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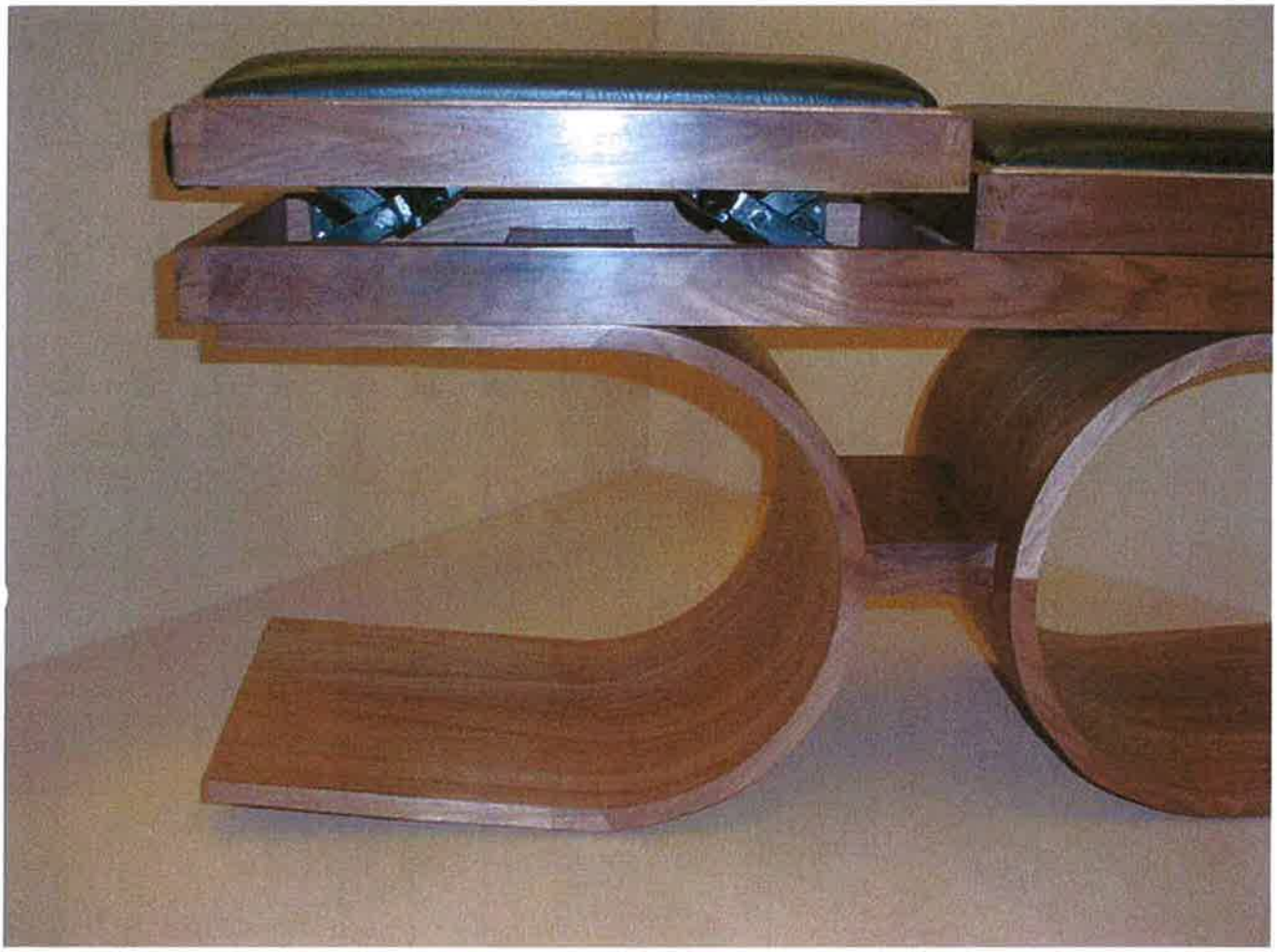
Website Exemplar

GCE D&T Resistant Materials.

Unit: 6RM04.

Topic: Piano Stool.

Piano Seat



Contents Page

Situation; Client; Design Brief

My client
Interview

I have been taught piano for the past 11 years and I have asked my teacher if she had any problems when teaching or if anything could make her job easier. Her name is Louise Stewart, she has been teaching piano for 13 years.

When I asked her if I could make anything to make her teaching easier she asked for a week to think about it and when she responded she said;

"When I have to teach younger children (which are around 60% of my pupils) it is at times difficult to communicate with them when I am such a distance away from them. If I could be on the same level and play the piece an octave lower, it would make it easier to communicate what I am trying to teach. I have seen a duet seat in some shops but they are very expensive and I cannot justify it at the moment. If it is possible for you to make something along the lines of the duet seats on the market, or solve the problem in another way it would be a great help to both myself and the pupils."

This was a great project to have because there was a lot of scope for creativity to make the product original and not like the designs that are on the market at the minute.

Situation

When teaching piano to students, young students especially, it can be difficult to communicate what you mean by just standing over them or kneeling down beside them.

The best way would be to sit beside them, on the same level and play the tune with them an octave lower.

However ordinary solo piano stools are not long enough to sit two people.

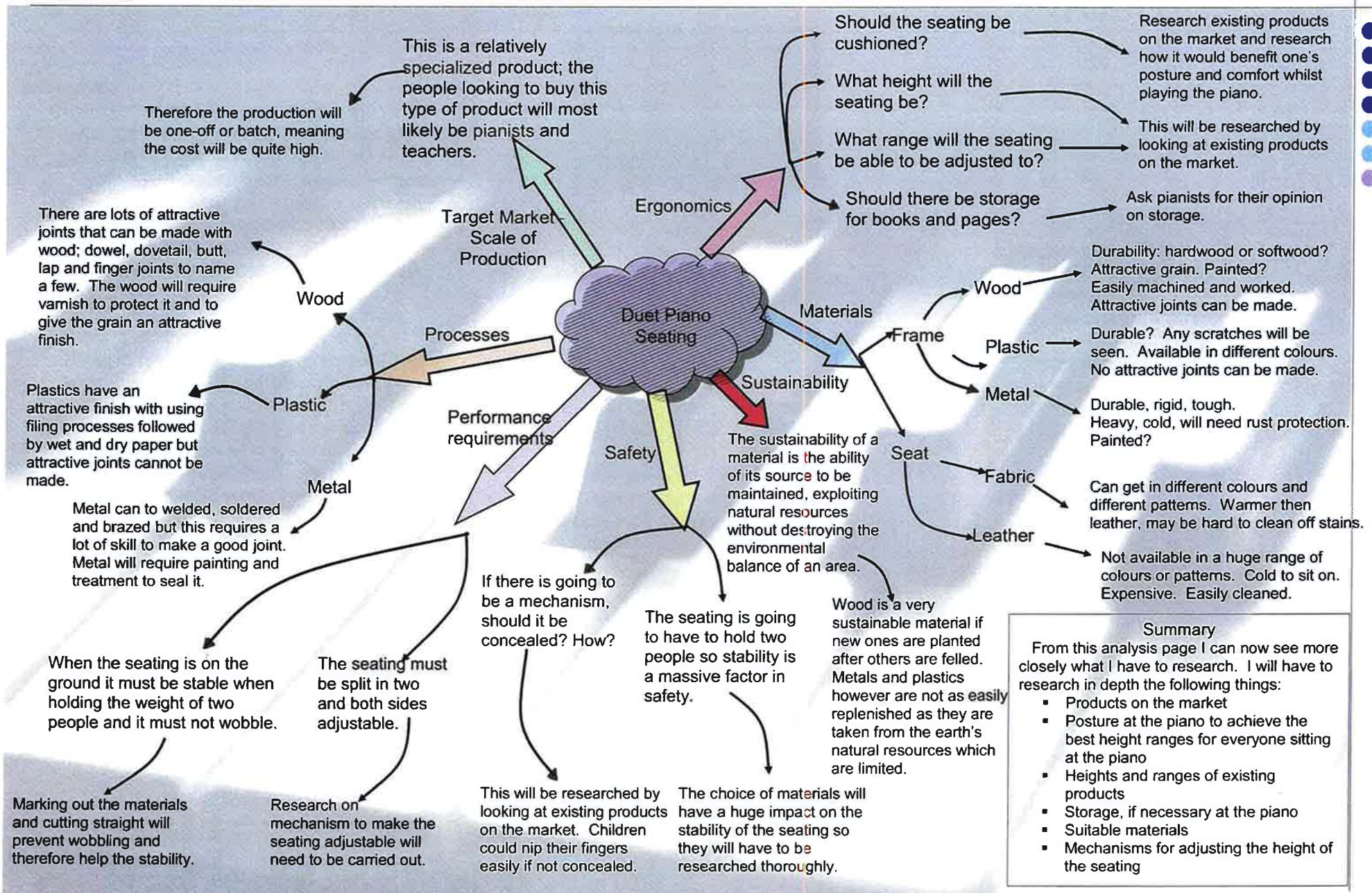
There is also the issue that young children are smaller than the teacher and if they were both to sit on a seat, the seat would be better if it was split in two and each side is adjustable in height.

Design Brief

To overcome this problem I am going to design and make a longer, duet seat for the piano with two seats which are individually adjustable in height. This will enable the child to adjust the height for their comfort and the teacher can adjust their side to their preferred height, thus making teaching that much easier.

The seat must be wide and long enough for two people to sit contentedly and also so they both have sufficient arm room. The seat will have to be comfortable to sit on and be easily adjusted in height. It must also be stable - able to hold the weight of two people, and made of sustainable materials and processes.

Analysis



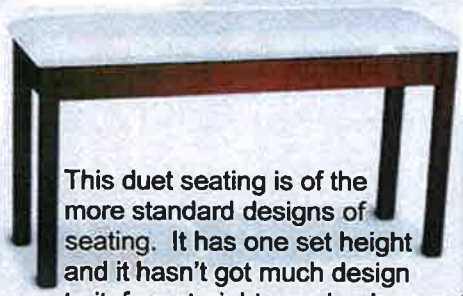
Summary

From this analysis page I can now see more closely what I have to research. I will have to research in depth the following things:

- Products on the market
- Posture at the piano to achieve the best height ranges for everyone sitting at the piano
- Heights and ranges of existing products
- Storage, if necessary at the piano
- Suitable materials
- Mechanisms for adjusting the height of the seating

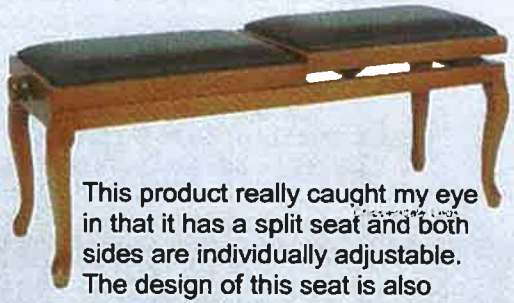
Research

There are many piano seating arrangements on the market, some are very standard but there are also more advanced seats that can adjust in height.



This duet seating is of the more standard designs of seating. It has one set height and it hasn't got much design to it, four straight wooden legs. However it has a cushioned top for the comfort of the user. It is the cheapest of all the products in my research at £117.

This seat is more advanced than the previous as it is adjustable in height; its range is from 50.5cm to 58.5cm, meaning there is 8cm where the seating can go up, or down to accustom the player. This feature may be an advantage but not always because unless both pianists are of the same height and size, the adjustable mechanism is a bit of a waste.



