3rd Year Final Portfolio

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Product Design Engineering
The Glasgow School of Art

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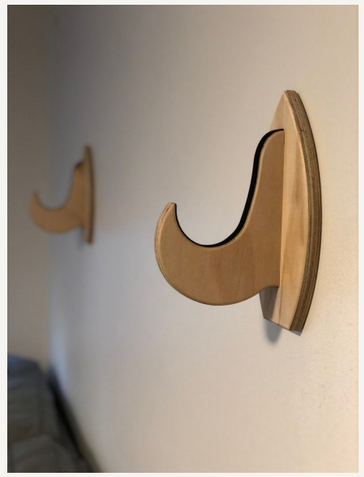
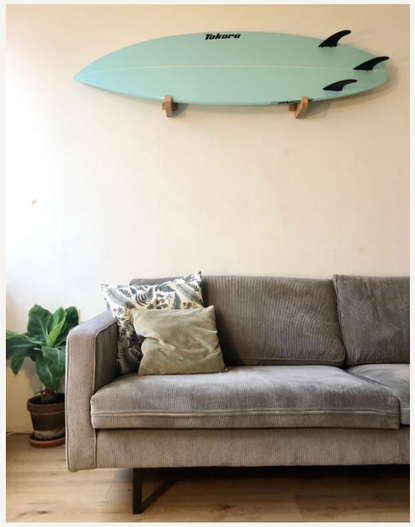
Home Ware

Folio Submission

PRODUCT DESIGN ENGINEERING
THE GLASGOW SCHOOL OF ART

Design Inspiration





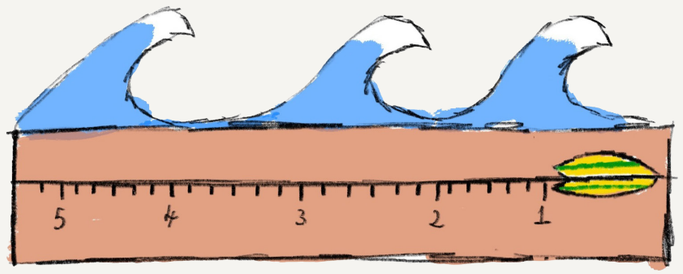
Analysis

The old fashion clock has a cool retro feel aesthetic to it, paired with the wooden aesthetic of the cupboard. The waves along with the surf board create a cool organic design.

For concept development I'll be looking into to pair the concept of time keeping with the waves and surf board theme to create something nice and organic.

Design Concepts

Concept 1



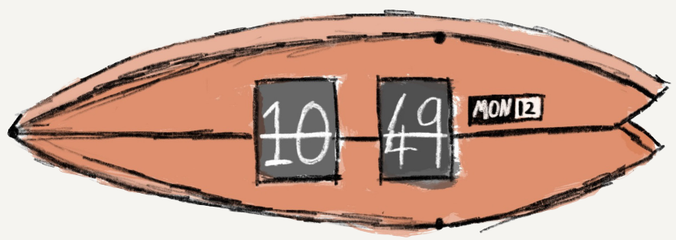
An egg timer, that works on a slider.

The surf board is the moving mechanism, where the tip is what will tell the time.

I liked this idea as it keeps to the theme of surfing, and waves and natural flow of the ocean, while being tied together with keeping time.

Development of this idea could lead to it being either a fridge magnet, wall mount, or on a stand

Concept 2



A surf board bedside clock.

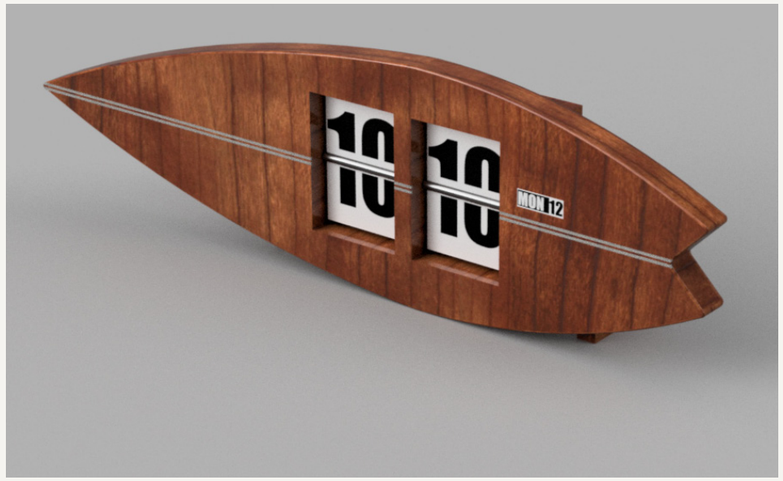
Using the mechanism of the clock to give it that flicking noise as the seconds pass.

Keeps to the theme of surfboards, with some nice long sweeping curves, and has a nice wooden aesthetic.

Development into how it would stand up and how all the components would fit into it.

Finale Design

Finale Renders



The surf clock has used the clock mechanism from the clock in the design inspiration. It has used the wooden aesthetics, and been shaped based off of a surf board. To add the detail two white lines have been added that are typically found on regular surf boards.

Clock Body Assembly

The box at the back of the clock will have the clock mechanism and components.

As it is a flipping clock there needs to space to allow for the rotation of the clock faces.

The stands on the back of the board are shaped like fins to try and tie into the surfing theme.

Project Review

This was a good first project, getting us to create a basis for our design language, designing inspirations and ultimately get us back in the flow of designing.

It allowed us to be creative as possible and really design something to our specifications without a closed brief

Senses Portfolio

Hearing

PRODUCT DESIGN ENGINEERING
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Project Plan

Names Key:	Week 1			Week 2			Week 3			Week 4			Week 5		
	Thursday	Friday		Thursday	Friday		Thursday	Friday		Thursday	Friday		Thursday	Friday	
	PM: 2rd Oct	**AM:** 3rd Oct	**PM:** 3rd Oct	**PM:** 9th Oct	**AM:** 10th Oct	**PM:** 10th Oct	**PM:** 16th Oct	**AM:** 17th Oct	**PM:** 17th Oct	**PM:** 23rd Oct	**AM:** 24th Oct	**PM:** 24th Oct	**PM:** 30th Oct	**AM:** 31st Oct	**PM:** 31st Oct
Task List:															
Research Places in Glasgow related to sense															
Walk around glasgow															
Begin Research into problems found															
Refine problems															
Explore 3 main problems															
Chose a problem to further research															
Problem Presentation page															
Solution Presentation Page															
Presentation 1															
Concept development Exercise															
Begin initial concept idea generation															
Evaluation Matrix															
Further concept development															
CAD Modelling															
Finale Solution breakdown															
Begin finale presentation															
Presentation 2															

Miro Design Journal

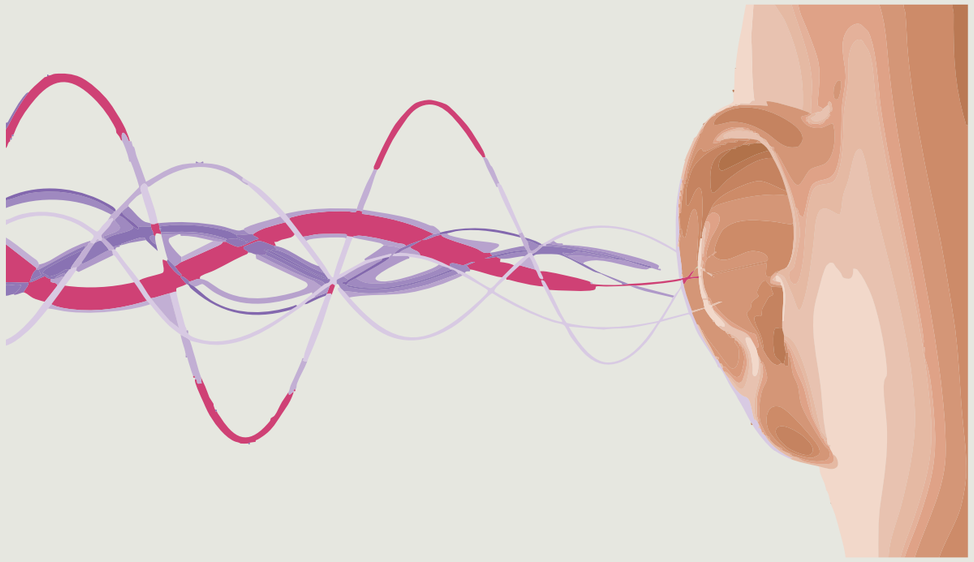
https://miro.com/app/board/uXjVJ_vEzJ0=/?share_link_id=414261402244

Project Summary

Project Brief Summary

Through a cycle of divergent and convergent thinking, different areas will be investigate for users needs in public spaces on a chosen human sense. This process will narrow down a broad range of problems to one specific one, which will then have multiple solutions which will then come to one finale solution.

Sense: Hearing



Problem: PA Announcements in Train Stations

The inital task involved asking the general public what issues they have with hearing or hearing related issues.

I decided to focus on PA systems, more specfically in train stations and airports.

I feel this is a good area to explore as a lot of people experience having an issue in hearing important information in loud crowded spaces.

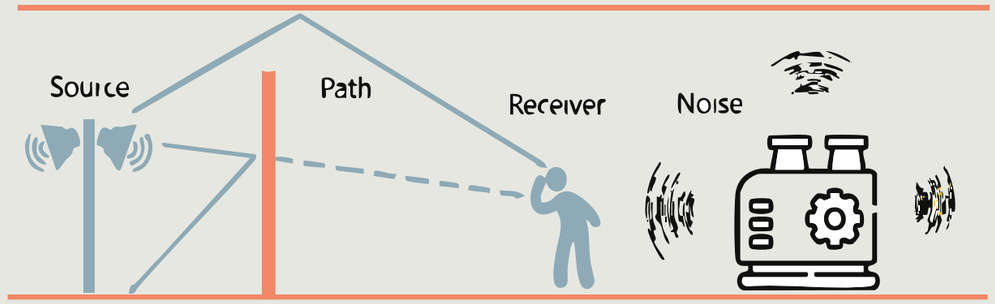
Users: For General Public

The product is to be mainly be used for general public.

Used in large public spaces.

To help the majority of people, with an ability to overcome language barriers through interactive language selections.

Solution: Improving Speech transmission Index



The conclusion from my research is that the most effective way to address this issue is by exploring the Speech Transmission Index (STI) and methods to improve speech clarity.

Based on this research, I will then develop ways to implement these improvements within a public space environment

Initial Problems

To find the initial problems, we explored Glasgow looking for initial issues. The three that I had found are described below.

Road Works

When walking around Glasgow, the noise road works caught my attention.

The noise can be very loud when walking past, disrupt conversations, and be a distraction when working.

The noise can reach 102dB-115dB.

Due to road works being this loud they aren't aloud to work nigh when its quieter.

This then has a knock on effect that then causes travel disruptions, that increases noises pollution to the surrounding area.

Opening Windows, Outside Noise Coming In

When talking to the GSA library, they said that when they open the windows the level of noise that comes can be a lot can travel through the building.

Not being able to open windows can increase temperature of the environment making it potentially uncomfortable to work.

Research into Psychoacoustics, shows that increases in noise can cause an increase in stress, so trying to keep these places as quite as possible is necessary.

For most buildings they have double glazed windows to help with this but this is not possible for old or listed buildings.

PA Systems In Train Stations

When walking through Glasgow central station I Discovered that when announcements came on that it was sometimes hard to hear due to background noise and the sound echoing around the place

The poor sound quality was a cause of, poor sound absorption, large crowds and background noise.

This lack of hearing can cause people to miss important announcements, leading on to them missing their trains potentially.

This also sparked interest into people that don't always understand the language making it harder for them to keep on top of live events

When seated in certain areas it can be harder to hear what's going on if people are having conversations around you.

Chosen Problem

From these initial problems I chose to go with improving PA systems in train stations.

Thi decision was made based off of the fact that is a problem that i feel effects everyone daily, and can be used in more than just train stations, but also airports, and bus stations

There also areas to research this problem in foreign countries where it can be hard to understand the language.

Research Phase: Problem

The Environment:

The lack of sound-absorbing materials and the large number of flat metal surfaces allow for significant sound reflection and interference noise. This decreases the **Speech Transmission Index.**

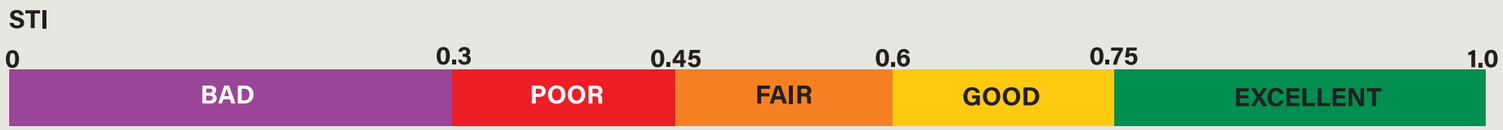
Having the speakers up in the roof, far away from people causes the **Speech Transmission Index** to decrease as it travels over a far distance, it also allows interference waves to have a bigger impact on the output sound.

Over 68,000 people use Glasgow Central Station, with an average of 1500 trains departing a day. That's a lot of announcements! 1 in 5 of those people already experience hearing loss, making speakers far away difficult to hear.

Speech Transmission Index:

What is it?
A measure of speech intelligibility in an acoustic environment, rated on a scale of 0 to 1, where 1 is excellent and 0 is poor.

How does it work?
Calculated by measuring the change in modulation of a test signal as it passes through the environment or communication channel.

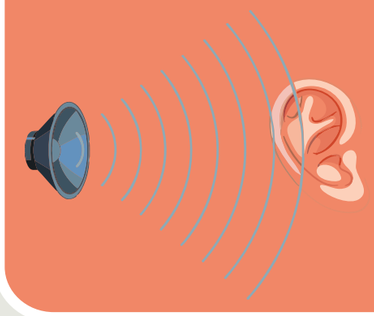


Research into International Stations:

The busiest train station in the world, Shinjuku station Tokyo Japan roughly deals with over 3.5 million passengers, 175,000 to 280,000 are international travellers that don't understand the language, and cannot understand what is being said over announcement speakers.

Research Phase: For Solution

Shortening Transmission Distance



Localising the output sound of the transmission will improve the speech transmission index.

From this one of the initial concepts should focus on localising the sound output

Display Boards

Use display boards alongside speakers to enhance clarity and accessibility of announcements.

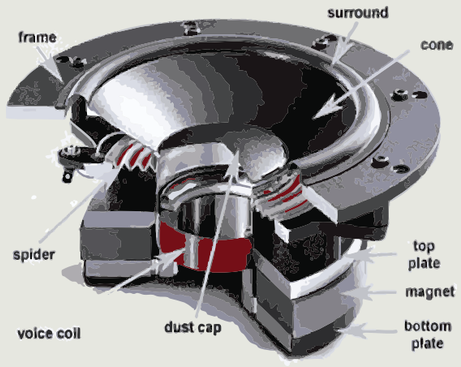
Provide visual information to support spoken messages, ensuring everyone can receive important updates.

Improve communication in noisy environments or for individuals with hearing impairments.

Advancement in Speaker technology

To ensure clarity of hearing the announcement development work could be implemented into directing sound to people or larger groups.

Improvements into material choice of the speaker can improve acoustic output, materials such as carbon fibre can be used as they have a high resistance bending, preventing distortion at higher volumes.

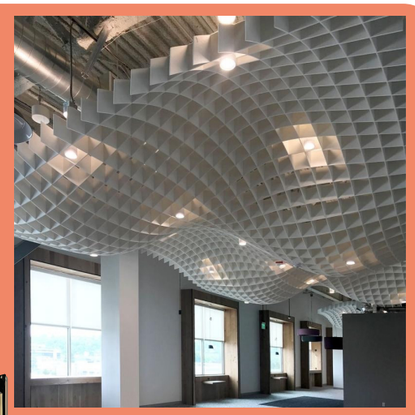


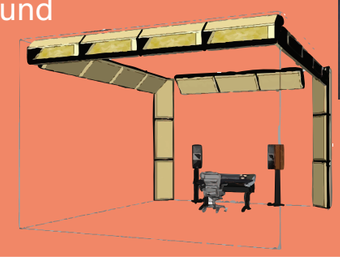
Implementing AI-driven room calibration enables speakers to automatically adjust to their surroundings

Reducing Reverberation

Avoid using flat surfaces that sound can easily reflect off.

