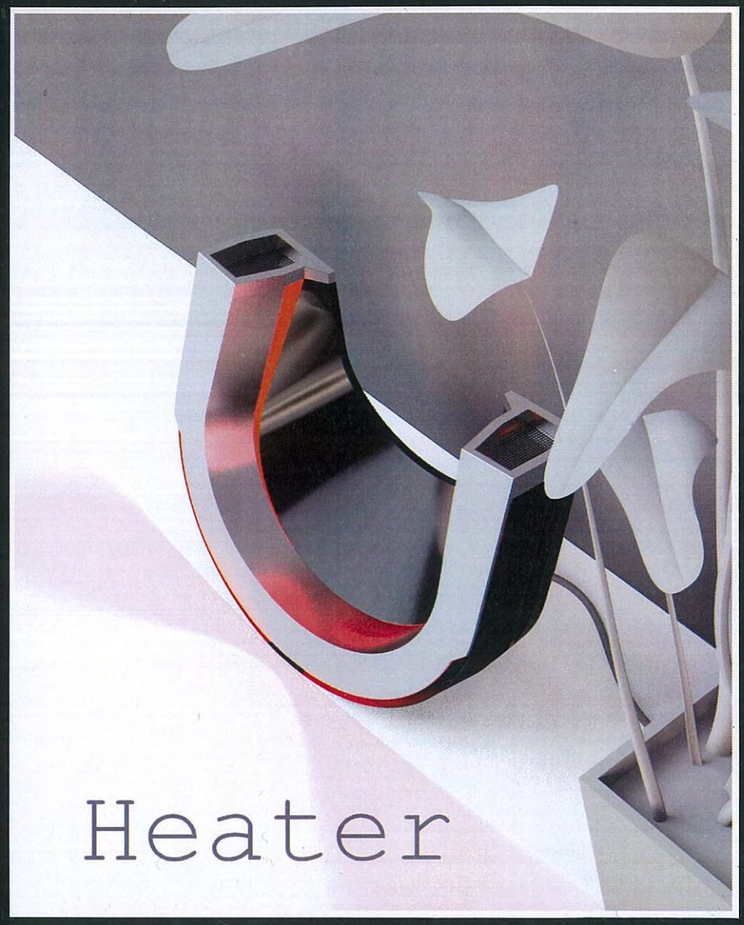
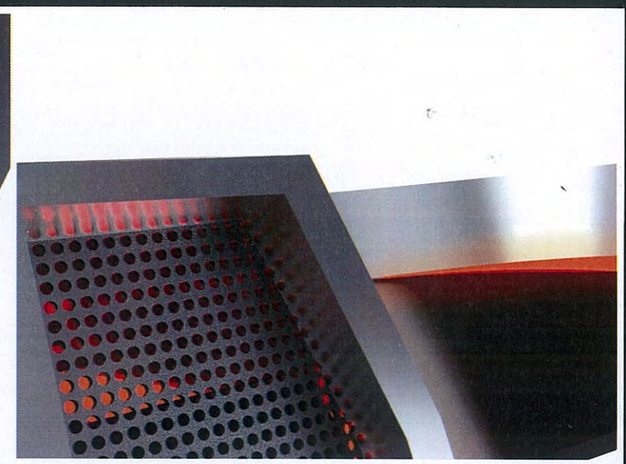
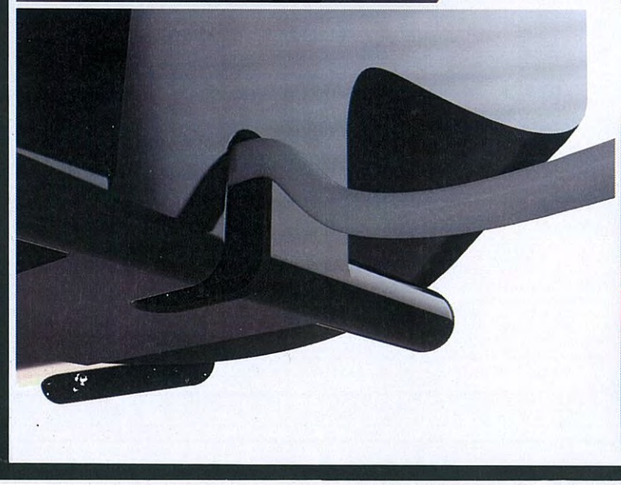
AUTODESK INVENTOR | AUTODESK FUSION 360

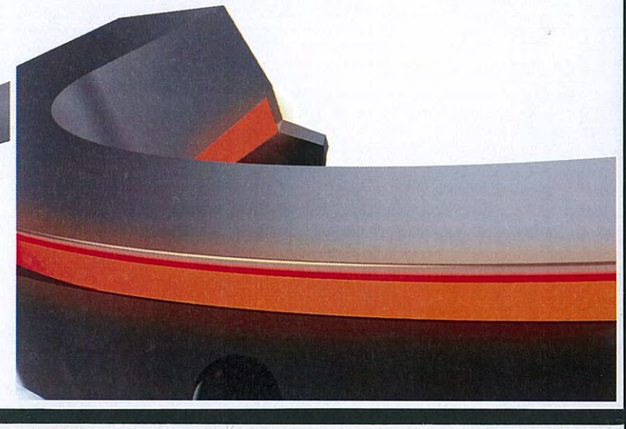
A portable, multipurpose, space heater concept.



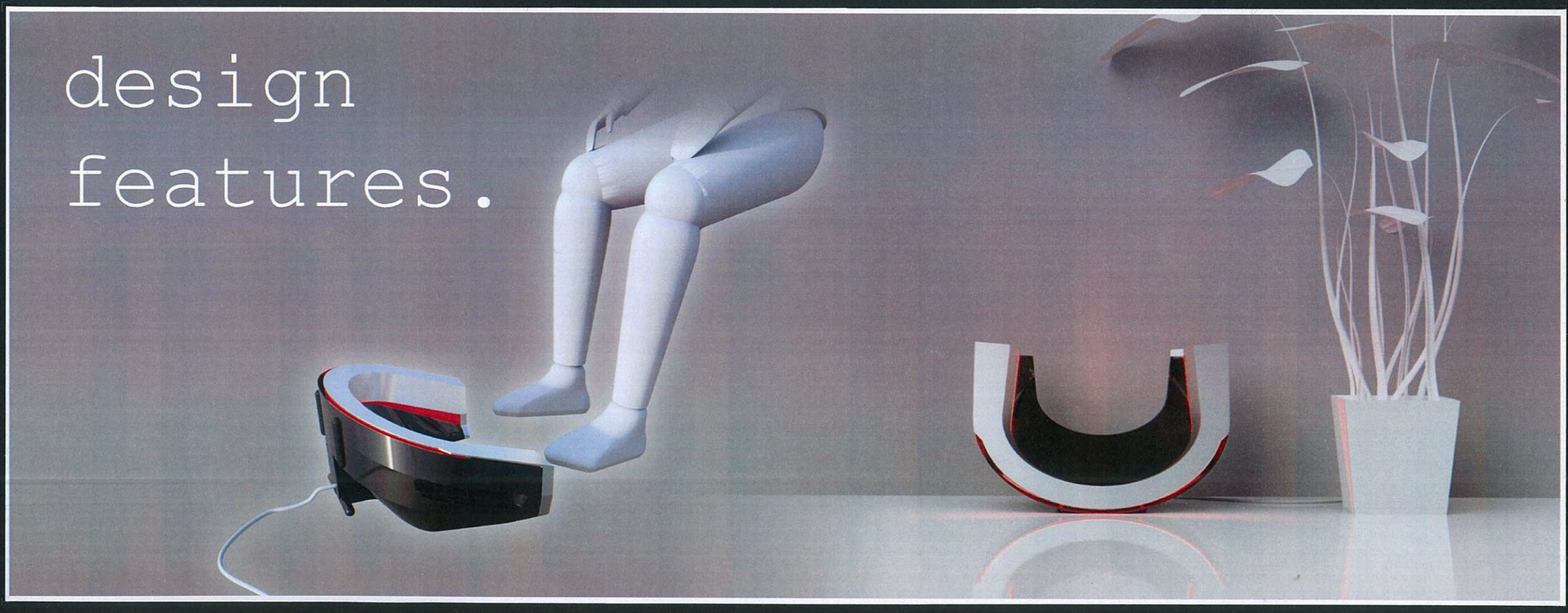
Heater







design features.



Initiation (AS91627)

1 Starting experience
2 Observation sketches
3 Overlay, shape study, rotation, pattern
4 Overlay continued, inversion, cropping
5 Tessellation, inversion, mirror
6 Subject destruction
7 Additional observation
9 Card abstractions
10 Paper shapes, 3d scans
11 Computer abstractions, combinations
12 Translocation, chosen starting ideas

Context (AS91630)

1 Timeline, psychological analysis
2 Situation, size
3 Heater Methods, refrigeration cycle
4 Fire safety, temperature, possible solutions
5 Micathermic heating technology
6 Colour considerations, James Dyson
7 Summary

Ideation (AS91630)

1 Thumbnail sketches
2 Sketch models
3 Thumbnail and exploitative sketches
4 Exploration continued
5 Thinking on stackable concept
6 Sound initiation, speaker idea
7 Speaker movement investigation
8 Applications of proportion
9 Thingking on pineapple concept
10 Chosen concept configurations
11 Geometry exploration, model, dimensions
12 Finalisation of chosen form
13 Practical details
14 Technical considerations
15 Inlet alternatives, stand options, scale model
16 Renewed concept, ratios, technical justifications
17 Ergonomic explorations
18 Usage considerations
19 Technical details
20 Materials
21 Opperating details

Ideation cont.

22 Interface
23 Model finalisation
24 Model finalisation continued
25 Appearance and lighting

Production (AS91631)

1 Full orthographic porjection
2 Intake assembly
3 Element assembly
4 Upper assembly
5 Parts drawing - overflow
6 Parts drawing - other components
7 Exploded view

My brief

Keeping warm is one of our most basic needs. You would think that by now we would have refined the way we heat our environments, so why is it that heating products are so disappointing. They are ugly, always in cream whites or bland metals where they borrow from generic column and fan heater designs. The types of heaters themselves cause nightmares for customers when deciding which to get; it all depends on how you use it, what you are heating, and how much you are heating. But besides all that, customers are let down by the failure rate of these cost cutting designs, some of which become safety hazards.

I will investigate the applicability of manufacturing a new heating product that is a portable, and multi-purpose, space heater.

Terminology: Space heaters can be used in different environments. So the concept must consider how it could be easily transported from one place to another (portable). Multipurpose refers to the designs ability to extend to meet different requirements e.g. alternative space sizes, and environments with different dynamics. Space heaters are designed for enclosed environments but these may contain a draught.

All software used in the making of this portfolio is verified for educational use (non commercial purposes).

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Provided brief

OPTIONAL: Produce a product design portfolio, based on a topic of your own choice, set within the context of the brief below.

A/Std 91627: Initiate design ideas through exploration
[Could be a stand alone unit - see page 15]
3 credits External Learning objectives: 1 2 4

A/Std 91631: Produce working drawings to communicate production details for a complex design ***6 credits External Learning objectives: 1 2 4***

REQUIREMENTS

RESEARCH and ANALYSIS

1 Identify opportunities and constraints presented by the context you have selected for the design.
- Analyse the design context. Explore:
  - aesthetics, ergonomic considerations, present and potential usage.
  - the use of appropriate materials and durability.
  - manufacturing factors, and other considerations, as appropriate.
  - the wider context, including, for example, legal, ethical, cultural, historical, economic factors.
  - technological factors - materials, sustainability etc.
- Use diagrams, photos, notes, sketches, or other techniques to show your findings.
- Explain how the design context will influence your design.

2 Justify your design ideas against the significant opportunities and constraints you have identified.

IDEATION and RESOLUTION

1 Use a range of visual communication methods to explore *[divergent thinking]* and refine *[convergent thinking]* your ideas. *Note that this can link back to your initiating of ideas exercise.*
- Freehand sketches, sketch models, overlays, collage etc.
- Use a sequence of visuals to show how your design has developed.
- Add comments to your visuals to explain how you reached crucial decisions.

2 Select a promising initial idea or combination of ideas and explain the reasons for your choices. Show:
- the main features of your selected idea[s].
- the potential of your selected idea[s] for further development.

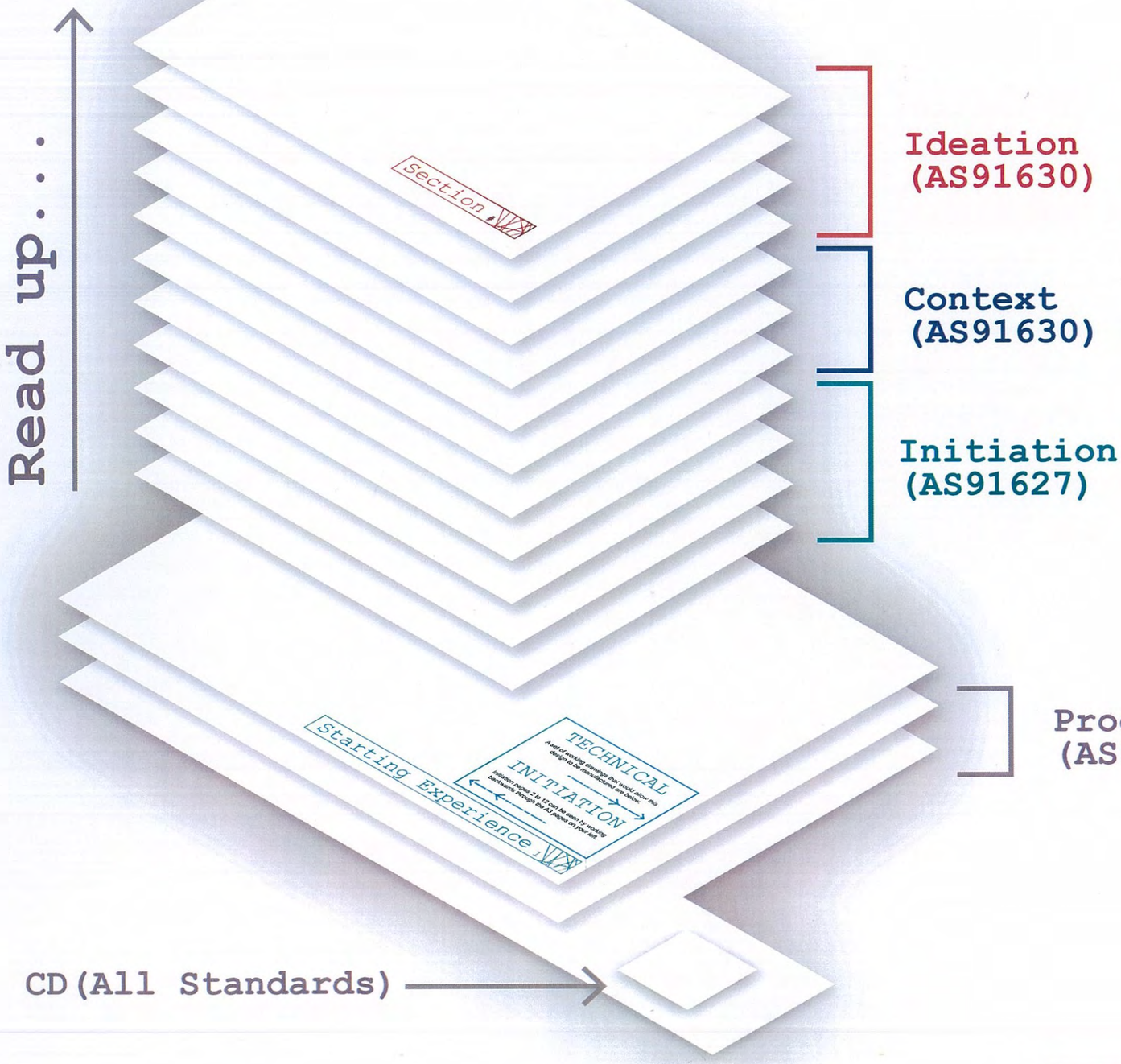
3 Identify the good and/or bad features and the potential of design ideas. Show an improvement, evolution and refinement of ideas.
4 Annotate each stage to explain crucial decision making.
5 Produce a series of detailed instrumental drawings that would provide information that would allow your design to be made [floor plans, site plans, elevations, cross sections etc]. Use a computer if you can.
6 Produce a realistic presentation drawing of your design. Use a computer if you can.
7 If you have time and the expertise to do so, make a scale model of your design.

PRODUCT DESIGN KNOWLEDGE

Use product design knowledge to develop, refine and improve your selected idea or combination of ideas in an iterative, logical, and organised way.
- Carry out research and analysis as needed to help you develop your ideas. Research could include, but is not limited to, consideration of the work of other designers, user needs, construction methods, and product design materials.
- Reflect on and critique your ideas, exploring possibilities and reviewing each idea for further exploration and consideration to improve the aesthetic and/or functional qualities of your design. You may work in a group to critique your own and others' design ideas. You will need to make designer judgements [judgements that reflect your perspective as a designer] to integrate the product knowledge gained. You will also need to integrate aspects of the wider environmental conditions and human factors relating to the design in the development of your idea[s].
- Identify the good and/or bad features and the potential of design ideas in terms of the broad principles of design, as well as the design considerations of your brief and your design context.
- Improve and evolve your design ideas, refining them as you go.

Complete your portfolio and submit it for assessment on the due date below.

Achievement Standards available from this brief:	3
Credits available from this brief:	16



Initiation
Context
Ideation

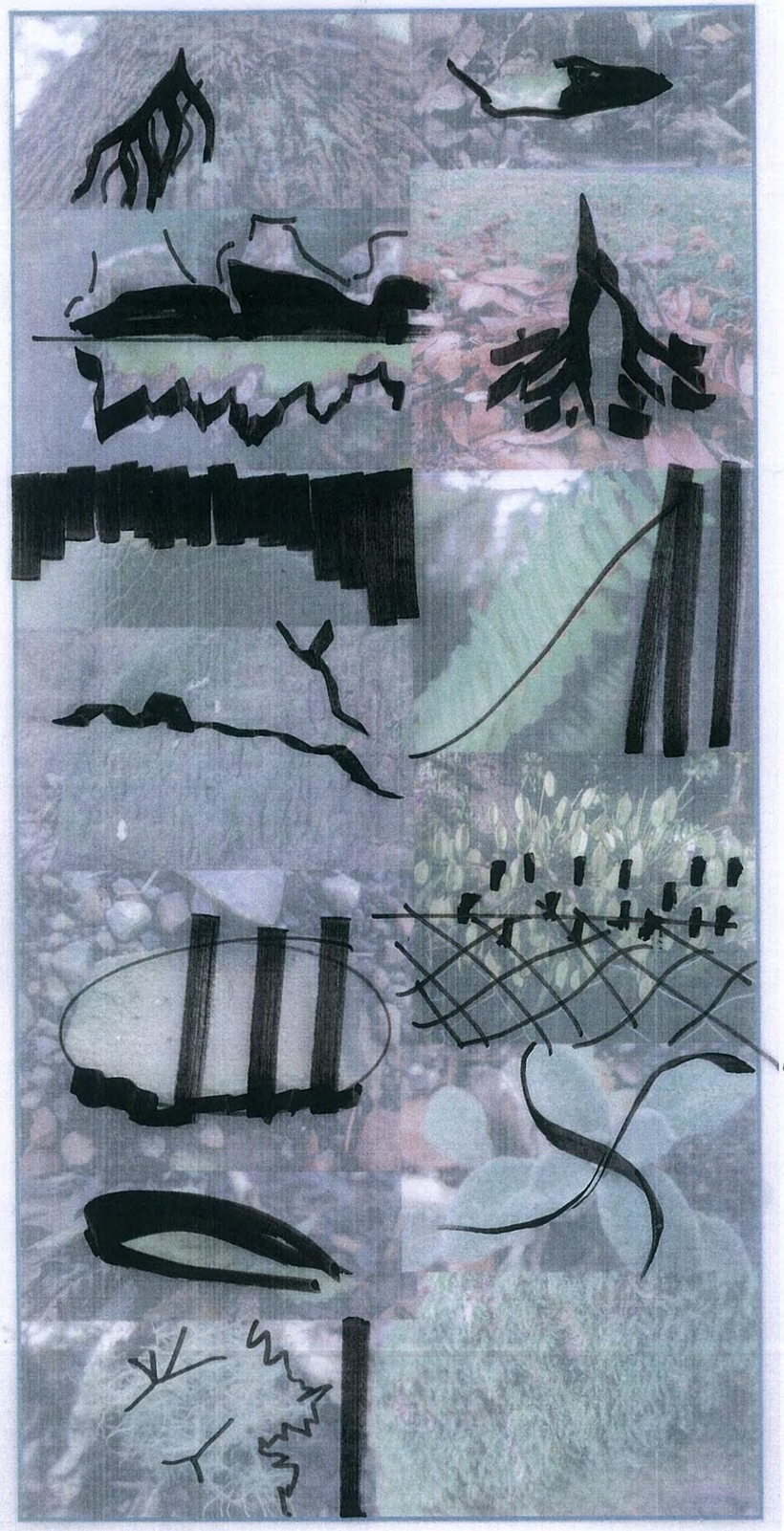
Link
to prev idea
D.2

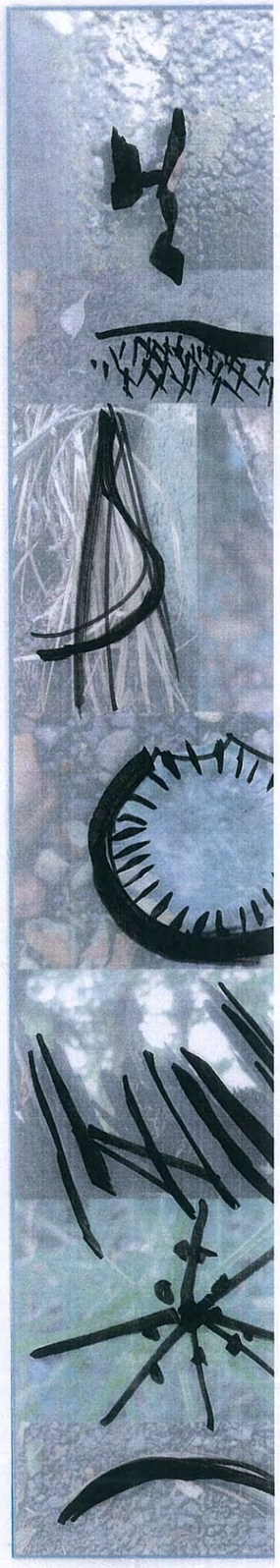
Links make visual reference to a previous idea. e.g. D.2 refers to ideation page 2. Links also come in the form of holes through pages.

CD (All Standards)

The included CD contains content referenced in, and as an extension of, the work in this portfolio. Please refer to the included "read me" file for further information.

Start here.





TECHNICAL

A set of working drawings that would allow this design to be manufactured are below.

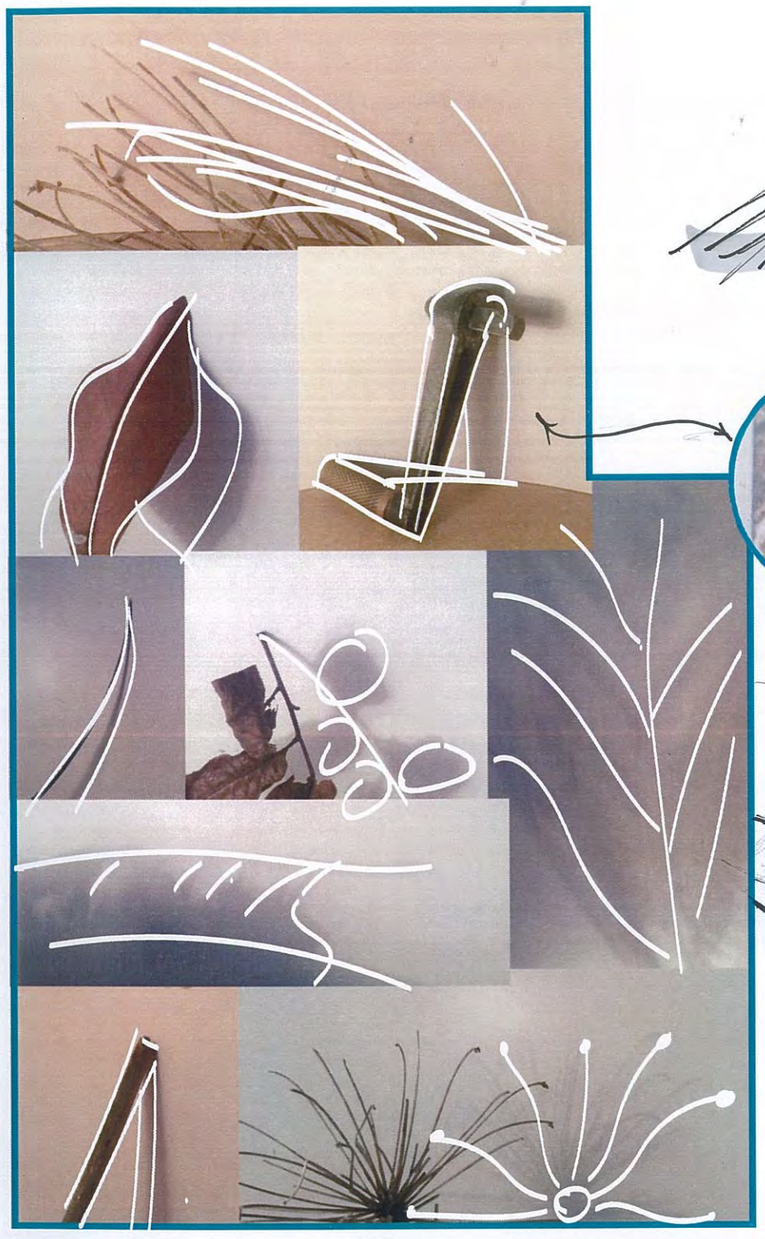
INITIATION

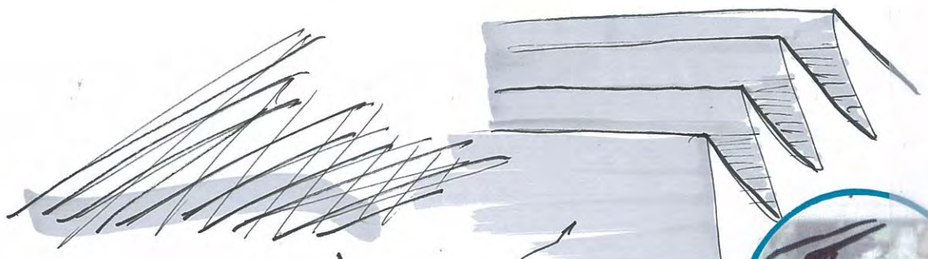
Initiation pages 2 to 12 can be seen by working backwards through the A3 pages on your left.

Segmented repetition makes complexity easy for the eye to process and could provid an effective, low cost, assembly method.

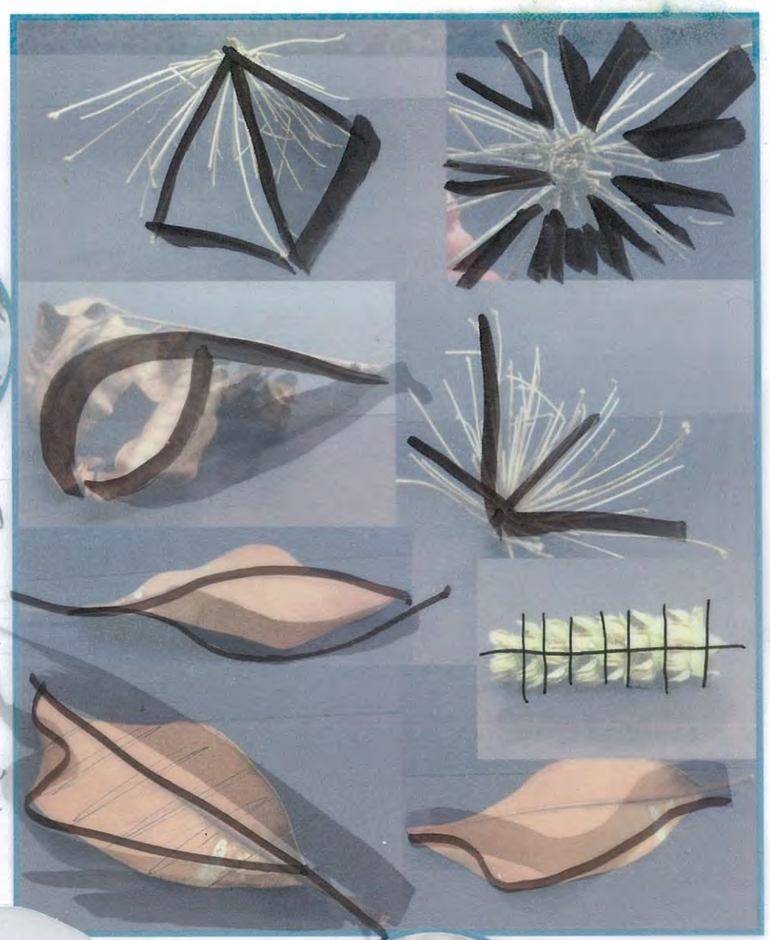
This dry leaf trigged memories of ignition by magnification. Burning it will provide a method of inspiration that maintains connection with the "heat/fire" theme of the brief.