This product really caught my eye in that it has a split seat and both sides are individually adjustable. The design of this seat is also very attractive as the legs are curved which brings an interesting flare to the product. £339.99

I tried to find a seating arrangement that did not have the standard four legged design, it was difficult to find such products but this one I liked. It has an old look to it with the design on the legs but this detail is very attractive. There is a thick cushion on each of the seats which would be nice to sit on.

This is my favourite of all the seating arrangements in my research as it is different from any of the others. It is round, not square. It has an interesting leg design, not the standard four legs. And finally, the detail in the base and the studding around the fabric is spectacular, not like the others on this page which look like they were produced off a manufacturing line in a factory; this product was carefully crafted by skilled and careful hands.

Research

Posture at the piano

The right height of the seating and its distance from the piano is very much a matter of personal taste. Sit at the piano with your elbows at your sides and forearms parallel to the keys. *With your hands on the keys in playing position, the elbows should be at the height of the keys.* Do not sit at the centre of the bench, sit closer to the front edge.

The best **height** for sitting at the piano is one which both allows the elbow/upper arm to fall freely from the shoulder, and allows the forearm to be parallel with the floor.

These pictures are of an adult (above) and a child (left) sitting with the correct posture at the piano. If the seat was not height adjustable, the child would not be able to sit comfortably. There is a big height difference in the two people and this is reflected in the amount the seat had to be adjusted.

If the two people where to sit on a duet seat together that could not be adjusted in height, one of them will not have the right posture to sit comfortably at the piano. This is why the both sides of the seat must be separately adjustable in height, so the two people can sit comfortably together.

Storage for books and pages of music is very useful to have in some cases, like if the pianist only owns a few books. All of your music books are then together in one place near your piano, without having to look for them. My client currently has storage for her music beneath her piano seat like the one below and she said currently it is filled with junk as it isn't big enough to store all of her music books. She requires a bigger storage unit and does not recommend the duet seating I am to design and make to have storage built in.

Average Heights, Widths and Lengths of 20 Typical Piano Duet Seating Arrangements

Height/cm	Width/cm	Length/cm
51	33	60
51	36	86
51	35	85
51	36	86
51	36	104
51	33	105
51	35	96
50.5 – 58.5	33	91
50.5 – 58.5	33	91
50.5 – 58.5	35	110
50.5 – 58.5	34	110
49 – 56.5	35	117
48 – 58	32	91
48 – 58	32	111
48 – 58	33	112
48 – 58	33	112
46 – 59	30	110
46– 59	30	110
44 – 55	32	90
44 – 54	32	108
Average set height: 52	Average: 33.4	Average: 100
Average range: 48 - 58		

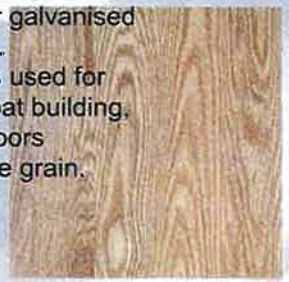
By doing this research on typical heights, widths and lengths of piano seating on the market, I now have an idea of the sizes and ranges I should be looking at when I start to take measurements for my seating. The width will be 33cm and the length will be 100cm. The lowest height should be around 48 centimetres, for an adult and the maximum height should be around 58 centimetres, for a child. Or if the seating is to be one standard height, it should be around 52 centimetres.

Research

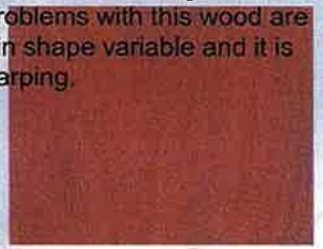
Oak is very strong, durable and hard. This hardwood machines well, and finishes very well with treatments like varnish and waxing. These properties make oak a good possibility for my piano seating as sustainability is important.

However, the acidic nature of oak will affect metals in direct contact and cause corrosion, therefore oak is liable to blue stain if in contact with iron compounds. Instead, non-ferrous or galvanised metals should be used.

This hardwood is used for high-class furniture, boat building, garden furniture and floors because of its attractive grain.



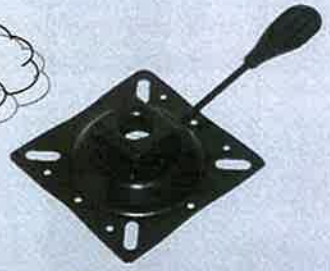
Mahogany has a generally straight grain and is usually free of voids and pockets. It has a reddish-brown colour, which darkens over time, and displays a beautiful reddish sheen when polished. It is easy to work, is very durable and finishes well. These properties make it a favourable wood for crafting furniture. The only problems with this wood are that its grain shape variable and it is prone to warping.



Beech is hard, tough and very strong. It has a straight grain and fine, even texture. The close grain means it does not split or splinter. It glues easily, stains well, has an excellent finish and withstands wear and shock well.
It is used mostly for functional furniture, tools and floors. It is exceptionally good for children's toys and kitchen utensils because of its non toxic nature.

Walnut is hard, dense, tight-grained and polishes to a very smooth finish. Because of its colour, hardness and grain it is a prized furniture and carving wood. Walnut works easily with power tools and finishes very well with varnish, waxing and staining.

Office Chair Mechanism



Closed

Open

Scissor Jack Mechanism

Fixed end of threaded bar

Threaded bar passes through

Lever at bottom

Research

Open Full

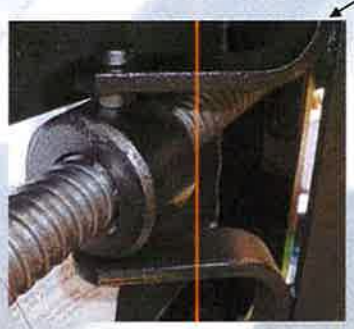
Lever mechanism

Threaded Bar

Mechanism

Brackets, welding and screws

Nut that screws along threaded bar to allow movement



Brackets holding threaded bar in place

Fully Closed

Handle which is screwed to enable linear movement of the seat up or down

Product Specification

1. Purpose
To provide a comfortable, safe duet seating arrangement for playing the piano.

2. Form
Practical, but modern; something different to the traditional seating arrangements but still meets all the requirements.

3. Function
Provide comfortable seating for two people to sit at the piano at their own preferred height, the seating being split in two separate sides with each side being individually adjustable in height.

4. User Requirements
- The seating must be stable and safe with no exposed mechanisms that may nip fingers.
- Each side of the seating arrangement must have its own individual height adjusting mechanism that can meet the requirements of the player.
- The seat must be comfortable to sit on for some time.

5. Performance Requirements
- The seat must be stable on the ground and not wobble.
- It must be able to support a maximum weight of two adults safely without the risk of collapsing.
- It must be split in two seats at the top so that each player can have their own side. Each seat must also be individually adjustable in height to accommodate the height ranges from adult to child.
- The mechanism for adjusting the height must be safe and easy to use so a child can adjust it themselves without assistance.

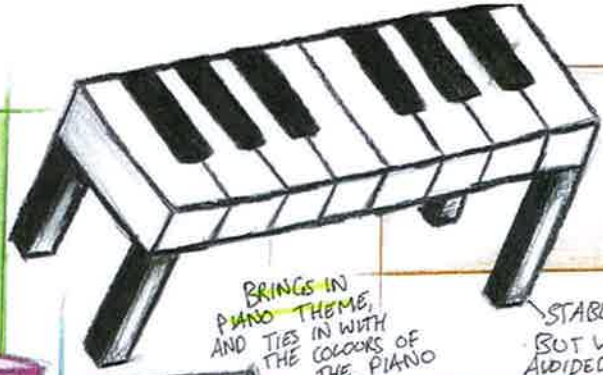
6. Materials and Components
The seating will have to tie in with the piano so it will have to be dark in colour regardless of the type of materials used.
The materials need to be sustainable, not destroying the natural balance of an area.
The mechanism will have to be made from a strong, durable material to support the weight of the person sitting on it.

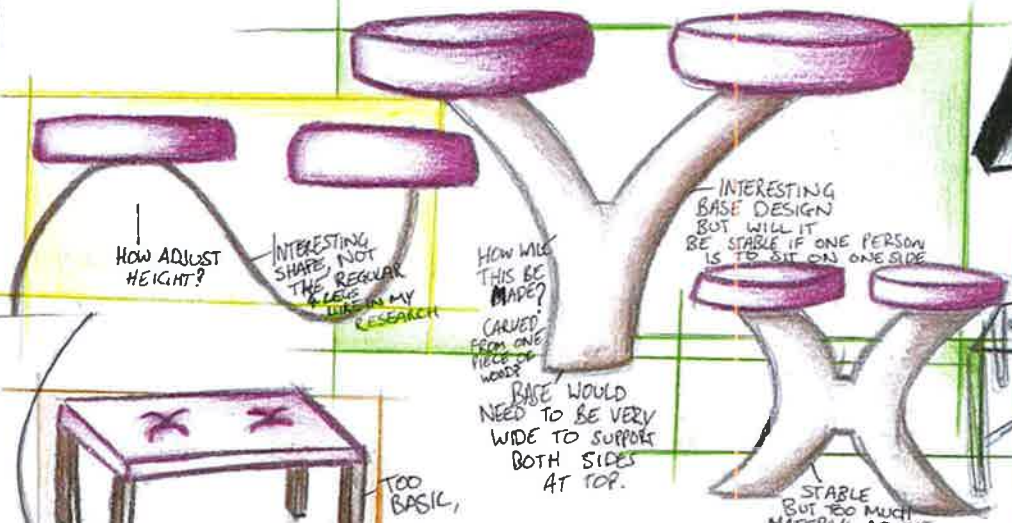
7. Size
From my research I have come up with a range of figures for the sizes of the seating; an adjustable height range of between 48cm and 58cm, a width of 33cm and a length of 100cm.
The seating will have to be lightweight enough for even a minor to lift of move along the floor.

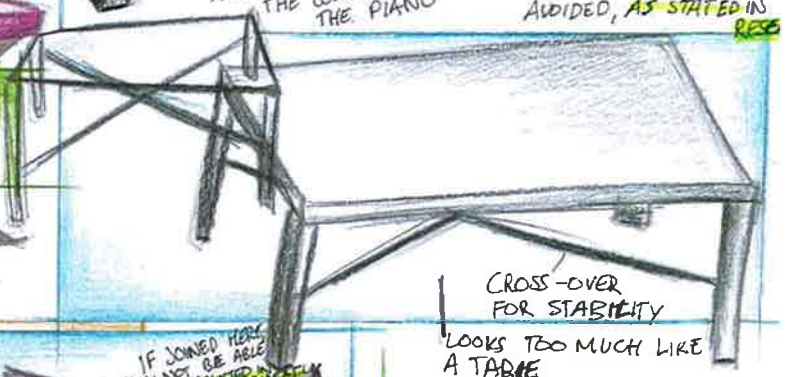
8. Safety
No sharp corners, edges or mechanisms are to be exposed where fingers can be nipped.
It must not weigh too much so it will not cause harm when moving.