Use bass traps, placing them primarily in the corners of rooms and along flat surfaces to absorb low-frequency sound





Conclusions From Research

Product Must Haves

From the research above the product must have the following features/design Specifications:

- The design must localise the output sound
- Have a form of a interactive digital display
- Over come language barriers
- To have incorporated new speaker technology
- Through material selection must reduce sound distortion
- Easy and intuitive to use
- Must be inline with anthropometric data
- Must be aesthetically appealing so that people want to interact and use it

These product must haves will be referred to through out the design processes ensuring that the finale product ad-hears to most if not all of them.

Considering these design must haves, and looking into the user profile, multiple concepts have been developed to try and solve the issues.

User Profile

Personal Information

Name(s): Sophia and James

Age(s): 34 and 36 years old

Occupation: Investment Bankers

Country of Origin: Scotland

City: Glasgow

Hobbies (Joint): Travelling, Hiking, Camping, Gym, Running Cycling, Sailing, Skiing/Snowboarding.

Description

As a couple they love to go travelling. Renting a car tends to be expensive, and can be a little stressful to they tend to use public transport to get from A to B.

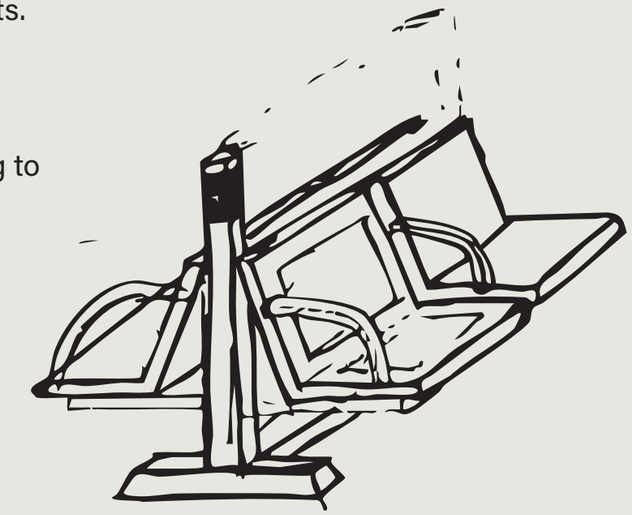
However a lot of time when travelling they don't understand the language, so can't sit and wait to hear announcements, and they don't like that they have to constantly walk over to panels to check for departures either bringing all of the heavy bags with them or having to leave them unattended for a short period of time.

Solution Phase

Concept 1

The main idea behind this concept is to integrate speakers directly into benches and chairs located in public spaces such as train stations, and airports.

By embedding the speakers within the seating, announcements can be delivered directly to individuals or small groups without contributing to overall noise levels in the environment.



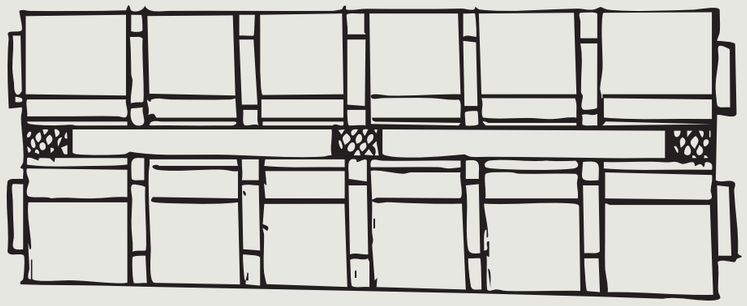
An interactive touch-screen display would be embedded into the armrest of the seat. This panel could provide:

Visual versions of announcements (for accessibility)

Real-time travel updates or public information

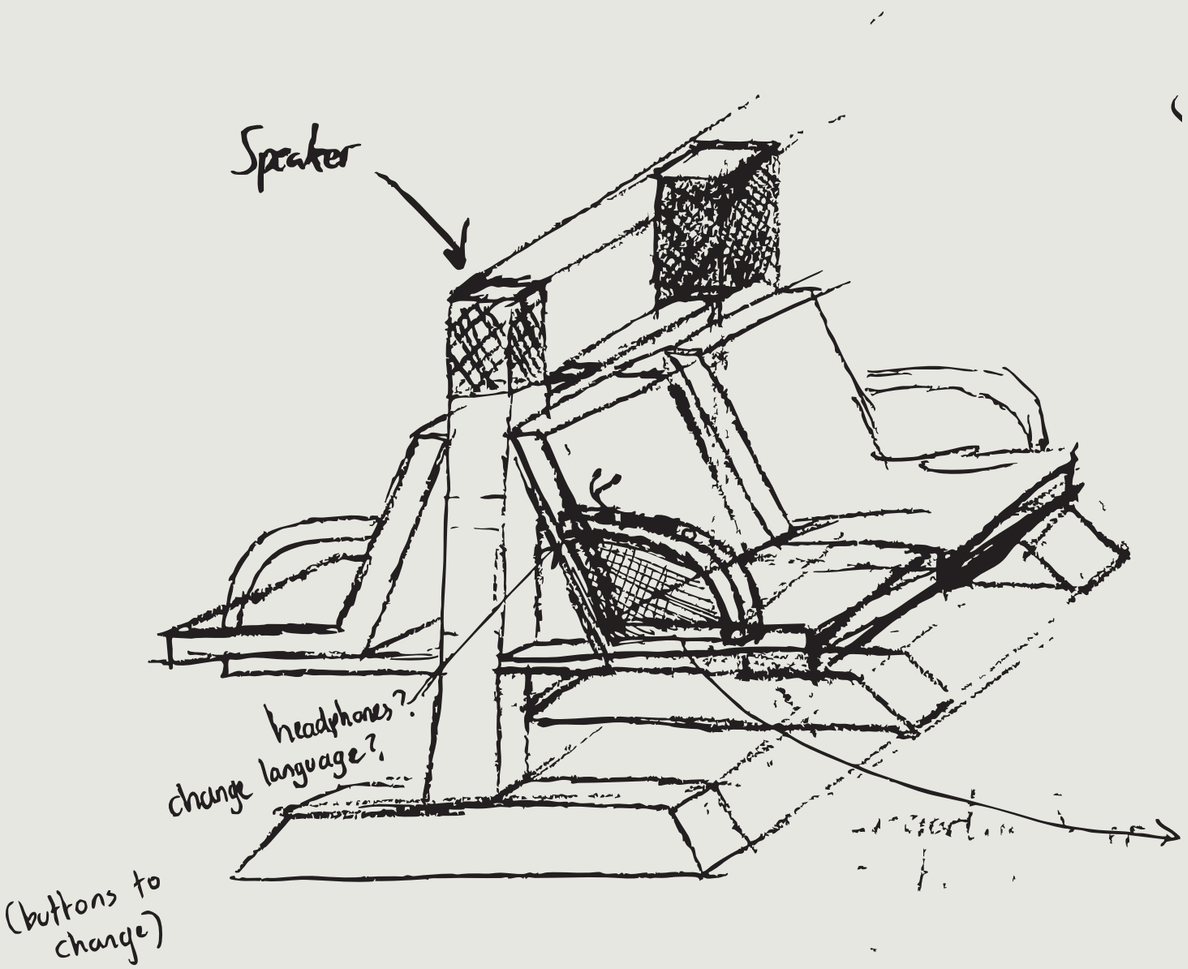
Language selection for international users

Additional features such as charging ports or way finding assistance



Each seating unit would contain built-in speakers capable of transmitting announcements clearly and directly to the people seated.

The system would be designed to cover up to four individuals per seating area, ensuring everyone receives the same message without distortion or excessive volume.

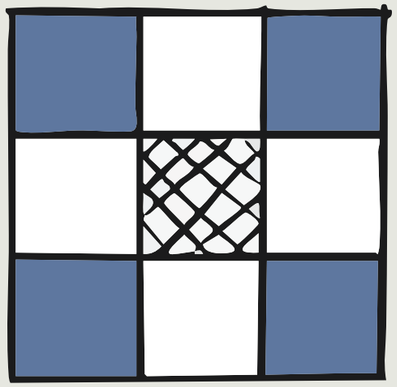


Solution Phase

Concept 2

This concept explores the idea of installing speakers in to mats/rugs, or completing redoing the floor.

The mats would feature adaptive volume control, automatically adjusting the sound level based on how many people are standing on them — increasing the volume when more people are present and lowering it when fewer are nearby.



Pressure resistor for adaptive volume

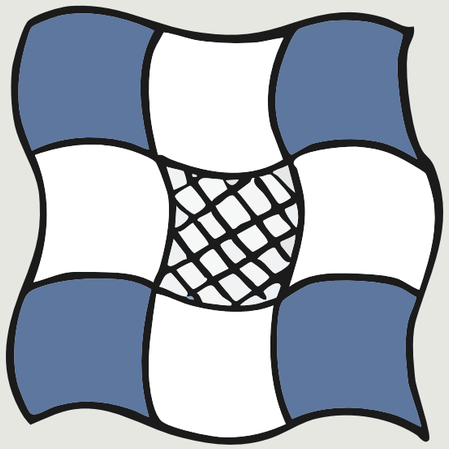
Mechanism Breakdown

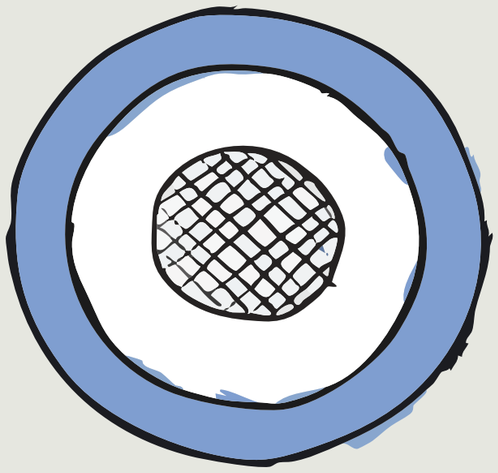
The squares would incorporate pressure sensors to detect whether the area is occupied and to adjust the level of the volume.

Form Exploration

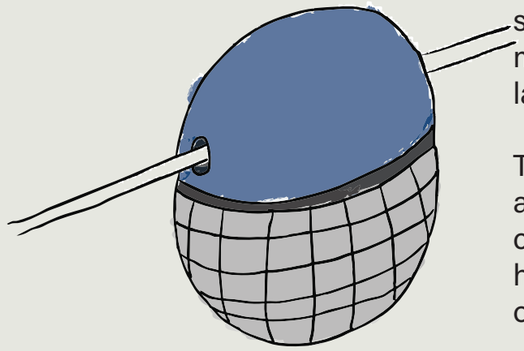
As per the initial research, flat edges and straight face allow for sound to reflect better allowing more interference noise to be generated.

These sketches are exploring the different shapes that can be used to help reduce any sound reflection



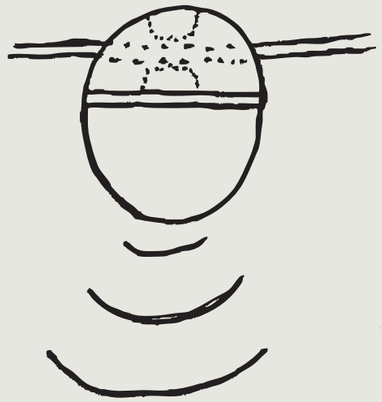


Concept 3



This concept focuses on suspending speaker orbs from wires that span across the main waiting areas of stations, airports, or other large public spaces.

The orbs would hang approximately 3–4 meters above the ground — low enough to maintain clear speech transmission and audio quality, yet high enough to avoid interference from people or surrounding objects.



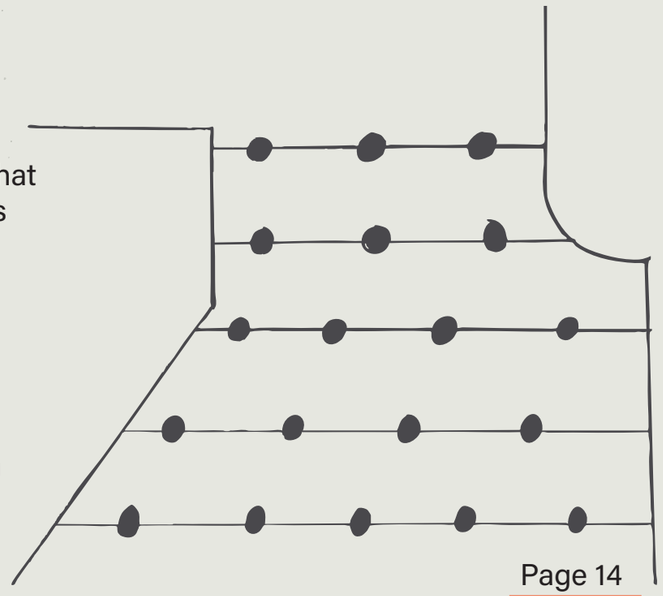
Mechanism Breakdown

Each orb would feature built-in mechanical rollers at the top, allowing it to glide smoothly along the wires suspended across the space.

When an announcement is about to be made, the orbs would move into position, projecting sound clearly across the area, and then retract back to their resting positions once the announcement is finished.

The main idea behind this rolling back-and-forth concept is to ensure that the speakers do not obstruct anyone's view of the ceiling.

This design is particularly suited to stations such as Grand Central Terminal in New York, where the architectural beauty and historical significance of the roof should remain fully visible.



Concept Evaluation Matrix

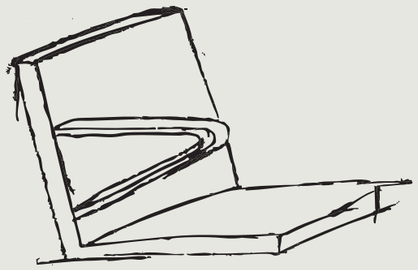
Criteria	Weight	Bench	Floor Matt	Suspended Speakers
Feasibility	0.7	7	8	5
Instalment	0.6	6	6	6
User Interaction	0.6	8	7	6
Aesthetic	0.4	8	8	5
Usefulness	0.8	8	7	8
Desirability	0.6	7	6	6
Solving Problem	0.9	9	8	9
Total		35.2	33	30.5

Chosen Concept

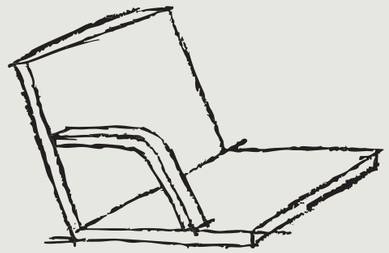
After reviewing the concepts, the bench will be further developed as its initial concept covers the most amount of design must haves, with the other two more focused around localising the output sound.

Concept Development

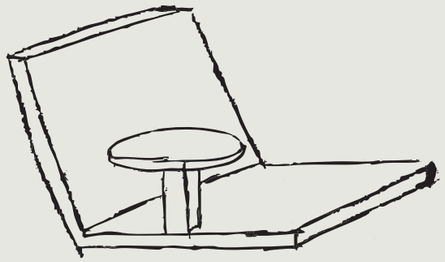
Exploration into Arm Rest



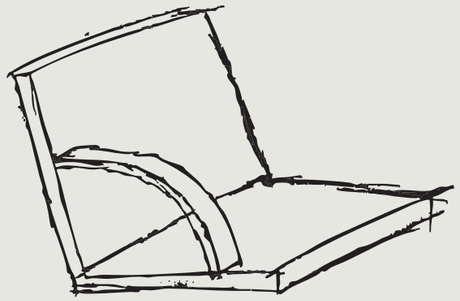
A similar design to existing arm rest in train station



A continuous sweeping rest providing a flat service at the top to rest arm on



Taken inspiration from desk chairs with an adjustable single arm rest



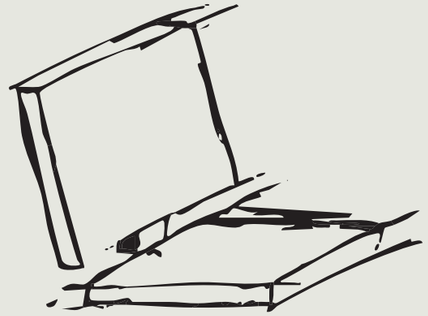
A smooth arc shape adding a little bit of an organic feel to the seat in quite an industrial environment

Additional Information:

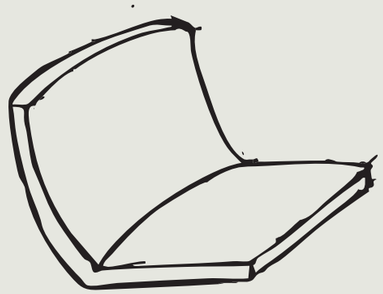
The seat rest will have in built headphone jack that will allow for multi-language announcement when plugged. The chosen language will be able to be chosen on the display console that will be integrated into the arm rest.