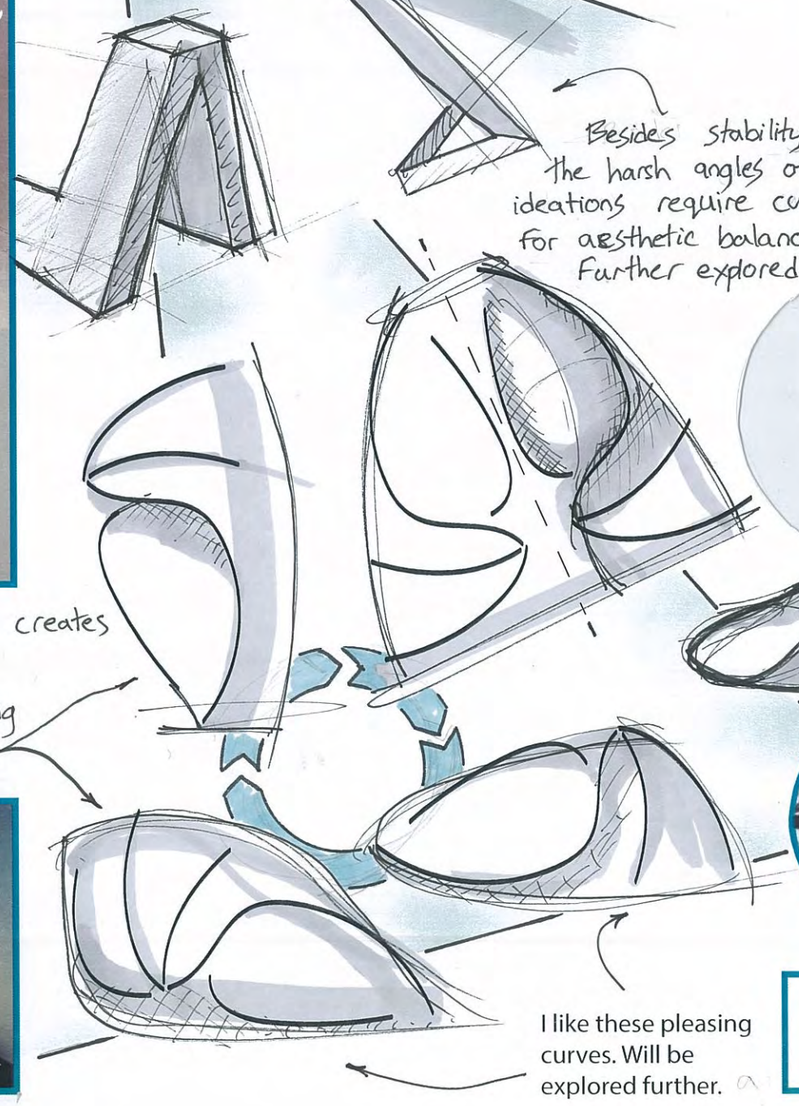
Observational





Imperfect arrangements embrace the idea's orgnic roots providing a softer flow than uniform pattern, but may provide manufacturing challenges and inflated cost.

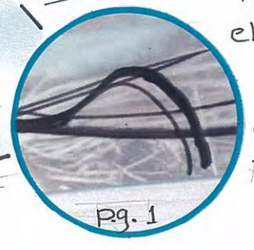




Besides stability issues, the harsh angles of these ideations require curves for aesthetic balance if further explored.

These forms could be air vents or exterior panneling.

Will explore further.



Negative design space creates visual depth, a useful consideration in triggering emotive connections.

I like these pleasing curves. Will be explored further.

Initiation 3

The balanced proportions of this shape complement its compact form.

Simplification required.

⇒ Disproportionate

I like this undulating edge.

The contrast of sharp angles and gental curves work together to create dramatic shadows and visual depth.

This shape creates high visual interest and the curves increase its surface area, a useful attribute for a heater as it improves heat transfer to the air.

The combination of angular and curvature arrangements overcomplicates and confuses these designs. Not continued.

This design is balanced by the 50/50 contrast of positive and negative space while maintaining a uniform possessive outline.

Initiation 4

Dispite its complexity and absents of a straight edge the shadow and depth create visual interest enough to further explore.

I.4

I.4

I.4

posible vent?

air flow

Possible heating method?

I.4

this tessellation mimics the screenshot from a movie intro scene.

https://youtube/9zHO8_NDIc?t=10s

Scale like patterns are connected with heat seeking reptiles which use them to store heat. Will explore further.

Does not flow, unstable.

Contrast of thick and thin compliment and give visual interest while providing greater surface area as a potental body form. Few pare angled designs have worked, will explore why this one has.

need to explore irregularity.

The design could be made of modules which connect to extend its potental usage.

I.4

could be plan view?

I.3

Disconected with context.

Reminds of a soup pot.

These two structures could make a statment using a contrast of materials => glass, wood, steal => will consider.

A channel could reflect heat more effectivly towards the user.

possible fan blade?

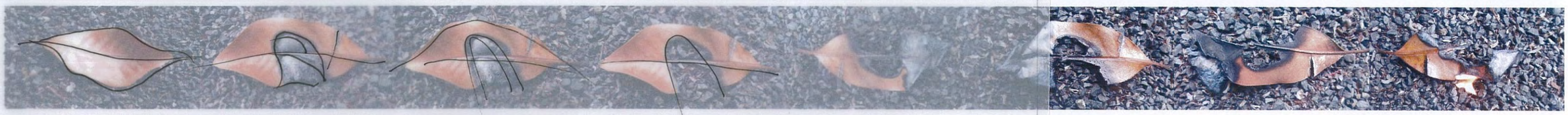
I will need to explore different blade configurations which, eliminate noise and maximise efficency.

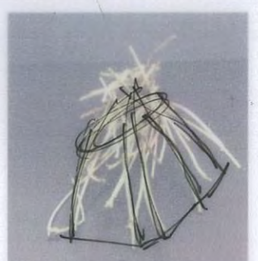
I.4

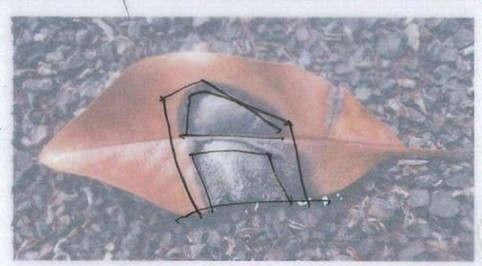
curved forms require balance via straight edges.

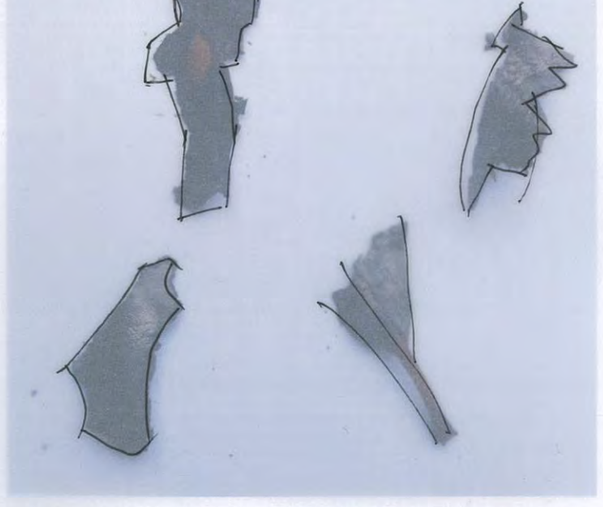
lack of stability and balance.

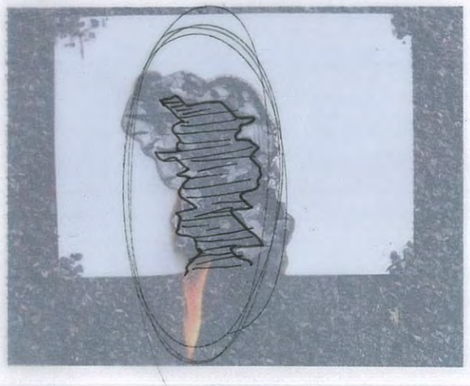
Initiation 5











The intense shadows give the mono-tonal leaf surface depth and visual interest.

Initiation p.g.1

Initiation p.g.2 cont.

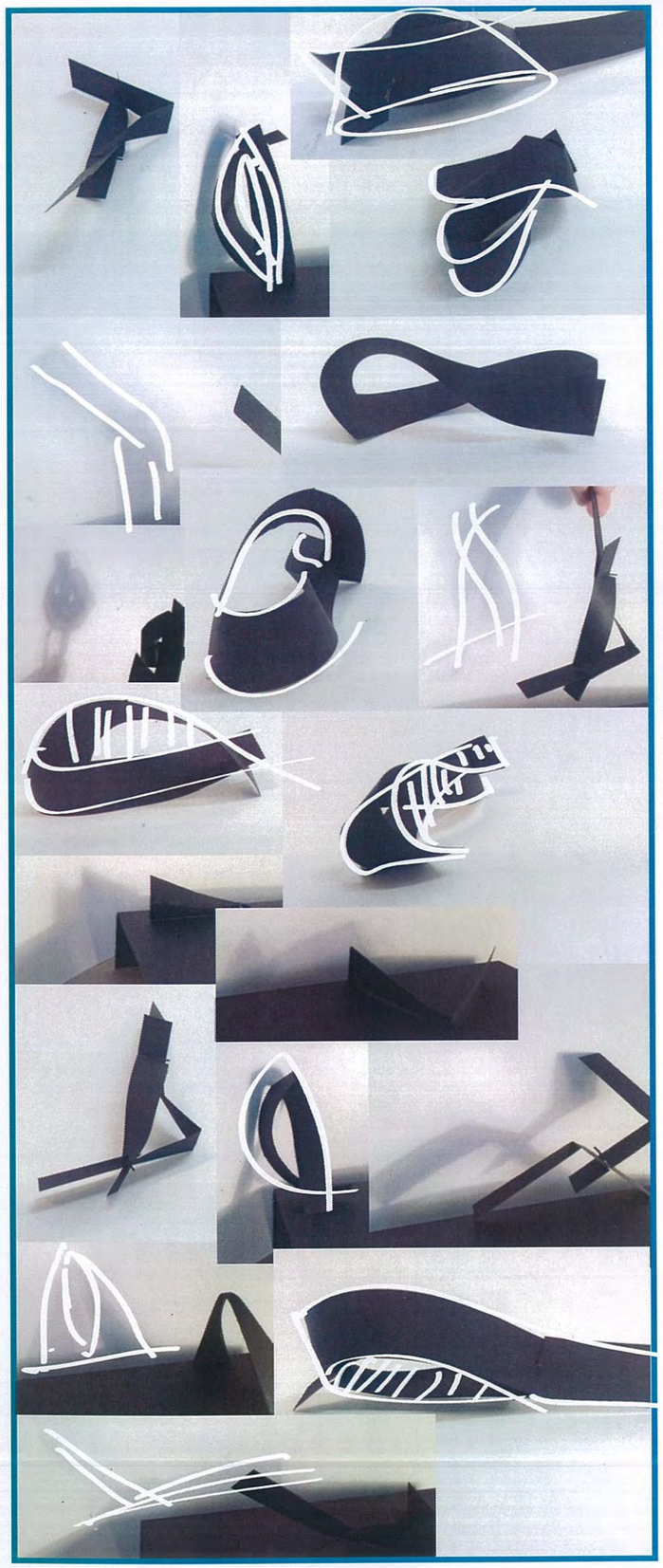
This organic monochromatic theme appeals to the design's natural and primitive connections.

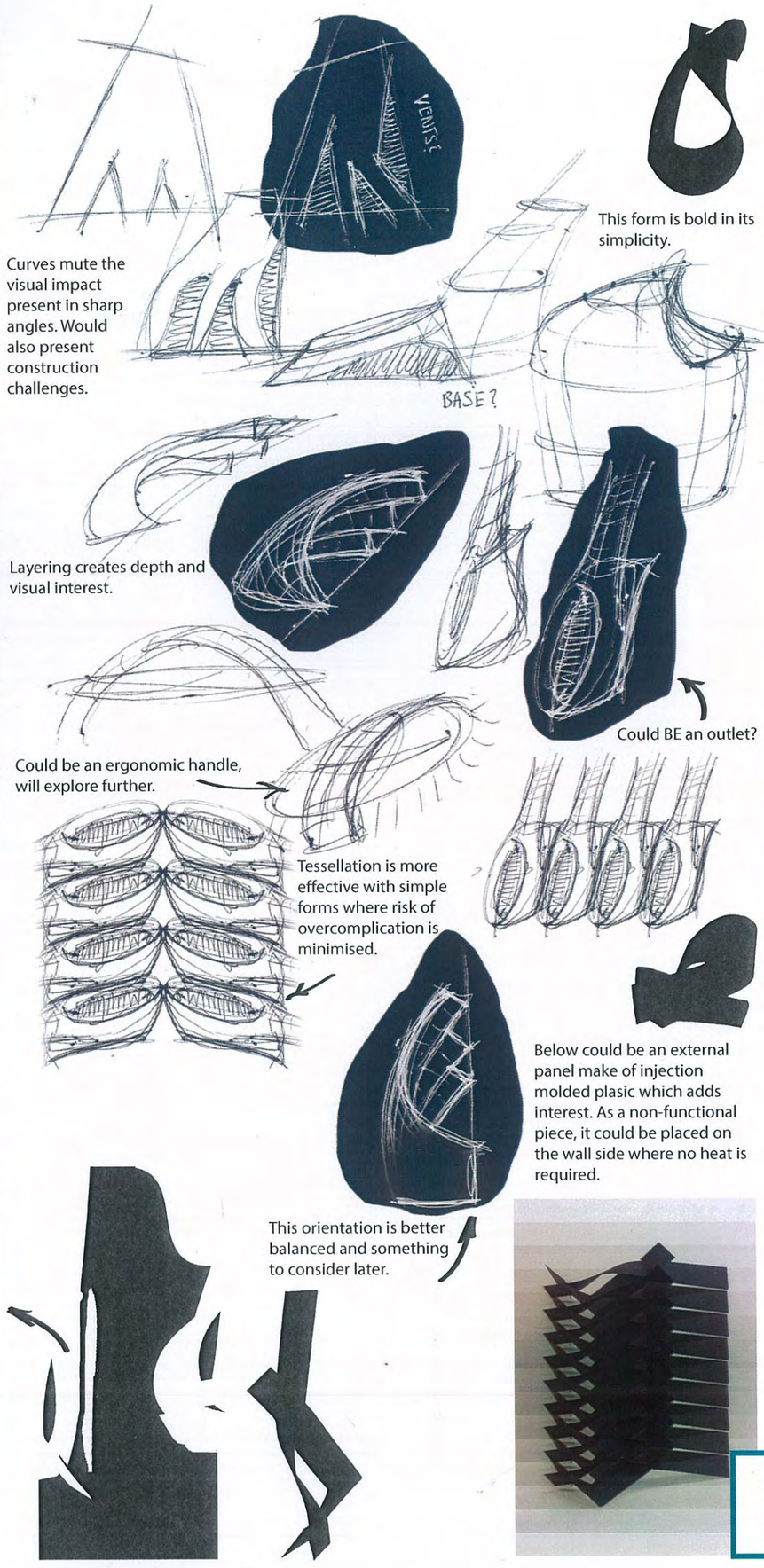
Pattern extraction...

Imperfection = organic feel

3D scans of the leaves and handle will perserve their geometry for further investigation.

I wanted to go back and expand on observations of the chosen subjects from initiation 2. The leaf stalk has been broken up into its component parts. Imperfect tessellation in the fern pattern is what adds visual interest and softens its appearance. I may apply this knowledge latter in the design process. The left hand image of a rusty pipeline shows how the rust, with a bark-like texture, peels away from a contrasting smooth flat surface. Could be used to define ~~of~~ separate visual elements.





Curves mute the visual impact present in sharp angles. Would also present construction challenges.

This form is bold in its simplicity.

Layering creates depth and visual interest.

Could BE an outlet?

Could be an ergonomic handle, will explore further.

Tessellation is more effective with simple forms where risk of overcomplication is minimised.

Below could be an external panel make of injection molded plasic which adds interest. As a non-functional piece, it could be placed on the wall side where no heat is required.

This orientation is better balanced and something to consider later.

I used 123D Catch to capture the handle, then it's rotated to show an inverted perspective.

These toned areas showcase the form's curvature and create a balanced cross-section without intruding its internal area.

None of these forms pop on the page, they are flat or disproportionate.

Rift

The inaccurate parallels of the rift accentuate its organic character while balancing the solid base with negative space. Will revisit.

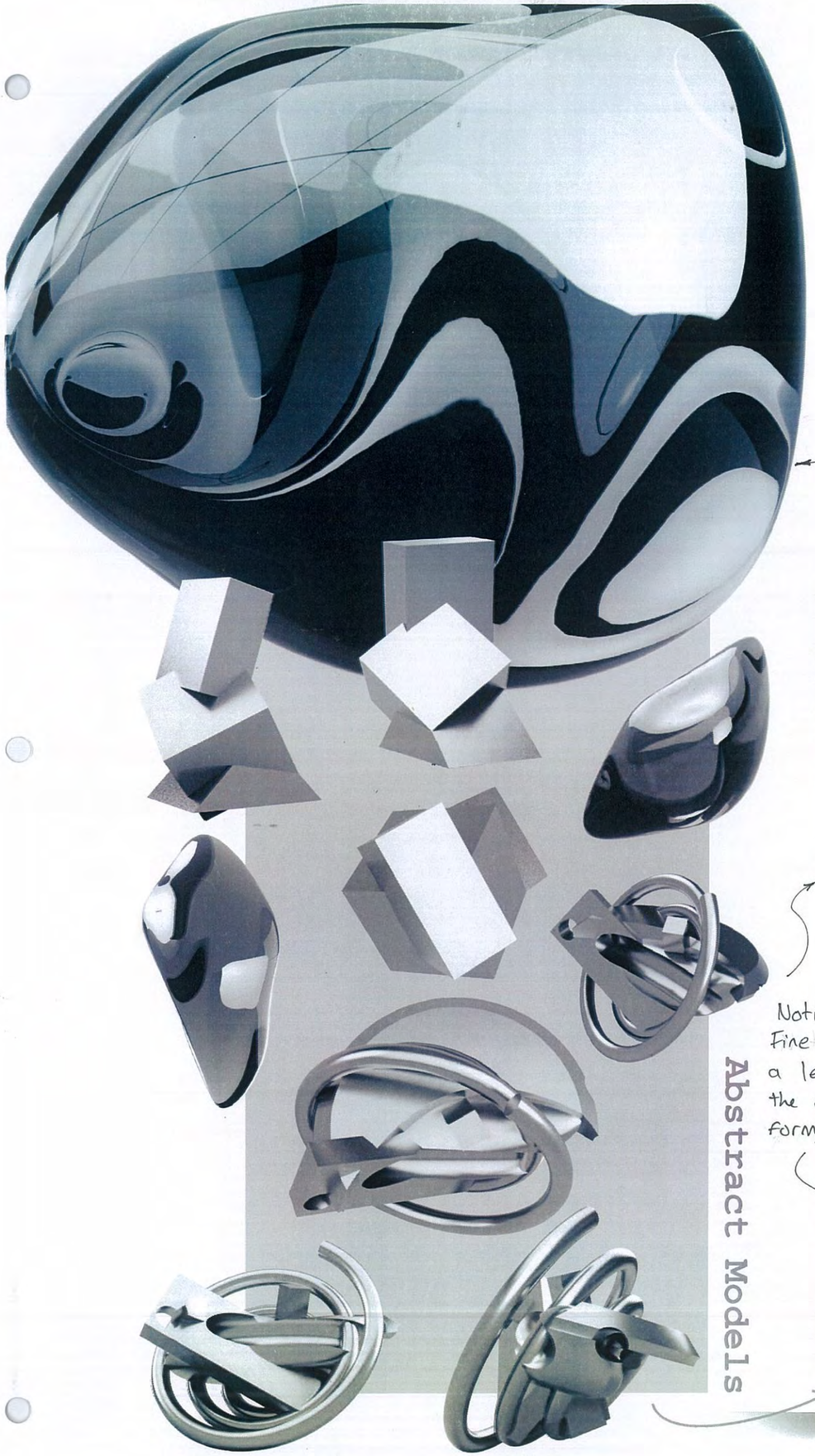
handle?

like angle and curve compliments.

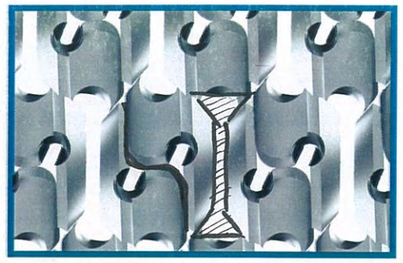
looks like bead cabord

layers.

3D Scans of leaf object show different angles from inside sections of the model and on the reverse plane.

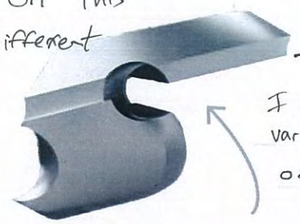


Abstract Models



A possible panel, grill, texture, lighting configuration, or tile pattern?

The light plays on this form to give different abstract shapes.

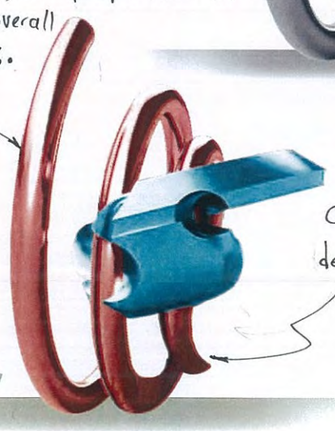


I wish to explore varying itterations on this concept.

Could be a vent, a control, or just a point of interest.

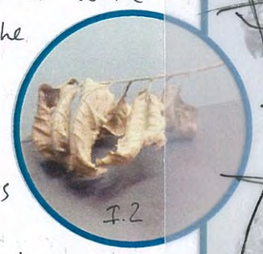
Gaps and channels add visual interest while the tall simple profile detains the wondering eye. This tactic could be used to non-disruptivly integrate features into the heaters form.

Notice: Fine detail occupies a lesser proportion of the overall forms.

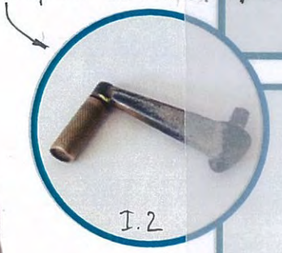


Large curves compliment angular details.

A glass texture defines the complex surfaces.



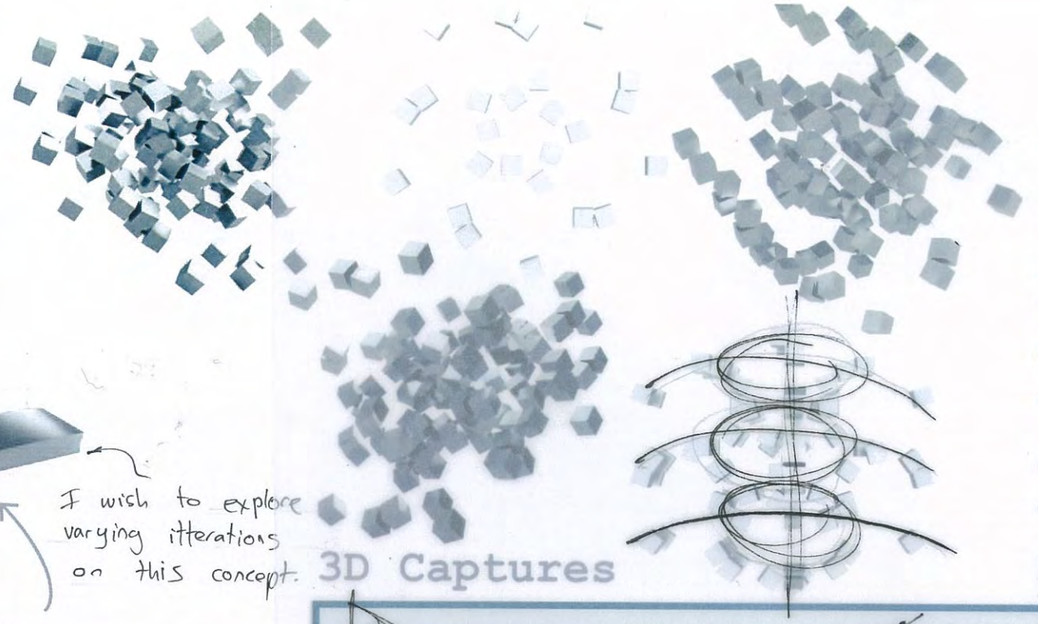
I.2



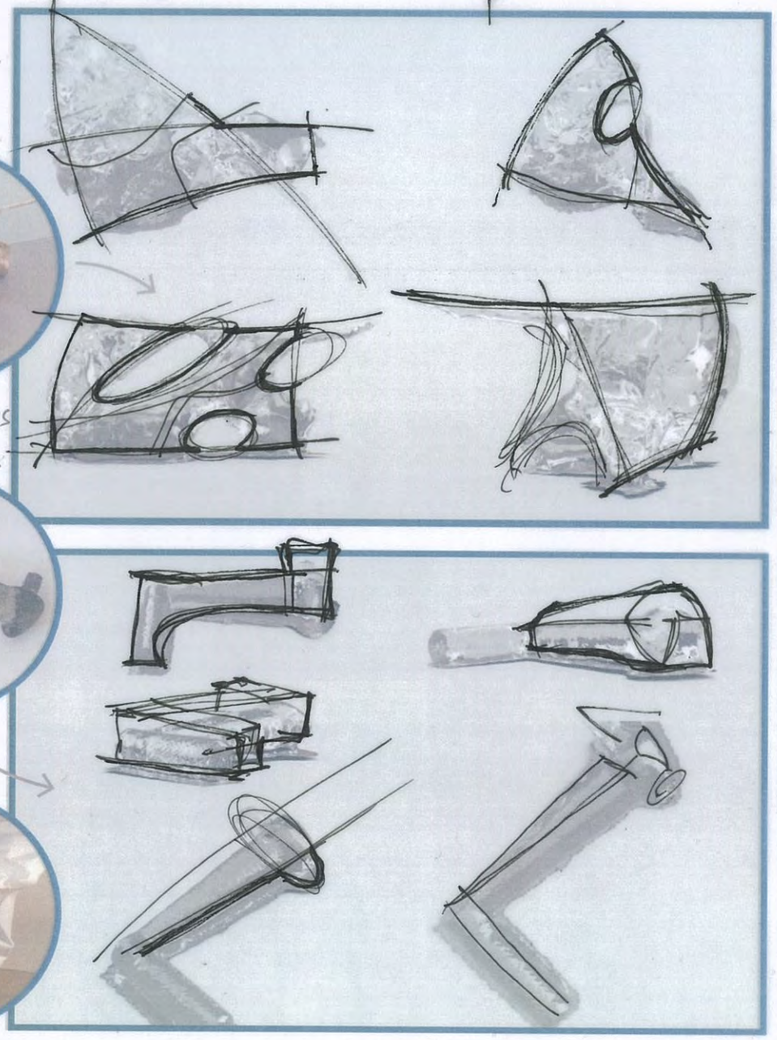
I.2

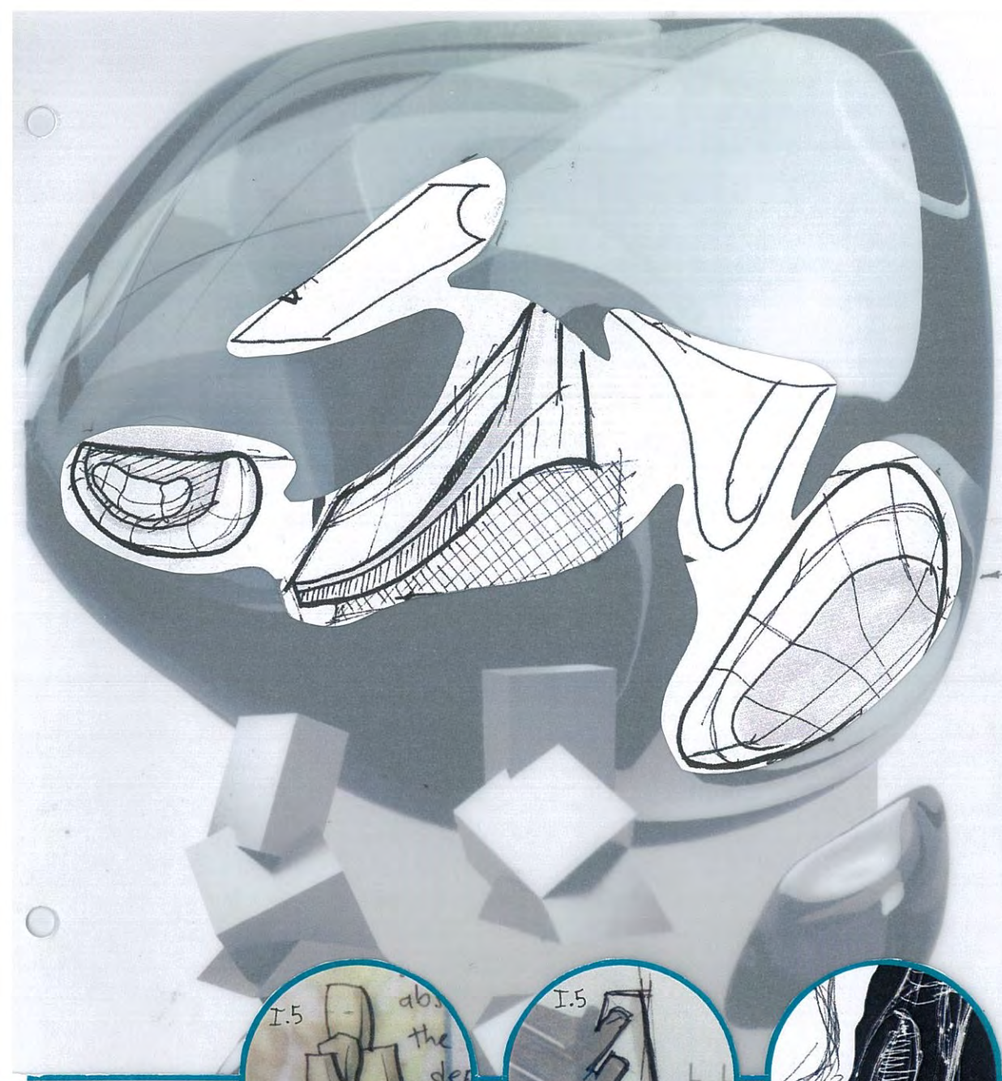
I.1Ø

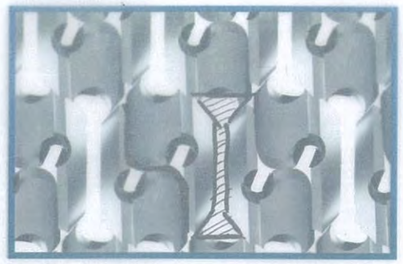
3D Captures



Modeled Patterns

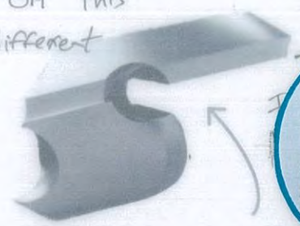






A possible panel, grill, texture, lighting configuration, or tile pattern?