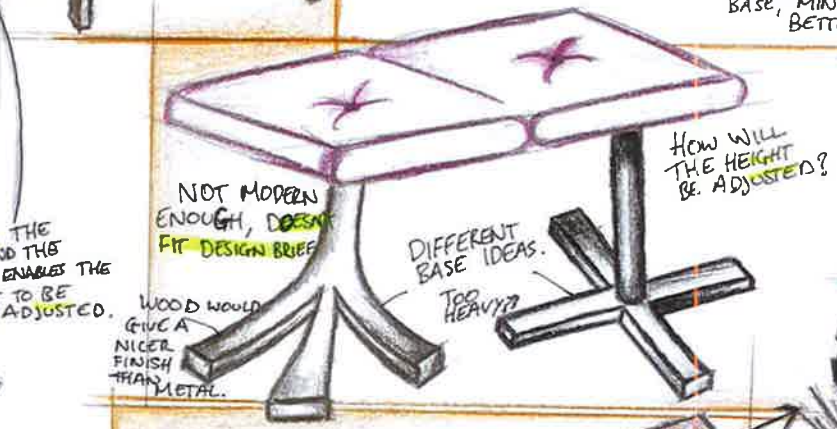
9. Quality
The choice of material will have to reflect the style and elegance of the piano it will be used with, and so the quality of manufacture and the final finish will also have to reflect the quality of the piano.
Quality control (QC) checks and procedures will have to be made frequently throughout the manufacturing process, checking stability and dimensions against the plan.

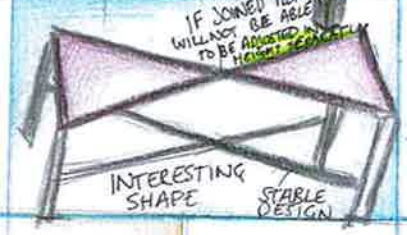
10. Scale of Production and Cost
This product is quite a specialist product and will be not sought after by a big percentage of the population, therefore the scale of production will be batch and in some cases one-off. Pianists and piano teachers would be the only real target market for this product and since this is so small, the cost of the product will be high.
On the market at present this type of product can be bought at prices starting at around £100 right up to £500 or £600. These are very expensive however the products are of exceptional quality.




HOW ADJUST HEIGHT?
INTERESTING SHAPE, NOT THE REGULAR 4 LEGS LIKE IN MY RESEARCH
HOW WILL THIS BE MADE? CARVED FROM ONE PIECE OF WOOD?
BASE WOULD NEED TO BE VERY WIDE TO SUPPORT BOTH SIDES AT TOP.
INTERESTING BASE DESIGN BUT WILL IT BE STABLE IF ONE PERSON IS TO SIT ON ONE SIDE
STABLE BUT TOO MUCH MATERIAL AT THE BASE, MINIMAL IS BETTER.

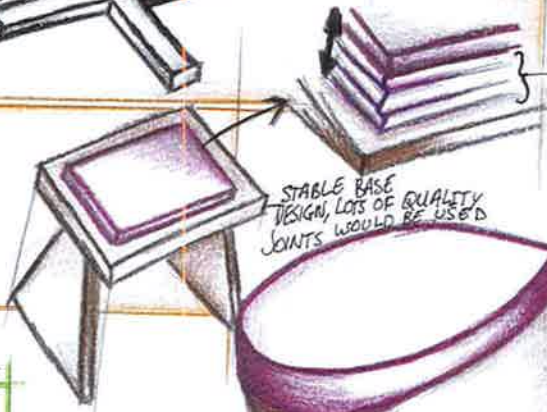

BRINGS IN PIANO THEME, AND TIES IN WITH THE COLOURS OF THE PIANO
STABLE BASE & LEGG
BUT WAS TO BE AVOIDED, AS STATED IN RESE
CROSS-OVER FOR STABILITY
LOOKS TOO MUCH LIKE A TABLE

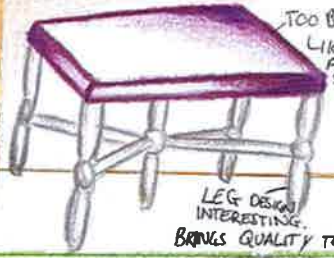

TOO BASIC,
NOT MODERN ENOUGH, DOESN'T FIT DESIGN BRIEF
HOW WILL THE HEIGHT BE ADJUSTED?
DIFFERENT BASE IDEAS.
TOO HEAVY??
WOOD WOULD GIVE A NICER FINISH THAN METAL.


IF JOINED HERE WILL NOT BE ABLE TO BE ADJUSTED IN HEIGHT SEPARATELY
INTERESTING SHAPE
STABLE DESIGN


WOULD IT TOPPLE IF SOMEONE WHERE TO SIT ON ONE SIDE ONLY?
BASE WOULD NEED TO BE WIDE TO SUPPORT TO


VERY BASIC DESIGN, TRADITIONAL STOOL
TWO WILL BE NEEDED.
SCREW THE SEAT AND THE THREAD ENABLES THE HEIGHT TO BE ADJUSTED.


ACCORDION IDEA FOR CONCEALING MECHANISM
STABLE BASE DESIGN, LOTS OF QUALITY JOINTS WOULD BE USED


TOO BASIC, LIKE A STOOL
LEG DESIGN INTERESTING, BRINGS QUALITY TO SEAT

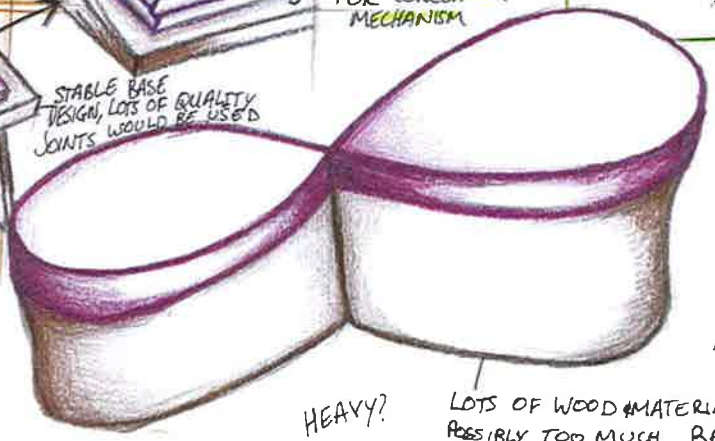
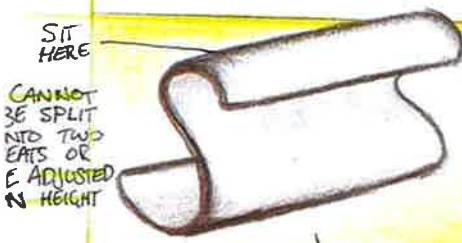
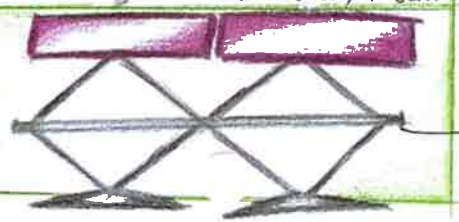
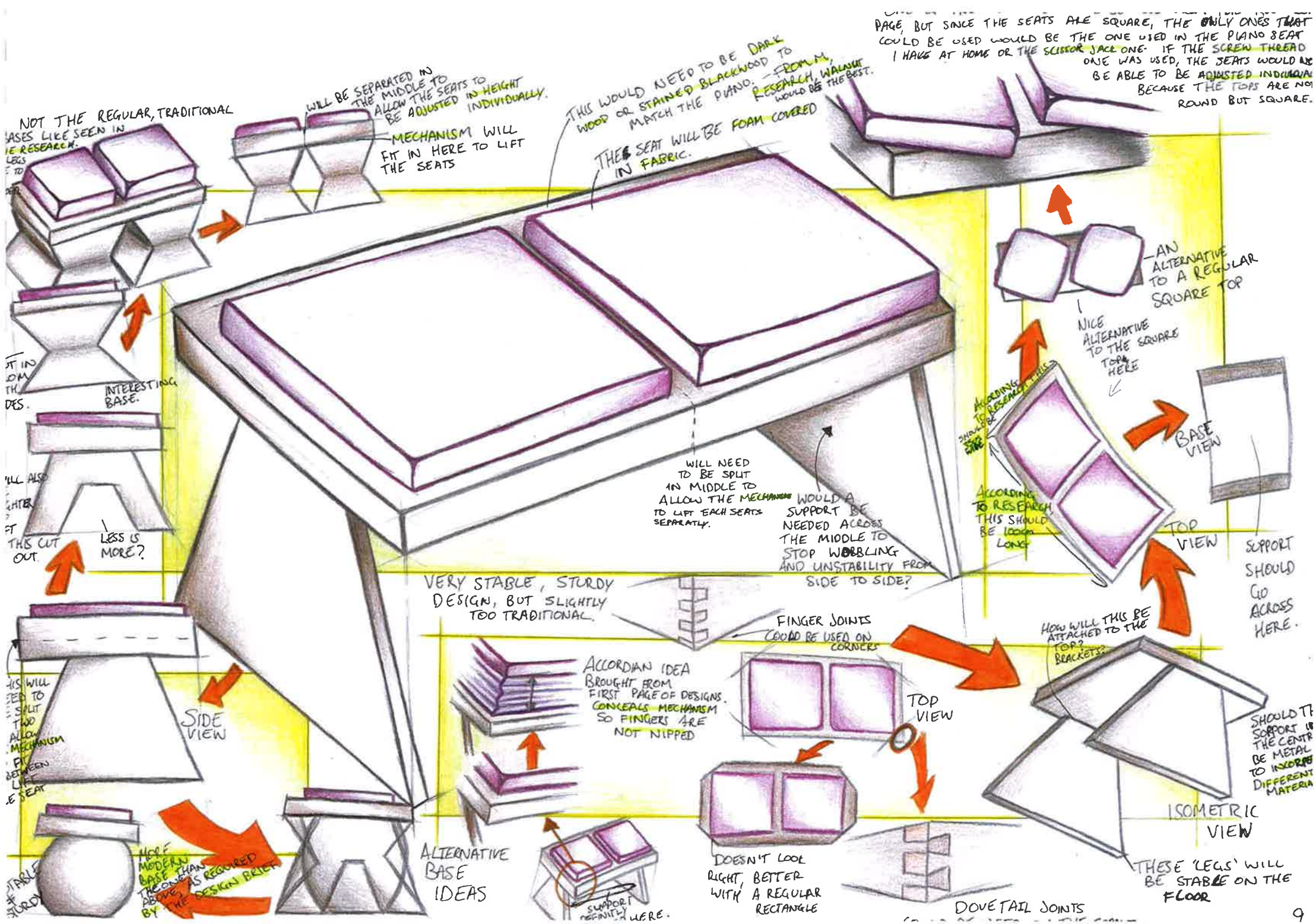
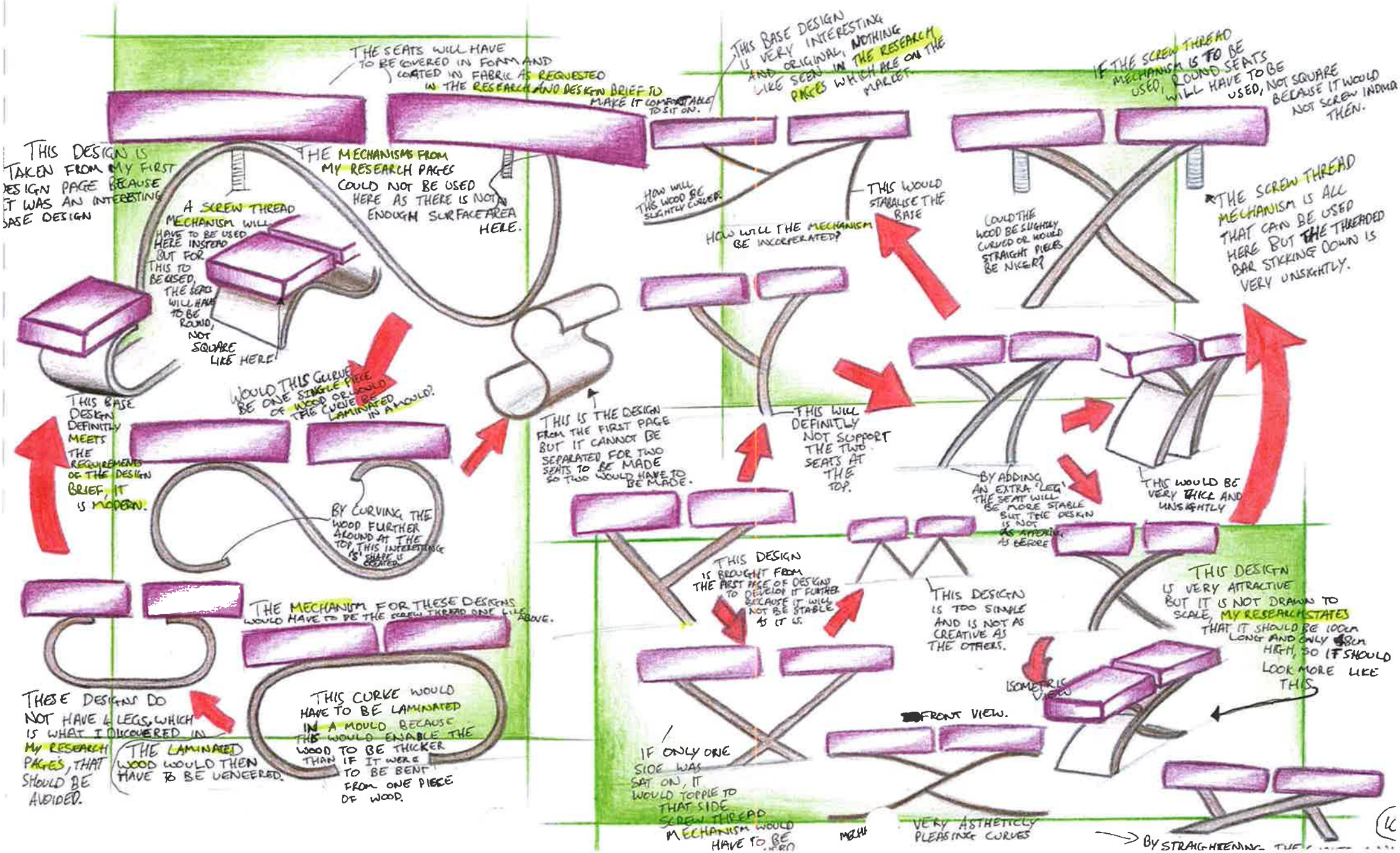