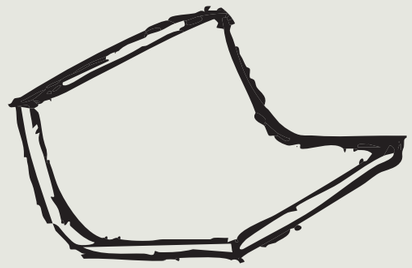
The chosen design will be the continuous sweeping arm rest as it has a nice sleek modern design to it.

Exploration into the seat design



The seat is split into 2 sections allowing for adjustable back support height, improving comfort for waiting passengers





A curved back help support the person all the way round, with a curved bottom allowing for a smooth transitioning the design from the back support to the seating area.

Additional Information:

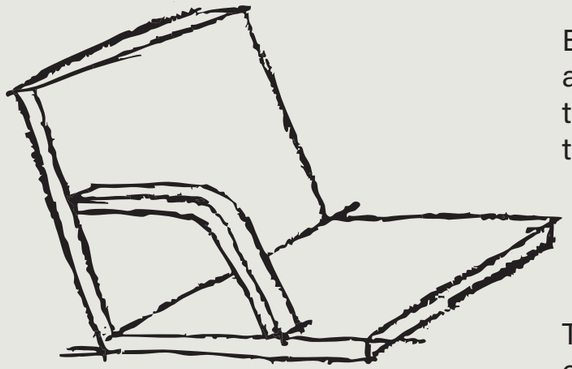
The seats will have a cushion on the seated area and the back rest to ensure full comfort, the cushion will have a foam core as it is cheap but still comfy for shorter periods of waiting, the outer layer will have a a vinyl coated fabric as it is easy clean and durable.

The chair design will have a curved bottom to add to the sleek modern design alongside the arm rest.

Concept Development

Looking into methods of integrating the new design into the current benches. This would be done to try and reduce cost for implementation into train stations

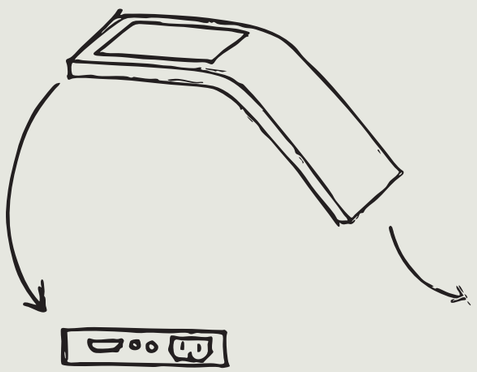
As the arm rest component would have a lot of technology inside of it, it wouldn't be feasible to try and add piece of technology to the existing arm rests, creating new ones is the best option



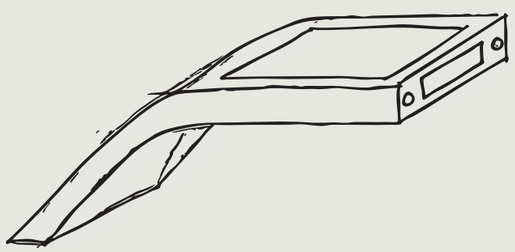
Exploring methods for attaching the arms rest to existing benches, with the existing technology built into the part.

The arm rest would be fitted to current existing benches, with the top half of the arm rest having the ports for power and for connecting the data for the train times.

The bottom of the arm rest would either be rubber bottom to stop it from moving or would be screwed into the bottom of the bench.

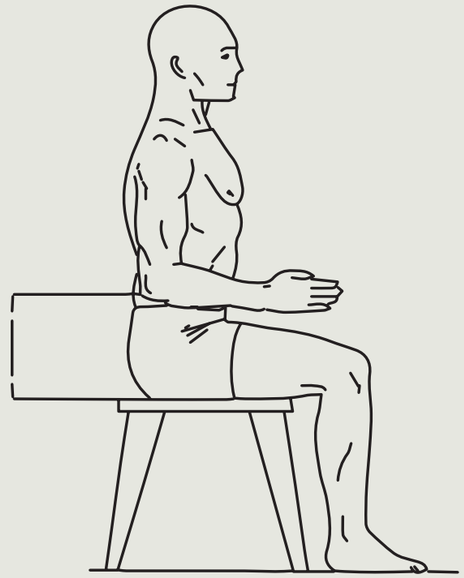


The arm rest will be screwed into the bench, the screw holes are on either side of where the electronic ports will be.



To ensure the arm rest is comfortable research was conducted into in to the anthropometric of a user arm to ensure that the length, and height of the arm rest will accommodate the majority of people.

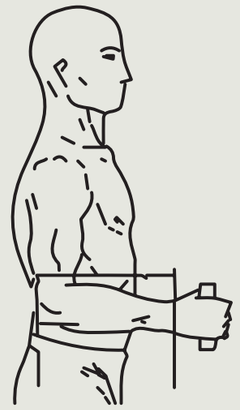
Anthropometric Data



Elbow Rest Height, Sitting

Female (cm)	Percentile	Male (cm)
17.57	5th	18.41
22.08	50th	23.19
26.44	95th	27.37

For the height of the arm rest, elbow rest height when seated is considered. From the table, I'll be using the 50th percentile height for males (23.19cm) as this way the majority of people can use it comfortably.



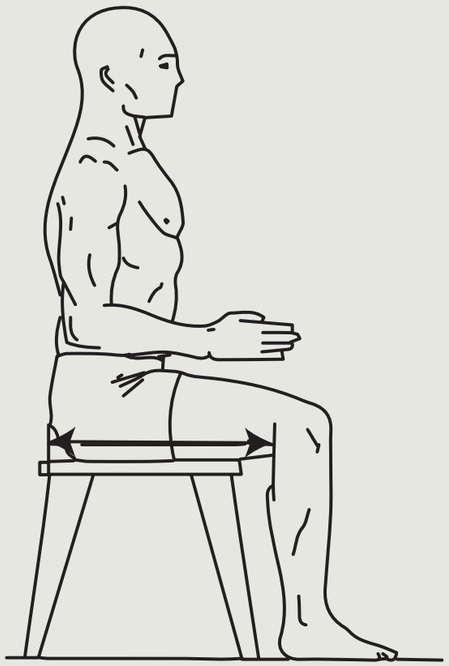
Elbow-Wrist Length

Female (cm)	Percentile	Male (cm)
17.57	5th	18.41
22.08	50th	23.19
26.44	95th	27.37

For the length of the arm rest the elbow-wrist length was considered. From the table the **50th percentile male** of lengths (23.19cm) was used so the majority of people can use it comfortably.

Concept Development: Anthropometric Data

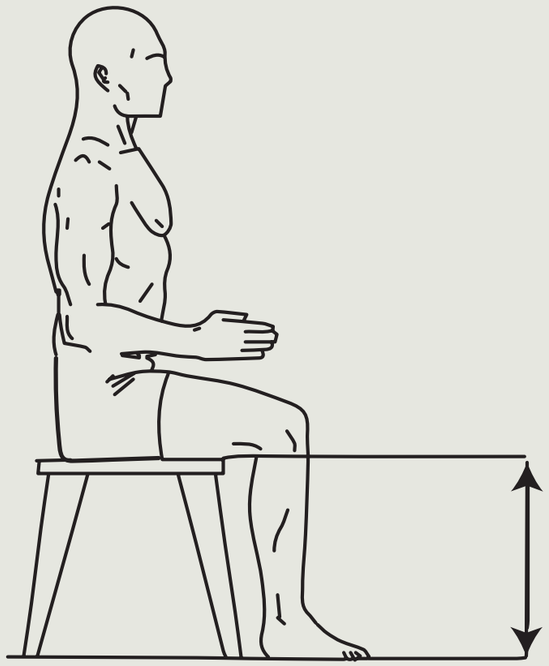
Buttock-Popliteal Length



Female (cm)	Percentile	Male (cm)
44	5th	45.81
48.05	50th	49.96
52.77	95th	54.55

Chosen Size: 49cm Deep

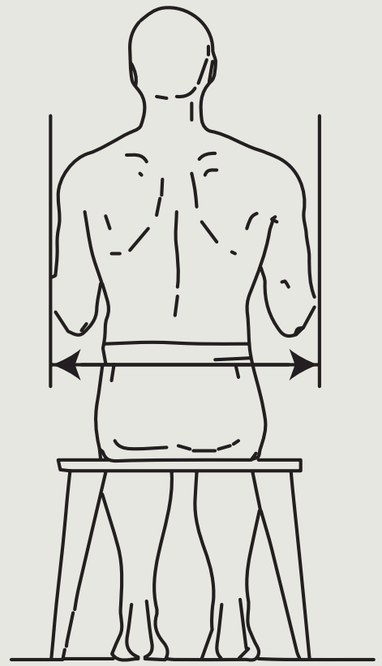
Popliteal Height



Female (cm)	Percentile	Male (cm)
35.13	5th	39.46
38.89	50th	43.32
42.94	95th	47.63

Chosen Size: 41.11cm High

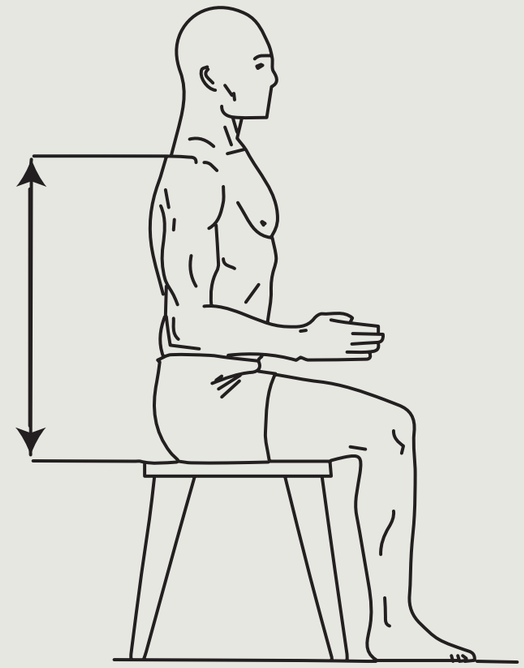
Forearm-Forearm Breadth



Female (cm)	Percentile	Male (cm)
41.47	5th	47.74
46.66	50th	54.45
52.84	95th	62.06

Chosen Size: 62.06cm Wide

Shoulder Height Sitting



Female (cm)	Percentile	Male (cm)
50.91	5th	54.85
55.51	50th	59.80
60.36	95th	64.63

Chosen Size: 48.47cm High

Analysis

Typically a seat may be designed either for lower limit of people or the higher limit, depending on its intended use. As this seat will be being used by thousands daily it'll need be designed for the 50th percentile of people. Adding the 50th percentile of male and female together to get the average high and depth of the seat to ensure that the majority of the people can fit into the chair.

These anthropometric measurements are taken for a human sitting perfectly upright with good posture, so some adjustment may need to be made to account for people slouching

Analysis

To ensure that everyone can fit into the seat the arm rests will need to be designed for the widest people which is the **95th percentile of males.**

Analysis

For back support when sitting the shoulder height was considered, using around 3/4 of length to ensure that a large enough area of the back supported but not supporting the full length of the back as that's not necessary.

Materials And Manufacture

Material Choice

As the benches can be used in places that are sheltered and outdoors, it necessary to make them high out of high corrosion resistant metals.

As multiple components will need be manufactured from metal, to reduce costs for the production they will be manufactured from the same material.

Material	Pros	Cons
Aluminium	Light weight, high natural corrosion resistance. Wide variety of manufacturing processes	Due to its softness it can dent, and scratch easily compared to steel or titanium.
Stainless Steel	High levels of strength, so doesn't dent easily. High levels of rust proof.	Can be heavy compared to aluminium, expensive. If in direct sunlight can heat up and burn.
Galvanised Steel	Cheap option, good corrosion resistance. High levels of strength, doesn't dent easily .	During some manufacturing process can have a rough finish. Not aesthetically appealing.
Titanium	The best corrosion resistant material, as strong as steel but 45% lighter.	Very expensive, not feasible for manufacture, requires special TIG welding.

To ensure that the bench has a high corrosion resistance, looks aesthetically appealing, and keeps manufacturing cost to a minimum, **Aluminium** is the best choice for manufacture.

Seat Cushion

As specified previously the bench will have a cushion to add comfort, to ensure that the cushion is manufactured from the best material the following research has been conducted.

Material	Pros	Cons
Vinyl's	100% waterproof, easy to clean, highly durable, won't fray if snagged or ripped	If wet and feel sticky on skin, can look industrial or plastic-y.
Acrylic Fabrics	Soft texture, UV resistance, can with stand strong cleaning chemicals	Is water absorbent, takes a while to dry once wet, can fray when ripped or punctured.

Manufacture Process Choice

To ensure that bench and the components are manufactured in the best way, to reduce and allow for mass manufacturing the following research has been conducted into different manufacturing processes.

Material	Pros	Cons
High Pressure Die Casting	High precision, smooth finish, high production rate, can handle complex geometry.	Expensive tooling cost, and an expensive initial set up cost. Material limits.
Sheet Bending	No expensive moulds, allows for work hardening ensuring a strong finish	Limited geometric shapes, spring back, can have leave visible marks.
Casting	Great for heavy, unbreakable furniture. Low tooling cost.	Parts tend to be heavy, rough surface finish, requires sanding post production
Extrusion	Material efficiency, low production cost.	Can only create shapes with a continuous cross section.

Bench Main Body

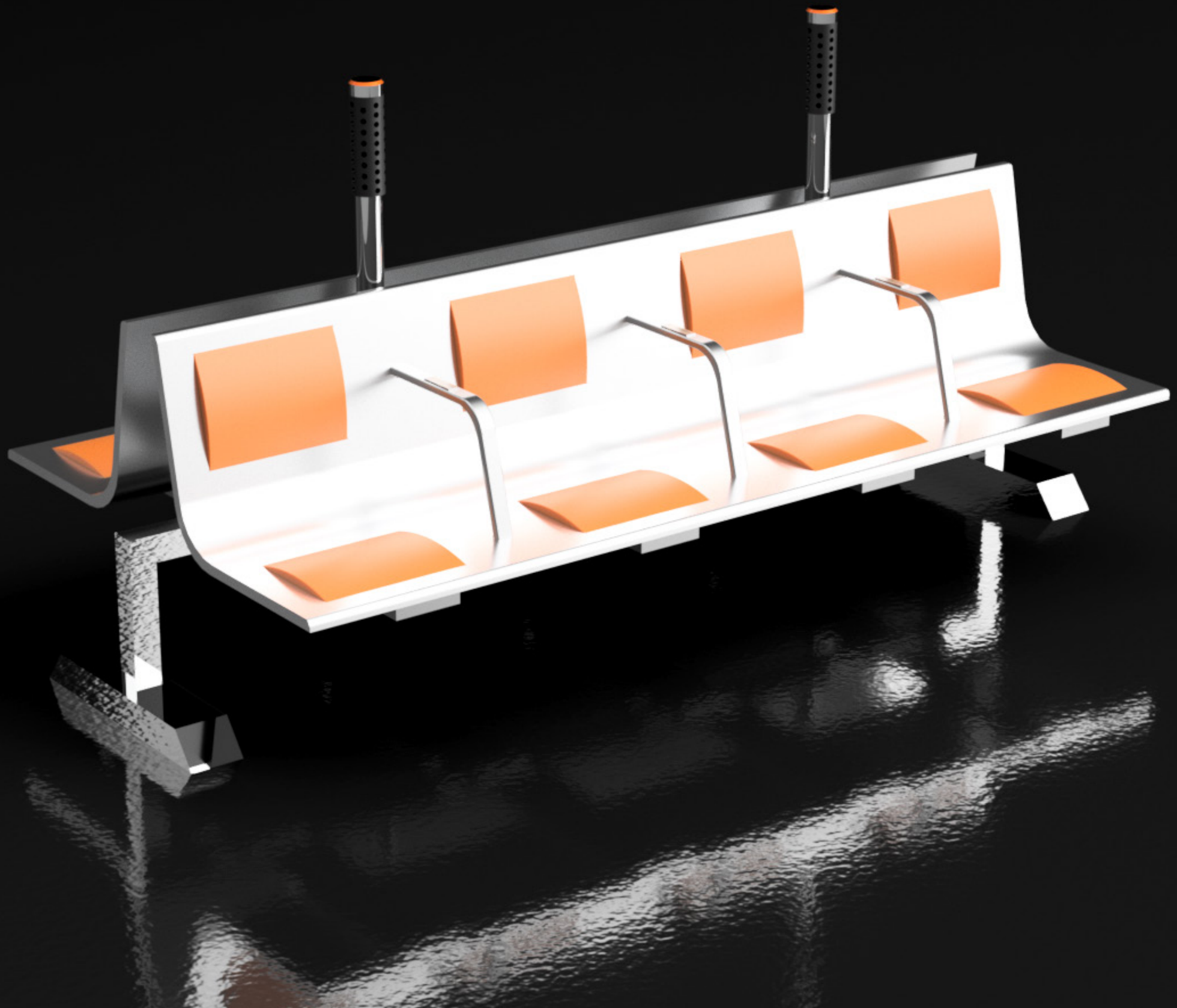
Due to the shape of the benches main frame, sheet of aluminium will be cut to the surface area of the benches dimensions then will **sheet bended** to the correct geometry. Post production holes will be drilled for assembly points to the legs and for the arm rests.