The light plays on this form to give different abstract shapes.



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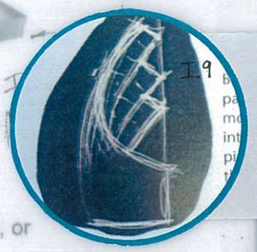
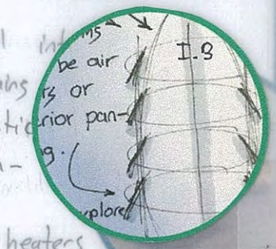
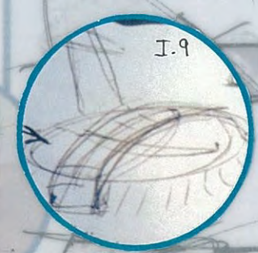
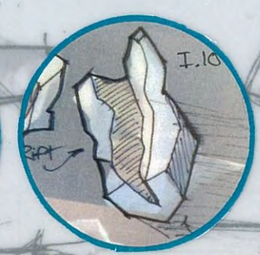
Gaps and channels add visual in... the tall simple profile detains wondering eye. This tacti... could be used to non-disruptivly integrate features into the heaters

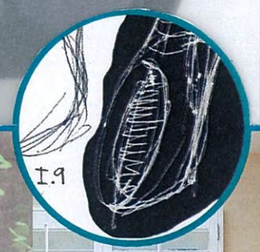


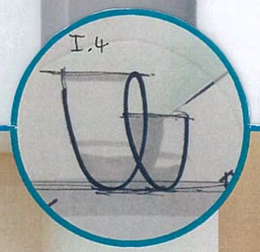


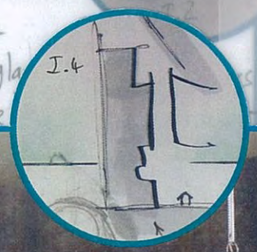


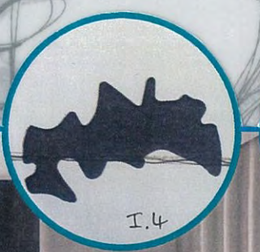


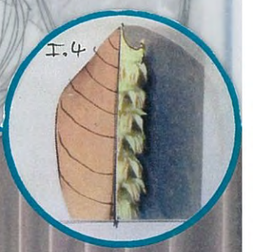
Chosen Design Ideas











Time line

Man soon began building hearths around their homes to keep warm. These are stone or brick lined pits made specially for fires and sometimes ovens. These pits were found in the remains of Neanderthal homes, a species closely related to modern humans, who lived between Europe and Asia.

The refinement of stove designs in the 17th century increased their popularity and wood and coal fired models became very popular creating pollution problems in big cities like London where sulfur dioxide is a byproduct of burning coal. Again these stoves were preferred because of their efficient generation of heat.

Somewhere in the 19th century the electric heater was invented along with the electric stove. By raping a resistance wire round in a coil, stoves produced clean heat with zero emissions – that is, if you don't consider where the electricity came from. By going electric, it also made heaters more portable around the home, however early heater were also very dangerous and the culprit for a lot of house fires.

1.2m yrs ago — **42,000B.C** — **1300's & 1400's** — **1700's** — **1800's** — **1900's** — **2000's** — **Now**

The first form of external heating technology was the open fire, usually powered by burning wood or, as time went on, coal. It was around 1.2 million years ago that the earliest of these man made fire pits is known to have existed.

By the 13th century, we started moving fires indoors. Houses were constructed with holes in the roof to allow the smoke to escape. Eventually stoves were also invented which were enclosed and much more efficient because stoves absorbed heat into the brick or clay shell rather than escaping through the roof. Later in the 14th century, Europeans slowly adopted chimneys to allow the fireplace to be moved to the edge of the room and provide more usable living space. This slowly spread through the world to the 17th century.

Steam and hot water technologies had come along way by the 18th century with many homes using these alternative methods to heat their homes. Radiators were often used in hallways and small rooms. Underfloor heating gained in popularity too. Oil and gas heaters also came into use around this time.

By the 2000's, home heating systems, such as hot water and warm air from heat pumps, became the most popular. Focusing on the refrigeration cycle, which is used most commonly in these systems, They are thus much more efficient at generating heat. The average home temperature increased from 18deg (in 1970) to 22deg due to the popularity of such systems. The focus of technology shifted to efficiency where storage heaters, which store heat and released it through the day, gained popularity to take advantage of low night time fares on electricity.

Psychology

For the time line we see that heat holds a powerful connection with humans. First is was the discovery of fire which allowed us to cook nutritious foods and survive in colder climates, freeing up our time to think about situations beyond just pure survival and move on to conquering the world. It is common opinion that fire separates us from animals. Fire creates comfort and warmth within humans in complete contrast to animals which run from this destructive threat. A study by the University of California around our psychological attraction to fire (partially in children) lead them to argue that we have evolved "psychological mechanisms" specifically dedicated to controlling fire and hence fear is substituted with safety.

Using emotive design attributes will encourage users to connect with the design on a deeper level. A study by a researcher from Harvard medical school studying monks showed that, through meditation, they could raise their body temperature up to 8 degrees celsius. This proves that state of mind effects our body temperature. Thus if the product can reproduce an emotive experience (safety, comfort, and warmth) which emulates these psychological traits, it will improve the users experience of the product and increase its perceived effectiveness (and possibly, actual effectiveness) making them more likely to recommend it. Existing products have begun to utilise this idea by placing screens on the front of convection heaters that mimic the image of an open fire, but this idea has the potential to be extended beyond just a pretty picture and involve the entire design.

I will need to explore aesthetic based methods and triggers in order to reproduce this emotive experience.

Psychology Sources:

http://news.discover.com/human/psychology/fire-fascination-humans -120424.htm (Interview with Daniel Fessler [evolutionary anthropologist])

http://blogs.asiantown.net/-/58/Monks-can-raise-body-temperature-high-enough-to-dry-wet-clothes-in-1- hour.aspx (Interview with Herbert Benson)

http://hankeringforhistory.com/history-of-home-heating-from-fire-in-a-cave-to-an-electric-fireplace/

Time Line Sources:

http://www.britishgas.co.uk/blog/history-of-home/

http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=4504539&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F28%2F4504518%2F04504539.pdf%3Farnumber%3D4504539

http://hankeringforhistory.com/history-of-home-heating-from-fire-in-a-cave-to-an-electric-fireplace/

http://www.britannica.com/EBchecked/topic/258832/heating

Situations

There are 4 main uses for heaters I have identified. Large spaces with multiple people; medium spaces with few people; direct heating; and direct and space heating. The first is to permanently control the background temperature of a large space such as a lounge, family room, or even a commercial space like a warehouse using a permanent convection system. Often these spaces have many people where it is usually enclosed. Next is to temporarily or permanently heat a medium space such as bedrooms, hallways, or offices where fewer people usually visit and a vast or permanent system is not required. Bedroom spaces have special requirements including silence when operating at night. Some people like to be directly heated; this is usually where a strong draft or open space prevents the room from retaining heat (e.g. a cafe). Lastly, using mostly direct heat but also slowly increasing the temperature of a small to medium space (such as a bathroom).

The first use is irrelevant to the brief as it is not portable. To fulfill "multipurpose" then the other three must all be considered as applicable situations.

Notice how the hot areas of these devices are purposely placed with a gap above the floor. In the heat lamp above, the designer has intentionally created an illusion that this is not the case, by extending the plastic skirt below where the heat is actually projected. This gap is a safety feature to protect from ignition of low objects and must be included in the design.

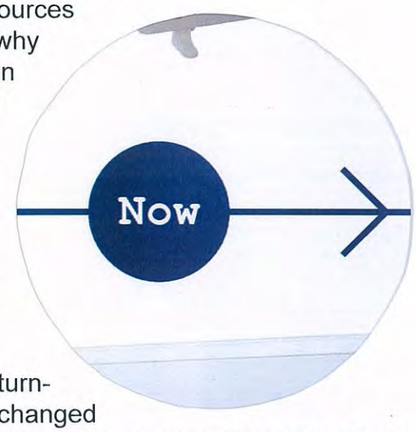
Sources:
https://www.consumer.org.nz/topics/choosing-a-heater
http://energy.gov/energysaver/articles/portable-heaters
http://www.energywise.govt.nz/your-home/heating-and-cooling/heating
http://www.britannica.com/EBchecked/topic/258832/heating
http://en.wikipedia.org/wiki/Infrared_heater
Long Bay College Yr13 students of T16

Size

The design must be small enough to be portable and carry around. Looking at torches and portable lights, they all have a compact form like a pot plant, small enough to be placed on a table or shelf. This design could be dangerous placed on shelves and tables if it gets very hot. Hence most modern portable heaters have a form slightly larger such as shown. I made a paper model to demonstrate 2 different possible sizes for the heater design and placed it around the room while getting others to comment on sizing. One was approximately the size of a small rubbish bin; the other approximated a small portable lamp.

The lamp looked easier to carry and sat nicely on the bench. However people commented that it was small when placed in the center of the floor (in both orientations) and could easily be tripped on creating a safety hazard. I think lamps get away with this as they give off light and thus announce their presence. If this design omitted light then this size would be acceptable. When in the corner of the room by a shelf, it was hard to notice.

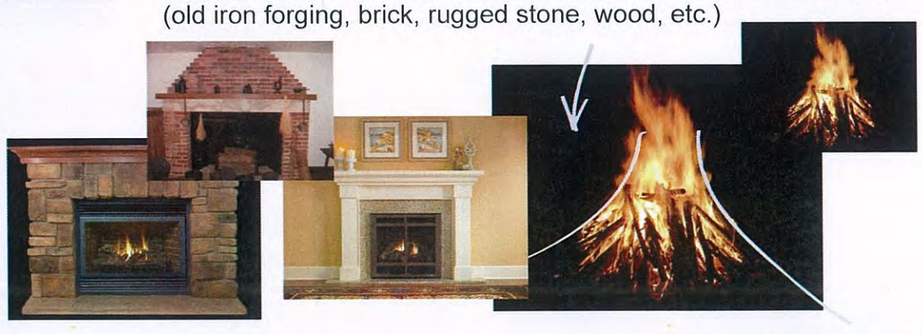
Again I attribute this to the fact lamps give off light, enhancing their presence. This also highlights the importance of light in the design even though it's purpose is not to light, but to heat. In reference to the time line page, fires gave off light and hence we expect that heat sources will do so too. This explains why some people still prefer open fires to heat pumps even through heat pumps are more cost effective. My intention to research lamps was purely to get ideas on size, but they have worked out more relevant than intended.



Having longer form factors (turning the shapes on their sides) changed how people responded to them. The larger sideways shape belonged and was rooted in place central to the floor while upright it was out of place and awkward. However, strangely both orientations worked when adjacent to the wall. Maybe this was because its presence disrupted the flow of the room, the same reason that fireplaces were moved to the outer walls in the 14th century after the invention of the chimney (time line page). This shows that while the design should be a feature of the room like a fireplace is, it should not get in way of living or working.

Overall, the design should be no bigger then a small bin, and a bit larger than a lamp, with a significant base which grounds the design. Use of light should also be kept in mind through the ideation process. To be revisited when finalizing design form.

To further explore from above... notice how all these fires and fireplaces are rooted fortified forms following a sturdy block or pyramid theme with thick columns etc. Will consider this shape/theme in ideation. Also could be an inspiration for materials (old iron forging, brick, rugged stone, wood, etc.)



Heater Methods

Weight	5	4	6	7	10	5	
Type	Time to heat	Area	Cost	Efficiency	Size	Noise	**Total**
Convection							80
Radiant							98
Fan							113
Heat Pump							104
Natural Gas							109
Panel Heater							103

Weight scores determine relevance to the brief.

Good	1
Average	3
Bad	5

Convection heaters rely on airflow where heat is conducted by air particles which then circulate a room warming other objects. Non-fan heaters heat a room at average speed as the initial heating of the air surrounding the heater takes time. Maintenance of room temperature is much more efficient. Fan heaters use a fan to increase the circulation of air and thus are faster, heat is also more evenly spread, and it can be made smaller, however more electricity is required to run them and they are noisy. The most popular convention heater is the oil filled column. Smaller portable fan heaters provide direct body warming but are inefficient when heating large spaces. This scored best at 80 on the comparison matrix where as the heat pump scored 104 reflective of its greater size requirements. Also having been around longer than heat pumps, convection heaters are often used in smaller spaces where heat pumps are unnecessary or as a portable alternative hence they are still very popular.

Radiant heaters use reflectors to project infrared heat energy in a small area. An infrared ray is a form of electromagnetic radiation with a wavelength beyond visible light. These waves are absorbed by molecules to generate heat. Because infrared travels in waves, no medium (such as air) is required to transfer heat and thus this method of heating the body is very fast, but as a method of heating the room is very slow. Radiant heaters emulate the warmth from fireplaces and the sun (where the sun is more than 50% infrared heat and the other is visible light). Radiant heaters need to be calibrated with wavelengths specifically chosen depending on the medium required to absorb heat. Thus when there are many different mediums in a room, it is hard for these heaters to be efficient, so they are mostly used in industrial situations where a specific material (e.g. plastic) needs heating. Even though these heaters can be around 85% efficient, if no objects exist that can absorb this energy, or the rays take another direction, this efficiency is lost. This scored 98, the second best after normal convection due to its properties as a close up heater. Because of its ability to emulate sun light and open fire heat it is also useful in reproducing psychological associations with these types of heat as discussed on the previous page.

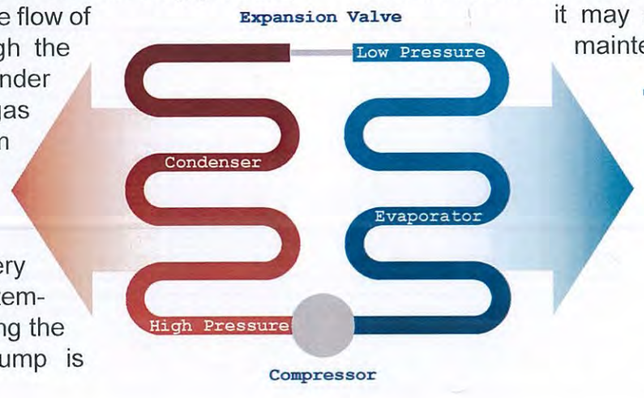
Other: Convection and Radiant heaters are the only two methods of transferring heat. However many variations exist with more efficient methods for speeding up and fully utilising these two processes (e.g. refrigeration). Scores were calculated by multiplying the weight score with each type score.

Sources:
http://en.wikipedia.org/wiki/Infrared_heater – https://www.consumer.org.nz/topics/choosing-a-heater – http://energy.gov/energysaver/articles/portable-heaters
http://www.energywise.govt.nz/your-home/heating-and-cooling/heating

Refrigeration Cycle

The most common method of generating heat is via the refrigeration cycle which relies on the changing state of a liquid or gas (called the refrigerant) in order to transport heat energy from one area to another. This cycle is used in fridges, heat pumps, and in large scale industrial setups such as air conditioning.

In physics, heat does not magically move from a cold place to a heated place as we desire. Heat will rise and mix with cold air to become as evenly distributed as possible. Hence work (or energy) is required to drive this process in the form of the compressor as seen in the diagram below. It takes in a cool gas at the bottom right and compresses it to form a hot liquid which releases heat as it move through the condenser. An expansion valve is simply a tube with a smaller diameter which restricts the flow of liquid. Upon the liquid making it though the expansion value it partially evaporates under the sudden drop in pressure into a cool gas that removes heat from the medium which surround the evaporator. The cycle then repeats.



These types of systems can be very efficient, but will lose efficiency as the temperature drops in the medium surrounding the evaporator (usually air). The heat pump is impractical for this design context. Reason being the one factor that is most important (size) got the worst ranking and hence attributing to its final score of 104 despite outperforming in other areas. The biggest downfall of the refrigeration cycle is the requirement of two mediums to move heat between. In homes this is acceptable because the fixture is permanent and units can be externally mounted which use the outside air, or the ground heat. So for portable heaters, the refrigeration cycle is impractical in my design. I thought it may be possible to have a medium, such as clay or tiling, in the base of the design to extract heat from. Besides adding extreme weight to the design, eventually the system would lose massive efficiency when the medium cooled and would need to be replaced, thus it may as well just be an inefficient, high maintenance panel heater.

Sources:
http://www.air-conditioning-and-refrigeration-guide.com/refrigeration-cycle.html
http://home.howstuffworks.com/refrigerator4.htm
https://www.youtube.com/watch?v=gSmaXrj6u9A

Determinants

To justify the weightings on the table under “Heater Methods”… Being portable means that size is the most important factor hence (10). Efficiency was rated (7) as the more power required the larger a portable power source will be, and the more it will cost. Area of coverage is the least important as a portable heater is expected to warm smaller areas. An extendible design would be to an advantage in terms of versatility. But, as any decent heater must cover at least some area this gets a (4). Cost is more important as consumers will not purchase this heater if it’s too dare.

With the exception of fireplaces, heaters are not generally seen as fashionable products, rather tools, so they are not wiling to pay as much. This does however present an opportunity to design a fashionable item, inline with fireplaces, which we can charge a higher price for. Thus cost receives a (6) as to be below efficiency and size.

Time to heat and noise both have about the same importance at (5) equal. A heater is useless if it takes too long to heat, but acceptable in some circumstances. And noise is also generally accepted in heaters, with the expectation of bedrooms, which I will have to be mindful of. Overall the convection heater is best suited as a general-purpose heater as per the brief. However incorporating a method of radiating heat is not out of the question as many modern heaters use a combination of both (e.g. Micathermic Heater as to be explained).

Fire Risk

The IFC (International Fire Code) states that for portable electric heaters the following must apply…

- *605.10 The use of portable, electric space heaters in which the heating element cannot exceed a temperature of 212°F (100°C) shall be permitted in non-sleeping staff and employee areas in Group I-2 occupancies.*
- *605.10.1 Listed and labeled. Only listed and labeled portable, electric space heaters shall be used.*
- *605.10.2 Power supply. Portable, electric space heaters shall be plugged directly into an approved receptacle.*
- *605.10.3 Extension cords. Portable, electric space heaters shall not be plugged into extension cords.*
- *605.10.4 Prohibited areas. Portable, electric space heaters shall not be operated within 3 feet (914 mm) of any combustible materials. Portable, electric space heaters shall be operated only in locations for which they are listed.*

Group I-2 Definition: *"This occupancy shall include buildings and structures used for medical care on a 24-hour basis for more than five persons who are not capable of self-preservation. This group shall include, but not be limited to, the following: Foster care facilities; Detoxification facilities; Hospitals; Nursing homes; Psychiatric hospitals."*

Sources:
http://publicecodes.cyberregs.com/icod/ifc/2012/icod_ifc_2012_6_par127.htm – http://www.compliance.gov/forms-pubs/eresources/fastfacts_spaceheaters.pdf
http://www.cpsc.gov/Global/Safety%20Education/Home-Appliances-Maintenance-Structure/098.pdf

Listed and labeled refers to being tested as an approved laboratory. Since this is not realistic, I will ignore this requirement.

The American Consumer Product Safety Commission estimated that from 2008 to 2010 portable electric heaters were involved in around 2,400 house fires in the U.S. I could not find New Zealand data but the risk is high no matter the country.

Heaters are fire hazards for the simple fact they create heat and consume large amounts of power in doing so. Thus any electrical faults can cause sparks igniting near by furniture, and any exposed heating elements/filaments can do so too. My design will need to contain many safety features to protect against faults and the ignition of other objects, which are too close. The use of proximity sensors, such as in cars, could be explored.

Another concern is that heaters can often be left unattended, while heating a room, and thus any smoldering would not be noticed. I could remedy this by looking into smoke alarms and seeing if this could be incorporated into my design as a smoke detection mechanism.

Portable heaters are small and can be hazardous to children if playing around the heater. So the design must avoid any exposed elements or hot surfaces. Sometimes heaters can fall over causing them to malfunction and start fires. Gyroscopes detect orientation and could be used to shut off the heater when it tips over.

Overall the IFC is aimed at the deployment of portable heaters instead of manufacturing. I was unable to find manufacturing guidelines so I have used the IFC code as well as other sources, that make recommendations around the use of portable heaters, to base my considerations...

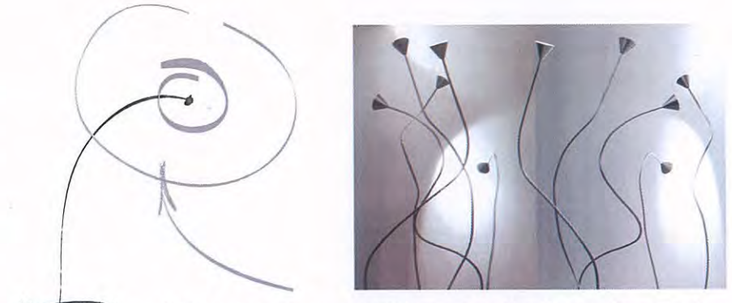
- Protect against electrical faults.
- Investigate proximity sensors to keep 914mm away from flammable materials.
- Investigate a smoke detector.
- Avoid exposed elements in the design and consider the placement of vents so to prevent children burning themselves.
- Investigate gyroscope.
- Keep below 100˚c if possible so that the heater can be used safely in Group I-2 areas.
- Investigate the applicability of alternative power sources other than mains.
- Investifage air temperature measurment options.

Measuring Temperature

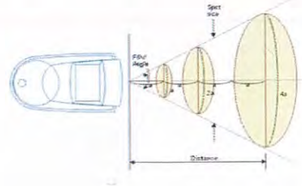
The heater must be able to regulate its own temperature to prevent it from overheating and the room from overheating. There is also the 100˚c limit identified above. People who have left heaters on in the night have suffocated in the heat and died – which is not ideal.

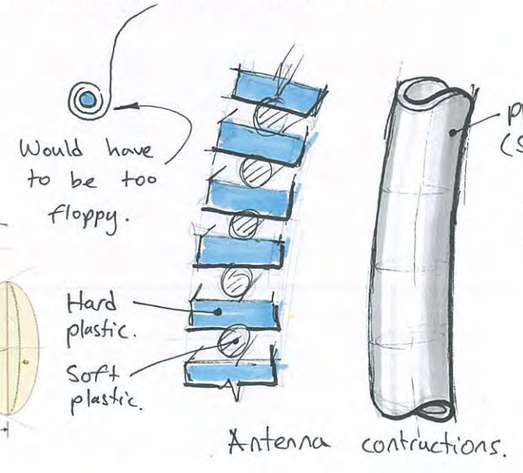
One idea was to use an app in the users phones to tell the heater the temperature around the person. Although all phones have thermostats in them, very few measure the air temperature direct, and all are very inaccurate. Sensors are mostly imbedded in their processes and thus read the phones core temperature. I stumbled across a company, which designed a sensor for phones to measure the ambient air temperature. Maybe this could be used in my design provided there is minimal interference from the heaters own heat.

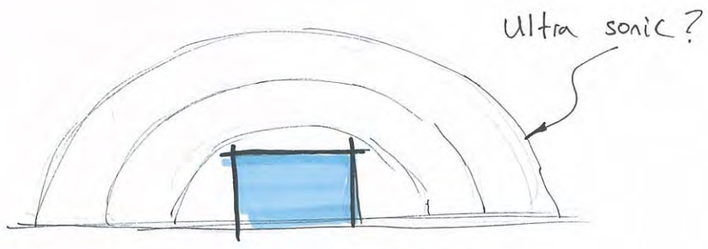
Infrared sensors for measuring the air temperature is not possible. Assuming no interference from the heaters own infrared, the sensor would measure the average temperature of all surfaces in the room. So if 3 people walked into the room, the heater would think the air temperature increased, where in fact it has decreased because the 3 people absorb heat from the air.

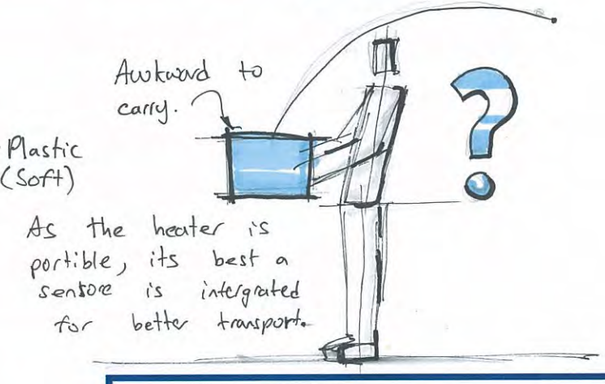


A large antenna could suspend a thermistor in the air away from the heater. Will explore later.







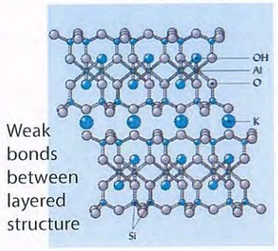


Micathermic Heaters

Modern is not something people associate with heaters. They are one of those products, like toasters, that have been around so long consumers think we have come up will all the options. However, recent innovations in the field of heating have produced a new method of producing both radiation and convection heat called Micathermic Heating Elements.

These elements use a mineral called "Mica" which is well known in the electronics industry for being one of the few insulators (does not conduct electricity), which can withstand high temperatures. Mica laminate can also be made very thin, such that the complete element is only as small as half a millimeter. The inventors clam it can produce up to "99% heat to the air instantly" which means 99% of the electrical input energy is converted to output heat energy with no warm up time. Thus defiantly filling the efficiency box.

Historically Mica was used as glitter, now it's also used in many paints, fillers, and even concretes, because of its attractive sheen and near perfect basal cleavage. Basal cleavage describes the minerals ability to part into thin sheets and fill gaps, which is down to the layered structure of Mica's molecules (much like graphite in a pencil).



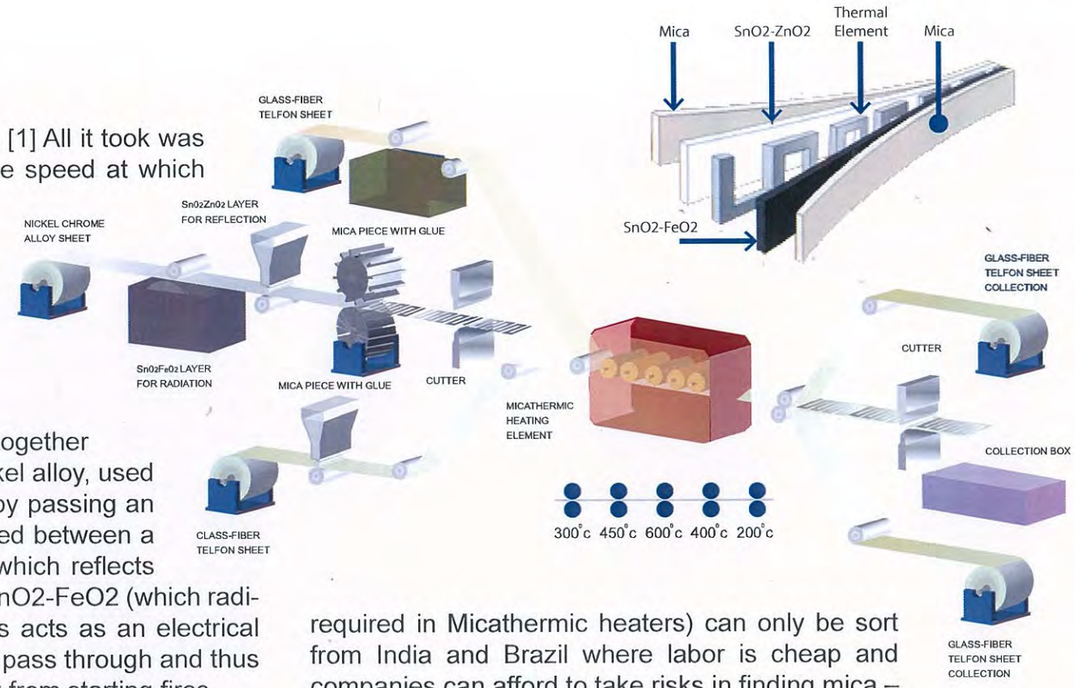
Scored using the same system as on context 3, the time to heat for the Micathermic Heater is excellent along with high efficiency and extreme quietness. However although the elements can be made incredibly thin, the amount of surface area require means that manufactures have treated them like panel heaters. Thus they are thin but very tall and long. They are designed to heat medium spaces, but as area is weighted as the least important, it

Type	Time to heat	Area	Cost	Efficiency	Size	Noise	Total
Micathermic							71

Good	1
Average	3
Bad	5

does not overly affect the final score of 71 where 37 is the best possible score. This score is far better than 80, the previous best, making this new method of heating a serious consideration in the design. I will need to consider how to achieve this larger surface area requirement and investigate how it works to see how this will affect the design, and judge the applicability of its inclusion.

Because these heaters are so new, there are not many reviews or insights available, nor products. However, for the comments and comparisons that do exist, the biggest downfalls to the Micathermic Heater is build quality and controllability. In order to compete with existing heats, manufactures get these heaters made in China and India. One person commented they had owned "4 of these . . heaters for about 3 years" (Bernalgas). [1] All it took was for it to fall over. The latter is due to the speed at which these heaters heat a room, consumers where often surprised and said it was easy for the room to become overheated. Commonly, heaters only had simple timers, as a safe guard against this – could be better.



Laminating materials together forms the Micathermic Element. The nickel alloy, used in conventional heater to produce heat by passing an electrical current through it, is sandwiched between a layer of semi conductive SnO2-ZnO2 (which reflects 80% for the heat) and semi conductive SnO2-FeO2 (which radiates heat). The surrounding mica layers acts as an electrical insulator while allowing radiation heat to pass through and thus remains relatively cool while protecting it from starting fires.

After some research into metal oxide nanostructures I found that SnO2-ZnO2 is not the most infrared reflective material that the original creators could have used. Polished aluminum can be much more reflective (as proven below), but the use of SnO2-ZnO2 means that 20% of the infrared that is not reflected becomes convection heat while the rest is radiated heat. Thus these substances could be changed out in order to fine-tune the percentages of each type of heat. However, because these specific sheets are already in production for existing Micathermic Heaters, it would be more cost effective to purchase pre-made sheets than custom manufacturing them.