FIGURE 8 TOP, VERY STABLE DESIGN
HOW WILL THE MECHAN FIT IN?
HEAVY?
LOTS OF WOOD MATERIAL, POSSIBLY TOO MUCH, BETTER BROKEN UP A BIT.


SIT HERE
CANNOT BE SPLIT INTO TWO SEATS OR BE ADJUSTED IN HEIGHT
HOW WILL THIS BE MADE, WILL THE WOOD BE BENT OR LAMINATED IN A MOULD.
WOULD IT BE STABLE TO SIT ON? WOBBLE? BREAK IN MIDDLE?


SCISSOR/CAR JACK MECHANISM, ADJUSTS HEIGHT OF SEATS INDIVIDUALLY FROM


PAGE, BUT SINCE THE SEATS ARE SQUARE, THE ONLY ONES THAT COULD BE USED WOULD BE THE ONE USED IN THE PIANO SEAT I HAVE AT HOME OR THE SCISSOR JACK ONE. IF THE SCREW THREAD ONE WAS USED, THE SEATS WOULD BE BE ABLE TO BE ADJUSTED INDIVIDUA BECAUSE THE TOPS ARE NO ROUND BUT SQUARE.
NOT THE REGULAR, TRADITIONAL
ASES LIKE SEEN IN
E RESEARCH.
WILL BE SEPARATED IN THE MIDDLE TO ALLOW THE SEATS TO BE ADJUSTED IN HEIGHT INDIVIDUALLY.
MECHANISM WILL FIT IN HERE TO LIFT THE SEATS
THIS WOULD NEED TO BE DARK WOOD OR STAINED BLACKWOOD TO MATCH THE PIANO. FROM M, RESEARCH, WALNUT WOULD BE THE BEST.
THE SEAT WILL BE FOAM COVERED IN FABRIC.
AN ALTERNATIVE TO A REGULAR SQUARE TOP
NICE ALTERNATIVE TO THE SQUARE TOPS HERE
ACCORDING TO RESEARCH SHOULD BE
BASE VIEW
ACCORDING TO RESEARCH, THIS SHOULD BE LOOSE LONG
TOP VIEW
SUPPORT SHOULD GO ACROSS HERE.
INTERESTING BASE.
LESS IS MORE?
THIS CUT OUT.
WILL NEED TO BE SPLIT IN MIDDLE TO ALLOW THE MECHANISM TO LIFT EACH SEATS SEPARATLY.
WOULD A SUPPORT BE NEEDED ACROSS THE MIDDLE TO STOP WOBBLING AND UNSTABILITY FROM SIDE TO SIDE?
VERY STABLE, STURDY DESIGN, BUT SLIGHTLY TOO TRADITIONAL.
FINGER JOINTS COULD BE USED ON CORNERS
HOW WILL THIS BE ATTACHED TO THE TOP? BRACKETS?
SIDE VIEW
ACCORDIAN IDEA BROUGHT FROM FIRST PAGE OF DESIGNS. CONCEALS MECHANISM SO FINGERS ARE NOT NIPPED
TOP VIEW
ISOMETRIC VIEW
MORE MODERN BASE THAN THE ONES ABOVE, AS REQUIRED BY THE DESIGN BRIEF
ALTERNATIVE BASE IDEAS
DOESN'T LOOK RIGHT, BETTER WITH A REGULAR RECTANGLE
THESE 'LEGS' WILL BE STABLE ON THE FLOOR
DOVETAIL JOINTS
9


THE SEATS WILL HAVE TO BE COVERED IN FOAM AND COATED IN FABRIC AS REQUESTED IN THE RESEARCH AND DESIGN BRIEF TO MAKE IT COMFORTABLE TO SIT ON.
THIS BASE DESIGN IS VERY INTERESTING AND ORIGINAL, NOTHING LIKE SEEN IN THE RESEARCH PAGES WHICH ARE ON THE MARKET.
IF THE SCREW THREAD MECHANISM IS TO BE USED, ROUND SEATS WILL HAVE TO BE USED, NOT SQUARE BECAUSE IT WOULD NOT SCREW IN/MA THEN.
THIS DESIGN IS TAKEN FROM MY FIRST DESIGN PAGE BECAUSE IT WAS AN INTERESTING BASE DESIGN
A SCREW THREAD MECHANISM WILL HAVE TO BE USED HERE INSTEAD BUT FOR THIS TO BE USED, THE SEATS WILL HAVE TO BE ROUND, NOT SQUARE LIKE HERE!
THE MECHANISMS FROM MY RESEARCH PAGES COULD NOT BE USED HERE AS THERE IS NOT ENOUGH SURFACE AREA HERE.
HOW WILL THIS WOOD BE SLIGHTLY CURVED?
THIS WOULD STABALISE THE BASE
HOW WILL THE MECHANISM BE INCORPERATED?
COULD THE WOOD BE SLIGHTLY CURVED OR WOULD STRAIGHT PIECES BE NICER?
THE SCREW THREAD MECHANISM IS ALL THAT CAN BE USED HERE BUT THE THREADED BAR STICKING DOWN IS VERY UNSIGHTLY.
THIS BASE DESIGN DEFINITLY MEETS THE REQUIREMENTS OF THE DESIGN BRIEF, IT IS MODERN.
WOULD THIS CURVE BE ONE SINGLE PIECE OF WOOD OR WOULD THE CURVE BE LAMINATED IN A MOULD?
BY CURVING THE WOOD FURTHER AROUND AT THE TOP, THIS INTERESTING 'S' SHAPE IS CREATED
THIS IS THE DESIGN FROM THE FIRST PAGE BUT IT CANNOT BE SEPARATED FOR TWO SEATS TO BE MADE SO TWO WOULD HAVE TO BE MADE.
THIS WILL DEFINITLY NOT SUPPORT THE TWO SEATS AT THE TOP.
BY ADDING AN EXTRA 'LEG' THE SEAT WILL BE MORE STABLE BUT THE DESIGN IS NOT AS APPEALING AS BEFORE
THIS WOULD BE VERY THICK AND UNSIGHTLY
THE MECHANISM FOR THESE DESIGNS WOULD HAVE TO BE THE SCREW THREAD ONE LIKE ABOVE.
THIS DESIGN IS BROUGHT FROM THE FIRST PAGE OF DESIGNS TO DEVELOP IT FURTHER BECAUSE IT WILL NOT BE STABLE AS IT IS.
THIS DESIGN IS TOO SIMPLE AND IS NOT AS CREATIVE AS THE OTHERS.
THIS DESIGN IS VERY ATTRACTIVE BUT IT IS NOT DRAWN TO SCALE, MY RESEARCH STATES THAT IT SHOULD BE 100cm LONG AND ONLY 45cm HIGH, SO IF SHOULD LOOK MORE LIKE THIS
ISOMETRIC VIEW
FRONT VIEW.
THESE DESIGNS DO NOT HAVE 4 LEGS, WHICH IS WHAT I DISCOVERED IN MY RESEARCH PAGES, THAT SHOULD BE AVOIDED.
THE LAMINATED WOOD WOULD THEN HAVE TO BE VENEERED.
THIS CURVE WOULD HAVE TO BE LAMINATED IN A MOULD BECAUSE THIS WOULD ENABLE THE WOOD TO BE THICKER THAN IF IT WERE TO BE BENT FROM ONE PIECE OF WOOD.
IF ONLY ONE SIDE WAS SAT ON, IT WOULD TOPPLE TO THAT SIDE
SCREW THREAD MECHANISM WOULD HAVE TO BE
VERY AESTHETICLY PLEASING CURVES
BY STRAIGHTENING

THIS PAGE GOES INTO MORE DETAIL ON HOW THE DESIGNS WILL BE MADE, FITTED TOGETHER, AND IT INCORPORATES DIFFERENT MATERIALS TOGETHER.

THE METAL IS ATTACHED TO THE SEAT WITH BRACKETS.

THIS DESIGN CAME FROM THE DESIGN ON THE RIGHT →

THE MECHANISM HERE WILL HAVE TO BE A SCREW THREAD MECHANISM AGAIN BUT THIS WILL BE VERY UNATTRACTIVE AND WILL TAKE AWAY FROM THE ASTHETICS OF THE DESIGN

THIS CURVE OF WOOD IS THE SAME BUT THE TWO CURVES OF METAL ARE REARRANGED.

THE DESIGN IS STABLE AND THE METAL MAKES IT VERY STURDY

WHEN SEEN IN AN ISOMETRIC VIEW, IT IS A VERY NICE DESIGN

THIS BASE DESIGN IS ALSO VERY ATTRACTIVE AND IT IS VERY MODERN SO IT FITS IN WITH THE DESIGN BRIEF AND THE RESEARCH PAGES

THESE WOULD BE VERY STURDY DESIGNS

THE WOOD COULD POSSIBLY BE CURVED IN ONE PIECE PROVIDED THE CURVE ISN'T TOO TIGHT.

THIS DESIGN IS AGAIN BROUGHT FOR FURTHER DEVELOPMENT, ALL THE OTHER DESIGNS ON THIS PAGE ARE INSPIRED BY THIS ONE.