Bench Legs

The legs will be **extruded** as they have a contentious hollow cross section. And then post production holes will be drilled for screws and the bar will be bend to the correct geometry.

Arm Rests

The arm rests will be **extruded** into a hollow die, cut to the desired length, and then bent round a mould to the correct geometry. The arm rests are hollow on the inside to allow for the internal electrical components.



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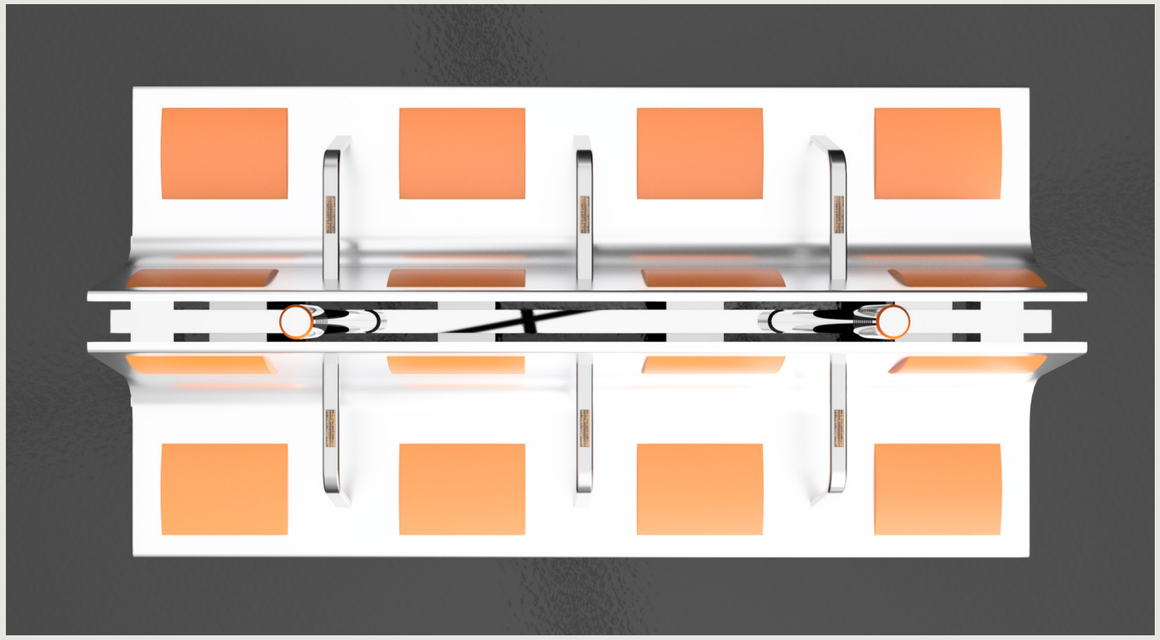
Final Solution



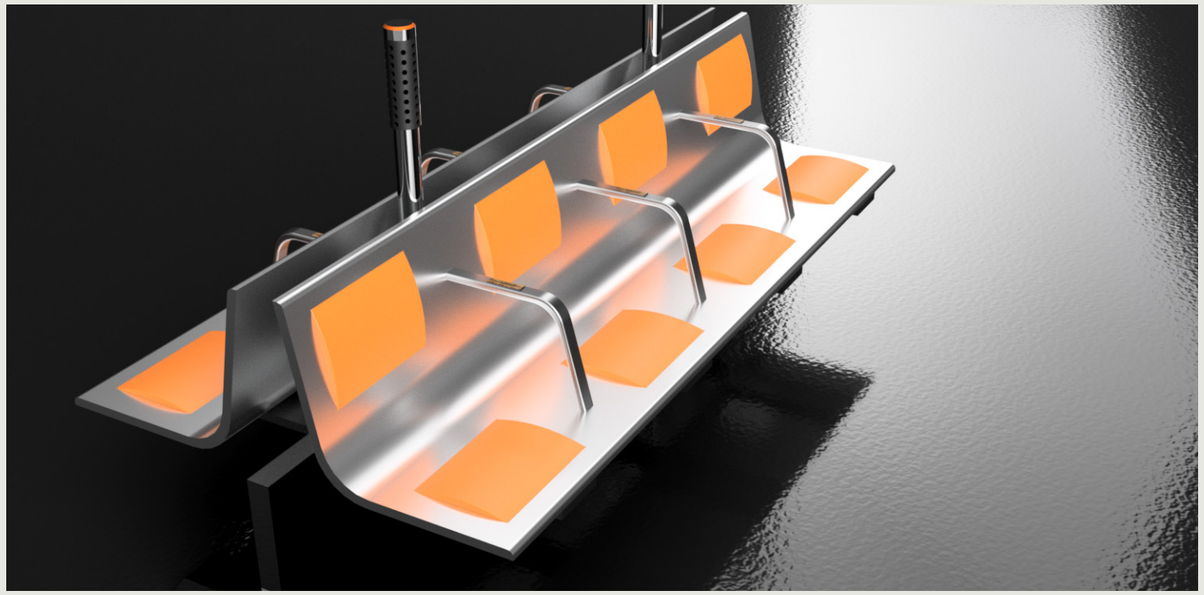
User Interaction

The positioning of the speakers enables each unit to deliver announcements to up to four people at a time, creating a more personal experience and ensuring clear audio transmission for waiting passengers.

The Bench

This product features an innovative audio delivery system, seamlessly integrating speakers into benches and chairs in public spaces like train stations and airports.

This embedded design allows announcements to be transmitted directly to seated individuals or small groups, ensuring clear communication without adding to ambient noise levels. The solution enhances accessibility, reduces auditory clutter, and creates a more comfortable environment for all users.



Features

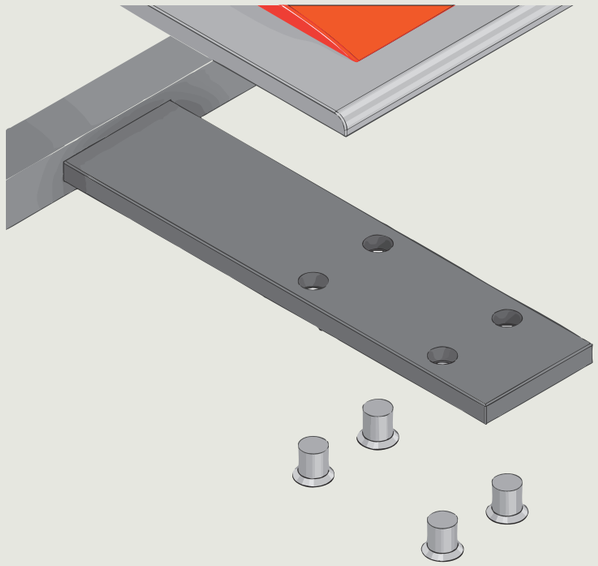
An interactive display screen is built into each seat, allowing passengers to view missed announcements and departure boards directly from where they’re sitting. This adds convenience and helps ensure no important information is missed.

A headphone jack is also included, offering multilingual audio options for those who don’t understand English. Language preferences can be selected from the display screen on the armrest.

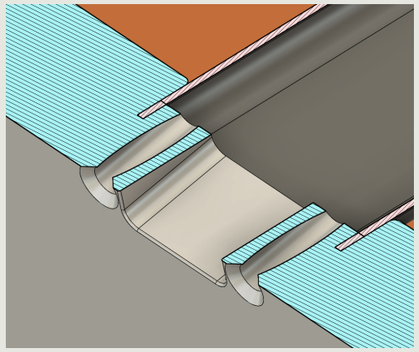
Final Solution

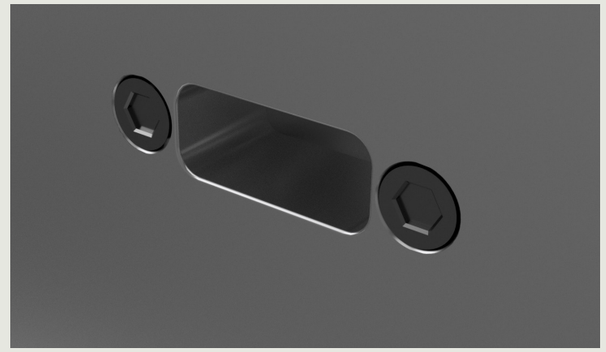
Bench Assembly

On the underside of the bench support arms will come out, these will allow for screws to attach to the bottom of the bench assembling the bench together.



Exploded view for showing the screw assembly





The back of the bench for where the arm rest will attach, screws will hold it in place and centre hole is for the cables for connecting up the display board in the arm rest.

Project Review

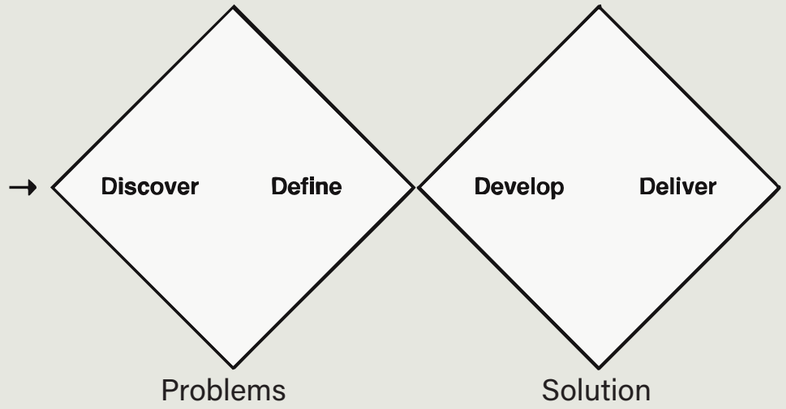
Product Review

The problems outlined through the initial research helped develop the finale design. Looking at the product must haves, the product does full fill these, with it being aesthetically appealing, ergonomically designed, localising the output sound, and having a method for overcoming language barriers.

With these features the product would be successful in the real world with further development.

Project Review

Overall the project was completed well, challenging us to use our research skills to go out into public, find multiple problems, identity what is causing the problems and then start to develop solutions to fix these issues.



This project was mainly focusing on developing the double diamond process.

Design Improvements

The design of the bench is good idea for solving the issues with existing PA systems in train stations. However there are still areas to develop the overall design to maximise the performance.

- Further development of material choice to decrease sound distortion.
- Looking at specific train station and designing the aesthetic of the bench to that.
- As the bench is a solid sheet of metal, holes could be added to reduce the weight of the bench.
- Looking into how to apply the technology into the benches

Origami Project

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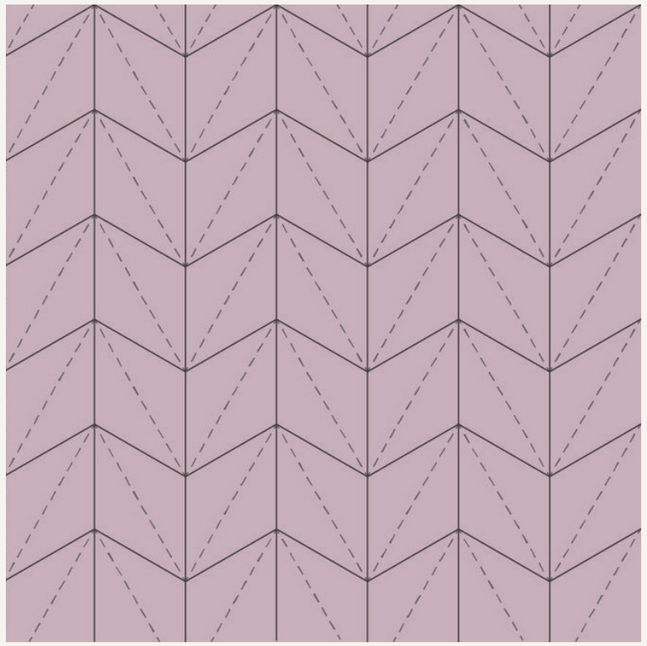
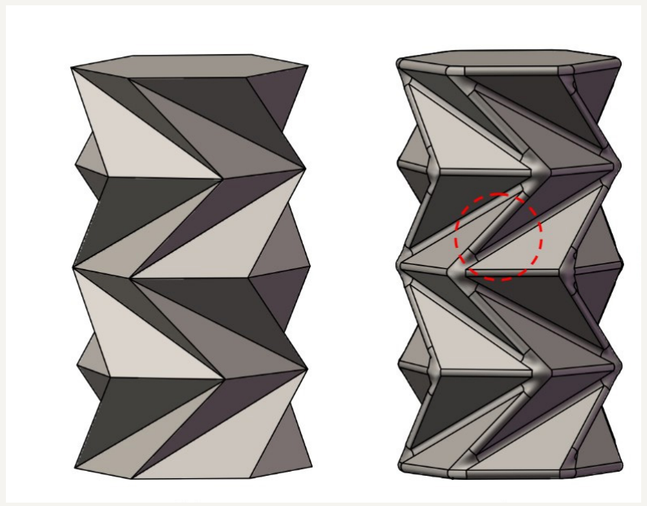
Initial Research

Origami Folds

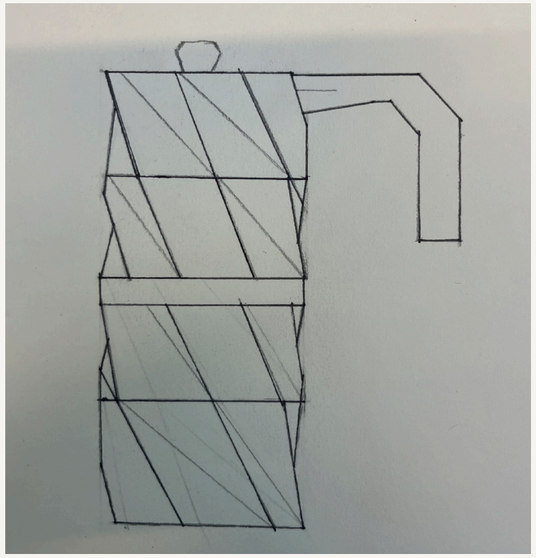


Kresling Fold



This fold allows a cylindrical shape to fold into a flat 2D shape. Geometry of the folds allow for the shape to support itself when up right, and requires a twisting and pushing down method to collapse the shape.