To calculate reflectivity: following the conservation of energy principle, the initial Incident Heat Energy (Ei) will equal to the sum of the Reflected Heat Energy (Er), Emitted Heat Energy (Ee, also called Absorbed Heat Energy), and Transmitted Heat Energy (Et, or heat that passes through the material). Aluminum allows very little heat to pass through, thus we can assume it to be negligible. This is an estimate because emissivity is different for different wavelengths.

$E_i = E_e + E_r + E_t$ *where* E_t *is negligable* $\therefore E_i = E_e + E_r$

let $E_i = 1.0$ *or* 100%, *let* $E_e = 0.04$

Polished Aluminium Plate:

$1.0 = 0.04 + E_r \therefore E_r \approx 0.96$ *or* ***96% reflectivity***

Social Impacts: If the chosen design requires the use of mica (phologopite) then more research will need to be done into a responsible alternative. Mica is difficult to find and thus expensive to mine. Mica sheets (which are required in Micathermic heaters) can only be sort from India and Brazil where labor is cheap and companies can afford to take risks in finding mica – this can also mean pour working conditions. The USA only produces scrap Mica (from the mining of quartz) that is used in electrical components. Scientists are working on synthetic alternatives to mica for electrical components, but this usually means forfeiting its ability to withstand high heat, which is critical in heaters.

Laminating Sources:
http://www.gns.cri.nz/static/pubs/2013/SR%202013-039.pdf (metal oxide nanostructures)
http://www.optotherm.com/emiss-physics.htm
http://www.infrared-thermography.com/material.htm (emissivity values)

Other Sources:
http://techcrunch.com/2009/10/03/micathermic-heaters-do-they-work-well/ [1]
http://www.consumersearch.com/space-heaters
http://www.mineralszone.com/minerals/mica.html
http://www.amazon.com/s?ie=UTF8&page=1&rh=i%3Aaps%2Ck%3Amicathermic%20-heater
http://www.micathermic.com/content_about.htm (Diagrams)
http://www.britannica.com/EBchecked/topic/379747/mica
http://www.mineralseducationcoalition.org/minerals/mica
http://faculty.yc.edu/ycfaculty/ags105/week08/soil_colloids/soil_colloids_print.html (Bond structure image)
http://www.mineralszone.com/minerals/mica.html

Colours

Sources:
http://www.colormatters.com/index.php, http://www.workwithcolor.com/color-vision-1089.htm
http://www.feng-shui-and-beyond.com/color-psychology.html

Colours mean different things to different cultures... For example, North American stock markets denote a fall in the value of a share with red; where, in China, they show the growth of a share as red. Their cultures place different means on this colour; in this case it is a dangerous colour versus a lucky colour.

Blues tend to be calming, soft and trustworthy. Alongside green, it is the easiest colour for us to process. Like all colours, it can impact differently given some context. In the Dyson product bellow, the strong blue and silver/grey combination creates impact with a modern and futuristic undertone. Blues can also relate to heat, as the seconds hottest stage in a fire is blue (white/invisible is the hottest flame). Thus small amounts of vibrant blue could be used to create impact.

Yellow through Red can have many meanings. For red alone, a more blue red can be love or lust, where a vibrant red means either danger or luck. Orange and yellow can both simulate conversation – which goes some way to explaining group social behaviour around open fires. These warm colours also denote heat.

A vibrant red could highlight vents or elements in the design as a warning that installs visual interest; along with orange (which is more simulative and warm), and blue for some contrast, modernism, and reliability. Adding green would fight against the orange and red trying to calm them down; with the exception of a vibrant green, it should be avoided. Despite the upmarket target audience discussed below, I think it would be better to achieve this luxurious undertone using grey tones and black instead of purple. Adding purple into the mix would saturate the design and thus dull the impact of each existing colour.

Colours will need to be explored in more detail later in the design process where the context of its form can be considered against this pallet.

First Colour Palet

James Dyson

Sources:
http://www.fastcompany.com/3019288/most-innovative-companies-2004/36james-dyson, http://www.dyson.co.nz/community/about-dyson.aspx
http://news.bbc.co.uk/2/hi/business/1802155.stm, http://content.dyson.co.nz/about/story/default.asp?searchType=story&story=jamesdyson

James Dyson is a billionaire design engineer and entrepreneur who is famous for inventing the bag-less vacuum cleaner and is currently the sole shareholder of Dyson Ltd.

Beginnings: He was born the year 1947 in Norfolk, England where he went on to study at the Royal College of Art, first in furniture design, then interior design, and finally ending up in engineering. During his last years of study in the 1970's Dyson, along with some other students, invented the Sea Truck, which has produced sales of around $500 million over the years. After completing study, he went on to design the ball barrow, the wheel boat (travels at 40mph on land and water), and trolley ball (a boat launcher).

Some years later, James Dyson designs and builds a industrial cyclone tower for the ball barrow spray finishing room in his factory, because the air filters kept getting filled with paint particles. Around this time, he is renovating his house and becomes frustrated with his fancy hoover vacuum clogging up with dust all the time. He wonders if he could apply the same cyclone technology into a vacuum cleaner. From 1978 to 1983 he works to produce 5,127 prototypes for what will become the worlds first bag-less vacuum.

Big vacuum cleaner companies liked bags as they generated around 535 million NZD each year in extra revenue. Hoover, Black and Decker, and Electrolux were among the companies who turned Dyson's idea down. Ironically, Dyson is now one of their biggest competitors in the market.

His first product, named G-Force, was finally licensed in japan (the high tech capital of the world) in 1991. Dyson's design was a hit and became a status symbol for the middle to upper class. It won him the international design fair prize that year. Royalties from the G-Force went into funding a new research center and factory in England where he establishes Dyson Ltd in 1993.

In 1999 he brushes with bankruptcy while battling the big companies who had now began to copy his designs, Hoover was in time found guilty of infringing on his costly patents. Finally the DC01 becomes both their first product and the first vacuum to maintain 100% suction throughout its life.

By 2002 the James Dyson Foundation has been created to encourage and promote engineering.

Philosophy: James Dyson's Design philosophy makes room for both function and aesthetics. His designs preform their functions successfully, but also make strong design statements. He continues to prove that it is possible to innovate in everyday markets such as vacuums, fans, and heaters. Dyson's products incorporate bold color and sleek design to maintain Dyson's standing as a premium brand. The other market players had previously only focused on price and profit.

Influence: I identify which Dyson's drive to think differently. Setting ".. high expectations that you will succeed despite any setbacks or frustrations" is accentual when creating innovative products in competitive markets. Through the design process I will not dispense ideas just because they seem impossible, but instead break them down and attack the problem to the best of my ability.

Dyson has also reiterated the importance of colour in designs, which I will take one step further (above) by researching and improving the connection between color and initiating emotive response's from the user.

Heaters are a market that many big/medium players dominate. This makes breaking into the market difficult, thus a new design will need to have impact, be innovative, make a design/fashion statement, and generate discussion in the market place – just as Dyson did. Hence the plan is to target an upmarket audience with an extendible, all in one, solution.

"And don't be afraid to be different." - James Dyson.

Summary

Safety

- Small gap between vents and base.
- A Significant base is required to prevent tipping over. Use of gyroscopes to detect tipping is used by other products.
- Look at electrical faults prevention.
- Investigate poximity sensors for small children and flammable objects (914mm).
- Avoid exposed elements.
- Keep operating temperature bellow 100˚c to allow operation in hospitals an other situations the heater is unattended.
- Investigate builtin smoke detectors.
- Investigate applicability of alternative power sources other than mains.
- Use of lighting to make users aware of the products presence and danger.

Usage

- Medium and small enclosed spaces and small areas in an open space - bedrooms, offices, hallways, the outdoors, bathrooms.
- Convection is best for closed spaces, Micathermic heaters are fast, and radiant heaters best emulate the suns rays and the warmth of a camp fire; these are the best heating options.
- Area coverage is not a big deal as an extendable design could work together to maintain large areas.
- Micathermic elements could be used to create specific ratios of radiant and convection heat for different purposes.

Asthetics

- Humans and fire share a deep connection, considering the use of form, colour, and lighting will stimulate this connection creating a more effective and enjoyable user experience.
- Significan base that grounds the design visually like an open fire.
- Colours need to be considered later, but I have arrived at an initial colour palette as a guide...

- Warm and vibrant colours portray warning, attention, modernism, playfulness, and sociability; all target traites.
- A minimalist design uses few colours and does so sparingly for dramatic effect.

Human Factors

- No bigger than a small bin, and no smaller than a hand held lamp.
- Noise is widely excepted as part of a heater, but certain circumstances (such as bedrooms at night) require a silent heater.
- Design to encourage smarter use - it need to be simple and intuitive to operate. The design should encourage proper use of the heater by its nature. People are incline to turn heaters on to warm a room, then turn them off again, when it is more efficient if a heater is on all the time to maintain a stable room temperature.

Features

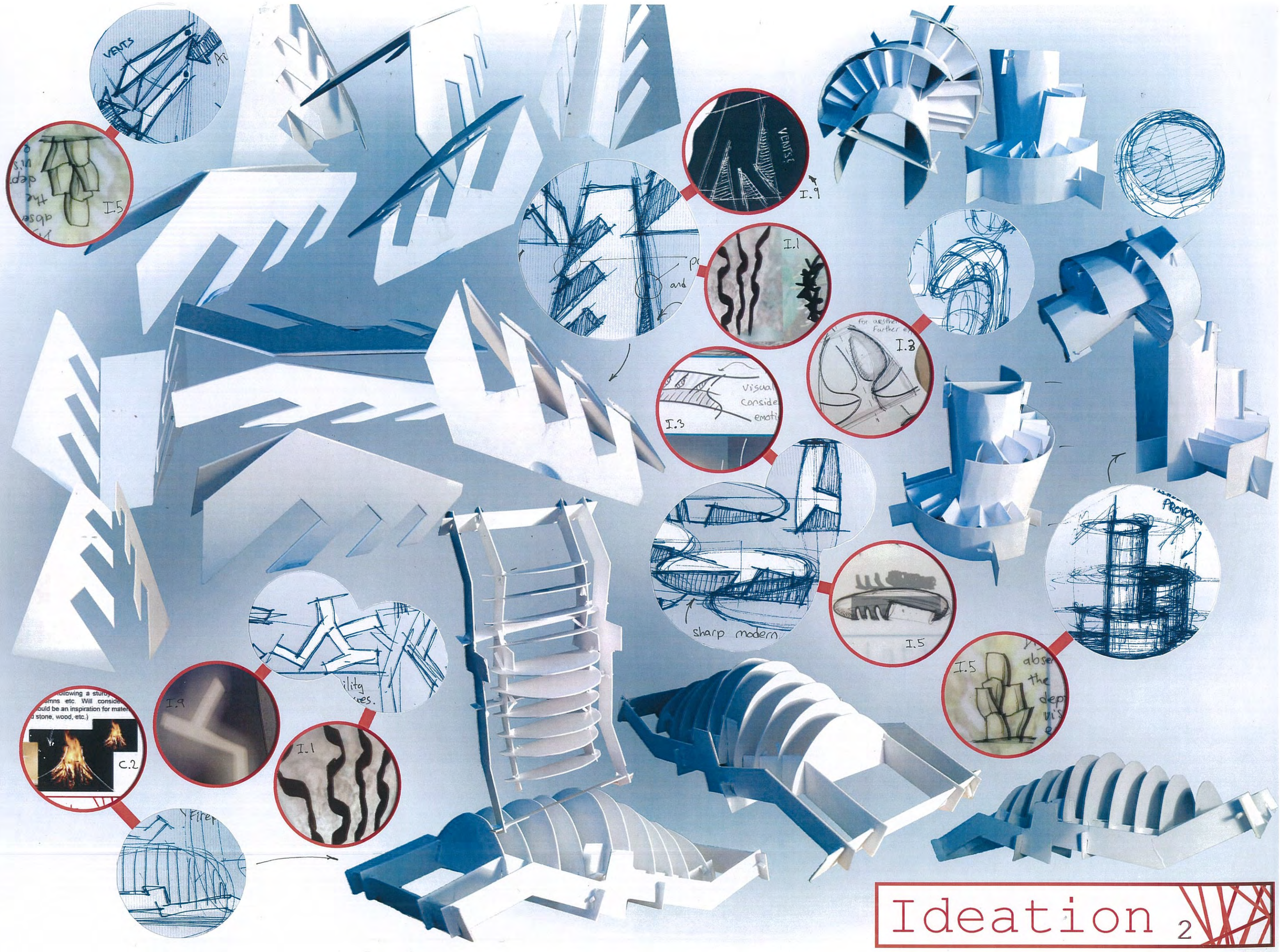
- Look at more accurate room temperature mesurent options.
- Build quality of most existing product is terrible, there may be some users willing to pay more for better quality.
- Look at measures to ensure no overheating of rooms occurs.
- More complex timers give the user more control and increase safety.

Context

- The use of mica has social impacts as it is sourced from countries with lax human rights.
- Existing heaters are predominantly cased in cheap plastic either white or black. This leaves opening to target a more upmarket ordinance.
- Keeping built costs low is important in this cut throat market.
- Don't dispense difficult ideas - innovation is important.
- Be different, innovative, make a statement to generate discussion.

VENTS
Air
Movement.
Likly to snag on stuff
Scale layout?
Needs to be light...
Aluminium, plastic, carbon fibre?
SCALES LINEAR
HORSE
Most explore layouts.
STABILITY
Solution
Plan?
parrellels complement and link across the design.
Most visually balanced option.
possibe 3D layout to explore with models.
Angled vs flat top.
Angled to compliment vents.
vents.
Top heavy.
Too exotic.
PLEASING PROPORTION.. to be explored.
Slit adds interest.
FORMS
Stability issues.
Fireplace emulation.
Need to keep in mind how this will be portable?
like the sharp modern, cleanliness.
From Seat pad.
(inhibitor)
TOP
TOO COMPACT
limited internal space.
TOP

Ideation 1



Ideation 2

I.9

COOL

OR VISA VERSEA

WARM

(mac pro)

INTAKE

A recessed handle maintains the forms simplicity because it avoids interrupting the outer profile. This is an effective method of—①

HANDLE

I.9

EASILY PORTIBLE

Need to think about a stand to hold the weight.

STACKABLE

① — discreetly adding design features (such as buttons, vents handles, etc) to keep in mind for the final design.

HANDLES

Symmetrically balanced.

Jet engine

I.11

looks like headphones.

Touch interface?

Must explore vent direction for better user coverage

AIR.

Parallels create visual interest and worth exploring to capture attention.

VENT

EXPAND

A central hole links the two sides.

Ideation 3

Visual clatter.

D.1

I.3

Solid base.

the tile pattern is worth investigating as a method of controlling air flow. This is the optimal

— orientation when compared with its sister design at the bottom of the page(which it could be combined).

I.9

Inspired by the New Zealand fern, I will discontinue this design due to its delicate and exposed nature. However it supports the concept of varying angles which create a point of visual interest and soften the overall appearence.

Overlapping angles reflect the designs rustic origins as identified in context research. It would be challenging to contain the working components of a heater into this shallow form and awkward to move it around.

Radiates in multiple directions. Too complex and large.

The design bellow widely distributes air, however it's protruding form extends from the wall to create a tripping hazard. Bulk defeats the requirement of a portible design but repetition provides opportunities from where it could be modularised (e.g. broken into 3 parts). I would like to explore its modular potential and alternate orientations.

locks usable interior space.

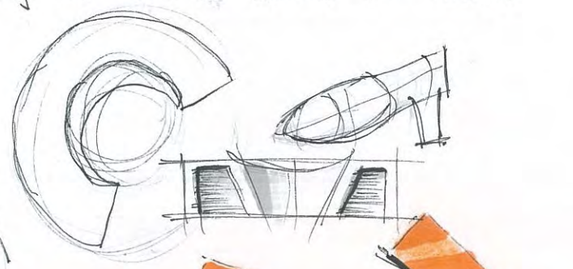
How to fit?

inlet fan element outlet

I.4

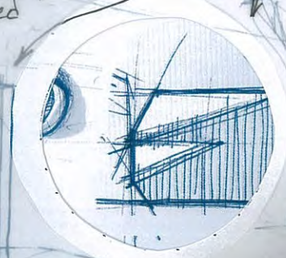
Ideation 4

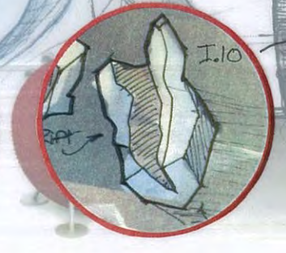
Highly portible, extendible (stackable), and appears to accomodate elements internally— This design offers the most potental at this stage. Its form needs critiquing and the techical details need exploring. I also wonder about the efficency of using two sets of elements and motors?



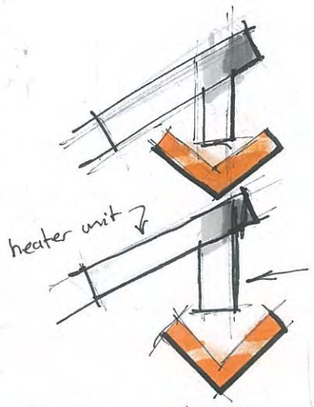
Angled stacking idea was inspired by previous design pattern.

These triangular segments on this pill shaped concept have pleasing complementary proportions and angles. This style is incorporated in the chosen design, in contrast to the origonal flowing curves, to better reflect the angular style identified as a link to the designs context (See context pages). Such angular arrangements were explored in initiation (as shown) which informed the new shape (chosen). This design overcomes one limitation of a pervious discontinued design (shown below) where its sweeping curve helps to balance the harsh angles.

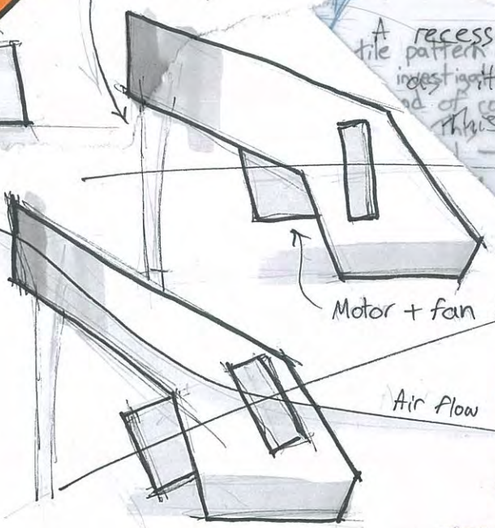


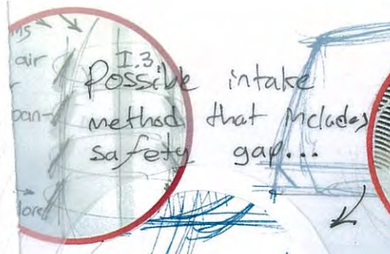


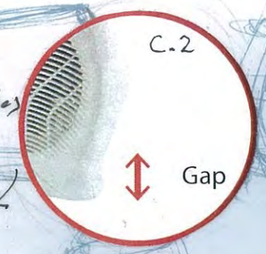
Vent on back to increase intake volume.



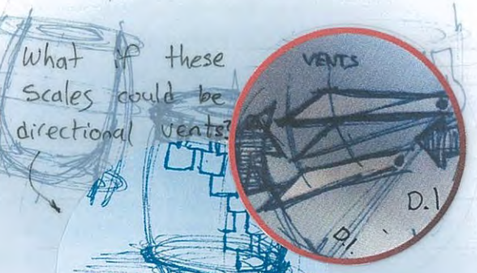
Angling up to target user.





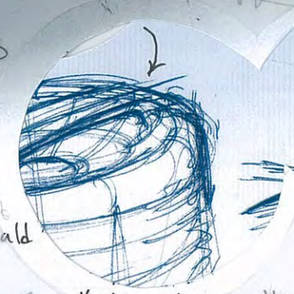


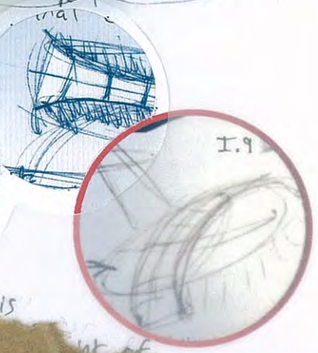
Tiles control air flow?



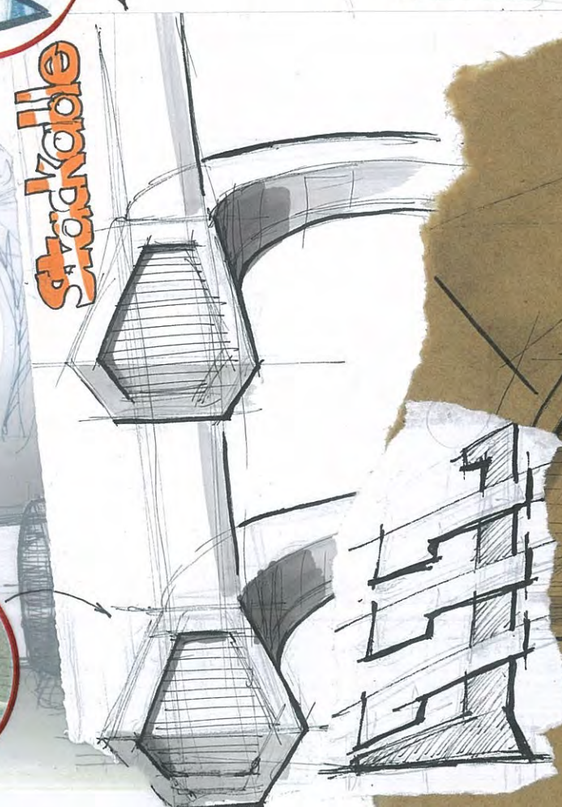
A recessed handle maintains the forms simplicity avoiding interupting the designs flow.

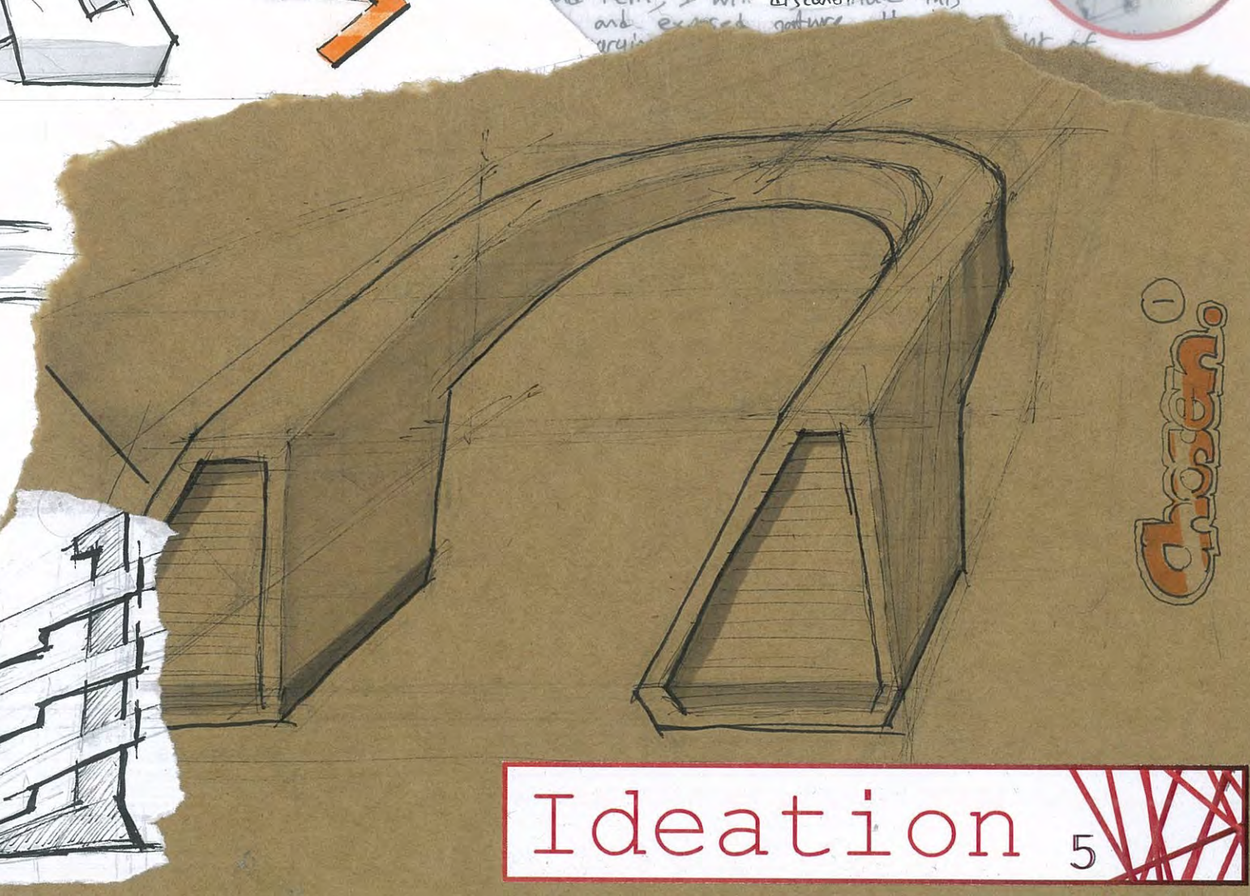
tile pattern is ... investigating ... ad of controlling ... this is effective in ... discreetly add features (such as button, etc) to keep ... rotating ... with its sister ... the bottom of ... which it could





and fern, I will discontinue this and ...



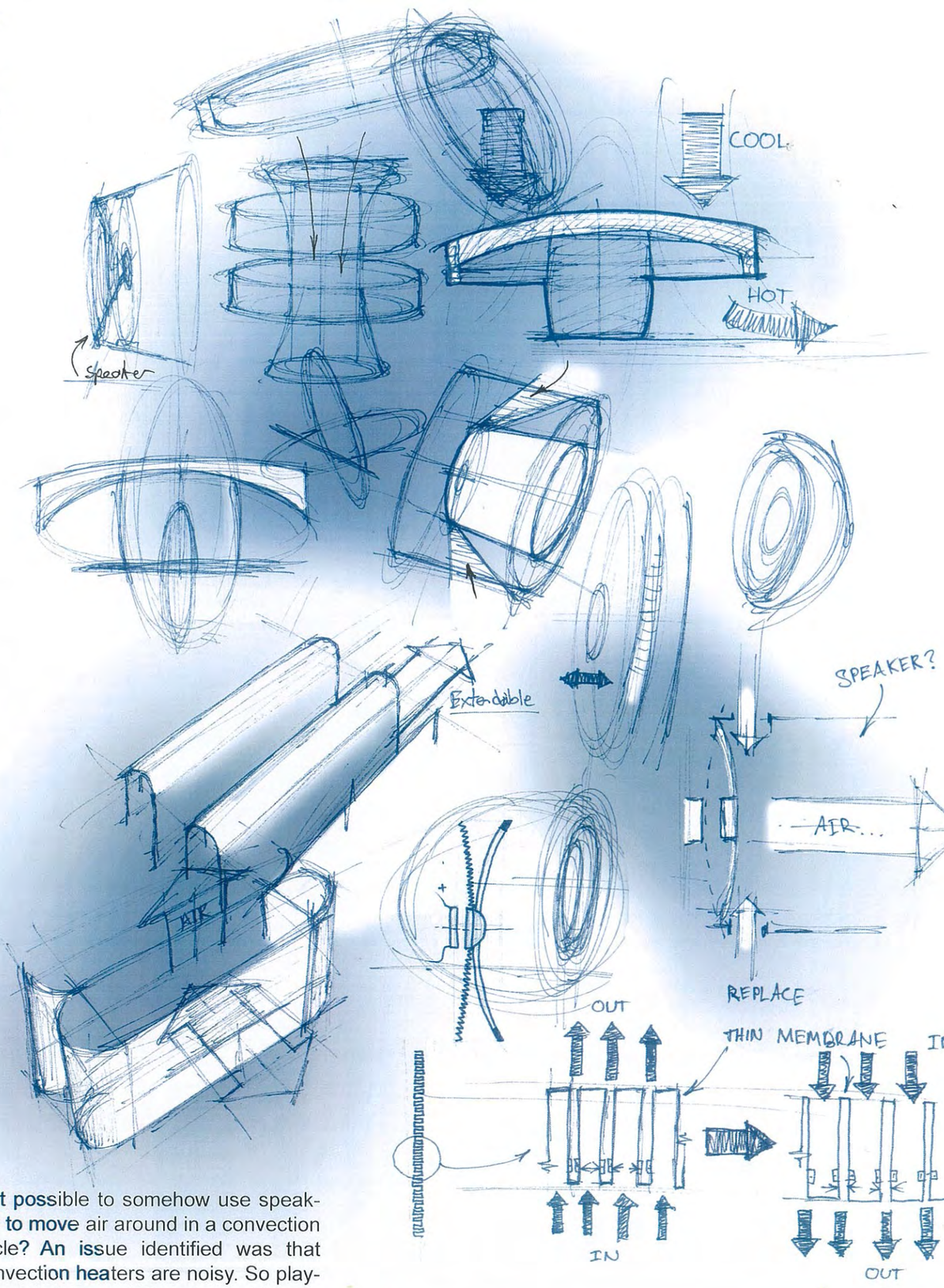


Sounds

The following abstractions were made listening to the numbered sounds... (#1) is the handle (as previously referenced) being rotated to create a squeaky noise. A leaf, from the leaf stalk (also used previously), was rolled in my hand for (#2); then waving it in the air made (#3). I found sounds of the wind and an open fire place for (#4) and (#5) respectively.

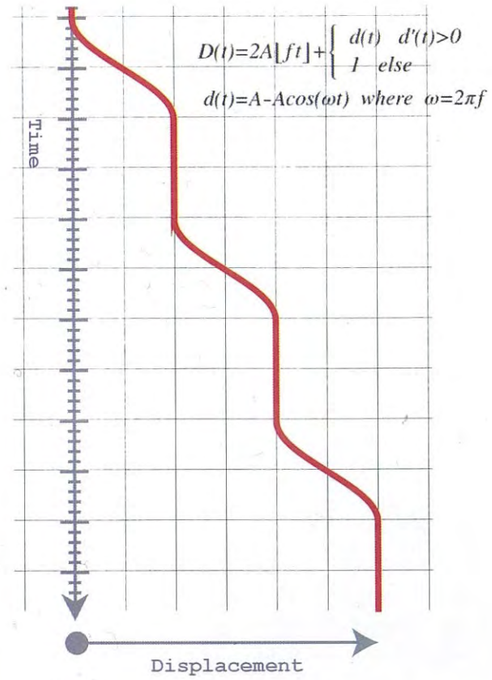
Knowing nothing about music, these images portray what came into my head at the time.