THE METAL WILL BE ATTACHED TO THE SEAT ABOVE WITH SCREWS, HOWEVER THE MECHANISM IN THE PIANO SEAT I OWN WOULD NOT WORK WITH THIS DESIGN SO THE SCREWTHREAD MECHANISM WILL HAVE TO BE USED.

HOWEVER THIS MECHANISM IS VERY UNSIGHTLY

THE DESIGN IS THE SAME AS ON THE PREVIOUS PAGE BUT DIFFERENT MATERIALS ARE USED.

THIS METAL IS USED INSTEAD OF WOOD.

THE MECHANISM WOULD BE ATTACHED TO THE SEAT BY A METAL PLATE AND THE SEATS SCREWED UP. - THEN HOWEVER THE SEATS WOULD NEED TO BE ROUND.

HERE IT CAN BE SEEN THAT THE METAL BRINGS AN INTERESTING LOOK TO THE BASE IT WOULD COMPLIMENT THE COLOUR OF THE WOOD.

THIS DESIGN IS VERY APPEALING AND EYE CATCHING, IT FITS WITH ALL THE REQUIRED POINTS, IT IS MODERN, STABLE IF THE WOOD IS THICK ENOUGH, AND IF A FRAME IS PUT AROUND THE TOP THE MECHANISM FROM MY RESEARCH PAGE 4 (IN THE PIANO SEAT) CAN BE USED WHICH IS HIDDEN IN THE TOP FRAME SO NO THREADED BAR WILL BE INTERUPTING THE DESIGN LIKE IN THE OTHER DESIGNS.

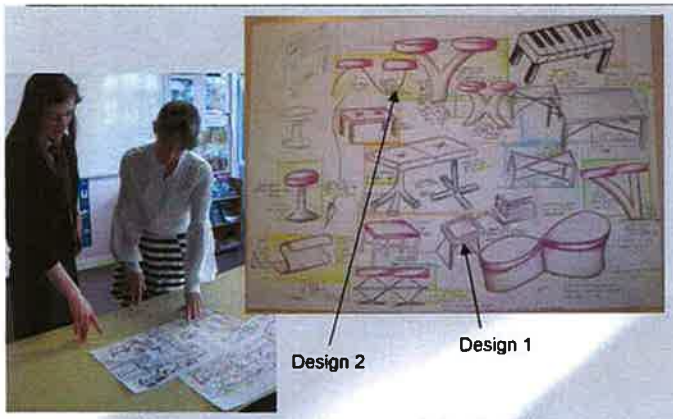
THE SCREW THREAD MECHANISM WOULD HAVE TO BE USED AGAIN WHICH WOULD RUIN THE CLEAN CURVES

THIS DESIGN IS BASICALLY THE ONE ON THE LEFT REARANGED.

CURVES WOULD NEED TO BE LAMINATED WITH THIN PLIES GLUED TOGETHER IN A MOULD

IF THE CURVE OF WOOD AT THE

Evaluation of Design Pages



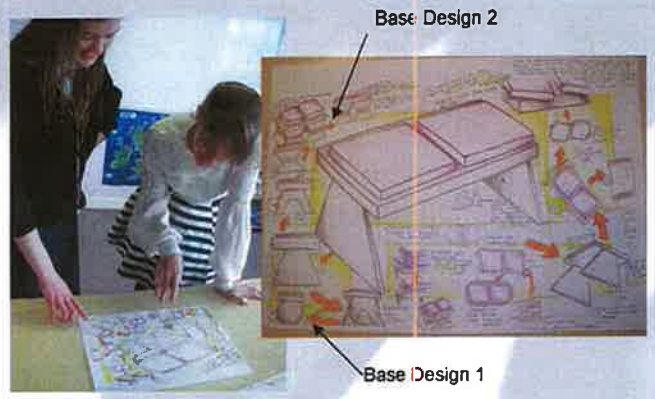
This was my first page of design ideas; I consider this page as a page of concept sketches, a mind map of ideas over the page as I had not yet really thought of many designs.

It was a useful page in some ways as I took a few designs on to the next pages to look at them in more depth. However the majority of the design thinking on the page is very narrow -minded and similar, they are quite traditional and some remind me of coffee tables which does not match the design brief of an original design.

When I showed my client, Louise, these designs she pointed out two of the designs on the page and said they had potential.

She said that design one was a stable, durable design that would work well and fits many of the points we made in the specification. It has a concealed, safe mechanism, it would be sturdy and quality could be incorporated in joints on the corners.

Design two has potential in the shape of the frame. The specification stated that the design should be modern, unlike anything on the market, not traditional; Louise felt that this design had the most potential to look modern. Therefore I took these designs to try and develop further on the next few pages.



This design was one of the ideas from my first page that Louise felt had potential; I tried to look at it in more depth as we thought it could be a stable, practical design.

It could be made of wood which is a sustainable material if sourced from properly managed forests. The type of wood used is important as some woods are more sustainable than others, wood from fast growing trees could be used.

I have explored various methods of joining the wood at the corners using different wood joints, skills acquired at AS Level technology, which will add a quality finish to the product as stated in the quality section of the specification.

The legs would be sturdy with a bar in-between to keep it from wobbling, but I did explore different ways of making a sturdy base.

The left hand side of the page has lots of different designs of the base with different views. It was interesting to look at different designs; I think base design one is modern but not very practical, it would be very heavy and bulky. Whereas base design two has good potential to be sturdy, modern and practical which are all important points on the specification.

When I showed this design to Louise she thought it would be "good but the original design is quite traditional", she said she would prefer base design two at the side of the page. She commented on the 'accordion' idea that would cover up the mechanism and said it was a "good feature to have as it is safe and meets the points on the specification."

Evaluation of Design Pages

This design page began with taking design two from the first page of designs. Louise, my client, thought this design had the most potential to be modern, unlike anything on the market, not traditional which are all important points on the specification. The potential comes in the shape of the frame, it is different and interesting, the curves are simple but they would be time consuming to manufacture. They would have to be made using a wood bending method, which would have to be carefully researched, and the processes will have to be sustainable, not using fossil fuels to power the process.

These curves inspired me to draw them in different ways, which is what fills the left-hand-side of the page. Whilst these curves are interesting and sparks modern design, they are however impractical. The 'S' shaped designs would be very unstable and wobbly and could possibly collapse if sat on, which is obviously not compatible with my specification points so I then contacted my client.

I showed these designs to Louise to ask her if she felt the curved designs are worth trying to make stable. She said they were interesting and perhaps not to forget about them, but try to straighten them out a bit which would help with the stability.

Therefore I began the designs on the right-hand-side of the page. These ideas flowed onto the page as they were very interesting. Some of my favourite designs are on this side of the page and so I went back to my client. She said they are modern but some could have to be modified if developed. Some would be unstable if the weight is not balanced properly on each side. This is a problem as the design brief states that the product is to be for teaching so an adult will be on one side but a child could be on the other so the product will be unstable, not meeting the specification points. My favourite design on the page is on the top right; it is solid and simple yet different. It would be sturdy, it would be made mostly from wood which is sustainable if managed properly, and it would be stable without having to balance the weight on both sides.

This is my final design page where I tried to incorporate different materials into the design. I continued some of the subtle curves and added some metal to the design. The pedals of the piano are a brassy gold colour so I would paint the metal this colour which matches the piano - another point in the specification; that the quality of the seating would have to match the quality of the piano and tie in with the style of the piano.

Whilst the designs are interesting, some of them again would be unstable and the weight would have to be balanced on each side. This is a very difficult problem to overcome in some of these designs without changing them completely.

I talked to Louise and she advised me to either stick with the design on the previous page or I could try to overcome the problem by making the bases a lot wider and longer so that they wouldn't topple as easily however that might not be very practical if space is limited.

I have looked at how the seat will be adjusted in height with mechanisms in more depth on this page. I have looked at the screw seat idea where there would be a fixed plate on the base and a screw thread attached to the seat which screws up and down, adjusting the height with a wing nut to hold it in place at a preferred height. The mechanism meets all the specification points but it does not need concealed as it is not dangerous.

The materials for these designs orbit around wood and metal which are both sustainable materials if they are managed appropriately, like not over extracting the metal ores from the earth and by having managed forests.

What next...

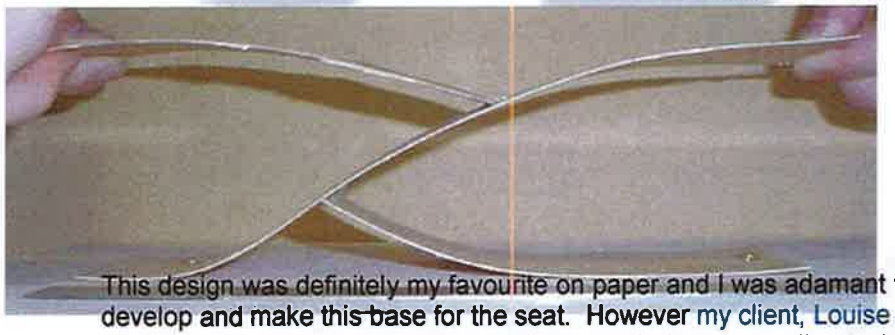
There are a number of the designs that Louise and I like but are not sue if they will be stable enough to go on and make so we have decided to take them to the development section where I will make a small scale model of them and do a series of checks and tests, like if they would hold a certain weight and if they will be strong enough since some of them contain tight curves. By making these simple scale models, some of the designs will be eliminated quite quickly so the chosen design will be sculpted from this modelling process. Also, stabilising methods can be experimented with and any changes that will have to be made to any of the designs can be done here and then the final idea will come from what has been learned in this development section.

Development

From my design pages my client and I selected the few ideas we liked best and felt had the most potential. I then got a very thin sheet of wood and bent it into different shapes according to the designs. I pinned the ends to a plywood block using thumbtacks and panel pins and took pictures of the designs in 3D. I showed the pictures to my client and we discussed if they still appealed to us. We looked at things like stability, materials, heights and sizes. It proved to be a very useful exercise for the development of the designs.

This was one of the early designed ideas, we liked it but thought it would be too difficult to make stable and would not hold itself up, nevertheless we wanted to see how well it would stand. Doing this design with the thin plies of wood confirmed our first thoughts as it was very unstable in the centre and we did not feel it would be realistic to carry on with it.

This design was very nice on paper but didn't look like it would be very stable or sturdy with all the curves. It is one continuous curve which we didn't think would be practical for two people to sit on so we dismissed it straight away.



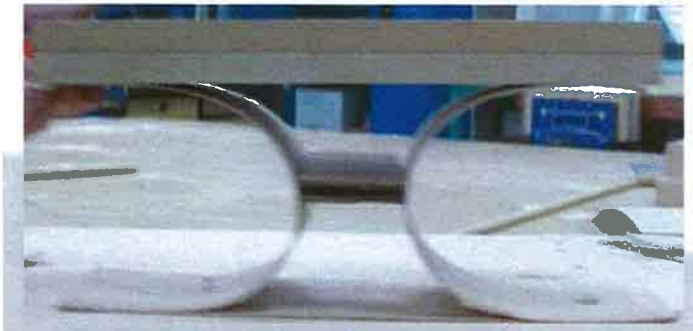
This design was definitely my favourite on paper and I was adamant that I was going to develop and make this base for the seat. However my client, Louise was not as passionate about it as I was and when the model was made I was very disappointed with what it looked like in 3D, I didn't like the curves. We decided that a nice straight, clean line or a deep curve is nicer than the slight curves here. Also it would be very unstable if only one person was sitting on one side; we didn't think it would have the stability to hold two people without breaking.