Concept

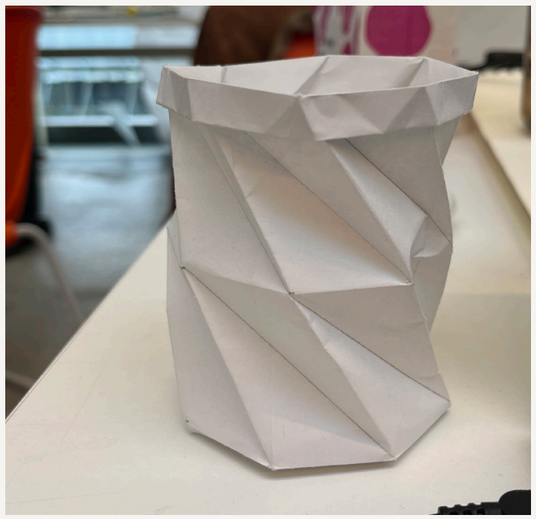


At first I wanted to use origami to try and solve an issue that I have in my life.

During my spare time over summer I like to camp so making some flat pack and take up no space is important.

When looking into the market of existing products one thing that always stood out was a kettles/ boiling water.

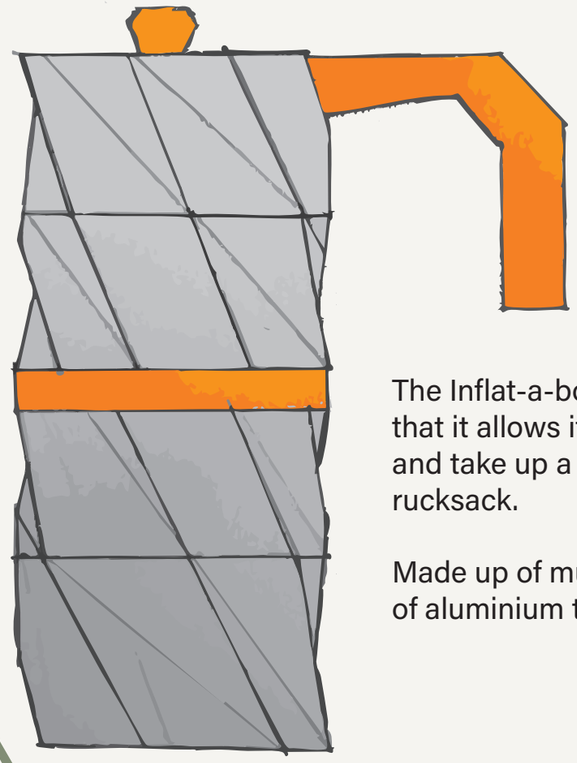
The Concept was to create a foldable kettle using Kresling fold.



This is the initial paper model that I made to show how my finale concept would work.

Final Concept

Inflat-a-boil



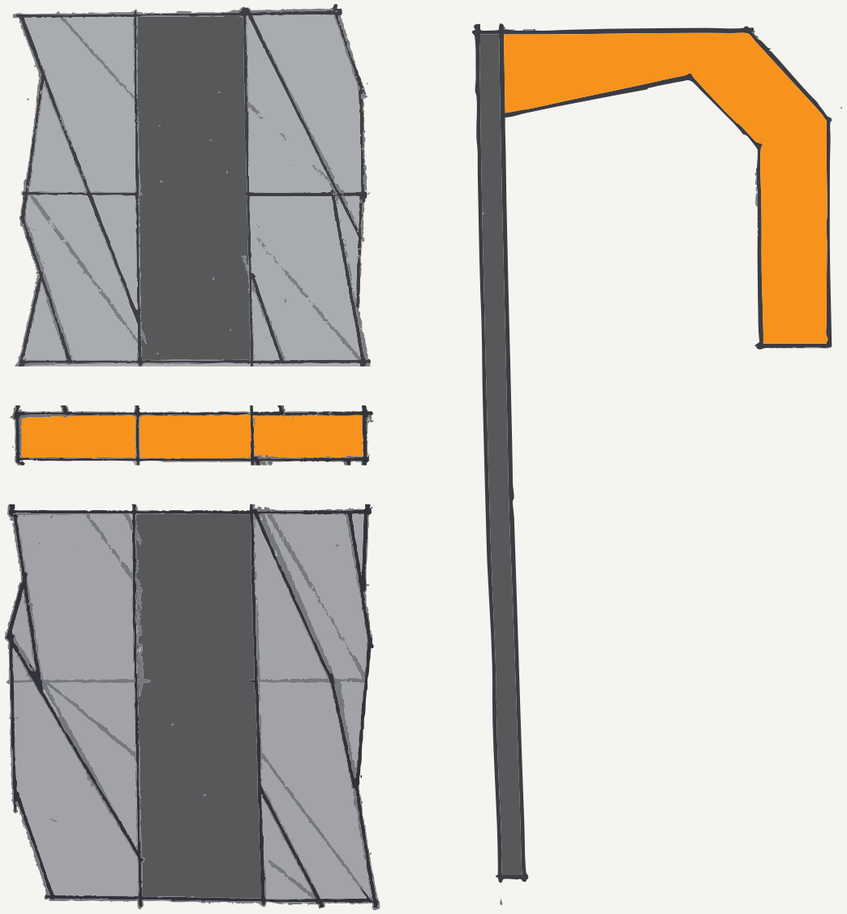
The Inflat-a-boil has a modular design that it allows it fold down completely flat and take up a small space in your rucksack.

Made up of multiple different sheet faces of aluminium that allow it to fold freely.

Assembly

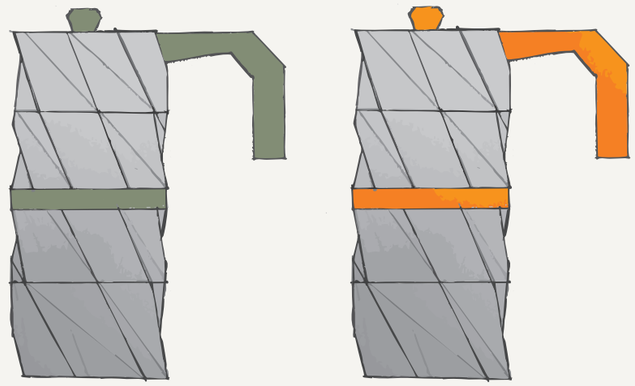
Made up four sections, the upper body, the middle band, the lower body and the handle.

The upper and lower bodies will slot and twist into the section. This modular design is done so that when boiling a small amount of water you can use the bottom section only and if its a lot of water you can attach the upper body to increase the volume.



The handle slots into the dark grey part of the kettle to add support and shape to the kettle when fully assembled.

Different Colour Options



Project Review

This project helped us understand the usefulness that origami can provide within design, and allowed us to apply this to interests that we have.

It was a good fun project that also helped develop prototyping skills with origami and using paper models to help show how our designs work.

Fridge Magnet

Madrid 2026

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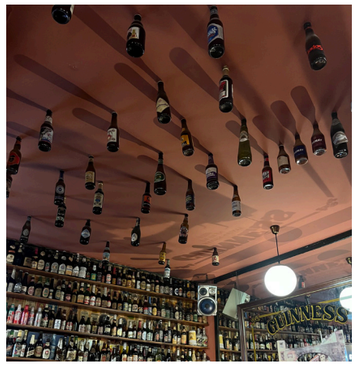
Madrid Trip

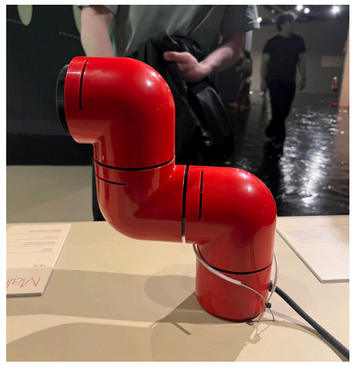
Photos From The Trip

Andre Ricard Exhibition



La Mayor Cerveceria

Mini Moke Andrea Ricard



lamp Andrea Ricard

From exploring Madrid and going to the Andre Ricard exhibition at the Madrid Design festival, I found the candles that reminded me of a telescopic system.

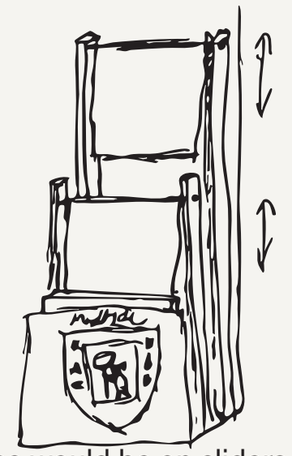
The candles paired with my thought of when holiday taking polaroid's of your trips inspired my design for a fridge magnet.

Design Idea

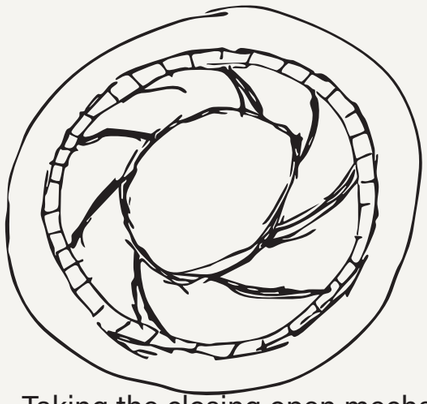
The concept was design a fridge magnet that was able to hold and display multiple polaroid's at the same time making them a centre piece to the fridge.

Inspiration for the shape comes from the lamp. The photos would be inserted into the top or bottom section.

Taking the bear from the Madrid crest as the shape for the photo frame, and then in the middle of the tree will be where the photo goes.



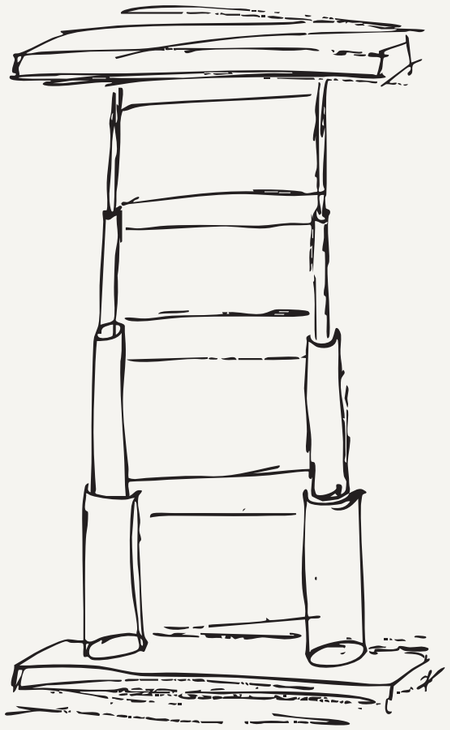
The photos would be on sliders, with a tier system in place. The photo at the back would slide up the furtherest to ensure it can be seen.



Taking the closing open mechanism of the lamp a s a cool way to hide and display the photo behind it.

Final Concept

Concept Develop

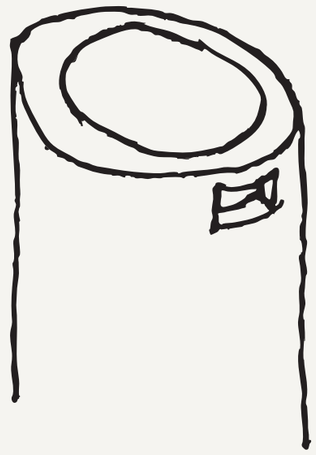


This design focused on the shape of the candles and the telescopic shape of them.

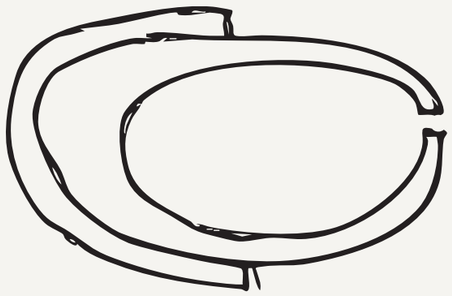
Holding the photos?

Bars could span across the uprights that the photos can rest on. The maximum gap would need to be a couple of millimetres short to ensure that the photo will stay in place.

The square hole will be in the uprights for the bar to slot into.



Bar Slot



Top View of the Uprights

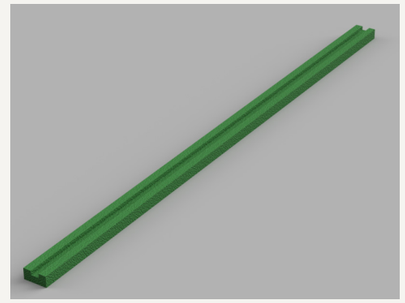
To ensure that the uprights will still be able to slide up and down a gap will need to be added to the uprights for to ensure the bar won't snag on it.

To ensure that the uprights won't slide out the upright on the inside the uprights will need to be slider bigger than the hole at the top.

Finale Concept

The fridge magnet has telescopic poles that slide up and down allowing you to increase the size of the holder or reduce the it depending on how many polaroid's the user is planning on displaying.

The polaroid's will rest on bars that will span between the telescopic uprights. The bars will have grooves in them that will stop the polaroid from popping out of the holder.



Project Review

This project was a fun task that allowed us to develop our prototyping skills using 3D printers. With the design that had come up with, it had me working with tolerances ensuring that the parts could easily fit together and slide around with a reduction in friction.

The product that was developed does the original task, displaying the multiple polaroid's at the one time. However the overall design of the product is a little big and not as sleek as originally intended, so development could be done on reducing the size the of the product and making it more aesthetically pleasing.

Fix a Friend

Portfolio Submission

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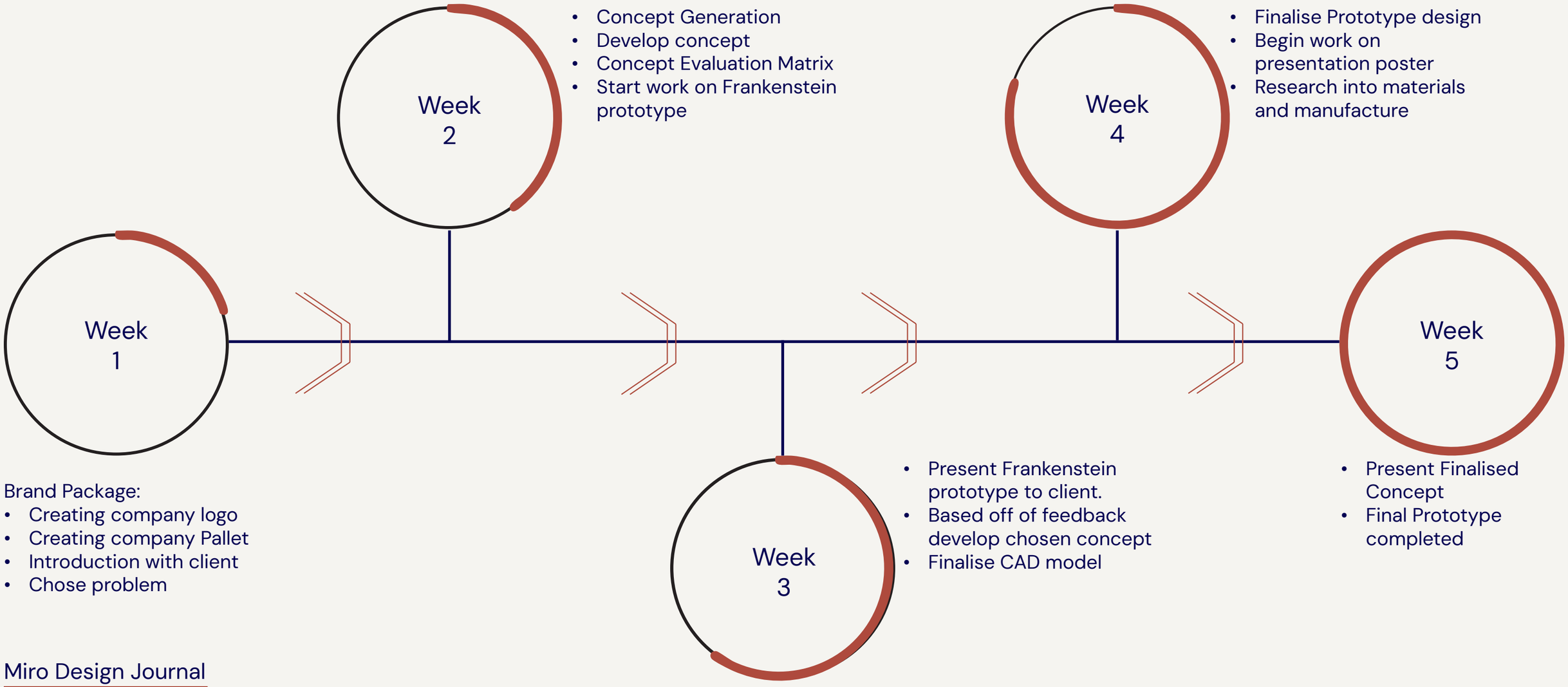
Project Plan



Brand Package:
- Creating company logo
- Creating company Pallet
- Introduction with client
- Chose problem

Miro Design Journal

https://miro.com/app/board/uXjVG1hluug=/?share_link_id=878939479544

Client Problem

Client Brand Guidelines

ACT *Design*

Main colour
Hex: #030052

Accent colour
Hex: #AF4D3C

Neutral colour
Hex: #DEACB7

Background colour Hex: #DEACB7
DM Sans main font

Purpose Driven design - slogan in Didot italic

Inspirations

High quality, long lasting goods

Simple patterns

Luxury textures

Stainless Steel accent

Brand Guidelines Plan

- Headings: Will be font sized 18, with a accent colour underline.