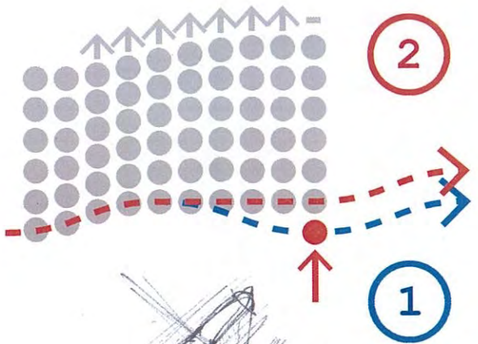
Speakers

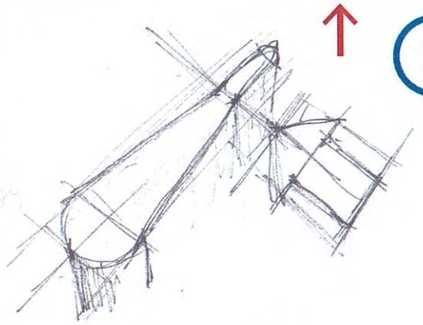


Is it possible to somehow use speakers to move air around in a convection cycle? An issue identified was that convection heaters are noisy. So playing sound to move the air would overcome this limitation.

Sounds could cancel, or music could mask the noise.



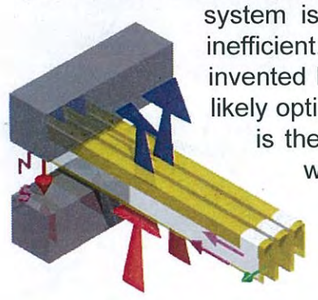




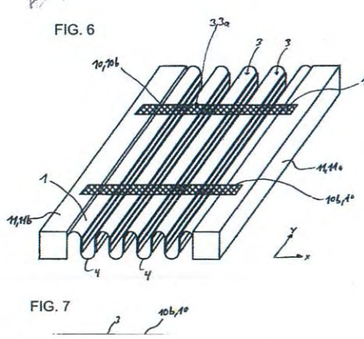
Air Motion Transformer

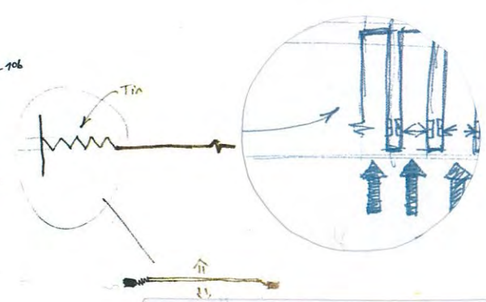
Speakers displace air particles causing them to oscillate back and forth propagating form the source in a wave pattern, hence creating sound. If the diaphragm only moved air forward, then a stream of air would be created and the normal noises associated with convection heaters could be overcome by matching the frequency. Frequency is the number of oscillations per second e.g. 100Hz is 100 times per second, this is equivalent to pitch in music. Amplitude is volume.

One option is a ribbon speaker – these are commonly used in tweeter (high frequency) sounds system speakers. However, the ribbons are usually very delicate and have large amounts of open space around them which means creating a closed, one way system is incredibly difficult and possibly very inefficient. The Air Motion Transformer [AMT], invented by Oskar Heil Kithara, seems the best likely option. Although a conventional diaphragm is the most common form of vibrating air, it would also be difficult to introduce a one way mechanism to replace air without effecting the diaphragm itself. The AMT is a different design which uses an accordion like mechanism to squeeze air particles in and out instead (as shown to the left), which also means it is more efficient.



Investigation: Following Dyson's don't be afraid policy, I'm going to carry out a small investigation into the applicability of using a modified AMT speaker to propagate air while minimising annoying noise. Two models are air particles are shown below, where (#1) is the current model and (#2) is the theoretical one. (#1) shows a conventional speaker moving the air in and out relative to its initial position (known as the equilibrium). (#2) shows the same wave where the particles are replaced with new air particles (●) thus causing a net displacement of the amplitude (volume) where there is no longer equilibrium. Instead, the air has an average velocity of one amplitude per cycle.

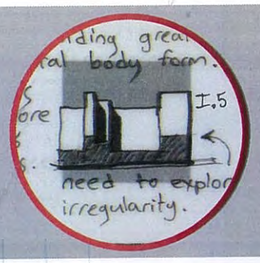


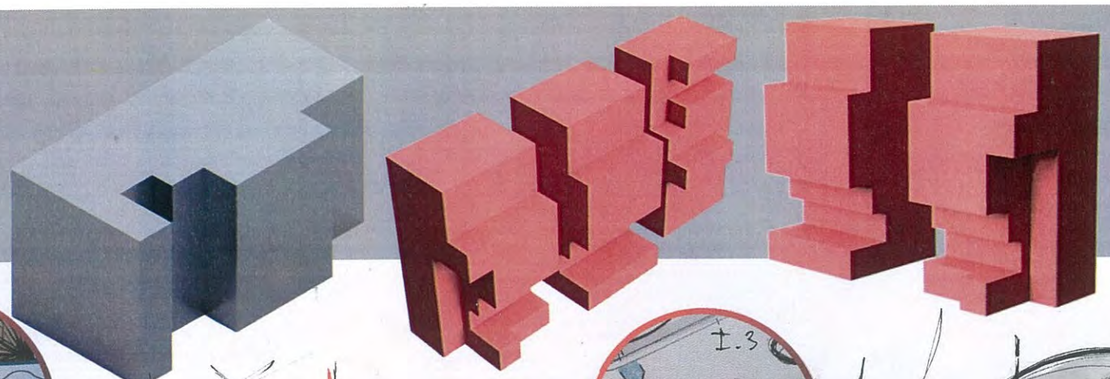


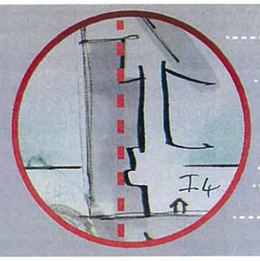
Please refer to Speaker Log Book

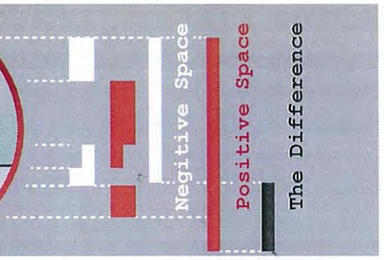
Sources:
http://www.enjoythemusic.com/superioraudio/equipment/0904/heilkithara.htm
http://www.gtaust.com/filter/12/12.shtml
http://www.precide.ch/eng/eheil/eheildetails.htm

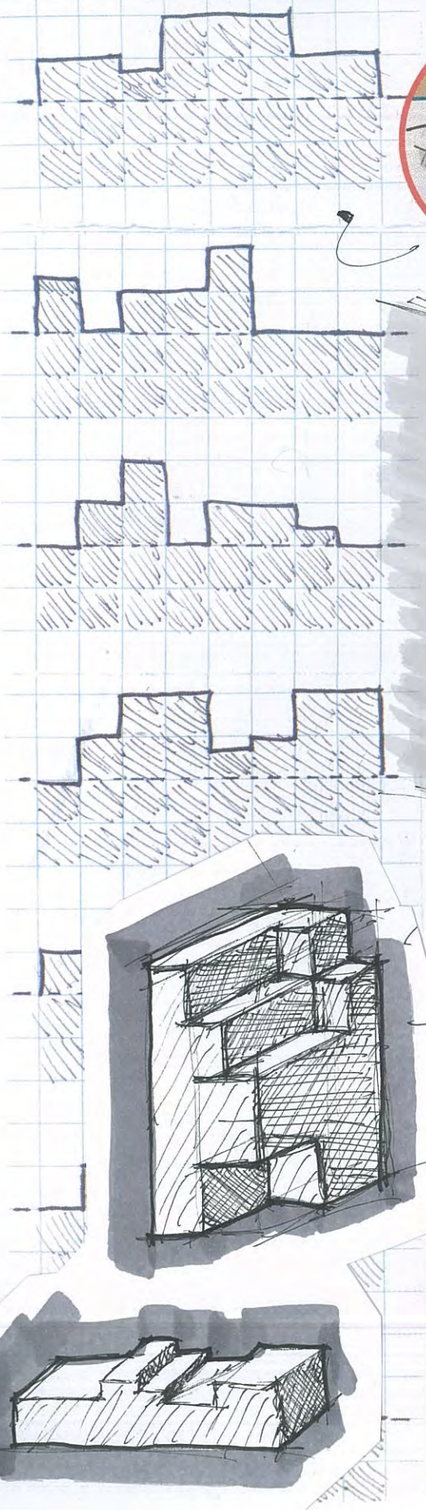
Computer Extrusions

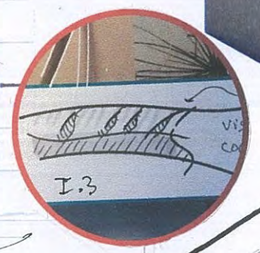


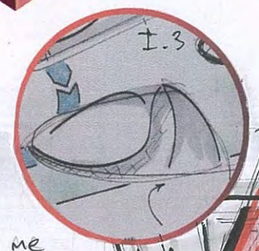


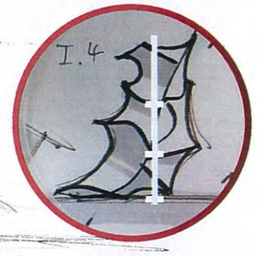


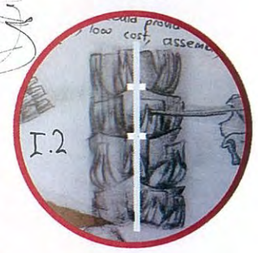


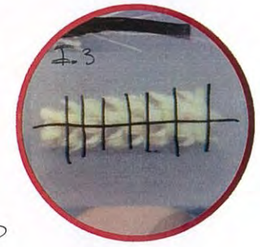






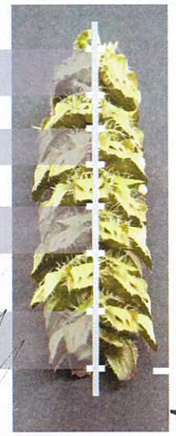




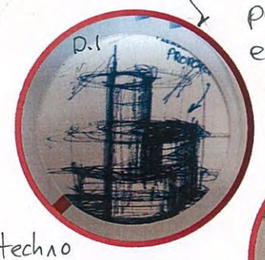


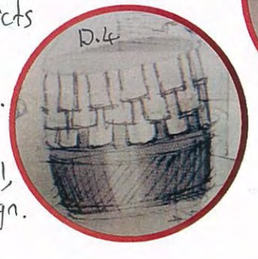
These remind me of vending machines or hand driers found in public toilets. I don't think this methodology will achieve the target feel.

Far too elegant, need to ruff it up!



Notice how natural proportions are not even / balanced yet remain visually pleasing.





This disproportion will help achieve the natural look.

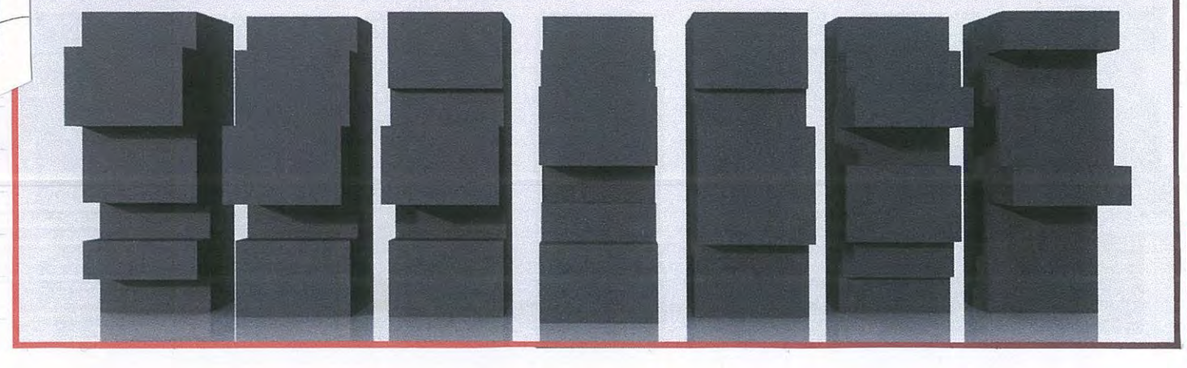
Has gap

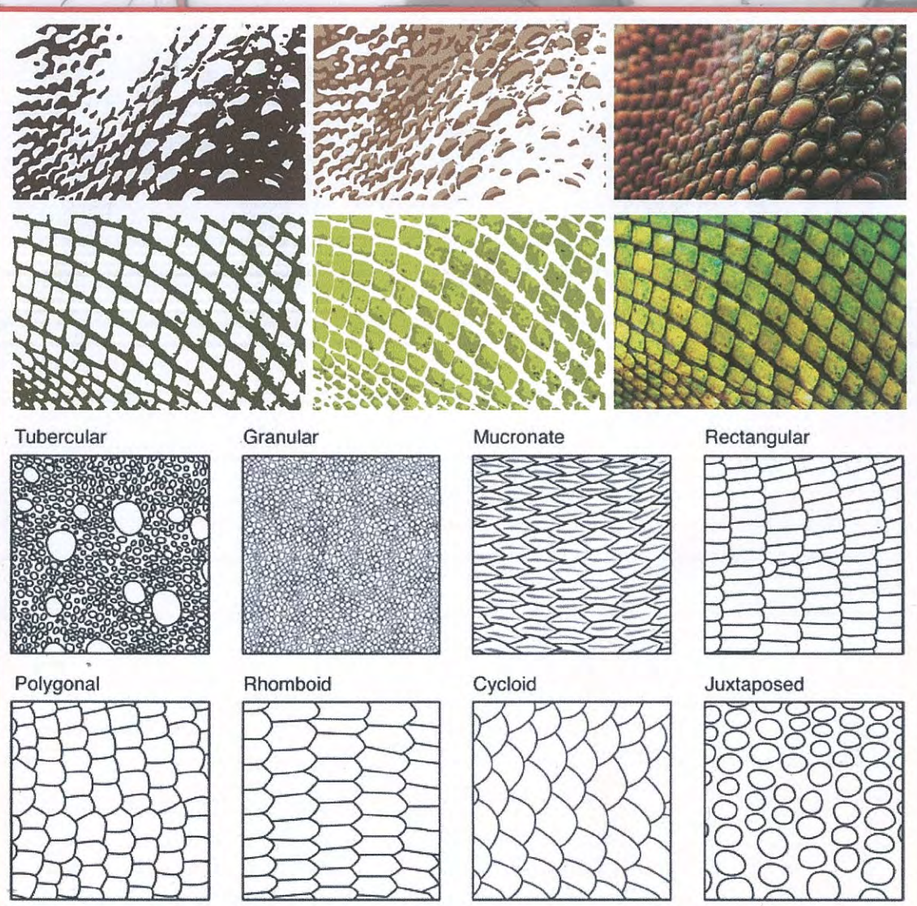
Experimenting with +ve to -ve ratio's, for visual space, I think a ratio of $\frac{2}{3}$ is the most visually balanced.

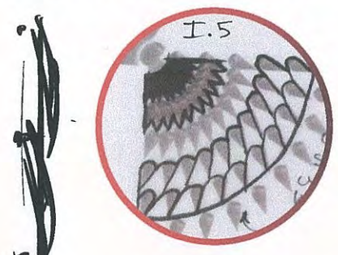
interface

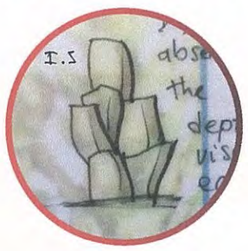
This retro / techno look contridicts the goal. Not continued. Where looking for a natural, grounded design.

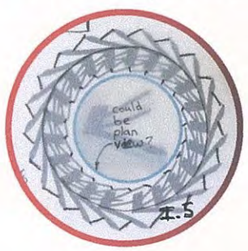
Proportion

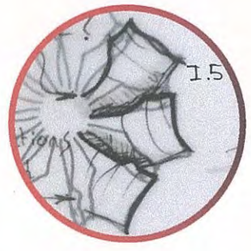












Scale Research

Of the scales above, larger and simpler shapes will be cheaper, easier to manufacture and less busy/crowded on the design. Hence I will predominantly explore dimond and triangle shapes.

Sources:

http://www.tropicalherping.com/publications/books/mindo/intro.html
http://amoghavarsha.com/photographs/view/Large -scaled+Forest+Lizard+scales/Agumbe+Karnataka/160/?tag=agumbe

Positioning vents to
intake
the base
room fo
an ergo
handle.

Radiant heat will be difficult to incorporate where no flat surface exists. Conforming to the "extendible" aspect of the breif is difficult given this self contained unit.

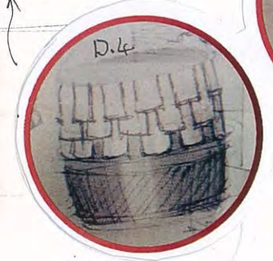
2

chosen.

This simple shape controls the visual chaos of its scaled surface. Those rotating scales can be used to direct air flow.

Scale pattern.

Scales cover form.



Most efficent overlap.

ontrol air flow

Working position.

Air could circulate under desk to warm user.

Represents the heater.

What if there is a wall here?

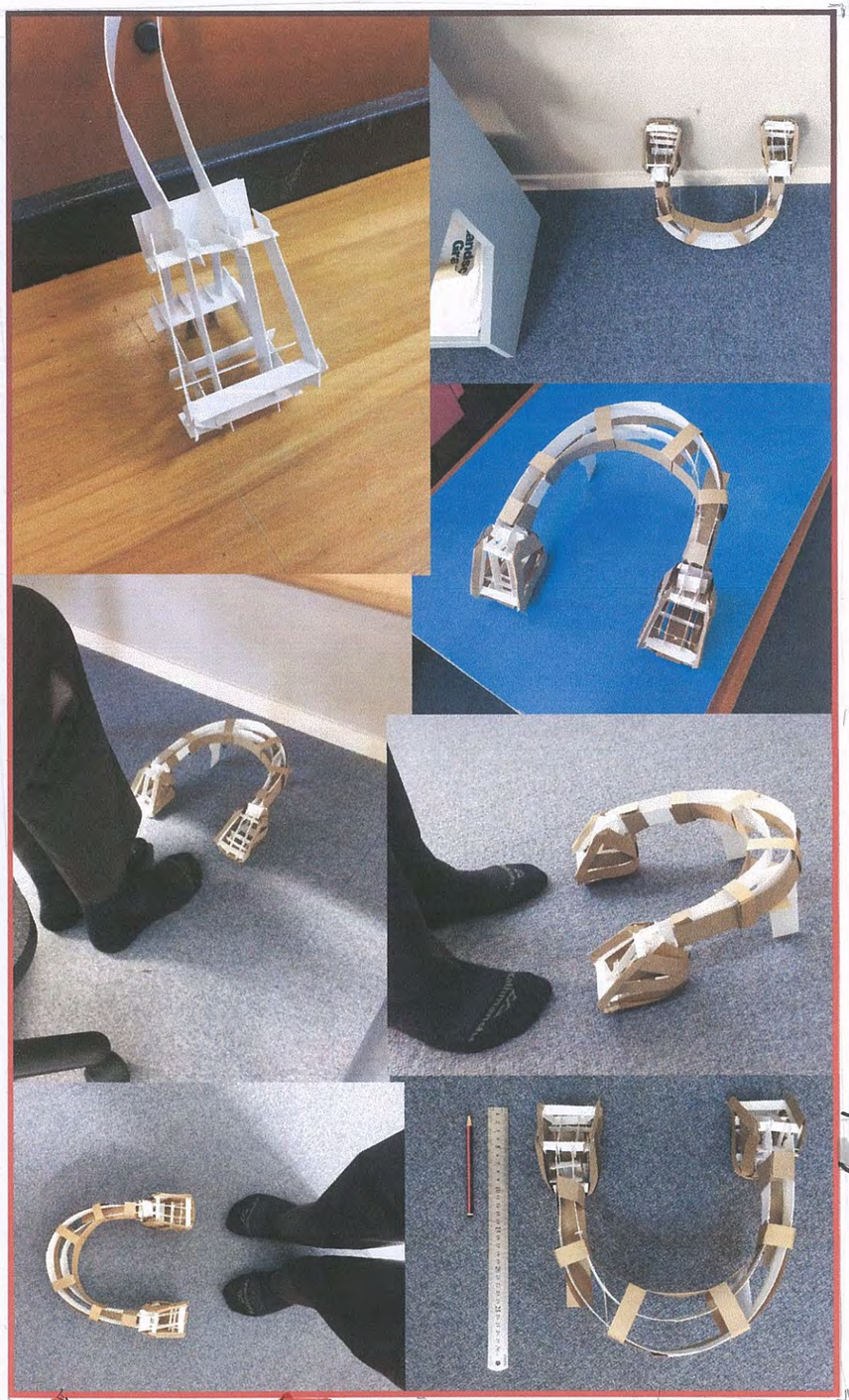
Chosen #1's form is defiant to the typical heater shape (shown on prev p.g.'s) which has the ability to draw public interest when marketing such a design. I feel this has the greater... (below)

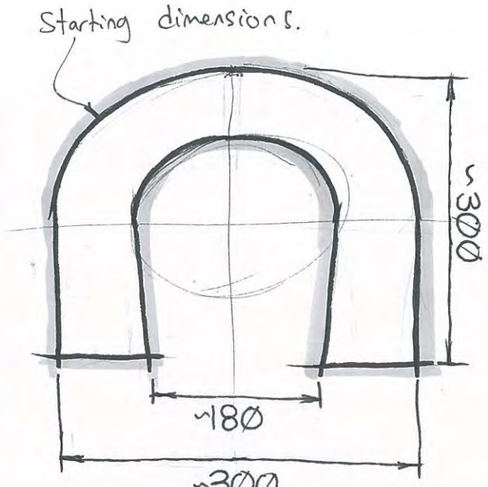
Maltiple is more efficant

... potental for possible configurations and uses hence it is "extendible" as part of the breif. This versatility appeals to its target audiences need for a multipurpose heater. The large defining curves of each unit are soft on the eye and the visaul details of the vents (shown here) create interest. This shape will, however, create challenges when configuring its internal components in the curves. Chosen #2 offers more space for this. Despite its simplistic form and potental of the ergonomic and discreet handle, it is versatile and, with many moving parts, creates issues with reliability. Hence the desision to continue with chosen #1 (this design).

Large coverage.

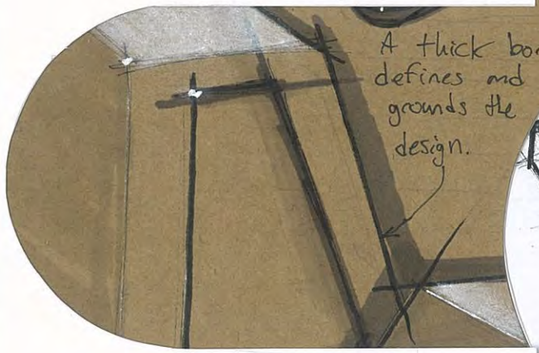
Concept Development + Chosen Idea





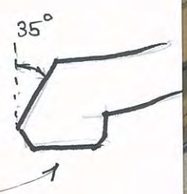
Model 3

Testing for size and fit for purpose.)



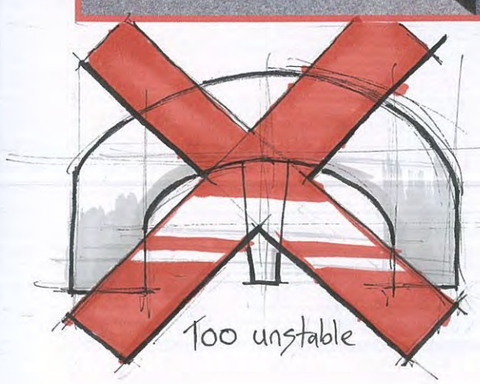
leg room: Increase width to give legs some room. 180 too small.

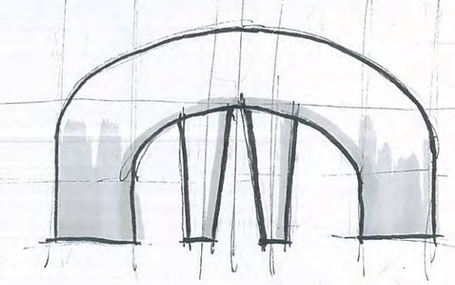
Keep angle at 35°. It aims straight at me: direct heating.

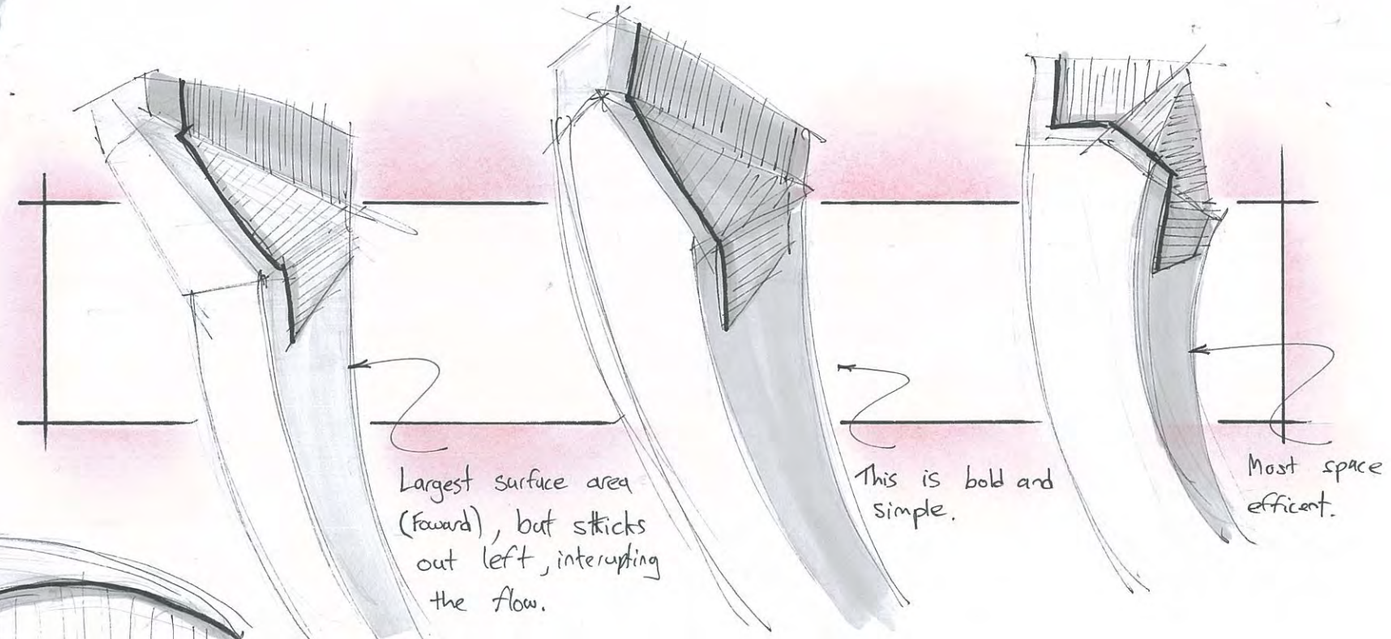


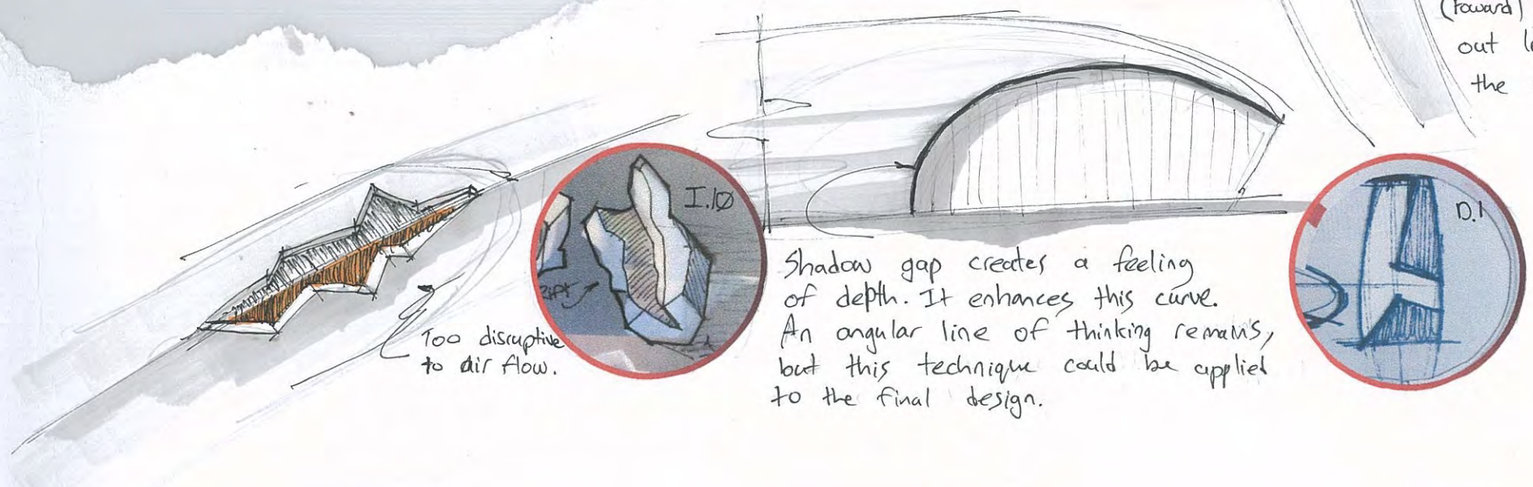
Lifting design here causes sag. Will need to add supports to take the load.

