my client's laptop stand the laptop screen is high enough. 7.6 - The desktop isn't too thick at the very front however it is thicker than 80mm at 500mm in	7.1 - 7.2 - A good size for where I'm working 7.3 - 7.4 - Especially important now that the desktop is being lifted in this way 7.5 - I can always adjust this with my laptop stand. 7.6 - This didn't look to be a problem in your testing so hopefully it's fine.
Sustainability	8.1 - The desk must be comprised of at least 80% wood by mass 8.2 - Components must be easily separated into their individual materials to help with recycling. 8.3 - All materials must be sustainably sourced. 8.4 - The desk must also use very little of materials that are extremely energy intensive to produce. 8.5 - Any jigs or templates used during manufacture must be made from sustainably sourced materials.	8.1 - The desk is comprised of greater than 80 percent of wood by mass 8.2 - Wood and brass are easily separated as well as brass hinges and the magnets 8.3 - The school workshop only use sustainably sourced materials 8.4 - Brass is the material that is most energy intensive to make in my project and there isn't a huge amount 8.5 - All jigs will be made from MDF or acrylic from the school workshop.	8.1 - Good job 8.2 - 8.3 - 8.4 - 8.5 -
Safety	9.1 - There must be no more than six plug sockets allowed per supply. 9.2 - Power supply cords must not exceed 2m in visible length on exit from the desk clamp. 9.3 - Cable must be clamped at point of entry to desk and/ or at both ends where cables connect separate moving parts. 9.4 - All extraneous metalwork should be earthed. 9.5 - The weight distribution of the desk should be towards the base in order to increase stability 9.6 - There should be no wobble at any of the heights of the desk. 9.7 - Desk corners should not be able to be caught on clothing.	9.1 - There is one plug socket needed and an extension cable with 4 sockets 9.2 - This depends on where the desk is located within the room 9.3 - Cable is clamped to desk leg 9.4 - There is no extraneous metal work that needs to be earthed 9.5 - This isn't the case however the legs widen to increase stability 9.6 - Development has considered joint stability to help that this is the case after testing 9.7 - There is a radius on all corners which should make this likely when the desk is tested	9.1 - 9.2 - 9.3 - A bit late now but I would have liked the cable to run inside the desk leg 9.4 - 9.5 - Your testing should tell 9.6 - Again we will see when you test it 9.7 - Also high quality manufacturing will help with this
Scale of Production	10.1 - The prototype will be made as a one-off bespoke piece 10.2 - Should the desk become commercially available, it will be manufactured in batch production. 10.3 - Even though the prototype is a one-off, the manufacturing processes should aim to reflect those of batch production.	10.1 - This is the case 10.2 - Yes 10.3 - Jigs and templates for the brass slot and the routed groove have already been made and tested	10.1 - 10.2 - 10.3 - Great use of jigs in your testing that can be replicated in your manufacturing
Cost	11.1 - The budget for this project is £1,000	11.1 - The materials cost is lower than the proposed budget	11.1 -
Quality	12.1 - When the Ashesion Test is carried out, the detachment of small flakes at the intersections of the cuts must not be greater than 5% 12.2 - The scratch test should be carried out using a scribe and different masses. The effects shouldn't appear visible until the mass reaches 800g. 12.3 - When a 19mm steel ball of mass 28g is dropped from 2m above the surface of the desk, the defect or crack must be no deeper than 5mm.	12.1 - To be tested after manufacture 12.2 - To be tested after manufacture 12.3 - To be tested after manufacture	12.1 - 12.2 - 12.3 -

## Client Conclusion

A desk that suits my needs very well and should also be practical in a shared workspace. Well done.

## My Conclusion

My development helped me to design a prototype that meets almost all of my specification points and seems like an attractive option to my client. There are still lots of things that can be tested after manufacturing. Modelling was key in many ways. It dealt heavily with issues of stability and I was able to consider the best option for particular joints. It also helped to develop concrete heights for the desk where I used a friend to determine comfortable standing and sitting heights with the full sized model of the A frame that I manufactured. All the test pieces taught me about the manufacturing process and I now have jigs and templates to use in manufacture that I know performed well in my testing. Overall I am very happy with how my prototype fits with the specification points.



**Grid 9**

**Making a Final  
Prototype**