- Subheadings: Will be font sized 16, with a blue underline

- Main Body Text: Will be font sized 12

- Background: Using the neutral colour used on the page.

- Accent Colour Use: Will be used for underlines, dividing lines, and for other pieces of text that aren't super important.

Clients Object:

Coat Hanger

Clients Existing Trousers

- Cargo Trousers
- Linen Trousers
- Chinos
- Smart Trousers

Issue: When putting trousers on the coat hanger, they tend to slight around when the coat hanger is tilted causing the trousers to crease, bunch up in one corner, or fall off the hanger.

Pros

- Easy to place a pair of trousers on the hanger
- Large gap allows for the users hand to easily fit through with a pair of trousers
- Simple design that looks sleek

Cons

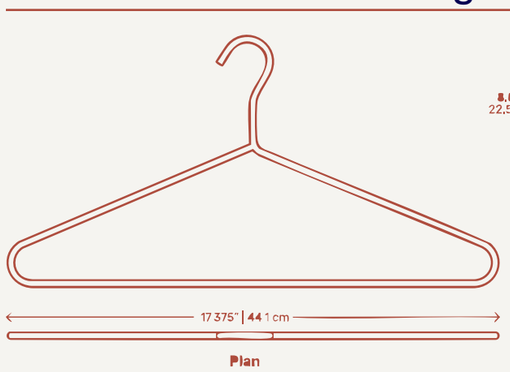
- Lack of friction allows for items to slide around.
- Traditional hangers can be rather bulky and old fashioned.

Research & PDS

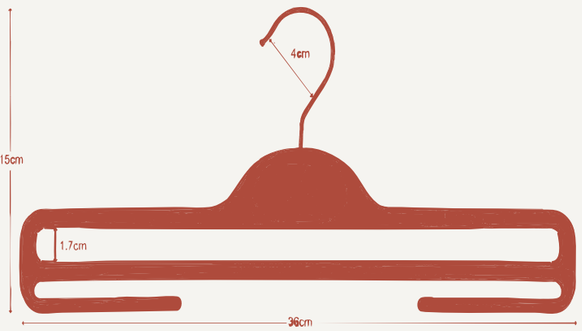
Product Design Specification

Target market	High end market, luxury product, all ages but mainly for adults wanting to keep through trousers crease free.
Function	Must be able to hold trousers firmly in place stopping them from sliding around. Must also still be able to be used for hanging jackets and other items i.e. suits.
Materials	For the main frame must be made out of wood, along with any other components to be made from polished stainless steel
Aesthetic	Simple patterns, luxury texture, simple sleek design with a modern look to it.
Form	Easy to hold in hand, rounded smooth edges, no sharp corners
Finish/Colour	Smooth, shiny mental accents, wooden texture.
Size	No bigger than existing hanger dimensions: 45cmx22cm

Dimensions Of Coat Hangers



Height & Width



Researching the minimum gap for trousers. (17mm)

Existing Products

-**Pros:** The clamps have padding on the inside which reduce marks left on the trousers.

-**Cons:** The hanger has no way to hang jackets, tops, and jumpers.

-**Pros:** A clamp that applies a uniformly distributed force that will reduce spot marks or creases.

-**Cons:** The hanger has no way to hang jackets, tops, and jumpers.

-**Pros:** Can have both trousers and tops hung on it at the same time.

-**Cons:** Doesn't have a method of holding the trousers in place once on the hanger.

-**Pros:** Has a simple way of having trousers on the hanger, and can feed the trousers through the bottom to hold the trousers in place.

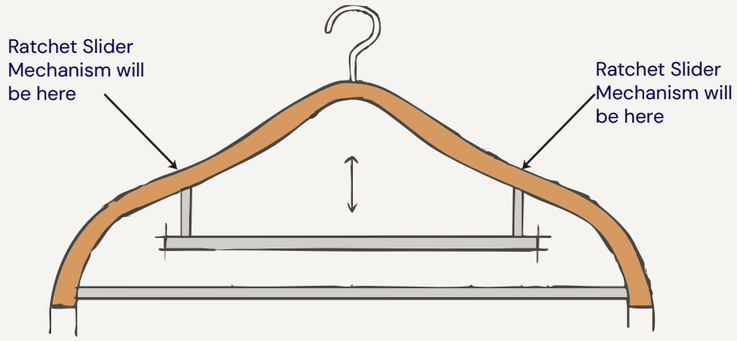
-**Cons:** The hanger is very difficult to feed trousers through as the gap is very small and fiddly to feed trousers through.

-**Pros:** Felt strip on the bar increases the friction on the bar to help keep the trousers in place.

-**Cons:** The hanger aesthetically looks quite cheap and doesn't look high end.

Concept Generation

Concept 1

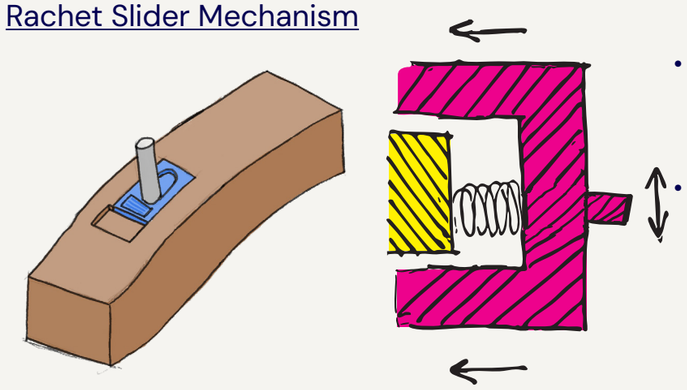


A coat hanger that has a vertical clamping mechanism.

Mechanism Breakdown:

- The bar would be able to move up out of the way when the user wants to put there trousers in.
- And then the bar would move down holding the trousers in position
- Ratchet slider mechanism would allow the trouser to stay up of down.

Rachet Slider Mechanism

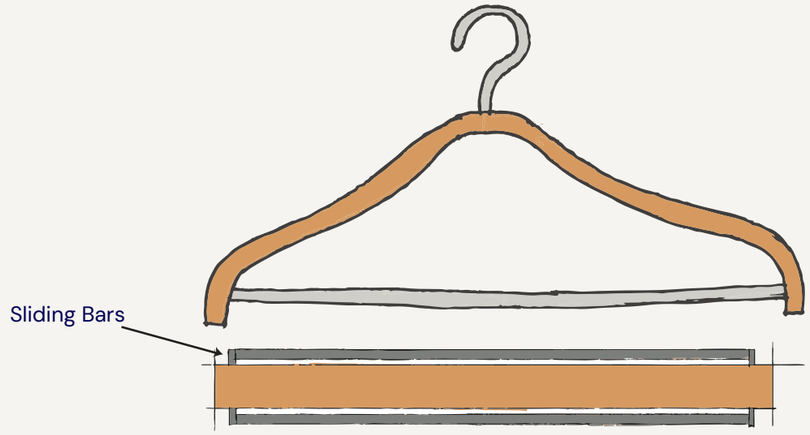


- The blue section would slide out the way, pulling a pin out of the bar allowing it to slide
- There would be a spring that would then push the pin back into the nearest hole stopping the bar from moving up or down.

Further Development

- The width of the bar will limit the maximum height the bar will be able to achieve effecting the gap for the trousers and hand to fit through.
- The Bars currently will end up poking out the top of the hanger, potentially snacking on a top if one is on the hanger.

Concept 2

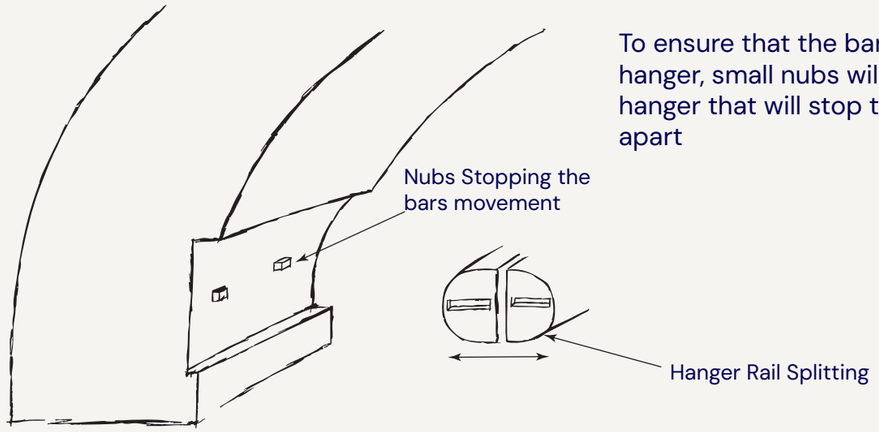


Plan

A coat hanger that has the middle rail that splits in two creating a gap for trousers to feed into.

Mechanism Breakdown:

- A coat hanger that uses the bar that the trousers sits on as the clamping mechanism
- The bar would split in half, creating a cap that the user would feed the trousers through.
- The clamp would hold the trousers the whole way across securing the trousers in place.



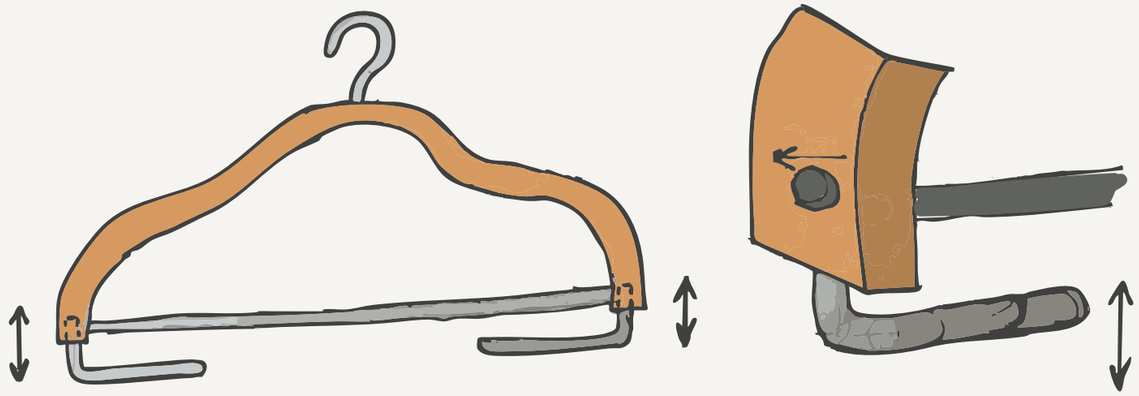
To ensure that the bars don't slide off the hanger, small nubs will slot into tracks on the hanger that will stop the bar from fully pulling apart

Further Development

- Making the gap as big as possible
- What holds the clamp shut when the trousers are on the hanger

Concept Generation

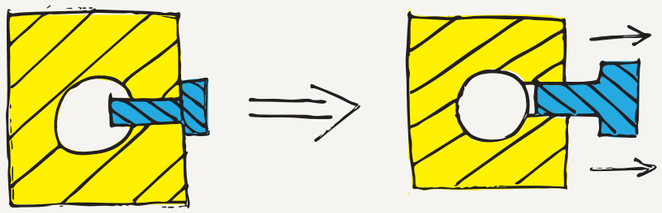
Concept 3



Mechanism Breakdown

- Similar to concept 1, a mechanism that clamps in the vertical direction.
- Inspiration taken from existing trouser coat hangers
- The bottom bars would slide up once the trousers are on the hanger, pinching them and holding them in place.

Pin Mechanism



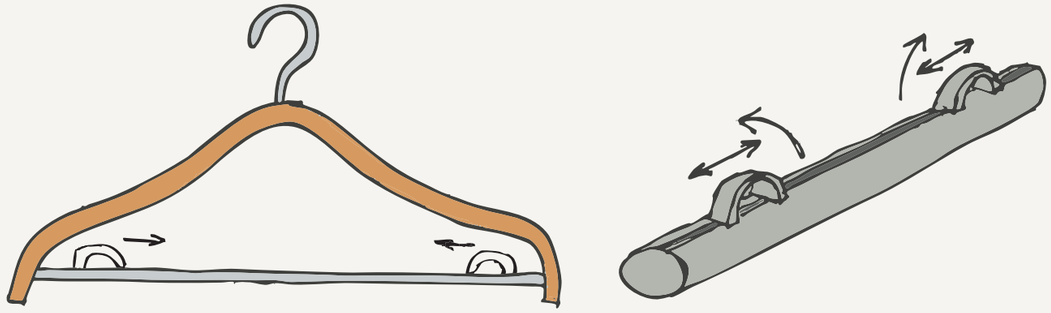
The pin on the side would be pulled out allowing the bar to slide up or down

The pin would be spring loaded so that it automatically shuts when the user lets go of it.

Further Development

- How would the spring and pin fit in within the body of the hanger
- How would the bars fit up inside the hanger body

Concept 4

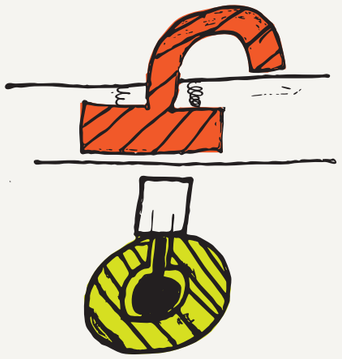


Moveable clips

Mechanism Breakdown

- Depending on the thickness of the trousers being put on the coat hanger.
- The clips are spring loaded, creating a constant downward pressure holding the trousers in place.

Sliding Mechanism



To move the clips push them down, and slide them along to the desired location

The spring at the front of the clip will be stronger than the one at the back to ensure that the majority of the force is being applied to the section holding the trousers.

Further Development

- How would this mechanism fit in the bar without making the bar to thick.
- The tips of the hook will need to be explored to reduce the chance of leaving pinch marks on the trousers.

Concept Evaluation Matrix

Criteria	Weight	Horizontal Clamp	Vertical Clamp	Moveable Clips	Adjustable Bars
Feasibility	0.7	7	7	4	6
User Interaction	0.7	8	8	5	5
Aesthetic	0.5	7	5	7	7
Usefulness	0.8	6	6	6	6
Desirability	0.6	7	7	5	5
Solving Problem	0.9	9	9	6	6
Total		31.1	30.1	23	24.4

Written Justification

This decision was based off how likely it was for me to manufacture the concept. With moveable clips being the least likely to be feasible due to the complexity of the design.

This decision was based off of how easy user would interact with the hangers. Move the moveable clips and adjustable bars are ranked the lowest as they both have two pieces to move compared to other designs.

This decision was for which hanger had the best aesthetics. With three of the options ranked the best as all they looked fairly similar to existing products.

This decision was based off of how useful each design was. With each of them being ranked the same as they all did the same thing just slightly differently.

This decision was based off of how likely someone was to want one of the designs. As can be seen both vertical and horizontal clamps were the highest scores.