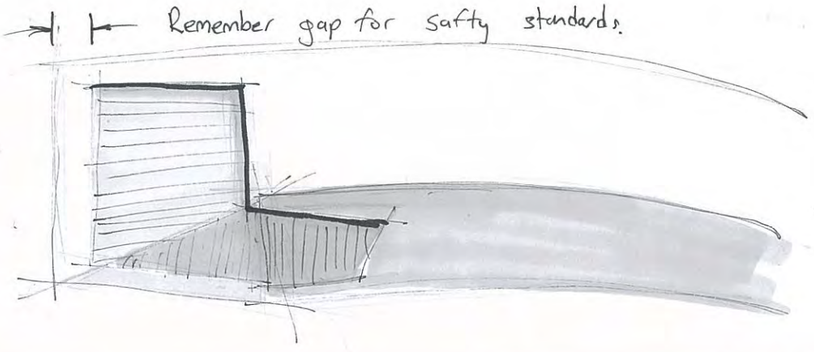
Aluminium?

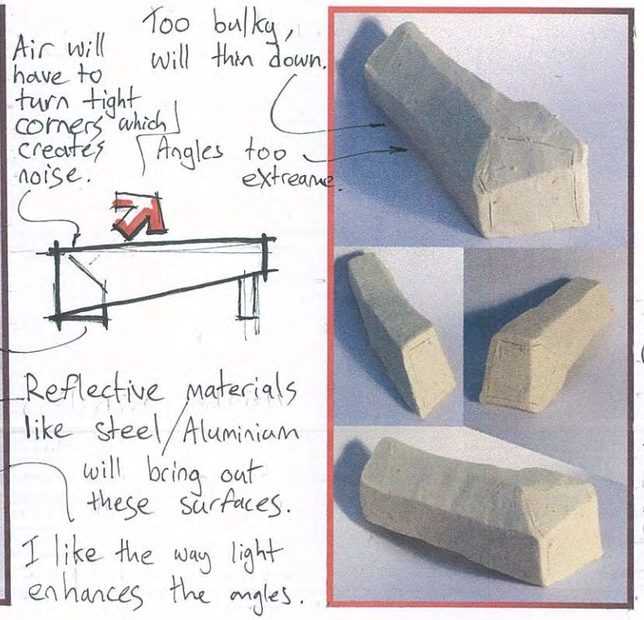


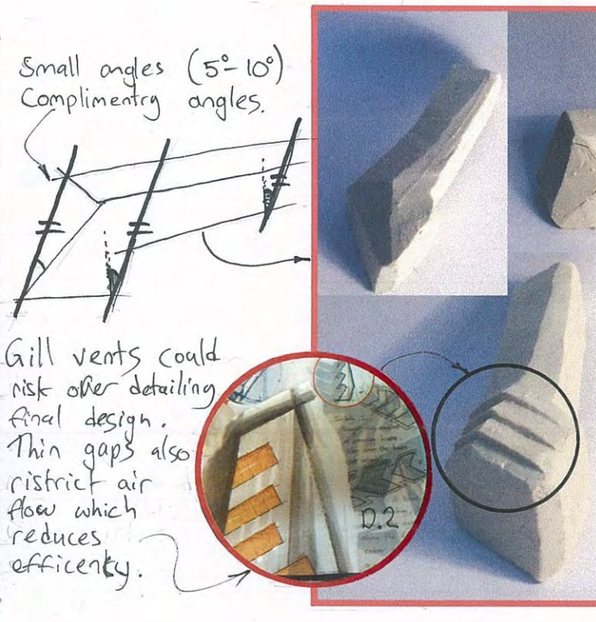


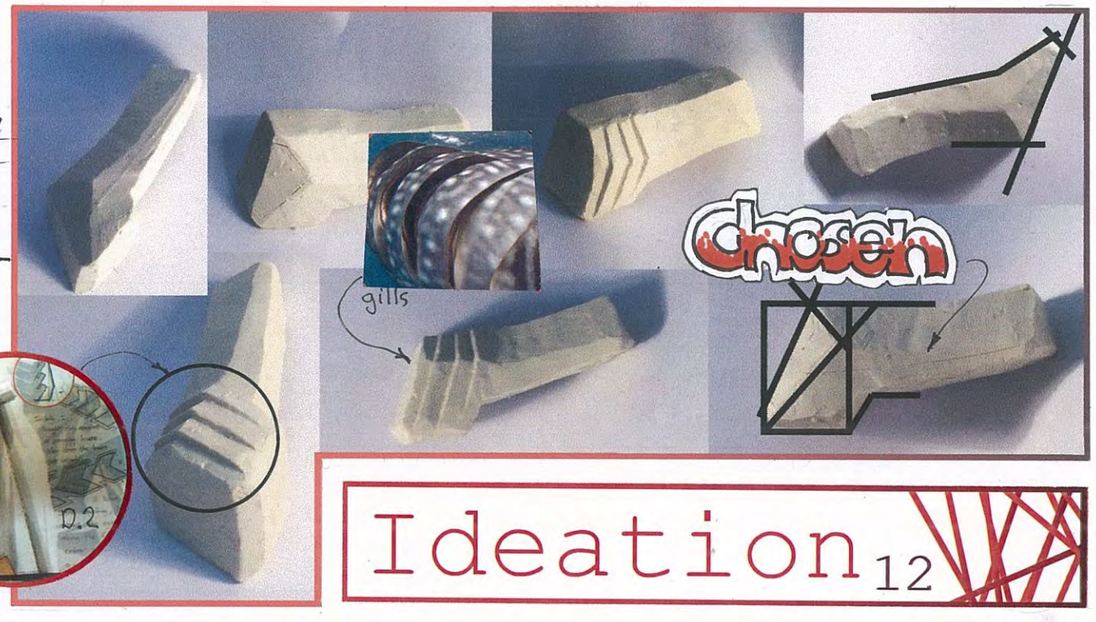

Largest surface area (foward), but sticks out left, interupting the flow.
This is bold and simple.
Most space efficent.


I.10
2pt
Too disruptive to air flow.
Shadow gap creates a feeling of depth. It enhances this curve. An angular line of thinking remains, but this technique could be applied to the final design.
D.1


Remember gap for safty standards.


Too bulky, will thin down.
Air will have to turn tight corners which creates noise.
Angles too extreame.
Reflective materials like steel/Aluminium will bring out these surfaces.
I like the way light enhances the angles.

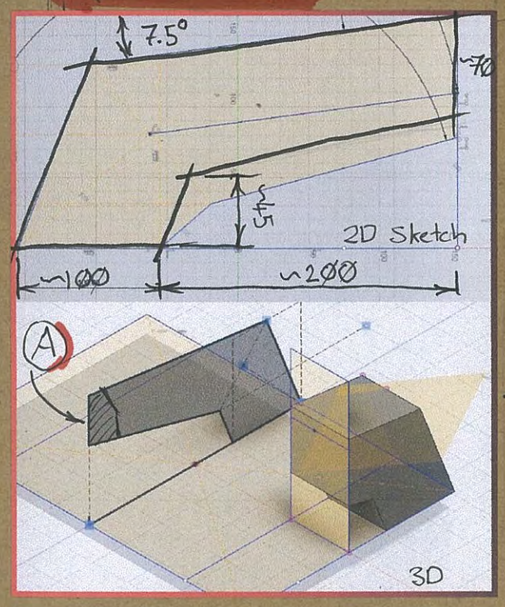

Small angles (5°-10°) Complimentry angles.
Gill vents could risk offer detailing final design. Thin gaps also ristrict air flow which reduces efficenty.
D.2


gills
chosen

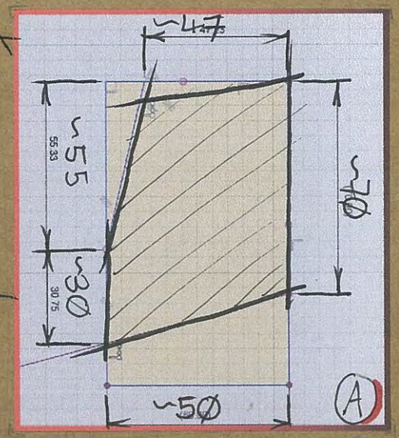
Ideation 12

Dimensions.

Final.



Should explore this stacking with models.



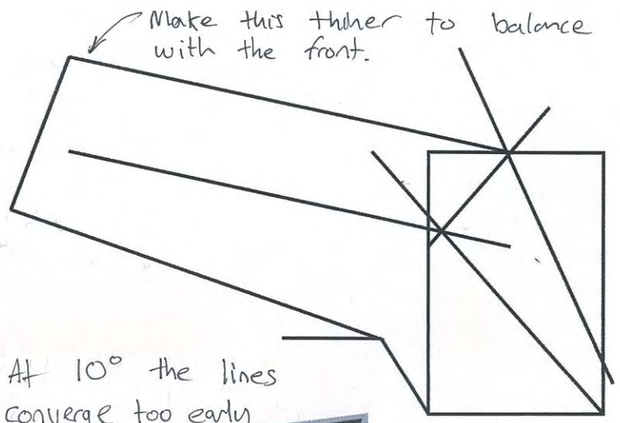
This is the most stable option hence is chosen design.

~160

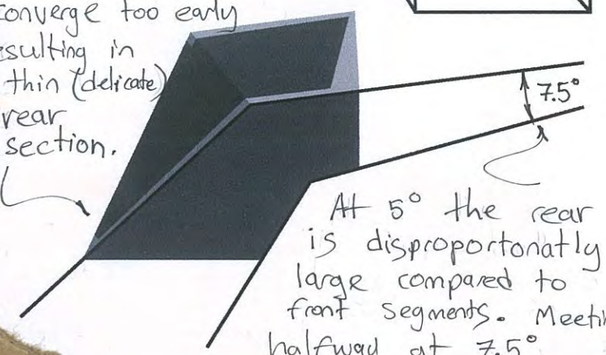
One advantage of parametric modeling is that I can change these values later.

Don't fall over.

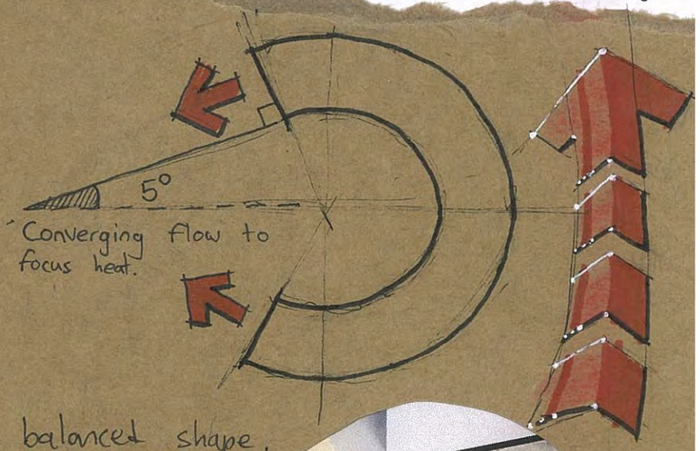
Slots + stand for stacking.



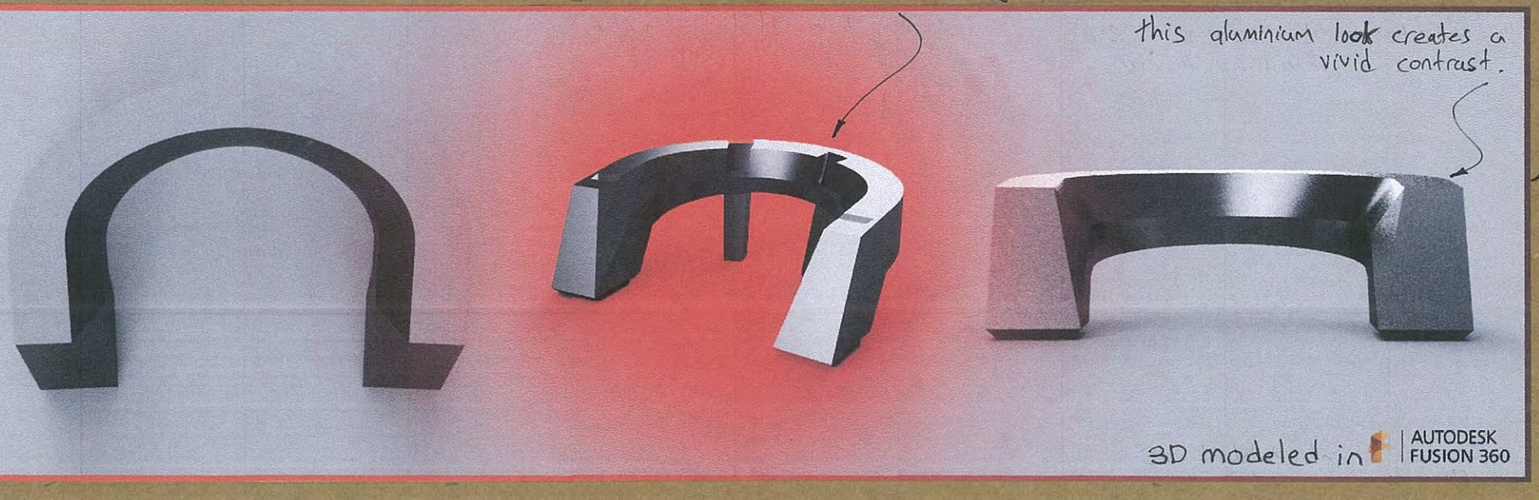
At 10° the lines converge too early resulting in thin (delicate) rear section.



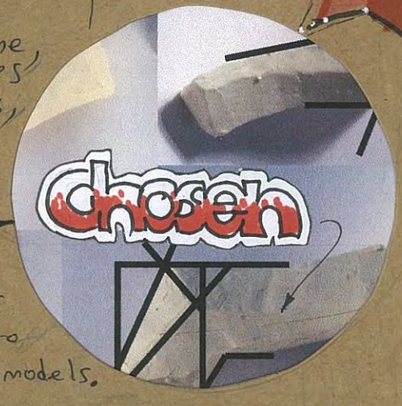
At 5° the rear is disproportionatly large compared to front segments. Meeting halfway at 7.5° balances the design.



Converging flow to focus heat.



Most balanced shape, simple with allowances for additional details, angles compliment across design.



The complexities of this shape make it hard to visualise, even with models.

I will create a physical model to investigate.

Intake

Motor

Fan

Elements

Heating element

Not all the air is heated (inefficent).

universal joint.

Angled?

elements

Air flow.

Motor

Elements

Fan

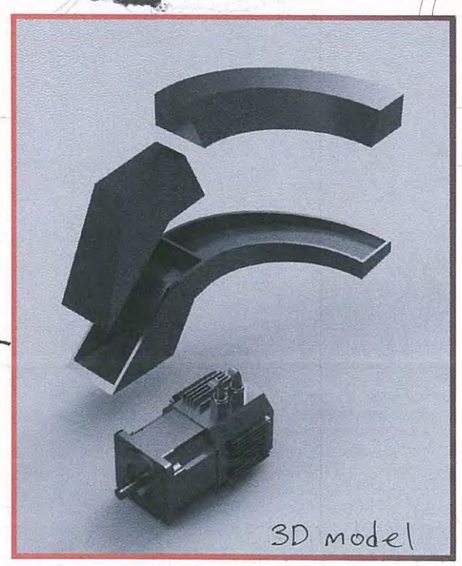
Aero dynamic support

More efficent with insulated shell. Less heat loss.

Design will need more interal volume to contain these components.

Will also explore motor types.

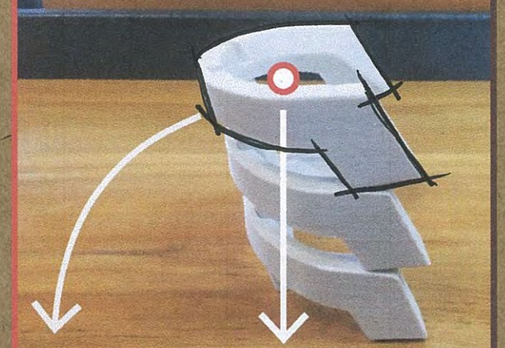
With hot air flowing over the motor it's at risk of overheating.



Vertical lines compliment the sweeping curve. Chosen.

Inlet

Center of mass.



Top at 15° slope. Not to scale.

Showing vent placement.

adds complexity.

Use of coloured light in vent resonates with target ambiance.

Wide stand too dominating.

Non disruptive, less dominant, and sturdy. Chosen.

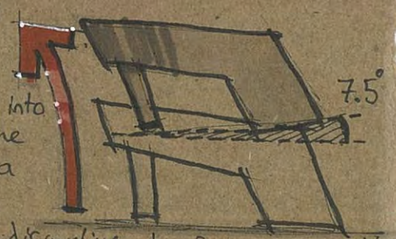
Interupts curve flow.

REAR ELEVATIONS

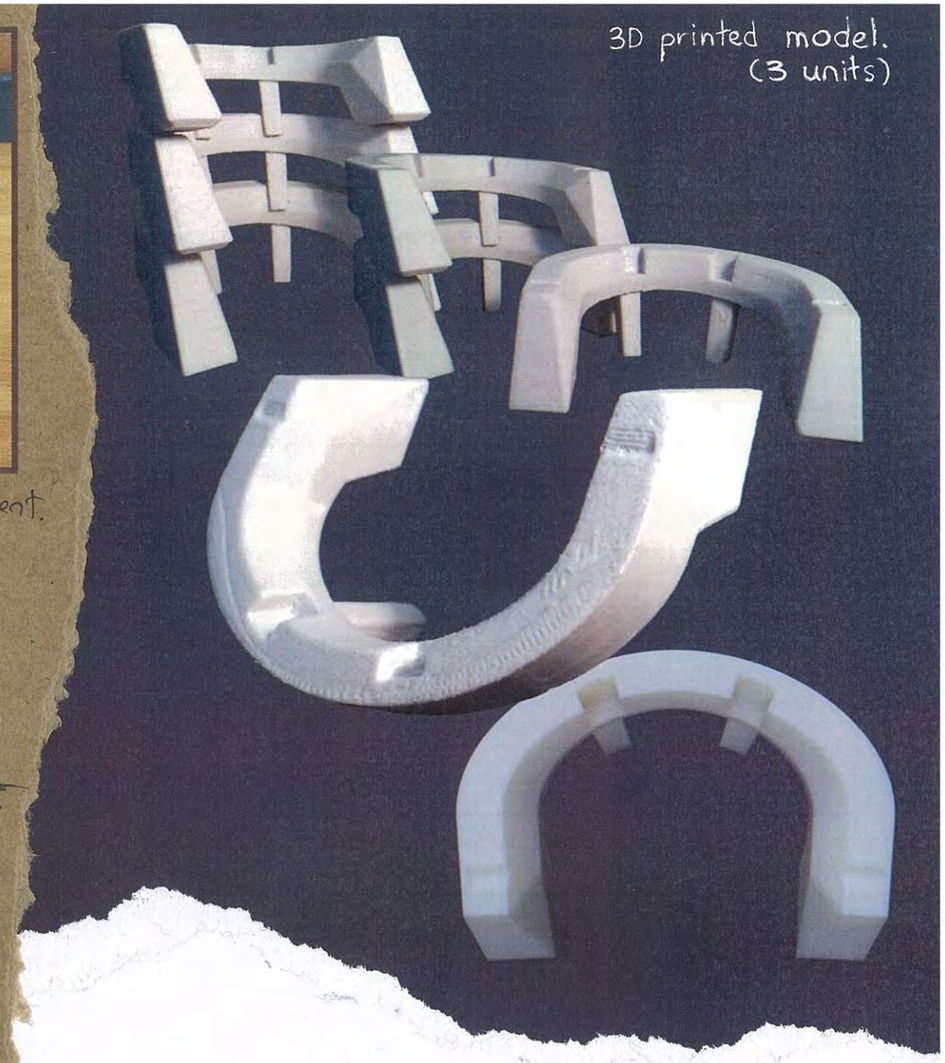
Restricting the intake of air could create access noise. Thus prefer intake with larger capacity.

Stand

For each unit to stack correctly, the rear stand must sink deeper into the groves than the front to ensure a firm hold, while remaining as non-disruptive to form as possible. This places each unit on a backwards slope at 7.5° per section, in keeping with the previously decided angle. Thus the 3rd unit will be at 15°.

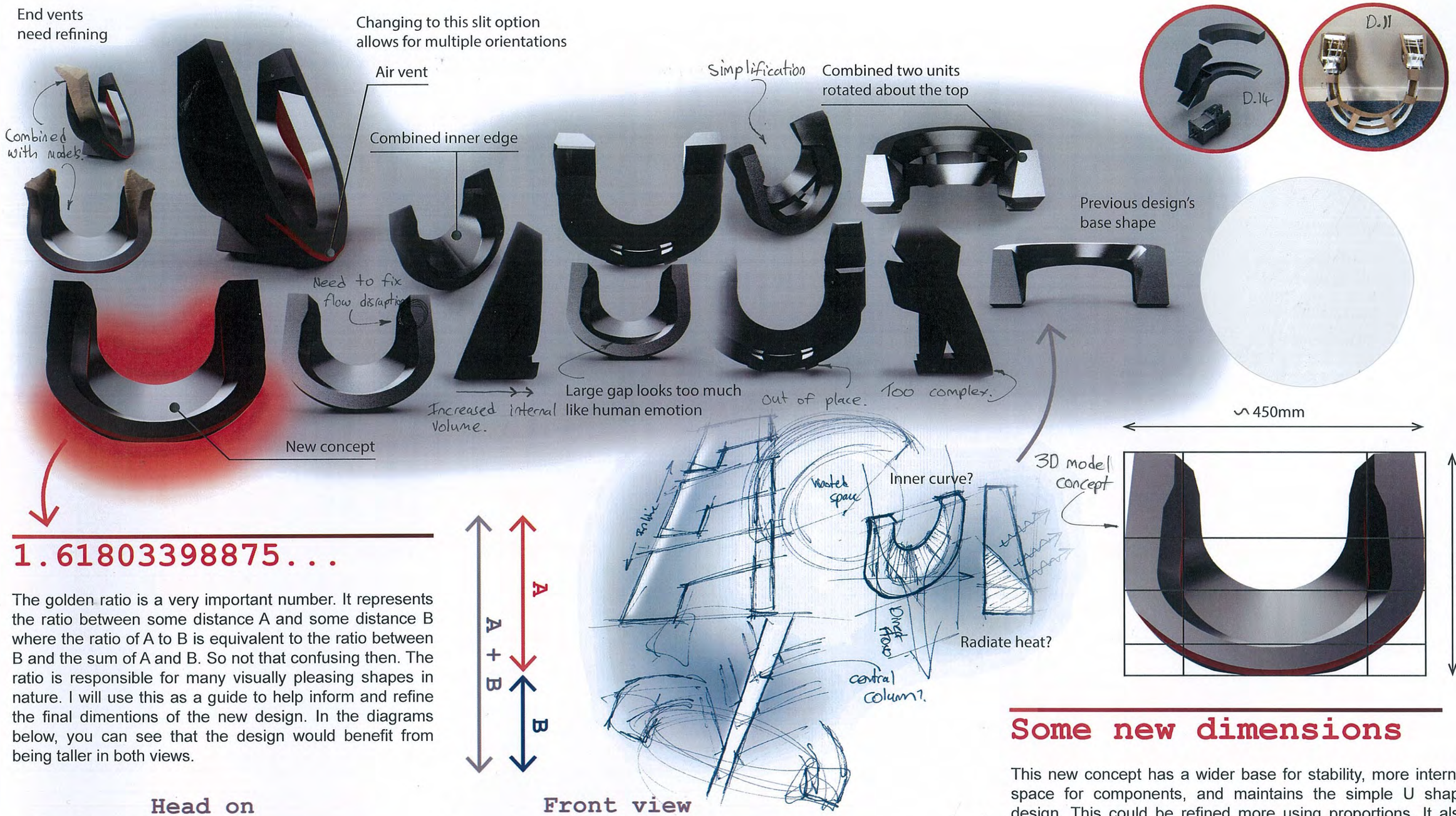


3D printed model. (3 units)



Rethink

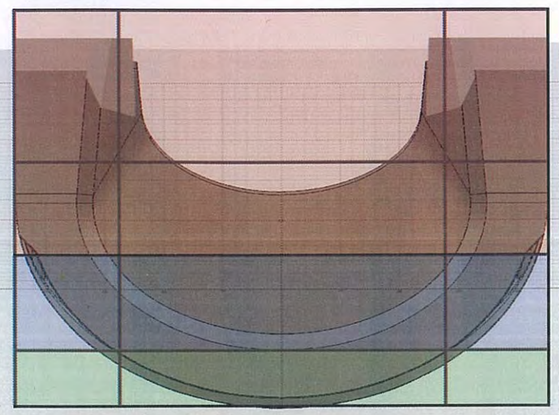
By 3d printing the shape it gives a better understanding of peoples reactions as well as its viability. Stacking works fluently and simply where the units slot into place in any order. Producing identical units reduces costs, rather than manufacturing 3 different sizes. The different ways light falls on the subtle angled surfaces creates visual interest as was intended. However, the front of the fully assembled design creates visual conflict where these edges don't fall parallel. The 7.5° slope also causes a lean, that is more notable than expected, leading to instability (I can easily knock it over). From technical exploration it is evident the design also lacks the required internal volume to house the heating components. The orientation of the centre model shown above gives me an idea for a variation with a wider base to be explored.



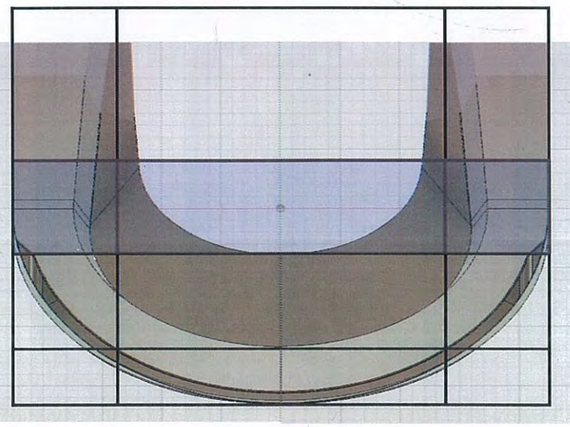
1.61803398875...

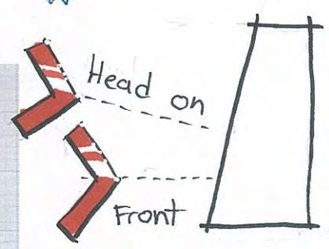
The golden ratio is a very important number. It represents the ratio between some distance A and some distance B where the ratio of A to B is equivalent to the ratio between B and the sum of A and B. So not that confusing then. The ratio is responsible for many visually pleasing shapes in nature. I will use this as a guide to help inform and refine the final dimentions of the new design. In the diagrams below, you can see that the design would benefit from being taller in both views.

Head on



Front view

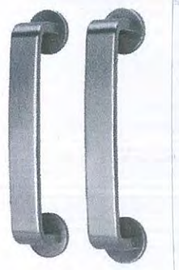




Being low to the ground, the design would be viewed at a steeper angle than the front view.

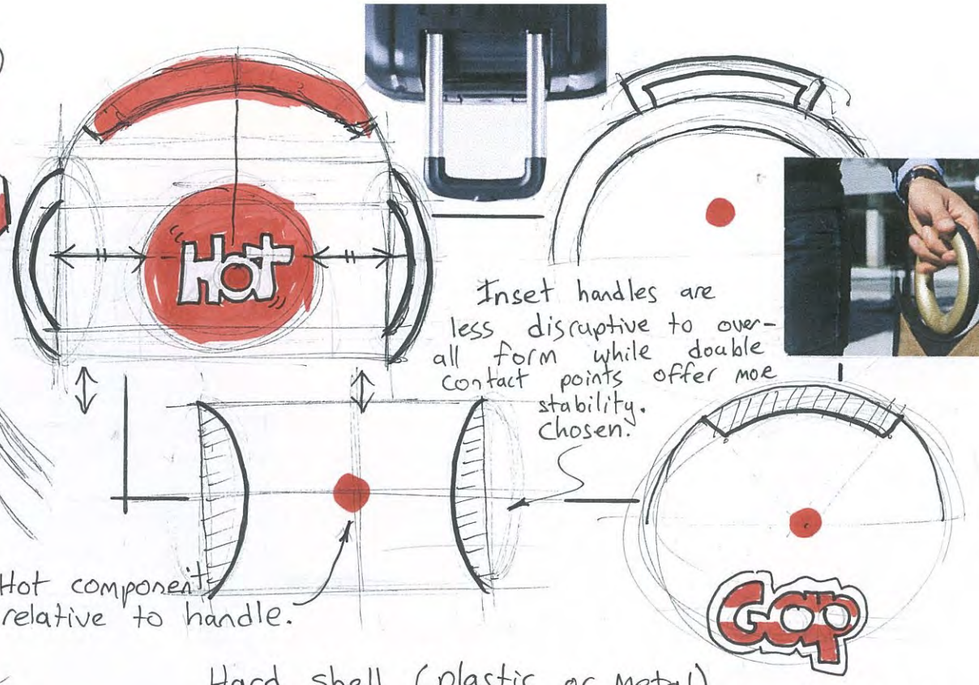
Some new dimensions

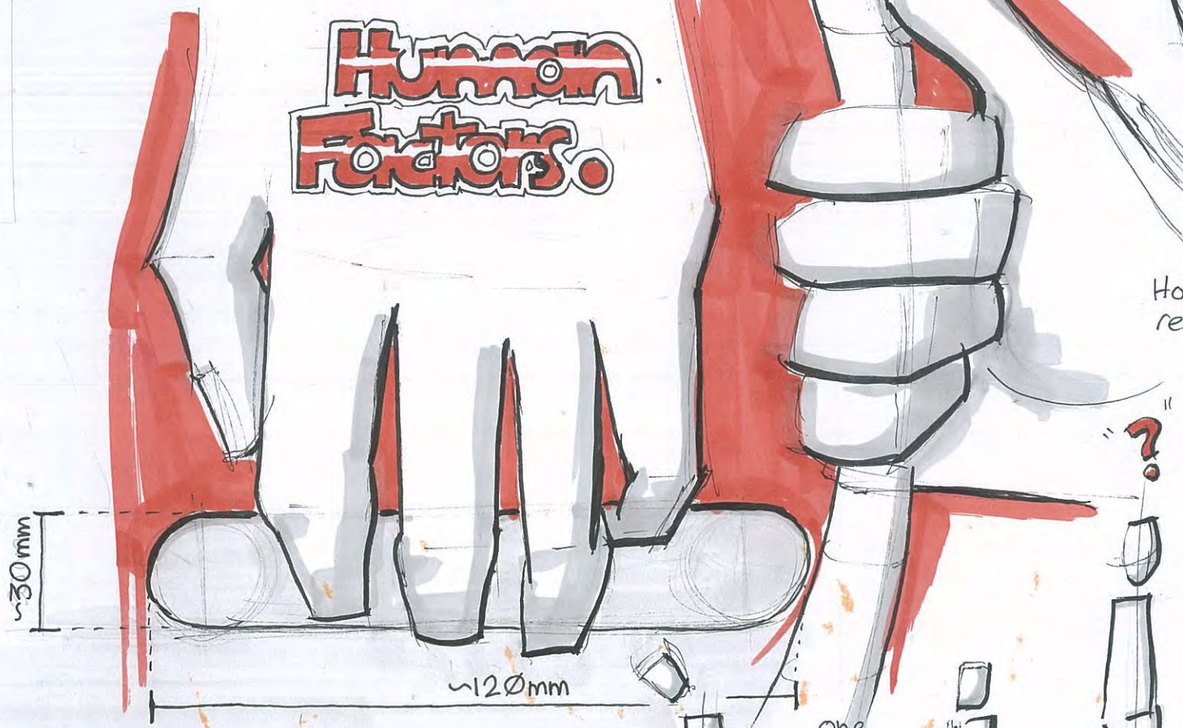
This new concept has a wider base for stability, more internal space for components, and maintains the simple U shape design. This could be refined more using proportions. It also seems that the abrupt angles on the terminating ends disrupt the visual flow unlike the previous option. The hybrid idea that the inner curve surface could also radiate heat, in combination with the existing convection heat, appeals to the multipurpose aspect of the brief. I like the possibility of adding small amounts of colour around the edges to create visual interest and help define that curve. Overall, this design option is continued in favour of the pervious.