Development

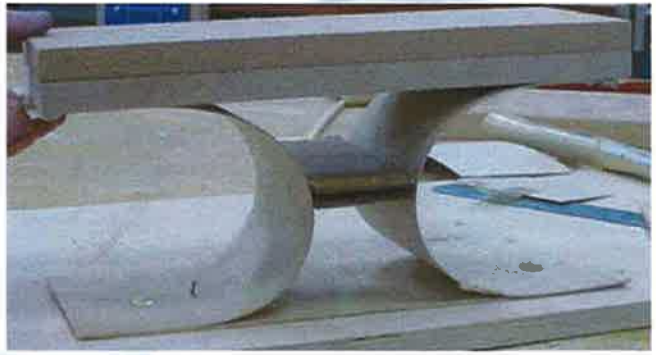
This design was not one of my top favourites on the design pages but it was however my client, Louise's favourite of all the designs. When I made the model of it I was very pleased with how it looked. I liked the deep 'C' shaped curves on either side; there is some simplicity to the design that was very appealing. However the design is not without its problems, I found that it very wobbly and unstable.

As it was so unstable when it was unsupported Louise and I tried to think of different ways to make it more stable. I got two lengths of wooden dowel and put them either side of the seat in the centre of each 'C' curve. This proved to be a very good stabilising method but it ruined the simplicity of the design as it looked like the dowel lengths where just put there for that reason alone, it took away from the aesthetics of the design.

As we started to consider this design for the final idea, more thought had to be put into the mechanism. The method we were going to use was the screw thread mechanism where the seat was screwed up and down the thread to adjust the height. However this mechanism cannot be used with this design because the threaded bar would come down too far and ruin the simplicity of the design. And so, Louise and I decided it would be best to make the mechanism (as seen on the fourth research page) this way the complex base design can be used and the design will not be ruined by the threaded bar protruding down. With this type of mechanism, the seat will be of better quality standard and also the design will be much nicer with the mechanism consealed.



Finally we decided to take away the dowel lengths and go back to the original, simple design because we realised that with the mechanism now taking up a lot of space at the top, the 'C' curves would not be as high as we thought. Therefore, if the wood for the curves was thick enough it should not be as wobbly and unstable as we once thought. We felt that it could work out well if the wood in the curves was thick so it will be strong enough to hold two people when sitting on the seat.



Development

Different Methods of Making Curves in Wood

Bend around mould, (laminate)

Thin plies of wood plywood ranging from 1 to 4mm can be glued together and moulded in a former. This allows for very strong curved forms to be made which are extensively used in the furniture industry. In industry, complex moulds and high-power presses are used, but laminating can be done in the workshop using some simple techniques. For small forms a mould can be made from a single block of wood that has the desired profile cut through it using a bandsaw. The two pieces then form the male and female moulds.
However for larger forms, such as furniture, it is not possible to cut the moulds from a single block of wood, so a box is made using cheap MDF, Plywood or similar material.
It is useful to 'lay up' the dry lamina in the mould for a while so that the plies can partially take the shape of the mould before reassembling with glue as the plies will have less spring the second time round. Once glued and clamped it should be left to cure for a few weeks and then the edges can be trimmed.

Steam Bending

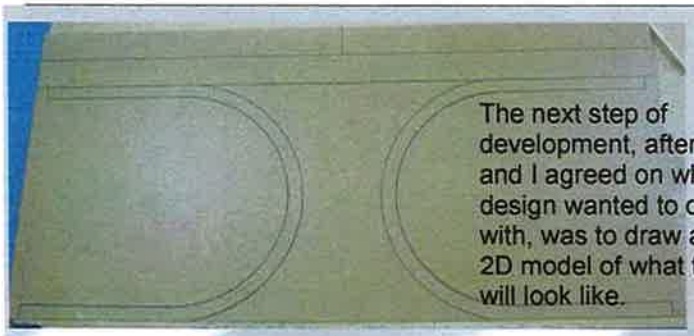
Steamed wood can be bent into relatively tight curves. The wood is put in a steam chamber where the steam softens the wood fibres sufficiently to allow them to bend and compress as the wood is bent around a shaped former. The radius to which it can be bent will depend on the thickness and natural stiffness of the wood. For tight bends the wood must be steamed and held around a former to set the wood to the required shape. The timber itself must be relatively straight-grained and free of knots as these could prove to be potential weaknesses when bending.
It is used mostly in industries but smaller ones can be got for schools.

Kerfing

Kerfing is cutting a series of kerfs (cuts) in a piece of wood in close proximity, so the wood can be curved. It is important not to make the cuts too deep, resulting in the wood cracking completely through or not deep enough so instead of bending, it snaps. The wood needs to be cut to the point that the remaining fibres are free to bend. Kerfing can only be done by crosscutting, it cannot be cut with the grain as the work is very likely to split Whole sheets and entire panels can be bent by kerfing.

From this research I have decided that the laminating process is most suitable for the school workshop and for the two 'C' curves which I am to make for the design.

Development



The next step of development, after Louise and I agreed on what base design wanted to carry on with, was to draw a full scale 2D model of what the design will look like.

Then we decided that it would be a useful exercise to make a practice curve and see if the wood would spring back much when it came out of the mould. Also to see; how sturdy it would be, if it would hold the weight of a person without breaking and if it would be stable and not too springy when sat on.

I started then making a mould in the workshop to laminate the wood around. I got 9 pieces of MDF and cut them all identically in the shape of the inside of the curve.

I had to make a bracket by screwing two pieces of wood perpendicular to each other. This enabled me to have a perpendicular frame to fix the curved pieces of MDF onto.

I had to drill holes in the outer-most plies of wood for the clamps to hold the sheets of wood that would be bent in place. I then screwed the 9 pieces of MDF to the bracket I made. I put smaller pieces of MDF in-between the bigger, curved pieces to space them out, minimising the total amount of MDF used.

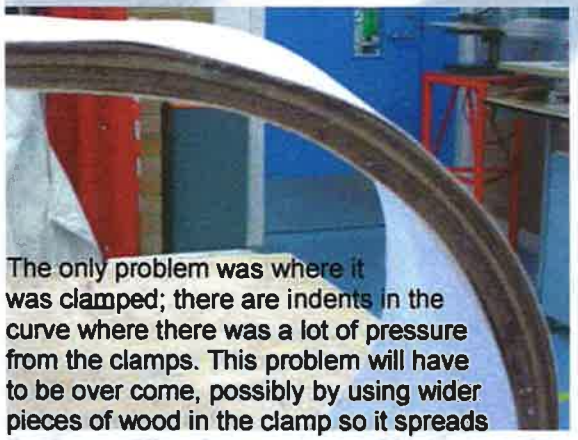
Development

8 sheets of hardboard were bent around the mould. Each sheet was glued to the one below it.

They were then held in clamps and left to cure for 2 weeks in the workshop where it was quite warm.

Development

When the two weeks were finished, I took the clamps off and expected the glued sheets to spring back a bit when the pressure was removed but surprisingly they didn't spring back at all; they stayed in the exact shape of the mould.

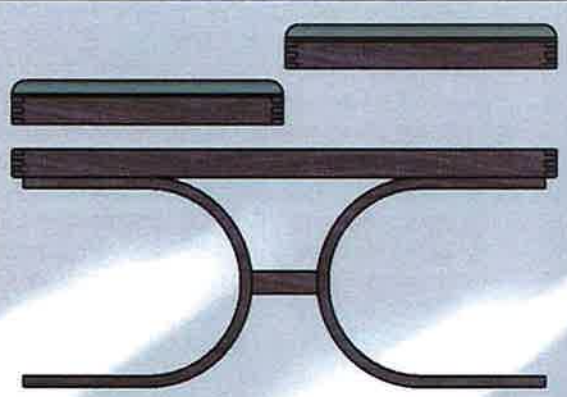


The only problem was where it was clamped; there are indents in the curve where there was a lot of pressure from the clamps. This problem will have to be over come, possibly by using wider pieces of wood in the clamp so it spreads the force of the clamps over a wider area, or by making a female mould to go around the outer side. However this would be very time consuming to make another mould and it would be awkward to get the outer mould in place without the sheets of hardboard displacing as they are very springy. Another possibility is that thicker sheet of wood could be bent around the laminated wood but not glued so the clamps will only affect the outer sheets and when they are removed the laminated wood will be a clean curve with no dents.

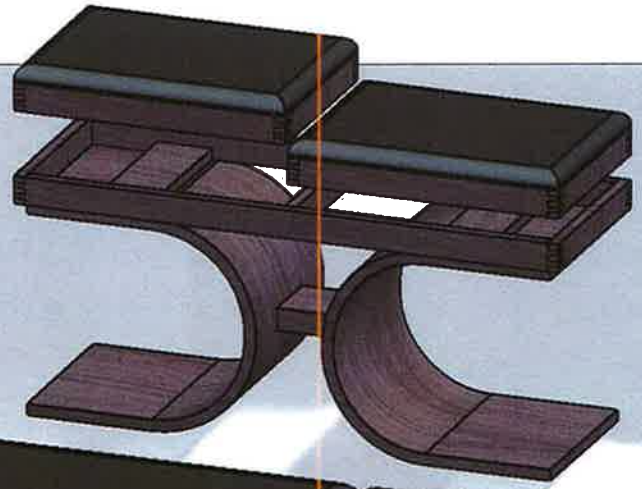
The laminated wood proved to be very sturdy. It was very stable with no threat of breaking when sat on, or even when stood on, which is not what I expected at all. The picture below shows that there is no change in the shape of the curve when it was sat on, whereas I expected the curve to deepen more like the letter 'C' with the pressure exerted.

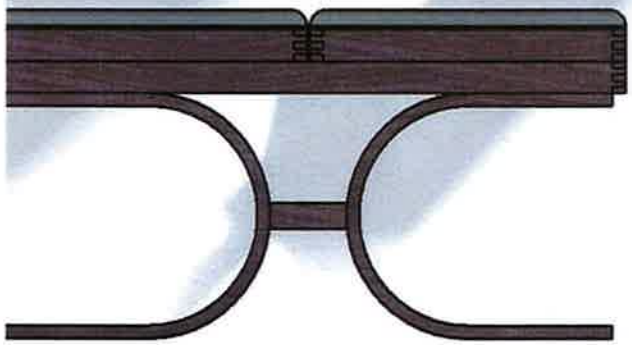
This was an invaluable process as it helped identify what to do differently next time. And also that the curve can be made so that it doesn't need support, which is very reassuring to know.