This decision was for the design that did everything the best and kept to the PDS the best. As can be seen both the horizontal and vertical clamps both were favourites.

Finale Decision

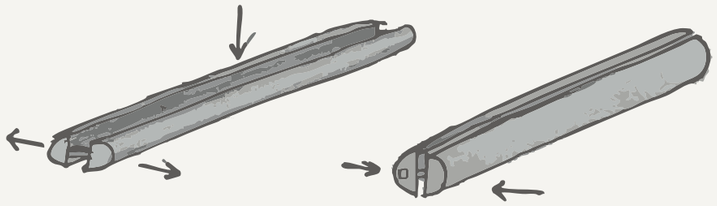
As can be seen from the table the horizontal clamp was the highest scoring concept. However as the vertical clamp was very evenly scored in the majority of the categories both concepts will be further developed to ensure that the best design is taken forward.

Product Development- Horizontal Clamping Mechanism

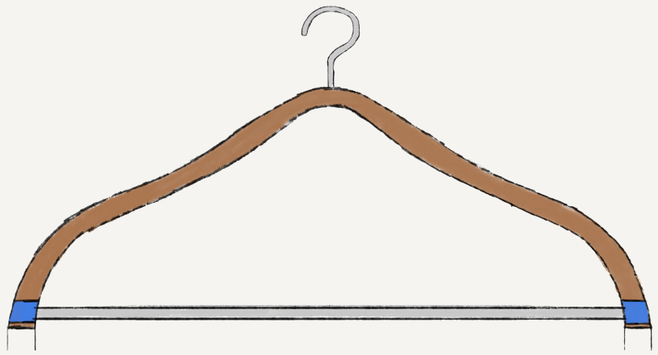
Considering the Bar as an Independent Piece

From the initial concept, it could be seen that it would be very difficult to try and and feed the trousers through while opening the bar.

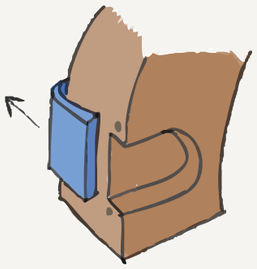
By taking the bar as a independent piece that can be taken out, the trousers can be easily fed through the gap.



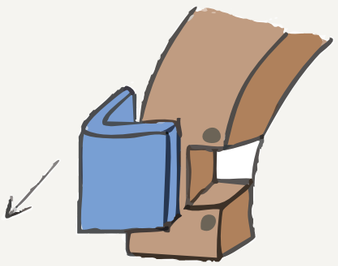
Holding the Bar in Place



The blue taps show where on the hanger these covers will be placed



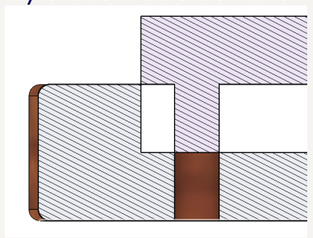
This method would have the blue cover slide side ways out of the way, with magnets on the front face to hold the cover in position when it is holding the rail in place.

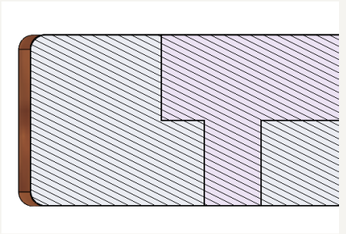


This method would have the cover come off the hanger completely, with magnets on the front and the side of the hanger body that will hold the clip on the place when holding the rail in place.

One Moving Part

To decrease complexity of the overall design, having one section of the bar move and the other stay static would achieve the same overall result.

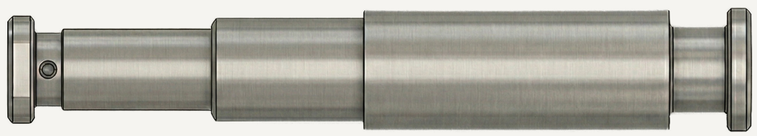




CAD Model

CAD renders are inline with the clients aesthetic
The model shows that a method for increasing the size of the gap is needed

Increasing The Gap



To try and maximise the size of the gap, telescopic pins could be used to ensure the bar is as thin as possible to stay inline with the clients specifications, whilst achieving a large enough gap.

Product Evaluation

Both methods have the same issue with trying to increase the size the gap without increasing the overall thickness of the hanger. Telescopic pins could work, but as the size of them would have to be very small it would be unlikely that they would work or for a cheap price.

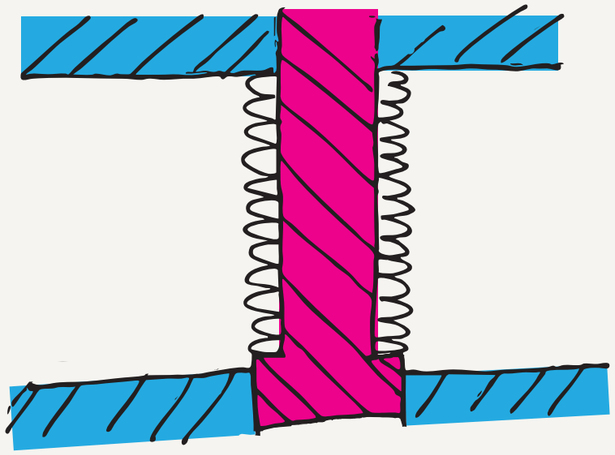
As both developments of the original concept are overlay complicated making the hanger non-feasible, this concept would be unsuitable for further development.

Product Development- Vertical Clamping Mechanism

Applying the Downward Force

The original spring and pin idea was a good method for holing the bar up out of the way when needed but would be difficult to apply pressure perfectly regardless of thickness.

Development: Springs on the outside.



The springs will be able to apply constant pressure on the bar increasing the friction force holding the trousers in place on the rail regardless of the thickness of the trousers.

Pros: Applies constant pressure regardless of trouser thickness.

Does not rely on holes perfectly lining up with the pin to hold the trousers in place, compared to previous design

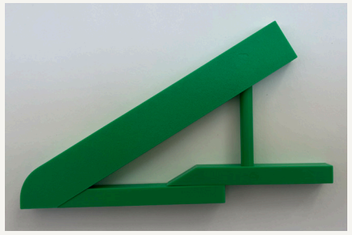
Cons: With the springs being on the outside the design does not fit with the clients aesthetics

First Iteration

CAD Model

This CAD model was used in the client drop in to check the aesthetics were what the client was looking for.

Client Check-In



A client check-in was arranged to ensure that the design was keeping to what the client was looking for.

The Frankenstein Prototype was made for the check-in to check a couple things with the client:

- Demonstrating the lifting up and sliding the trousers onto the bar with a 17mm gap.
- Checking with client if they like the thickness of the hanger main body.
- Also checking that the design of the hanger doesn't impact how the user currently interacts with the hanger.

Notes From Check-In

After client check-in the following feedback had been given to improve the design of the hanger to their specifications

- Reducing the full length of the bar.
- Making the frame thinner, less old fashion, more modern design.
- A mechanism that holds the bar up out of the way whilst placing trousers on the hanger.

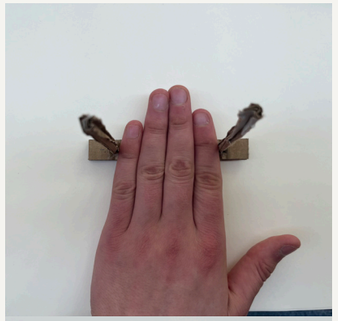
Clamping Bar Re-design

Cardboard Model

This model was used to test how the new bar length will feel in hand.

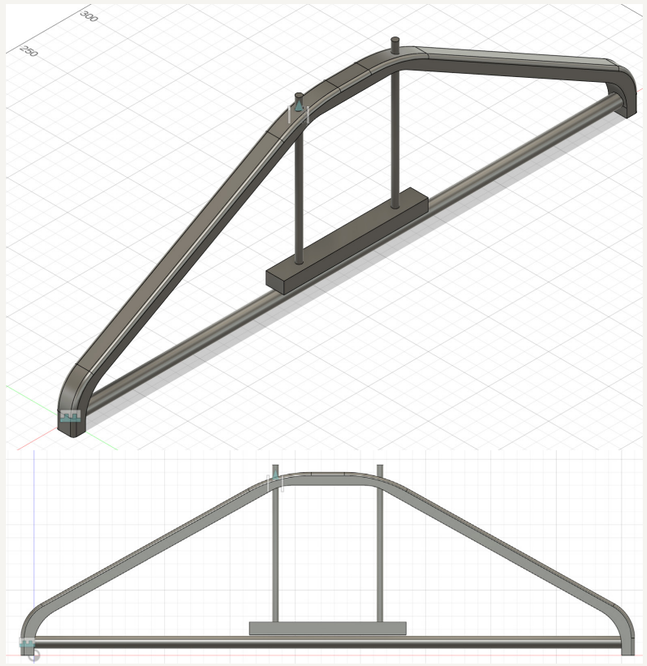
The dimensions were checked using a **anthropometric** table ensuring that the new size works for the 95th percentile of male users (Widest hands)

Through testing the new dimensions of the bar will be **120mmx15mm**



Product Development- Vertical Clamping Mechanism

Second Iteration

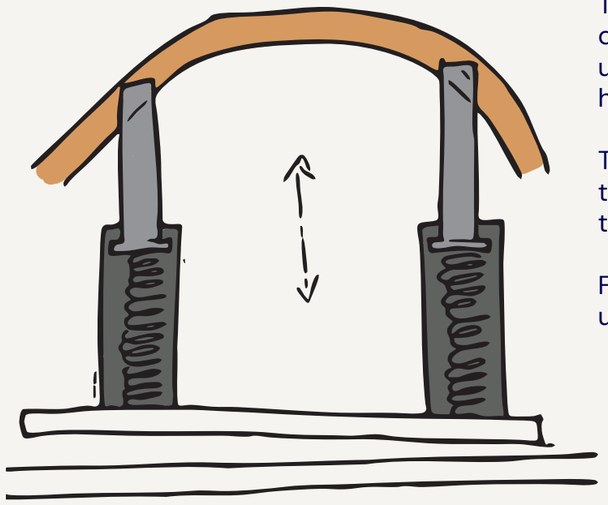


This new design of the main body has incorporated the clients design specs for a thinner body, with rounded edges.

It also has the smaller bar that will be the perfect width for the clients hands to feel comfortable in hand.

However with the pressure bar being thinner it means that the bars will be poking out quite high when the bar

Spring Mechanism Development



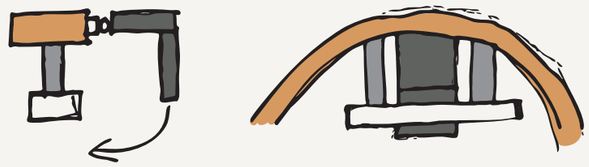
This design allows for the bar to move up and down whilst ensuring that the bars wont poke up out of the top of the hanger interfering with hanging on the hanger, i.e. tops, jumpers, etc.

This design also keeps with the clients design thickset, internalising the springs ensuring that the design is sleek, simple, and high end.

Further development of having the hanger stay up on its own is need.

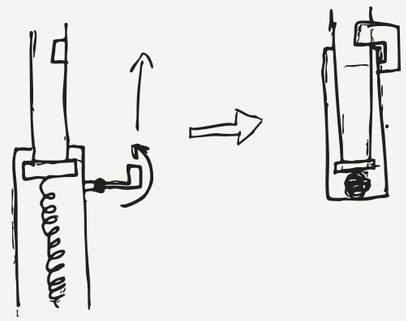
Mechanism for holding bar up

1.

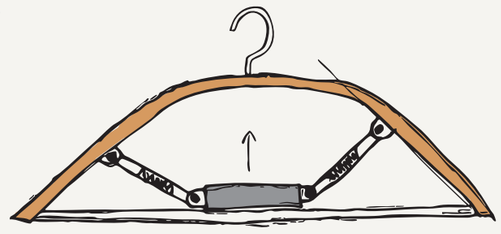


2.

3.



4.



Mechanism Descriptions

1. A bar will be placed on the back of the hanger on a hinge. Once clamp is raised the bar can be swung underneath the clamp holding it up out of the way.

2. A development from the first the one, instead the hook will be place at the top of the hanger. And once the clamp is raised the hook can we swung underneath and hold the clamp out of the way.

3. A pin will be attached to the outside of the piston casing and a hole will be made in the piston rod. Once the clamp is raised high enough the pin will swing into the hole and then hold the clamp up out of the way.

4. A different method, using pivots that when the bar is pushed up the spring pistons compress and once pasted half way they will then hold the bar up out the way by itself.

Chosen Mechanism

After reviewing the different concepts for technical feasibility, aesthetic appeal, and intuitive user interaction, number **4** was chosen for the further development of the hanger.

Research Into Materials

Main Body

As specified from the client they want the hanger to have wooden aesthetic.

Different possibles materials were considered to offer the best finish:

Solid Wood:

Oak:
- **Pros**- Offers nice grainy pattern, Strong
- **Cons**- Can be heavy and expensive.

Pine:
- **Pros**- Offers a nice grain, cheap in price due to its high growth rate.
- **Cons**- Softwood, so dents easily.

Walnut:
- **Pros**- Dark grainy aesthetic, strong, premium hardwood.
- **Cons**- As its premium its is very expensive.

Beech:
- **Pros**- High strength to weight ratio, steam bending.
- **Cons**- Difficulty to work with, can warp easily, visual blandness.

Maple:
- **Pros**- Good Durability, nice grain.
- **Cons**- Can be heavy, difficult to finishing.

Manufactured Wood:

MDF (Medium Density Fibreboard):
- **Pros**- Has a smooth finish, reuses off cuts of other pieces of wood.
- **Cons**- Can be heavy, no grain, not aesthetically pleasing.

Chipboard:
- **Pros**- Cheap and light weight as it uses larger chunks of wood and sawdust.
- **Cons**- Rough surface and no nice grain to it.

Hardboard:
- **Pros**-Cheap, offers a smooth finish on one side.
- **Cons**- Low structural integrity, heavy for its size.

Plywood:
- **Pros**- High warp resistance, high strength to weight ratio, cheap.
- **Cons**- Rough finish, not aesthetically appealing.

Review

While solid woods offer superior grain and finish, laminates can replicate this aesthetic at a lower price point. However, from an environmental standpoint, solid wood is the clear leader; it requires no adhesives or complex processing, making it easily recyclable compared to manufactured woods, which use difficult-to-recycle epoxy resins.

Since material research alone hasn't yielded a definitive choice, the manufacturing process must now be analysed to determine which option best balances cost-efficiency for mass production with a lower environmental impact.

Other Components

As specified from the client they would like the hanger to have metal accents.

As the majority of the other components will be manufactured from metal it makes sense to manufacture them all out of the same material.

Different possible materials were considered to offer the best finish:

List of Components:

- Hanger Rod
- Piston Casing
- Piston Rod
- End Cap
- Clamping Bar

List of Potential Materials:

Material	Pros	Cons
Aluminium	Light weight, high natural corrosion resistance, nice shiny finish. Wide variety of manufacturing processes	If not anodized can leave a grey smear on fabrics. Difficult to weld with.
Stainless Steel	High levels of strength, shiny finish, rust proof. Doesn't leave a mark on fabrics.	Can be heavy compared to aluminium, limited manufacturing process.
Zinc-Plated Steel	Cheaper alternative to stainless steel, good rust protection.	Slightly poorer finish, not as shiny.
Brass	Rustic luxury aesthetic, especially when paired with a dark wood such as Walnut.	Very heavy compared to aluminium, requires treatment to stop it from oxidising.

Review

From the list of materials above aluminium offers the best options for production of the components as it is a lightweight, cheap option. However when it comes to manufacturing options steel offers the widest range of processing.

To ensure that the best material is chosen it is important to consider different manufacturing processes before finalising the best material.

Research Into Manufacture Processes

Main Body

To ensure that the best process for the manufacture of the coat hanger is chosen extensive research has been conducted into different methods.