Grip

Human Factors.





Hard shell (plastic or metal)

load bearing surfaces.

Grippy material (rubber)

30mm

Comfortable gap.

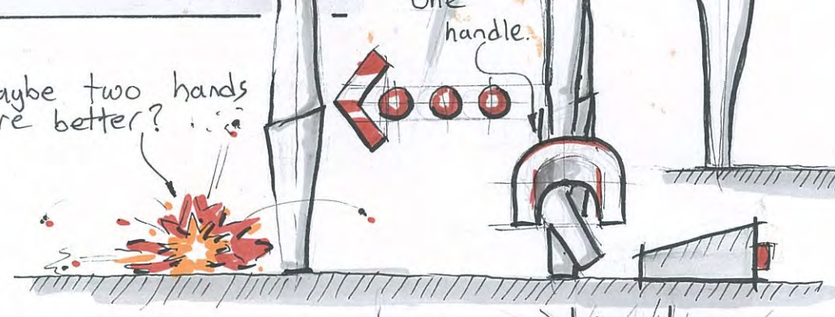
Obscured handle.

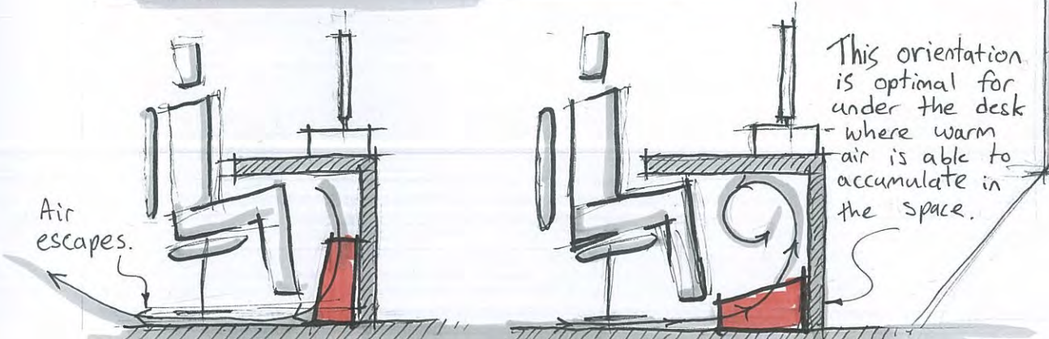
Supports

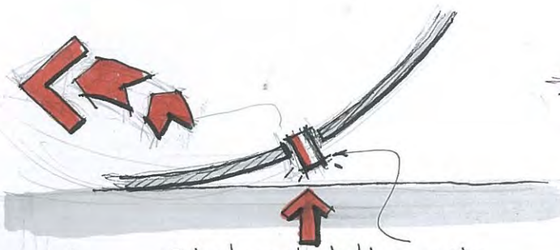
20~50mm

(depends on lip.)

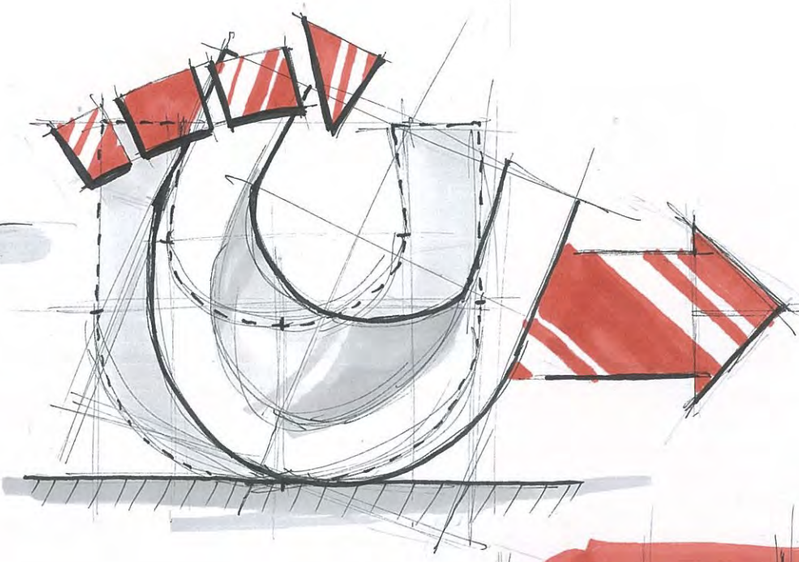
Comfort





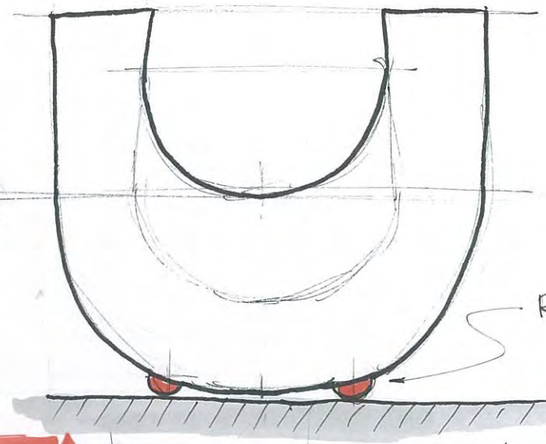


Detect orientation using push button.

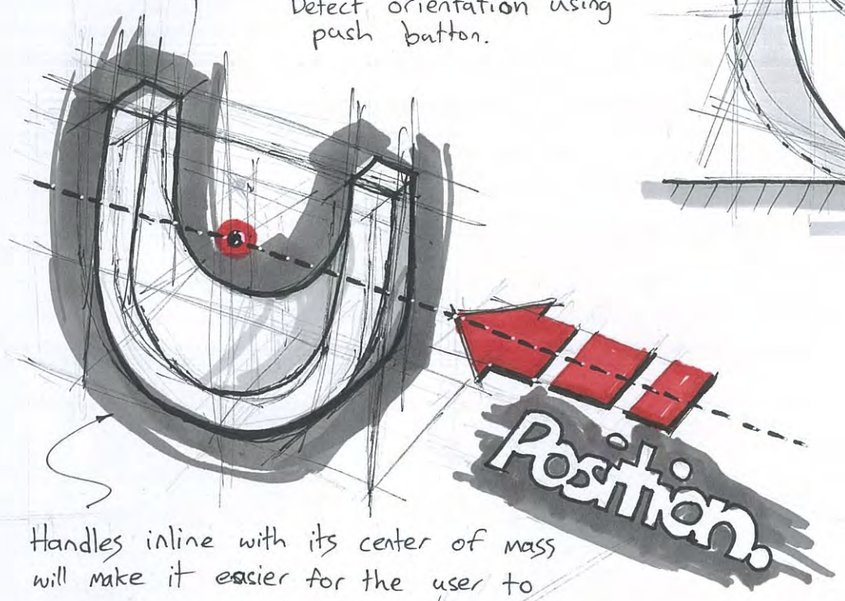


Aluminium - would scratch floor surfaces and cause shock forces on the design.

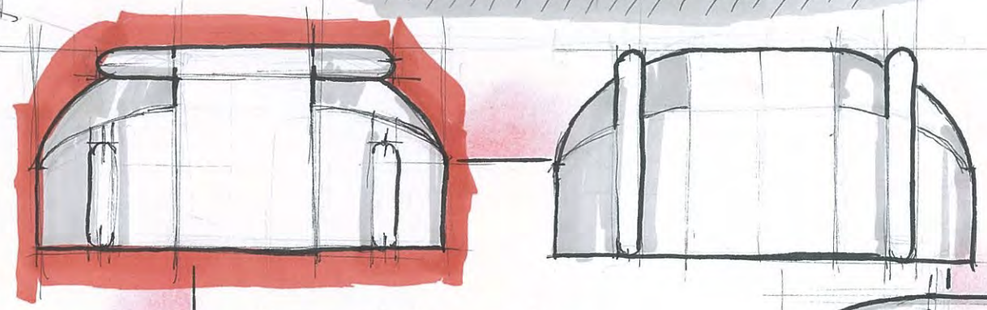
Rubber - absorbs shock and molds to surfaces preventing scratches.



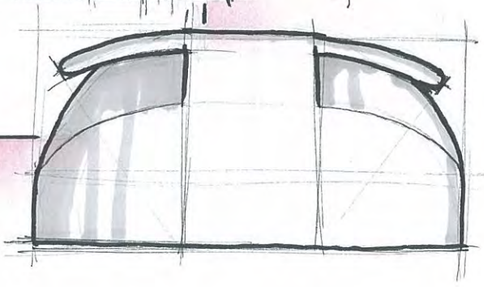
Rubber Feet.



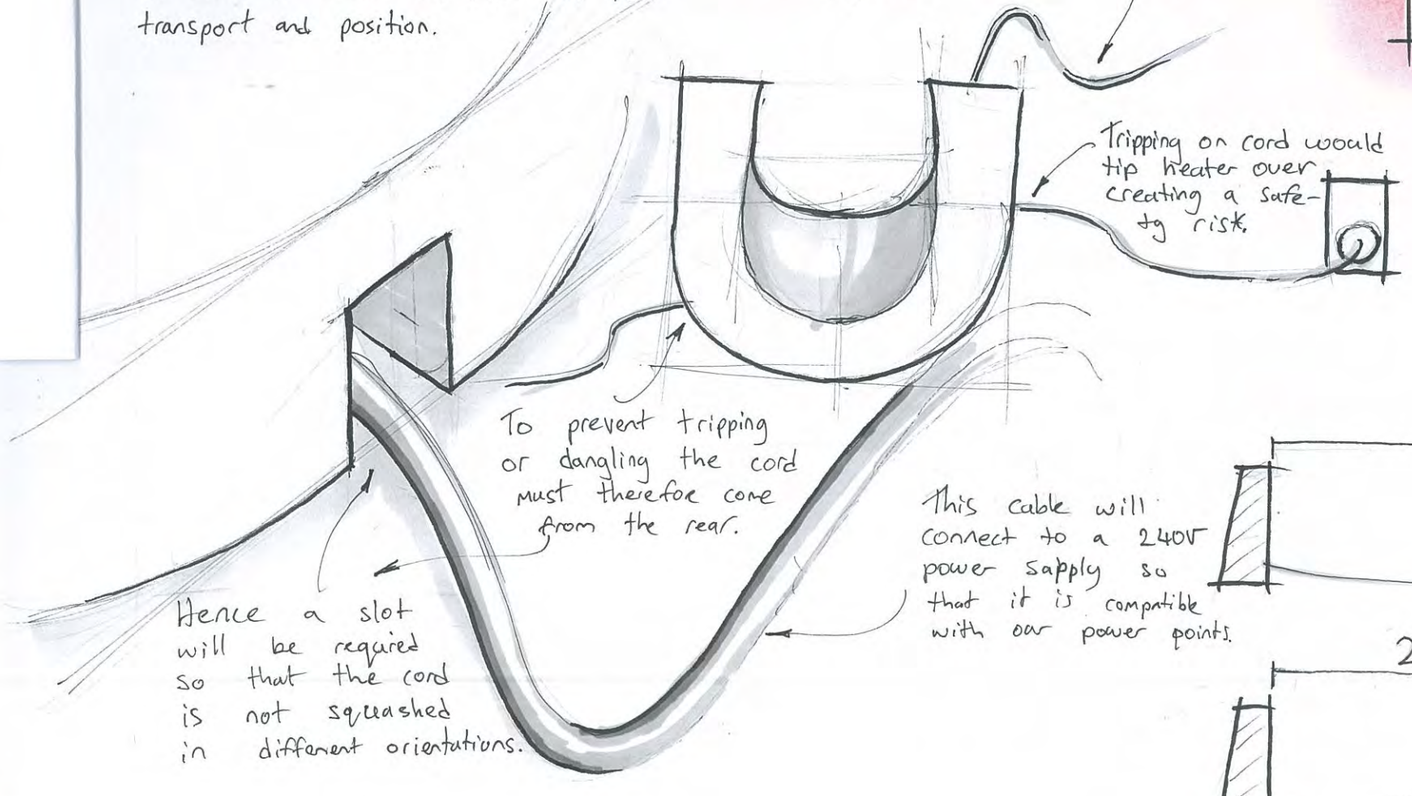
Handles inline with its center of mass will make it easier for the user to transport and position.



Views of designs base.



Up in the air, likly to snag and brake.

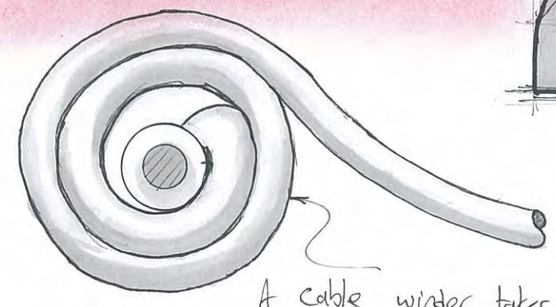


Tripping on cord would tip heater over creating a safety risk.

To prevent tripping or dangling the cord must therefore come from the rear.

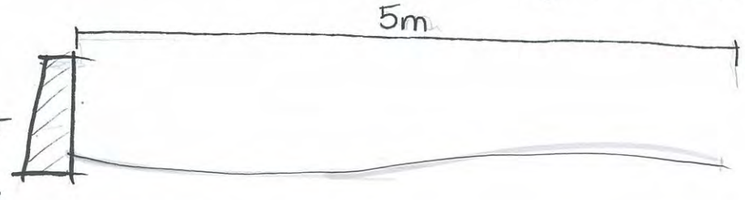
Hence a slot will be required so that the cord is not squashed in different orientations.

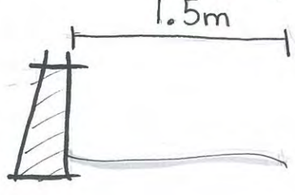
This cable will connect to a 240V power sapply so that it is compatible with our power points.

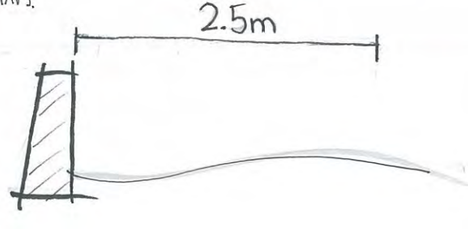


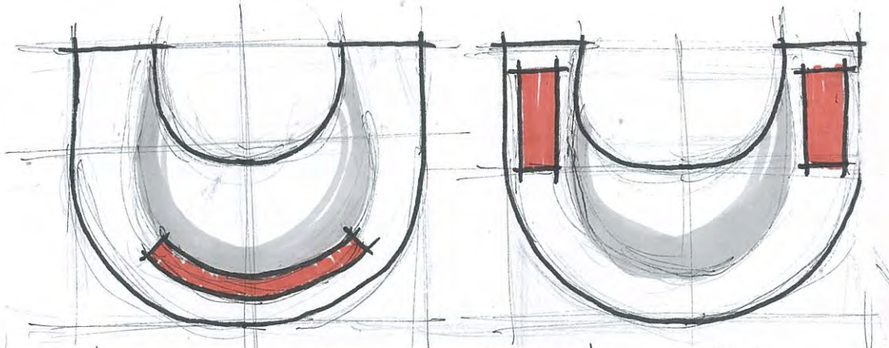
A cable winder takes up lots of room...

Thus to minimise weight, the cord will be a fixed length.

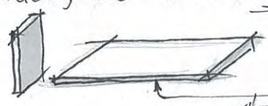




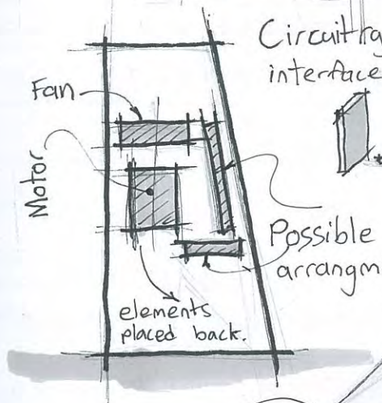


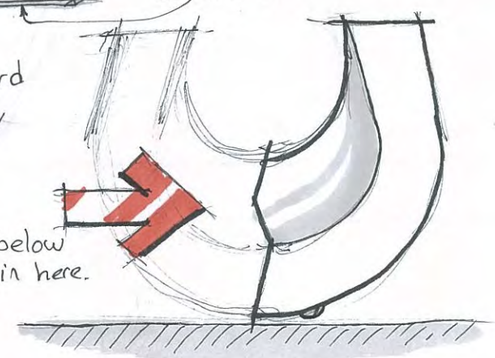


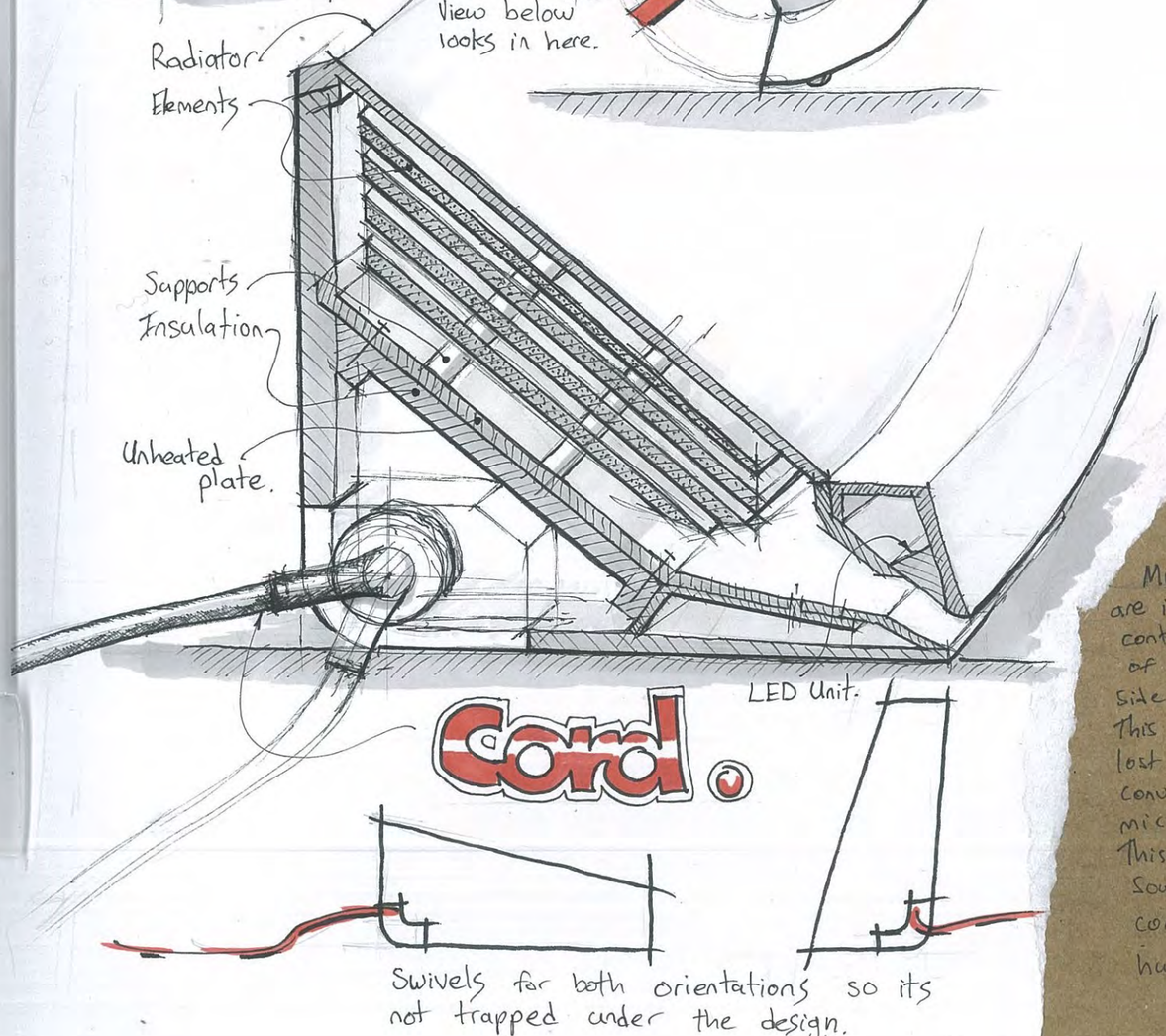
Circuiting placement: temperature control, interface, and converting voltages for the elements.



These shapes don't go on corners or curves.







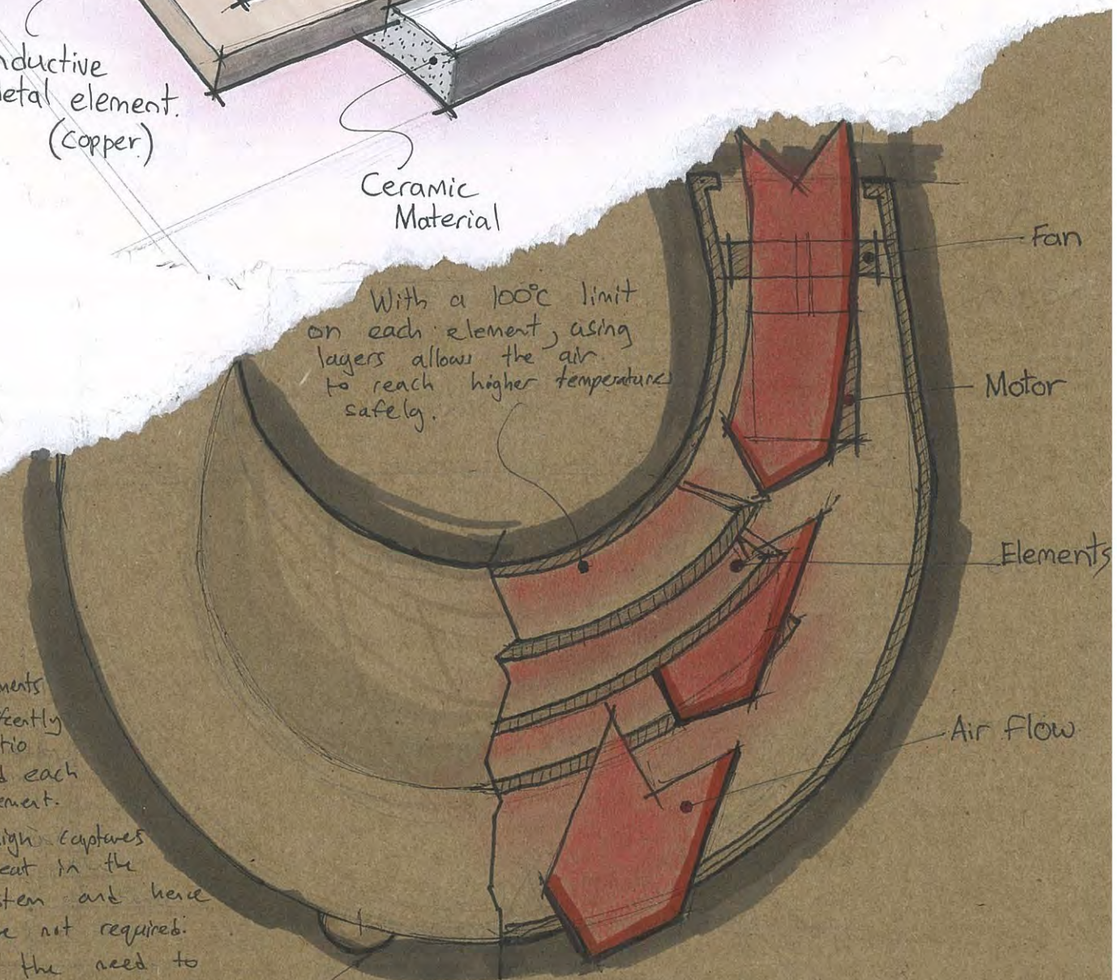
Cord.

Swivels for both orientations so its not trapped under the design.

Elements.

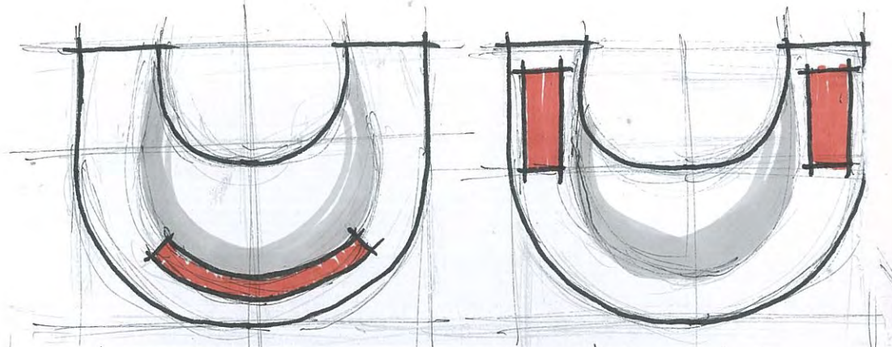
the ceramic layers can be set around the metal elements to follow the internal curves

These insulate the elements as discussed in context.



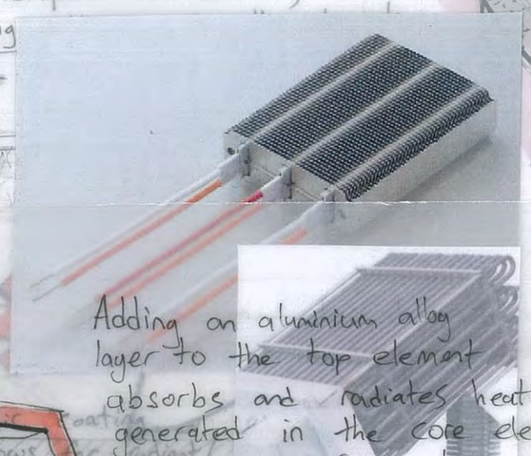
With a 100°C limit on each element, using layers allows the air to reach higher temperatures safely.

Micathermic elements are ideal for efficently controlling the ratio of heat emitted each side of said element. This unique design captures lost radiator heat in the convection system and hence micathermics are not required. This removes the need to source materials (mica) from contries who exercise poor human rights.



Circuiting placement: temperature control,

I've looked at some top, heating converting component producers. They have many different ways to maximise surface area. The chosen method remains optimal to Possible board less disruptive to airflow, more energy efficient (as they work together to maximise transmition) and prevent fires of short circuiting with a ceramic coating. This also allows for convection duality.



Adding an aluminium alloy layer to the top element absorbs and radiates heat generated in the core element.

Radiator

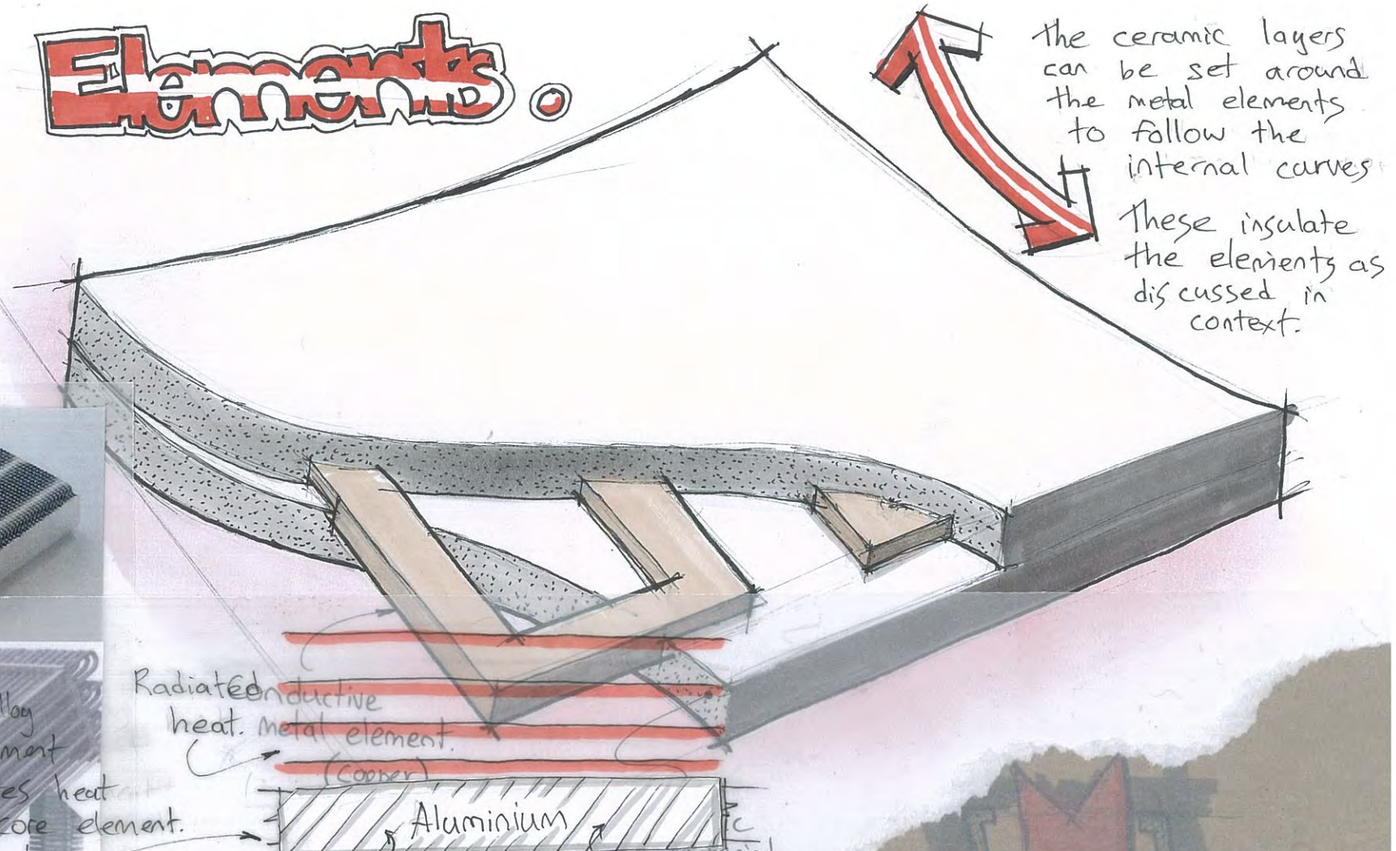
Requires gaps to allow air flow.