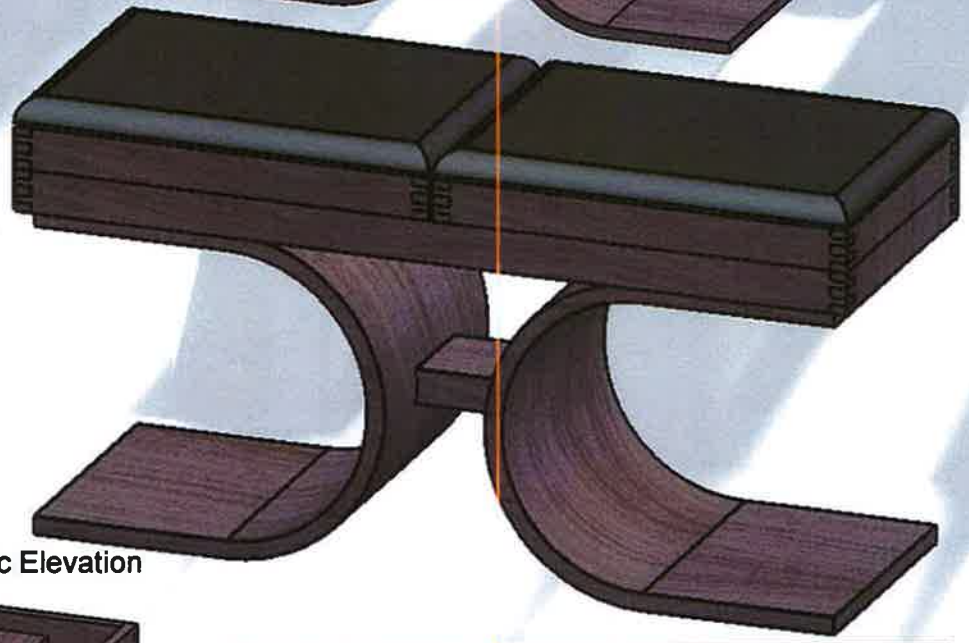
Chosen Design



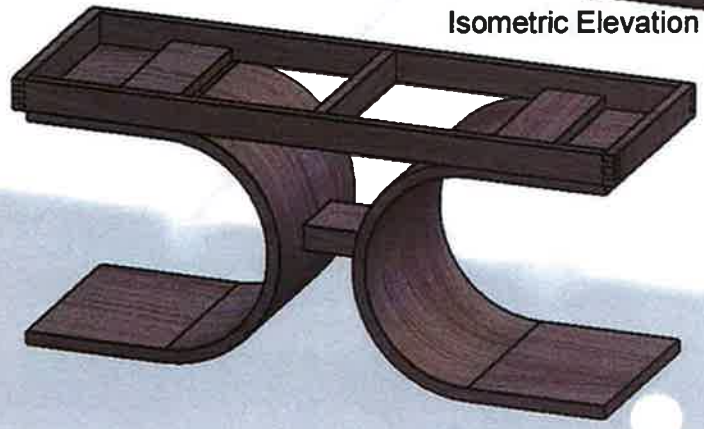
Front Elevation

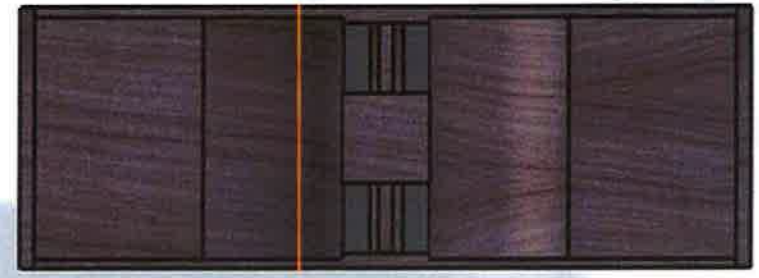






Isometric Elevation





Base Elevation

Side Elevation

Plan Elevation

Plan of Manufacture

Week 1 — Making the Base Curves

Make a mould for the curved wooden base. Get 9 plies of wood the mark out the inside of the curve of one of the plies. Cut this curve out on the router and use it as a template for the rest of the 8 plies of wood. Take care when using the router. Make sure the 9 plies of wood are identical. Make a bracket to fix the wood to by screwing two rectangular blocks of wood perpendicular to each other. Use the smaller scrap wood to put in-between the 9 plies to reduce the amount of wood used for the mould.

Week 2

Cut 6 lengths of hardboard to be bent around the mould using the machine saw. Take care when using the saw. Ensure the sheets are long enough to allow trimming after being bent into shape. Glue the plies of hardboard together with PVA wood glue and bend them around the mould. Clamp the hardboard around the mould; ensure the curve is smooth with no indents from the clamps. Leave it to cure for 2 weeks. Order the wood for the wooden top frame and collect.

Week 3 — Making the Wooden Top Frame

Cut the wood to the correct sizes using the machine saw. Mark out the dove tails and pins using a steel rule, try square, marking gauge and sliding bevel. Care when using the equipment. Check everything is square using the try square and steel rule. Cut out the tails using the dovetail saw. Remove waste material using coping saw. Keep hands behind cutting edge or on the handle at all times. Check cutting is square and on the marking line, not below the gauge line. Care when cutting out the waste wood that the tail of the joint is not damaged.

Week 4

Chisel out the 12 sets of tails making the edges straight and start undercutting. Fingers must be behind cutting edge of the chisel. Careful when chiselling the waste wood that the tails of the joints are not damaged.

Week 5

Scribe pins once tails are cut out using a Stanley knife and try square. Care when using the equipment. Check everything is square using the try square and steel rule. Cut out pins using a dovetail saw. Cut out waste material using a coping saw. Keep hands behind cutting edge or on the handle at all times. Check cutting is square and to the waste side of the marking line, not below the gauge line.

Week 6

Fit the joints by chiselling out the pins to suit the tails making the edges straight and not below the gauge line and start undercutting. Fingers must be behind the cutting edge of chisel. Check cutting is square and not below the gauge line.

Week 7 — Making the Base Curves

Take the clamps off the mould and remove the curved hardboard. Cut another 6 lengths of hardboard using the machine saw. Take care when using the saw. Ensure the sheets are long enough to allow trimming after being bent into shape. Glue them together with PVA wood glue. Bend the hardboard around the mould and clamp, ensuring the curve is smooth with no indents from the clamps. Leave it to cure for 2 weeks. Glue two pieces of wood 12cm² together to be placed between the base curves.

Week 8 — Making the Wooden Top Frame

Mark out a housing joint in the bottom half of the wooden top frame using a steel rule, try square and marking gauge. Cut using tenon saw and chisel out the waste material. Care when using equipment keeping hands behind the cutting edge. Check cutting is square and on the marking line, not below the gauge line.
Fit the joint

Week 9

Sand the inside of the frame and lacquer it. Then glue the joints together, ensuring all the corners are square. Plain the outside of the frame, this will show up the joints. Sand the outside of the frame using 150, then 100, then 50 grade sandpaper. Lacquer the outside.

Week 10 — Fitting the Mechanism

The top of the seats will be upholstered with black fabric. The mechanisms which enable the movement of the piano seat up and/or down will now be made and attached to the wooden top frame. Take care not to damage the wood or upholstery in any way.

Week 11 — Making the Base Curves

The veneer can now be put onto the base curves. Cut the pieces to size and veneer all surfaces of the curves with the wood veneer. Take care there are no air bubbles.

Week 12

Finally attach the curves to the wooden top frame by fixing two strips of wood across the base of the frame and screw the base curves to the wooden top frame. Finish the whole seat with beeswax.

Time Diagram	Weeks											
	1	2	3	4	5	6	7	8	9	10	11	12
Process												
Making Base Curves												
Wooden top Frame												
Fitting Mechanism												

Analysis of Chosen Idea

After completing the development section and discussing with my client, a final design idea has been chosen.

I communicated with my client throughout the development process and we discussed the problems, changes and decisions that had to be made in order to come up with the final design.

As seen in the development pages we discussed what frame to use and a few changes that would have to be made to the design and to the mould once the practice curve was made.

We also decided that, since the piano it is to be used with is black, the piano seat would have to be dark to match in with it.

We discussed using beech and staining in black but I would have liked the wood to be its natural colour, so we decided to use the dark wood from my research, American Black Walnut.

The wood has a very interesting grain pattern and will be a very rich colour and will finish very well with wax, enhancing the texture of the grain and the dark colour. It will add a great deal of quality to the seat which would not have been achieved with stained beech.

Comparing the Final Idea with the Specification Points

The design fits the purpose, providing a comfortable, safe duet seating arrangement for playing the piano. It will be practical, yet modern with nothing like this design on the market.

The functional requirements are met with the mechanism giving the desired height ranges and it has two seats on the top with enough space for two people to sit comfortably and enough elbow room when playing.

The heights can also be separately adjusted with the steel mechanism. This mechanism will be enclosed and not dangerous, it will be strong and stable with being well secured to the frame of the seat.

The top of the seat will be upholstered so it will be comfortable to sit on for some time. There will be a lot of surface area on the ground with the size of the curves so it will be stable and will not wobble.

The dark walnut used will tie in well with the dark piano and it is also a sustainable material, trees being planted in the place of ones cut down in managed forests.

The sizes that were suggested for heights, widths and lengths were all met, the minimum height being 48cm, accommodating adults and the maximum height being 58cm to accommodate a child. The width is slightly over my suggested 33cm; instead it is 35cm which will make a bigger, more comfortable seat to sit on. The length is the 100cm which was suggested in the research pages.

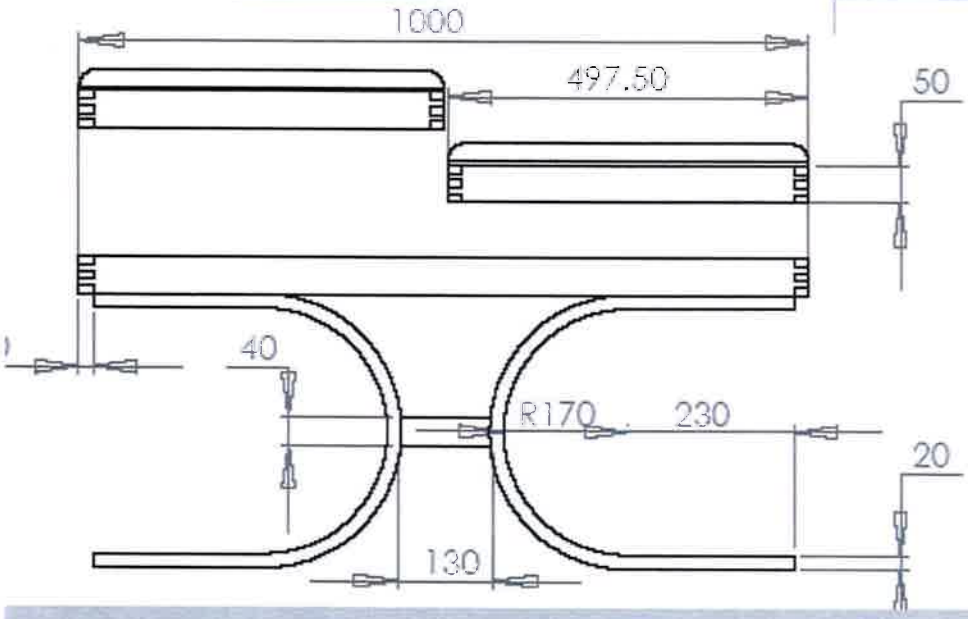
The joints decided upon for the top frame are dovetails which will definitely reflect the elegance of the piano and bring quality to the piece. These are skills which I have learned at AS Level.

The aspects that do not meet the specification points are the weight of the product and the presence of sharp corners.

As the seat is to be made entirely wood and metal, these materials will amount to a big weight which will perhaps require two people to lift it. This is unfortunate but strips floor protectors could be stuck to the base of the curves so that it could be slid or pushed along the floor. The dovetails will also have corners and edges which cannot be avoided.

Cutting List

Material	Sizes/cm	Quantity
Walnut Wood for Wooden Top Frame	100 x 2 x 5	2
	49.75 x 2 x 5	4
	35 x 2 x 5	6
Hardboard for Curves	32.5 x 0.3 x 110	12
Walnut Wood between Curves	12 x 2 x 5	2
Walnut Veneer	32.5 x 110 32.5 x 105	2 2



If this piano duet seating was to be batch produced, there would be some changes to the making and materials of the seat, it would not have the same quality since it will be produced by machines, rather than being handmade.