Processes

	Description	Pros	Cons
CNC Routing	A computer controlled blade cuts the hanger shape out of a flat wooden board	Very precise method for manufacture, great for mass manufacturing. Can be very good for limiting waste.	Has an expensive setup cost, and requires a large area to house the machine and its controls
Steam Bending	Using steam, you take a straight strip of wood and bend it over a shape. Once it cools it holds the shape.	As the grain of the material follows the shape, the wood has great structural integrity. Reduced waste material.	It has a high failure rate, slow and labour intensive and uses a lot of energy, expensive to run.
Lamination and Pressing	Uses thin laminates of wood, sandwiching them together to create the desired thickness.	Offers extreme stability and structural strength, predictable results and easy for manufacture. Material versatility.	Large amount of material waste, visible glue lines, and a large range of tools and set up space.

Review

For making the hanger out of a solid wood or manufactured wood, CNC routing would be the best process as it is quick and uses sheets of wood.

Another process for making the hanger out of solid wood would be steam bending, as you can cut the strips to correct thickness and then bend it them round the mould. However as discussed, it is a slow and labour intensive process so would not be good for mass manufacture.

Chosen Method and Material

The hanger will be made out of **stained Oak**. As it offers a lovely grain, dark colour, and a good strength to weight ratio, whilst still being relatively cheap. Paired with **CNC routing** as the manufacturing process, to deliver high-volume precision. To reduce waste material the hangers will be orientated on the board in orientation below, one above and one directly below it sitting inside the shape.

Other Components

Hanger Rail

As the hanger rail is going to be hollow tube, the best manufacturing process for this component will be to extrude it and then cut to length.

Spring Piston

	Description	Pros	Cons
High Pressure Die Casting	Injecting molten metal into die, or mould, forming the desired shape.	High accuracy, good for mass manufacture. Low waste material. Good with complex shapes.	Has an expensive initial cost. Limited material choice, aluminium, magnesium, zinc
CNC	Having a block of metal and cutting away at the material until you have the desired shape.	Good for mass manufacture, precision machining	As it cuts away material has high material waste.
Casting	Similar to HPDC, instead of injecting you pour molten metal into a mould and let it set.	Cheap, no machining cost, low maintenance cost.	Rough finish, lower levels of accuracy.

As the spring piston is a moving a component the tolerance is very small so will need a high accuracy process. From the ones listed above the best choice would be **High Pressure Die Casting.**

Post Production

The casing will need a thread put it on the inside, the thread is for the bottom cap to screw onto the casing. This thread cannot be done during the moulding process as its on the inside.

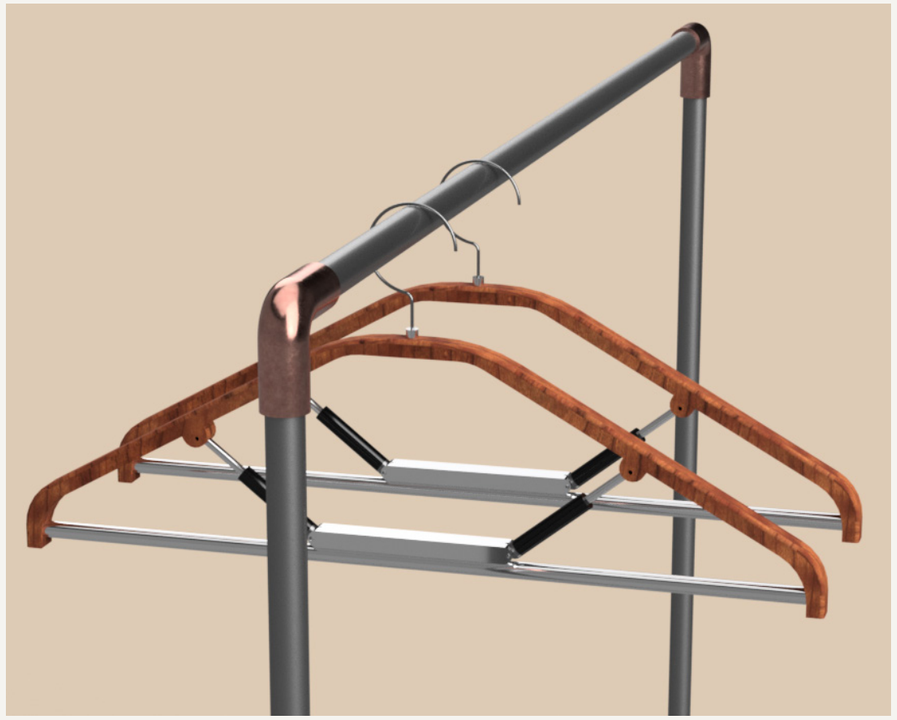
The casing will also have a black coating applied to it for aesthetic purposes.

Clamping Bar

Due to its shape, the bar will also be **HPDC**, with post production drilling will be done for the holes of the where the joining pins will go into. Whilst in post production a piece of felt will be attached using an adhesive ensuring that it is securely attached.

Final Product

CAD Renders



Physical Prototype

Images of the physical prototype used in the finale presentation.

Showing proof of concept of the bar applying a downward force, and then supporting its own weight when its in the upward position.

Also shows the too scale size of the finale product along with the aesthetic of the hanger with the silvery shiny from the components

Mechanism

- The hanger will hold the trousers in place.

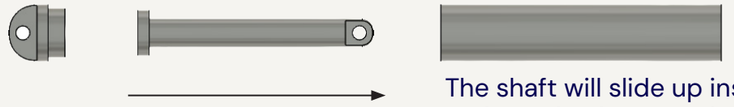
- The spring pistons in full compression being able to fit inside the hanger body.

- The bar is being held up out of the way, creating as large a gap as possible.

Additional Information

On the underside of the clamping bar, a piece of felt will be added to ensure that help increase the friction applied to trousers ensuring that they don't slide around.

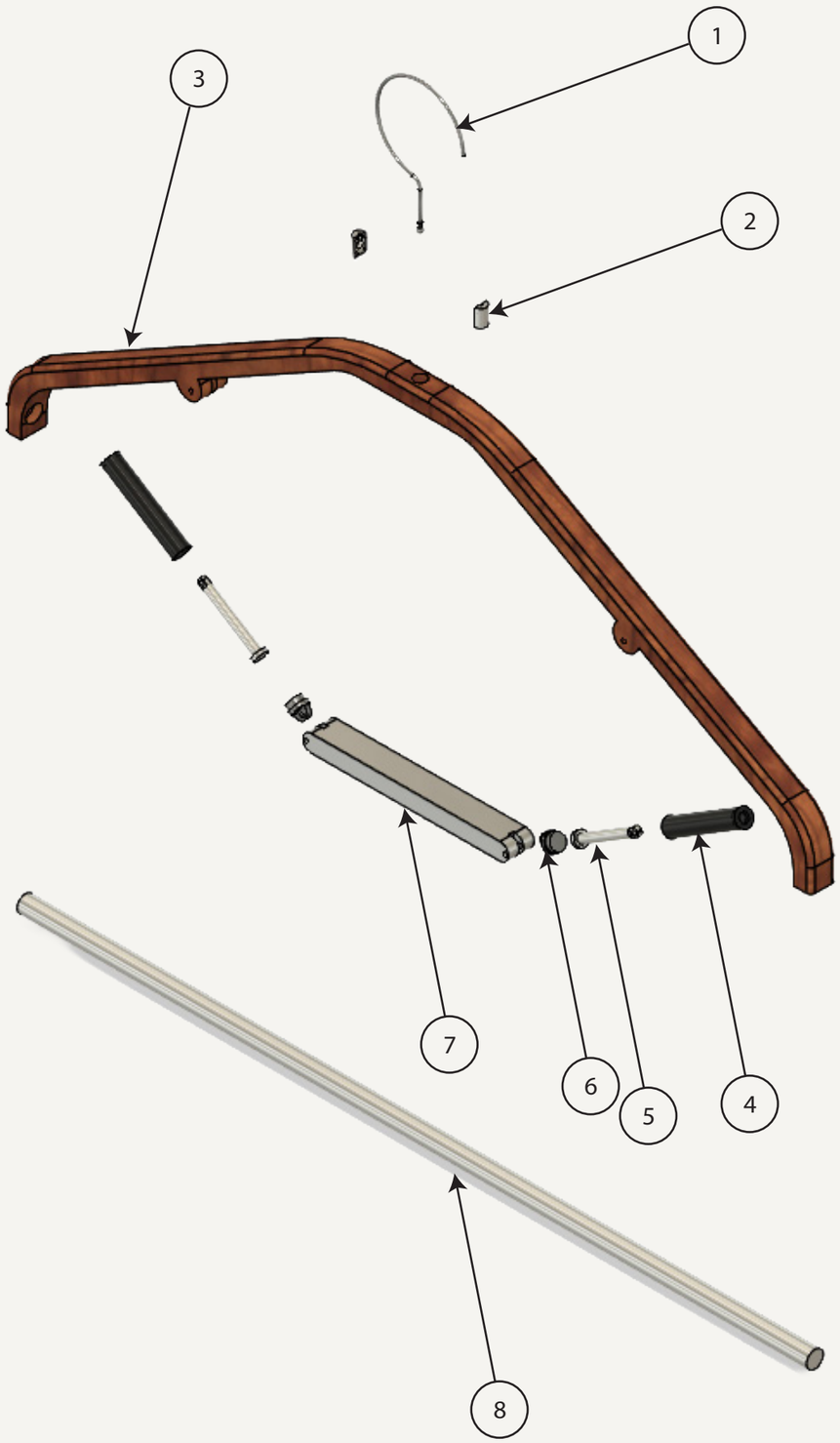
Spring Piston Assembly



The shaft will slide up inside the casing with a spring going in second.

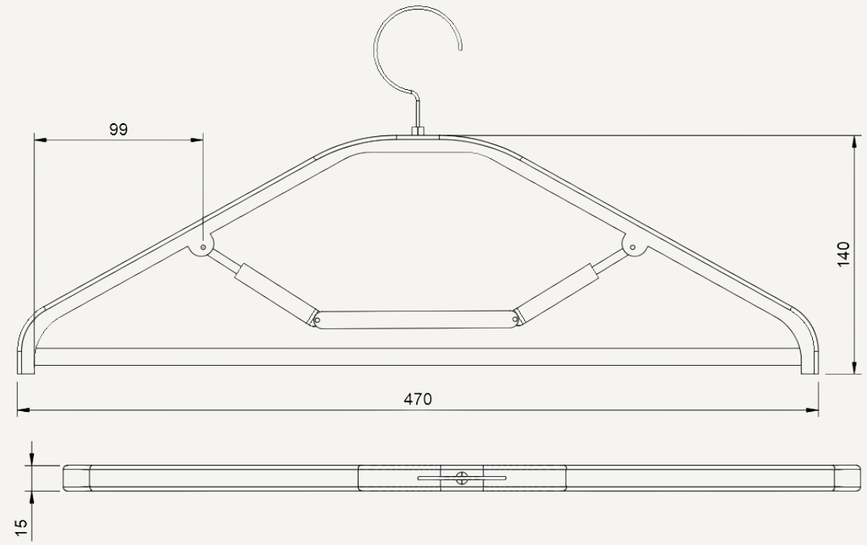
Once in place the bottom cap will then screw into place holding the spring piston together.

Final Product

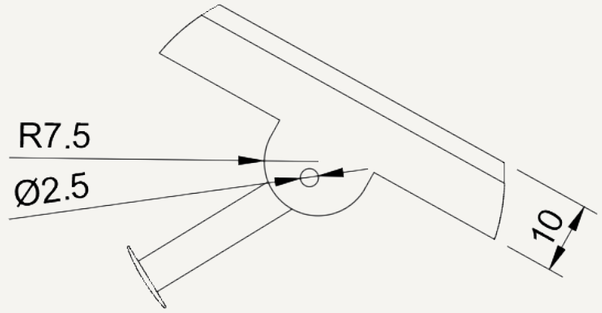


Part Number	Part Name	Number of Parts	Materials
1	Hook	1	Stainless Steel
2	Hook Casing	1	Stainless Steel
3	Main Body	1	Stained Oak
4	Piston Casing	2	Coated Aluminium
5	Piston Cylinder	2	Aluminium
6	Bottom Cap	2	Aluminium
7	Clamping Bar	1	Polished Aluminium
8	Hanger Rail	1	Polished Aluminium

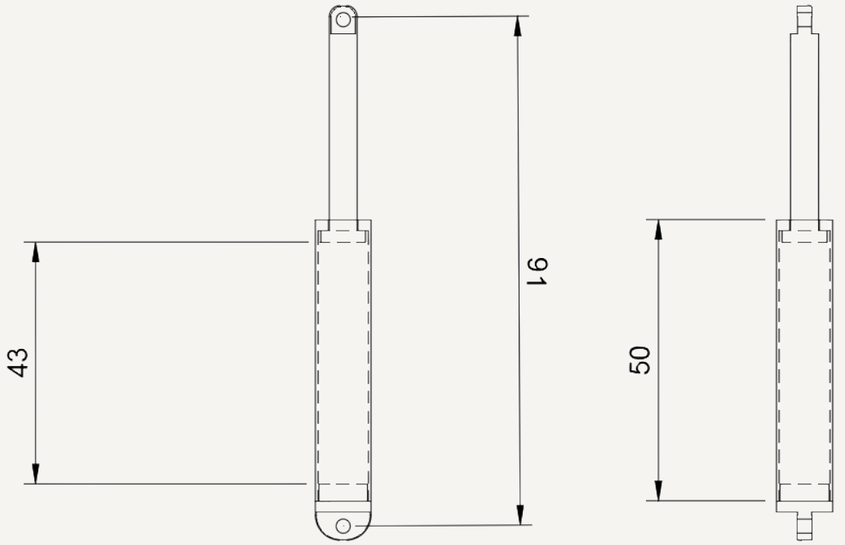
Technical Specifications



Main Body Dimension

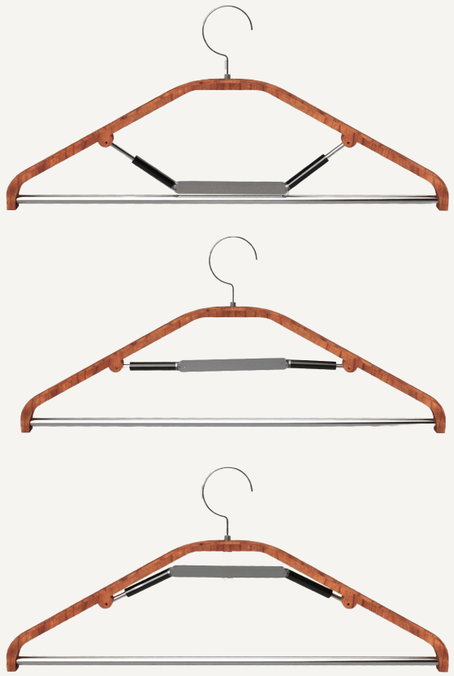


Close up on Piston Connection



Spring Piston at Full Length

Product Review



Project Review

Overall the project was completed to a fairly good standard. With multiple different concepts considered, developed, reviewed and then further developed, to achieve the best possible solution.

Throughout the project, I was constantly checking the PDS to ensure that the clients design requirements were met.

The finale product doesn't stray to far away from the existing products whilst, still using a method that hasn't been used before makes it still easily recognised what its intended use is.

Product Review

The original problem set out by my client was trousers would slide around on the hanger rail, crease the trousers, and fall of the hanger. From this the client wanted a solution that would stop the trousers from sliding around and minimise crease marks. The clamp in the middle solves this issue, while providing a firm grip of the trousers to hold them in place while not applying to much pressure that it'll leave marks.

The aesthetics of the hanger are very much tailored to the clients requirements, with high end woods, metallic accents, and smooth simple finishes. The hanger meets these requirements with its simple minimalistic design offering a high end look.

As specified the client they wanted a fully integrated mechanism to hold the trousers, i.e. no clips. This method is a little over engineered by does have a much more luxuries aesthetic compared to hangers made from plastic or have rubber bands.

Overall the hanger meets all requirements set out in the initial phases of the project, however there is always room for improvement and development.

Design Improvements

The design of the coat hanger is good however there is still areas for improvement. Some of these are as follows:

- Redesigning the shape of the clamping bar, maybe making form round the bar.
- Adding little notch's for hanging up dresses
- Exploring methods for disassembly, to ensure that components can be easily changed if broken.