The wood would not be walnut as it is quite rare and very expensive; it would be a more sustainable wood like beech. The beech would be stained different colours upon request to match different colours of different pianos.

The wood would be sanded using an industrial sander and the joints on the corners of the wooden top frame would be either finger joints or simple butt joints, cut out on the CNC router, as dovetail joints are too time consuming and the pins would be too thin to cut out with a machine.

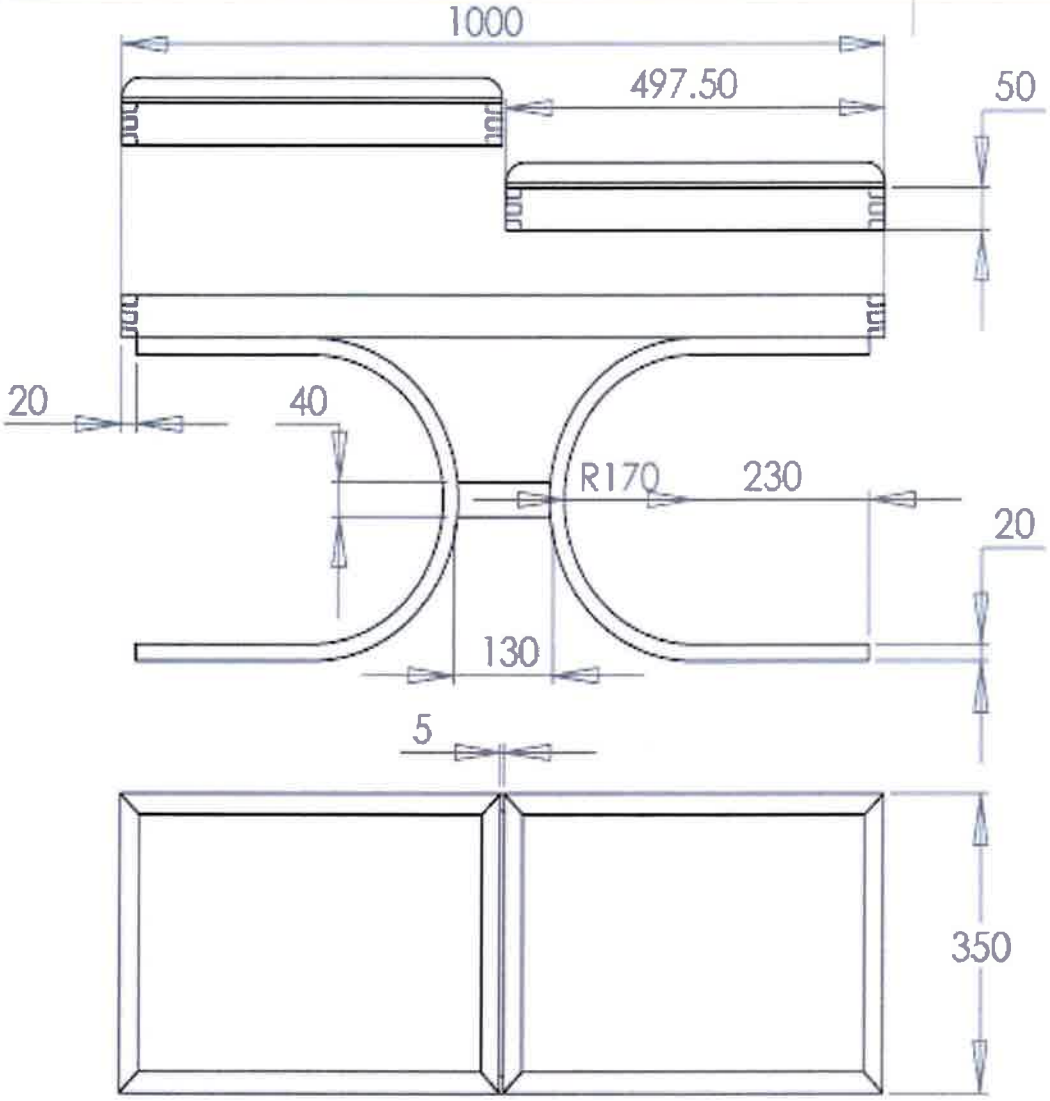
All the parts and the wood joints will be assembled in assembly cells by hand in different sections, using PVA glue for the wood joints.

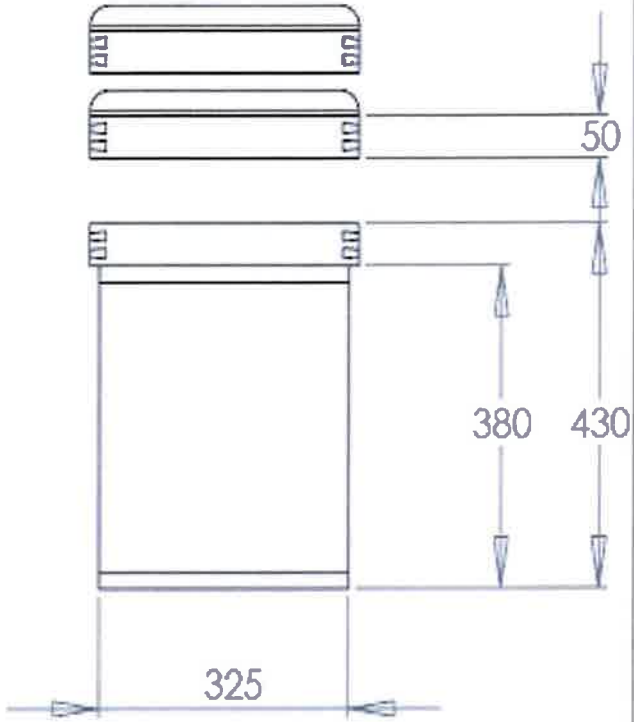
The curves would be bent in an industrial steam chamber instead of laminating because it would be too time consuming. This steam bending would also enable a solid piece of wood to be used instead of veneer being glued on.

The mechanism would have to be made in different sections, the brackets being bent in a former and the threaded bars would be machined on a lathe. All the parts would then be assembled together and screwed to the wooden top frame.

The finish would be the same, sand and sealed and then waxed.

Working Drawings





Manufacturing Processes

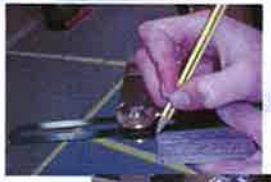
Making Curves

Veneering the Curves

Taking out of Mould

Cutting to Size

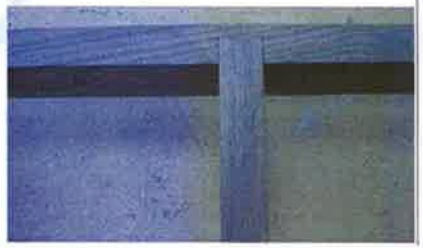
Dovetail Joints



Attaching Centre Piece of Wood

Veneering the Edges

Housing Joint



Manufacturing Processes

Fitting Piece of Wood for Curves to Screw Onto

Router Top for Cushioned Seating

Thin strips of wood mitre jointed at the corners to allow the seat have a tight fit

Wedges of wood to allow the glue to set

Fit the Mechanism after it is Made

Screw on Curves to Top

Sand all the Wood

Seal all the Wood with Sand & Sealer

Finally Finish with Beeswax

Manufacturing Processes

Testing

With setting the seat at the piano it is nice to see that the colours tie in quite well with each other which was one of the points in the specification, 'The seating will have to tie in with the piano so it will have to be dark in colour'.

This is the main test which can be carried out on the seating arrangement to test its performance and success. Here my client and one of her other pupils are using the seating arrangement in a piano lesson. The pupil is smaller then the teacher and so she requires the seat to be higher to the piano than Louise so she used the mechanism to raise the seat and now they are both sitting comfortably.
The seat is sturdy with both people on it and the mechanism was able to satisfy the height required by the users.

The height of the seat against the piano looks slightly small but with people sitting on the seat the gap does not look quite so big.

Another test was done (below) to check if the seat was stable with just one person sitting on one side. The test was to see if the curves would have rolled in the direction which the weight was on and to see if the curve deepened with the weight. The curve did not deepen but it did roll slightly toward the weight so she had to sit slightly more centred on the seat.

Sitting the seat beside the piano like this also allows me to do a quality test. The specification requested that the seating arrangement should reflect the quality and elegance of the piano. I feel the design of the seat does in fact reflect the quality but perhaps if the seating was black, and perhaps had some brass like the peddles of the piano, maybe it would have matched better.

The mechanism proved to be strong and sturdy, holding the weight well at height. It takes a while to screw it up because of the 'v' thread. It is not stiff to turn so a child can adjust the height themselves.

Evaluating

From carrying out a series of tests on the seating arrangement at the piano with my client and a third-party pupil, I can now evaluate the product's performance and quality according to the specification points and design brief.

First of all the dimensions that I had set to follow are all met and the product is exactly 100cm long, 35cm wide and 48cm high at its minimum height. The curves are 38cm at their highest point which is what I had set but they are only 36cm at the outside of the curve because after the curve was taken out of the mould the 'C' deepened slightly over the time it was out of the mould. This is unfortunate because this resulted in the curve not sitting flush on the floor when it was assembled.

I am not sure that this could have been avoided because even if it was kept in the mould up until assembly, it still would have happened when later on.

The only other measurement that was changed during manufacture was the piece of wood between the curves, on the working drawings it was said to be 13cm whereas now it is 12cm, this is because there was difficulty getting the piece level since the curves were not flush with the floor. This caused a few millimetres to be cut off.

The product itself meets the majority of the specification points that were made. It is a modern, original design that solves the problem set by the situation and fits the design brief. It has two seats which are individually adjustable in height enabling a child and teacher to adjust the height for their comfort whilst still having sufficient arm room. It is stable under the weight of two people and also when one person sits on one side, providing they sit relatively in the centre. The only materials used are wood and steel with process that only includes the use of glue and welding so therefore the product is sustainable. Wood and metal are both sustainable materials, not damaging the natural balance of the area, provided the forests are managed and the extraction of metal ore is controlled. The steel for the mechanism was cut into lengths with a hacksaw, bent in a vice with a hammer and welded with a mig welder. The sheets of laminate for the curves were glued together and walnut veneer and solid walnut wood was used, all of these materials are sustainable if their forests are managed properly.

The mechanism is safe and concealed so it will not nip any fingers and it is easy to turn so a child would be able to adjust the height themselves. The only thing I would change about the mechanism is the type of thread used. Instead of 'v' thread I would use square thread because the 'v' thread takes a lot of turns to move the nuts whereas the square thread would not take as many turns, however it would be stiffer to turn.

I am very happy with how the dovetail joints turned out in the wood; they definitely added quality to the seat as they are obviously handmade, a machine could not have cut the pins so thin. The walnut was easily worked and there was a varying colour with the grain, some parts were lighter in colour than others which made a nice contrast in some of the dovetail joints. This quality from the dovetails and the attractive colour and grain pattern of the walnut definitely reflects the elegance and quality of the piano itself which was one of the specification points.

The aspects which I am disappointed with are the sheer weight of the product once it was all assembled but most of this weight comes from the mechanisms as there is almost 20ft of steel and 1m of threaded bar. Also, some of the walnut on the wooden top frame was bowed when it arrived and so when it was assembled it does not all sit square with each other.

Louise was very pleased with the finished product and said it fitted her requirements perfectly. She was very thankful and said it worked wonders for teaching because she can communicate with her pupils better being on the same level as them and not having to lean over them. She is very happy with the originality of the design and is very pleased with the quality and how it matches with the piano.