Needed larger supports to firm up internal structure and support upper panels.

Supports
Insulation
Guide
Unheated plate

Slot in this way.

LED Unit.

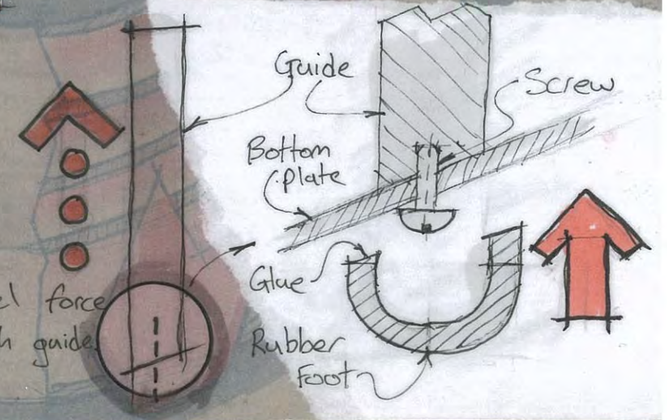


Cord.

Swivels for both orientations so its not trapped under the design.

Support.

Placeing the foot here covers the screw heads and puts the heaters weight force on to the guides.



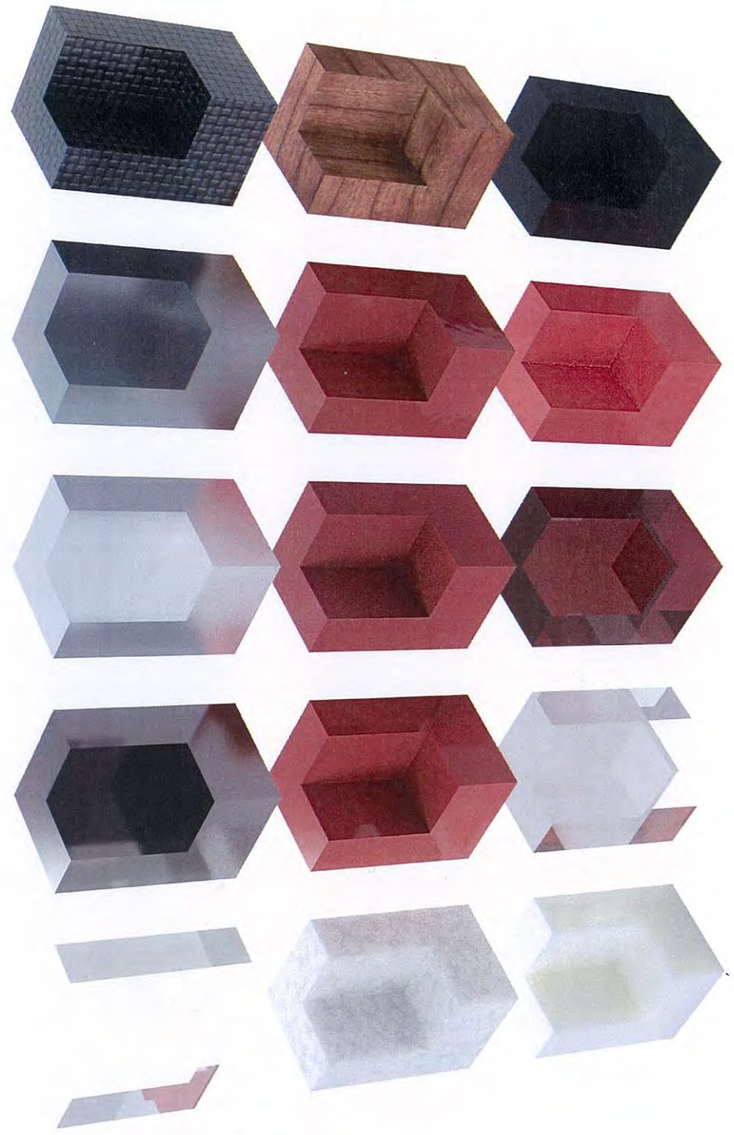
This unique design captures lost radiator heat in the convection system and hence micathermics are not required. This removes the need to source materials (mica) from contries who exercise poor human rights.

Material options

Usage	Material	Pros	Cons
Outer body/ shell	Carbon Fiber	Light weight, strong, can be made into many shapes, rigid, resistant to wear, fire resistant, does not expand.	Very expensive, non-biodegradable, brittle.
	ABS Plastic	Light weight, rigid, resistant to wear, relatively cheap, can be made into many shapes, reusable, an insulator (protects from heat and electricity)	brittle (depe), scratches, melts at high enough temperatures
	Aluminium	Light (for a metal), strong, recyclable, higher melting point than plastic	scratches, dents, marks over time, more expensive than plastic
	Glass	Transparent, strong, reusable	Brittle, prone to shattering, dangerous, could explode under pressure or heat.
	Acrylic	Transparent, strong, rigid, resistant to wear, an insulator, reusable, can be made into many forms, more flexible than glass	More expensive than ordinary plastic, could melt, some types are brittle
Vents	Acrylic	Same as above	Same as above
	Steel	Cheap, can be cast to many shapes, higher heat resistance and higher strength than aluminium, can take shock loads (sudden forces)	Bends, heavier than aluminium and plastic.
	Aluminium	Same as defined above	Same as defined above
Elements	Metal Alloy	Conducts heat, expands, high melting points, transmits heat, strong, can be made in many shapes, lighter than ceramic materials.	Absorbs much heat, lower melting point than ceramic materials, reflects some heat, electrical conductor.
	Ceramic	Absorbs very little heat, transmits most heat, cheap, reflects very little heat, can be made into many shapes, electrical insulator.	Heavier.
	Glass/Acrylic	In addition to the above… Transmits heat.	Absorbs some heat, reflects some heat.
Radiator	Steel	In addition to above… higher melting point, transmits heat.	In addition to above… reflects some heat.
	Aluminium	In addition to above… transmits heat	In addition to above… reflects some heat.
	ABS Plastic	Same as defined above	In addition to above… absorbs most heat.
Inner Supports	ABS Plastic	Same as defined above	Same as defined above
	Aluminium	Same as defined above	Same as defined above
Handle	Rubber	High friction, can be made into many shapes.	Low melting point, not environmental friendly.
	Gel	Squishy (high friction), can be made into many shapes.	Toxic if exposed or heated.
	Aluminium	In addition to above… softer finish is easy to hold, but not as easy as rubber.	Same as defined above

Number. Left to right:

1. Carbon fibre
2. Cherry Wood
3. Hard Rubber
4. Anodised aluminium
5. Textured powder coat
6. Fluorescent
7. Aluminium
8. Smooth powder coat
9. Tinted acrylic
10. Steel
11. Shinny paint
12. Acrylic
13. Glass
14. Polystyrene
15. ABS plastic



Choices

Outer Body: Carbon fibre is ruled out because of the cost, and glass too, because it is dangerous in a heater appliance. The outside needs to be durable if its moving around a lot, hence plastic is best for the base and sides as it can withstand wear and tear. The base will be move along abrasives such as carpet or tiles, and the sides will be handle by users when they go for the handles. Aluminium would get scratched and marked in these positions. Acrylic is also an option which has similar properties to plastic. Therefore, plastic is the best option.

Vents: The vents will see hot air passing through them constantly. Although acrylic could withstand this heat, it would be a safer bet to go with steel or aluminium. Because the vents are relatively small, using steel will help the design withstand to higher forces around this area with a small weight difference when used sparingly.

Elements: The elements surround the heater coils in the centre of the heater where the air is warmed. Thus the material requires a high heat resistance and the ability to transmit heat away from the coils. See context pages for reference. There are 3 different properties an element can have, transmittance, absorbance, and reflectance. We require that transmittance be high, and absorbance and reflectance be low. Hence ceramic elements are the best option despite the weight cost as the other materials could not withstand the heat and cause an inefficient transmittance of heat.

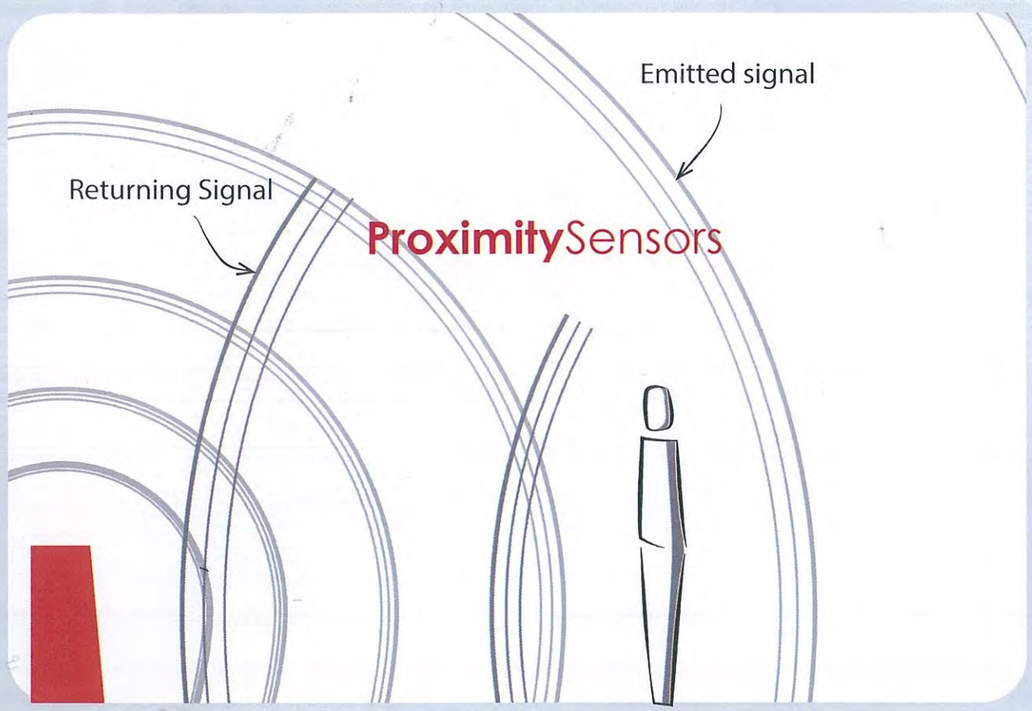
Radiator: The radiator sits above the elements. It also requires to be highly transitive, however it may not have to withstand as much direct heat given that the ceramic material lies between this and the coils. Hence to save weight, a thin aluminium layer can be place on the outside of the radiator to disperse the heat.

Inner Supports: These components provide the design with stratal integrity. Aluminium is better suited as it can withstand shock loads (dropping) and is light weight. Plastic is likely to shatter or split.

Handle: This is for the inside of the handle recesses. Rubber seems the obvious choice, but it is not recyclable and not very environmentally friendly. Gel is out of the question due to toxicity potential. Aluminium undergoes an oxidation reaction with the air and handling this material catalyses the reaction which degrades both the appearance and quality of the material. Thus after some research into rubber alternatives, it seems that rubber is the best compromise for this design. Rubber is either grown on the "Hevea brasiliensis" tree or manufactured from petroleum. The tree may seem the better option, however, in Asia, where more than 95% of natural rubber is produced, they are having deforestation issues. So overall, because a good grip is critical in this design, it cannot afford to compromise on the use of rubber.

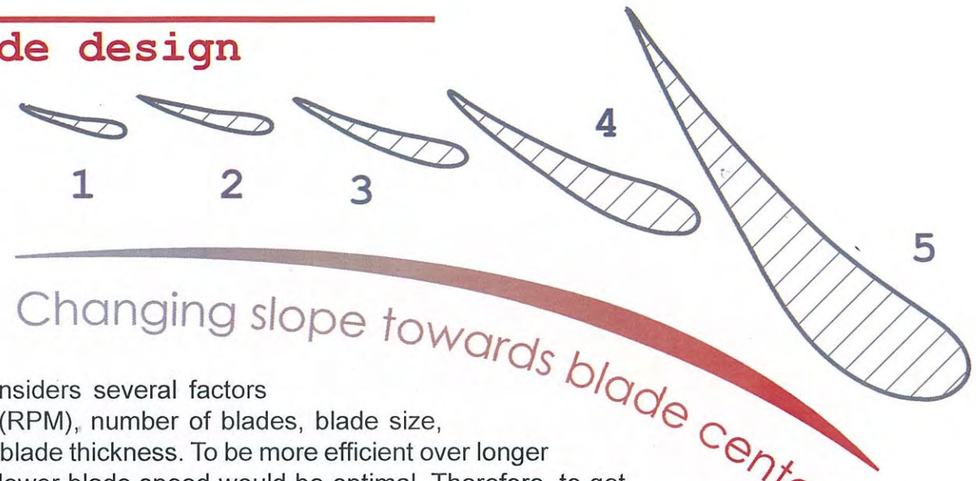
Sources:

http://www.metalcorp.co.nz/pricelist.php
http://www.christinedemerchant.com/carboncharacteristics.html
http://www.sustainablebrands.com/news_and_views/articles/bridgestone-researching-alternative-source-natural-rubber

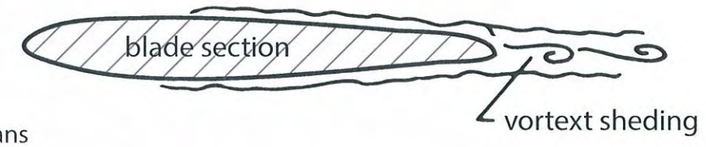


Combustible objects cannot be placed closer than 914mm to the heater if it should qualify for the hospitals/assisted homes/etc category (as found on context 4). Hence using ultrasonic sensors, emitted waves can detect how far away objects are by a given time delay in the returning signal. The heater can therefore shut down when objects obstruct its vents. Lighting effects could also change to communicate this to the user. Because of the design's internal element configuration, the back/base is well protected from heat. Thus in certification testing, it could be approved for its to be placed closer to walls, or other surfaces, so it is out of the way for users.

Fan blade design



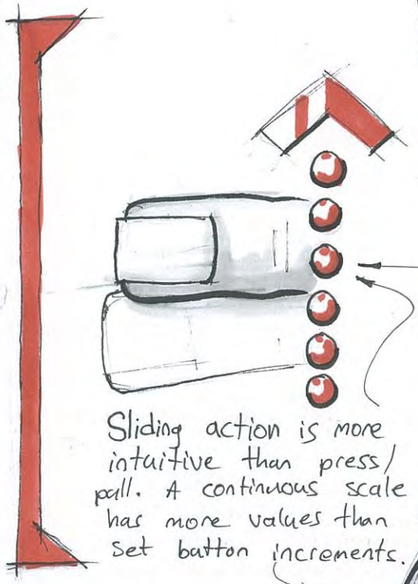
Blade design considers several factors including speed (RPM), number of blades, blade size, blade angle, and blade thickness. To be more efficient over longer time periods, a slower blade speed would be optimal. Therefore, to get extra air movement the design will favour more blades set at steeper angles and longer runs. Each blade tapers at a steeper angle towards the centre of the fan unit as these areas move slower, meaning less lift is generated on shallow angles, to help reduce turbulence and thus noise. Having an uneven back edge (shown below) means that the stream of air leaves the blade at different intervals and thus minimises resultant eddy currents from vortex sheding also reducing noise where these currents situate. The blade design below is specific to this design based on an identified need for quietness and efficenty.



Sources:
https://daviescraig.com.au/thermatic-fans
http://physics.stackexchange.com/questions/69915/what-part-of-the-fan-blade-actually-does-the-noise-generation
http://www.moorefans.com/pdfs/TMC_661P_.PDF

Fan blade designed in Fusion 360.

Interface



Most subtle yet simple method hence chosen.

Sliding action is more intuitive than press/pull. A continuous scale has more values than set button increments.

this option is bulky and does not suit the allready complex shape.

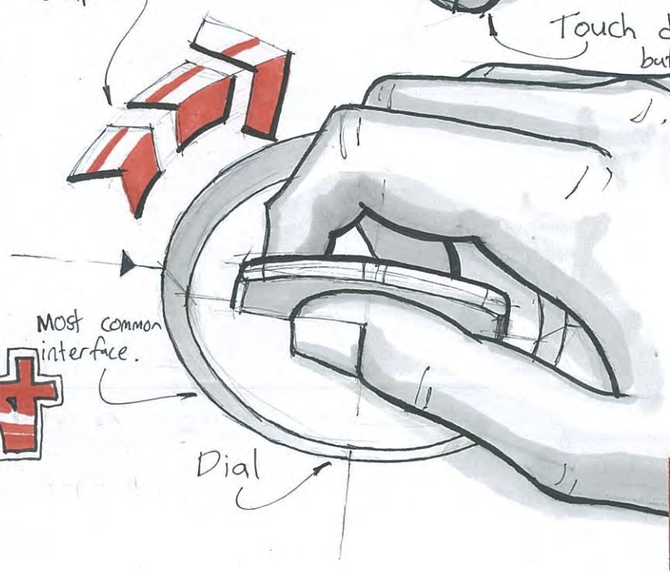
Pull Stick

Click to lock at each setting.

Buttion

Touch does not require buttons that stick out.

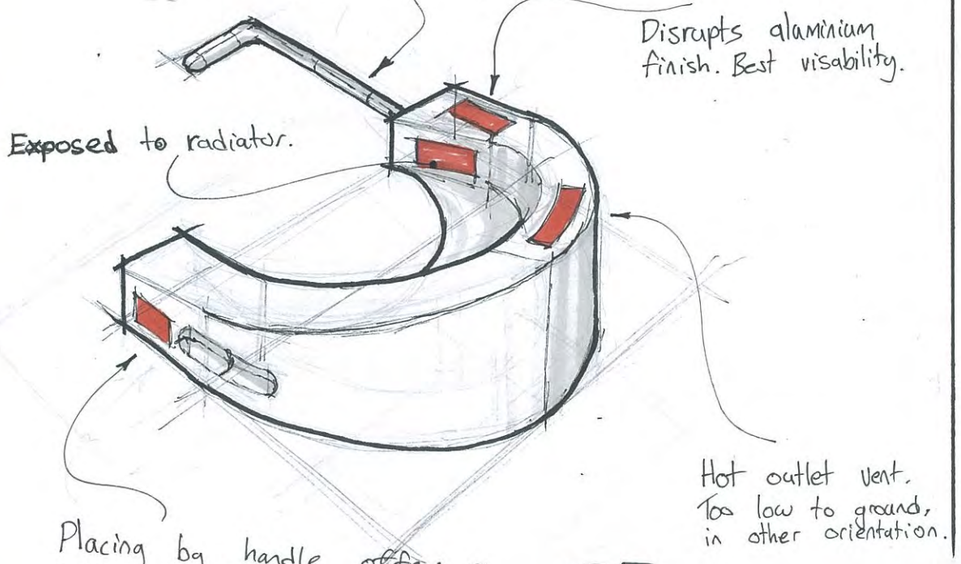
For visually impaired users, buttons and dials can be felt easily or, braille could communicate functions.



Most common interface.

Dial

Placement



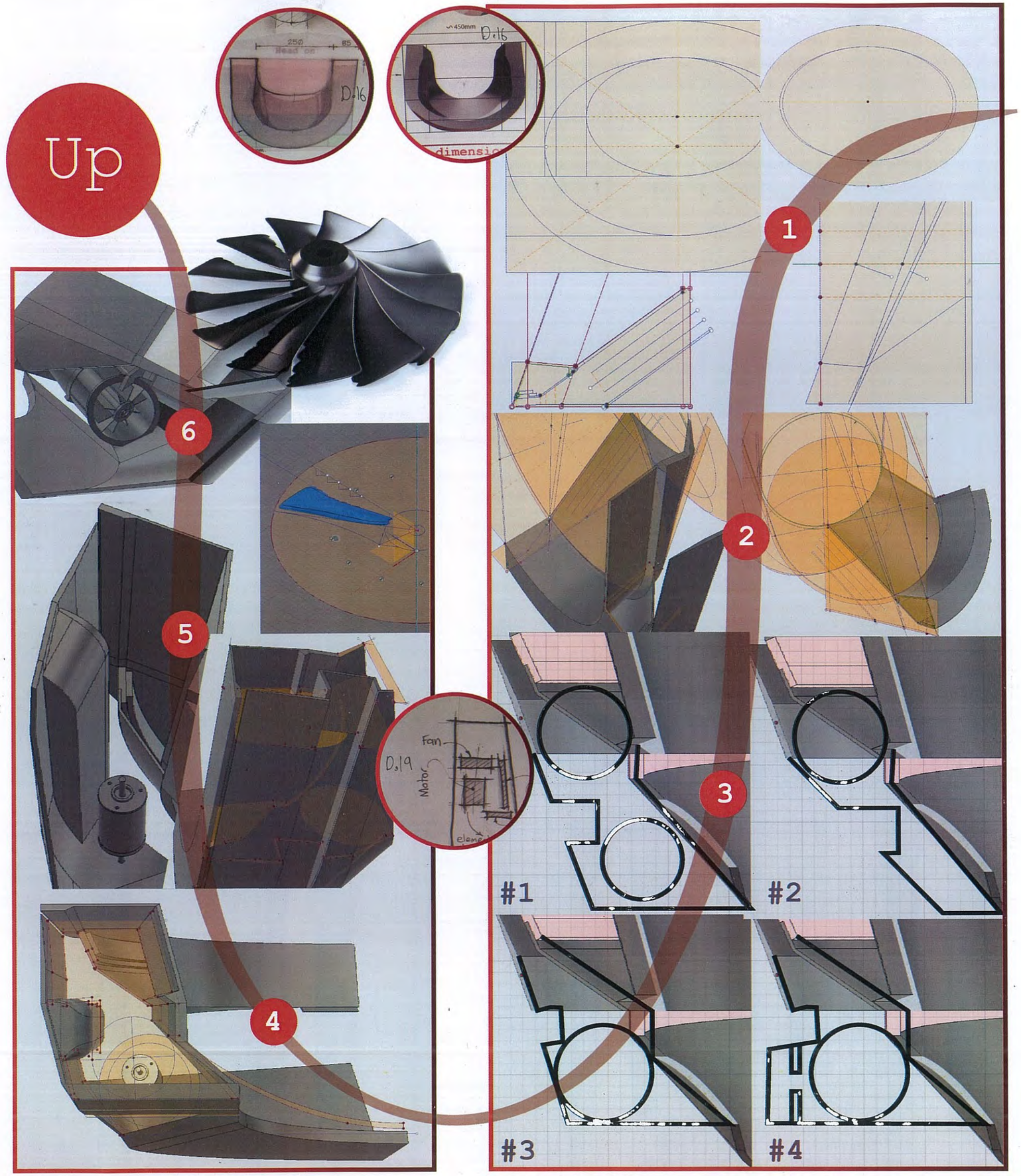
Stick is a tripping hazard in this position.

Disrupts alaminium finish. Best visability.

Exposed to radiator.

Hot outlet vent. Too low to ground, in other orientation.

Placing by handle offers a point of reference to opperate a touch interface. On the side is discreet, but with good visibility, and is accessible in both orientations. Chosen placement.



Construction

1 Initial sketches in different planes were measured from the previously refined sections and views of the chosen design based on the determined dimensions. It is quicker to model the right hand side for the design first (when viewed from the front) then mirror the model before completing the design.

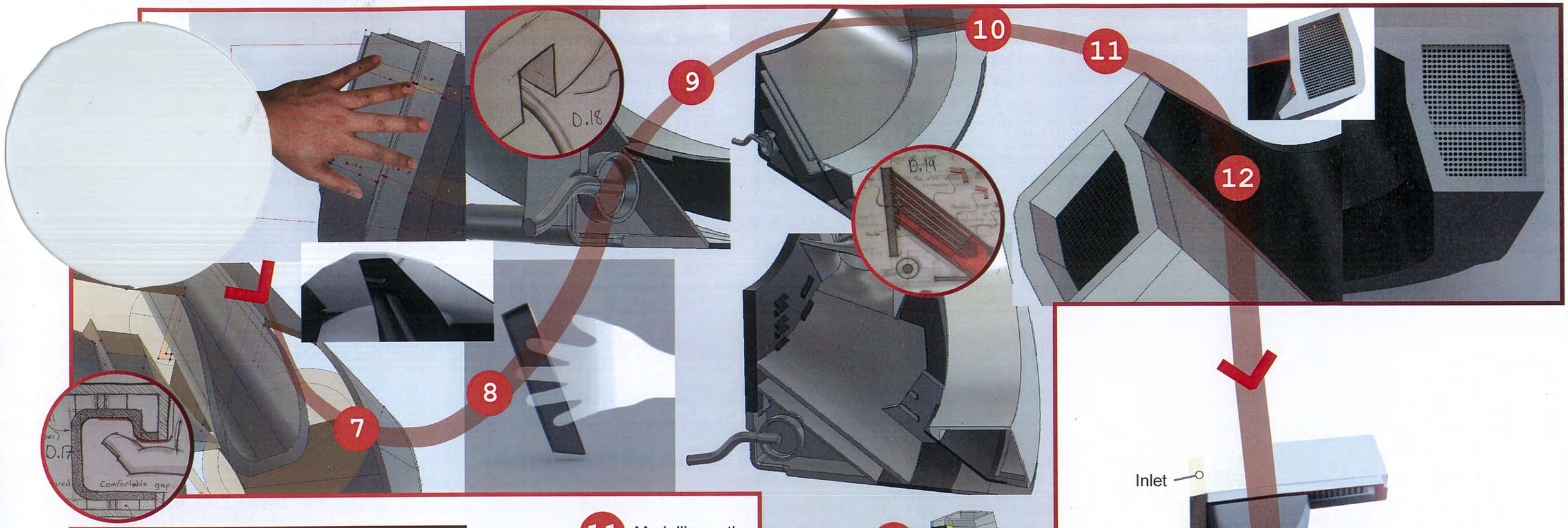
2 Parts were lofted and extruded using those sketches to create the outer shell of the design. These panels would be better machined out of aluminium as this is more accurate than casting giving a smoother finish. Plastic components should be made using injection moulding which is relatively cheap ofter initial set up costs are over come. To minimise the complexities of the external surfaces, the joinery of these components will expand on the slotted approach shown in ideation 19. This reduces the need for screws and other visually unpleasant joinery, however some screws and bolts will be necessary to hold the main components in place.

3 To refine the rear of the heater form screen shots were used to trace out possible options. The circle represents the motor placement. #1 requires a smaller motor that will be less efficient, #2 is more compact but the handle have been moved back meaning users with smaller hands will have trouble gripping between this and the front. With the motor forward next to the circuits, there is a risk of overheating where heat cannot dissipate. #3 moves the motor back but gains width to compensate. #4 shows a method of acoustic cancelling which uses chambers to reduce motor noise; due to this areas limited space, I think that an efficient fan blade and tubing system is enough to reduce noise to an adequate level for most users. Hence #3 is chosen because it allows the handle to be placed forward for easy grip and the circuits and motor have a sufficient air gap.

4 The chosen rear form is translated into sketch measurements based on motor size and the idea sketch.

5 Motor shown ready for housing design. A 22mm brushless motor is small and yet optimal for driving a slower moving blade. A brushless motor is built inside out such that no friction and thus little heat loss occurs. This makes brushless motors both more efficient and more reliable.

6 Fan and housing constructed around motor and shell dimensions. These casing help to move air smoothly around the motor and provide a path through the internals with minimal resistance and disruption to the flow. This reduces noise and increases the designs efficiency at all motor speeds.



Construction Cont.

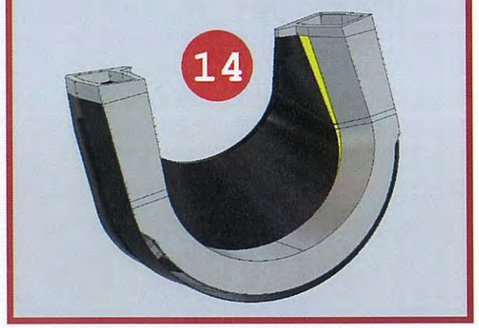
7 Altering the handles join to sit flush behind the outer shell helps the design to achieve a seamless finish while the advantages of using rubber for this component can be utilised. This effect is shown in a small rendered view above. To improve the strength of the design when being carried, some inner supports have been added which cup the rear of the handle inset shown in the above view. This allows the heaters weight to be spread through each column rather than stress the shell on the far sides.

8 To refine the grip/handle length a to-scale human hand image was used to best visualise how the user will hold the design. Based on human factors, the final handle dimensions could be finalised and apply to the model. The handles "lip" shown in human factors is omitted from the final model because the internal layout does not allow the handle to penetrate any deeper without interfering with the motor. This method is more compact, where the rubber still allows the user to firmly grip both sides of the design.

9 The cord rotator mechanism is inserted and a base is modelled based on the bottom view chosen when exploring stability.

10 Here the elements and top radiator plate have been lofted from the original proportion sketches.

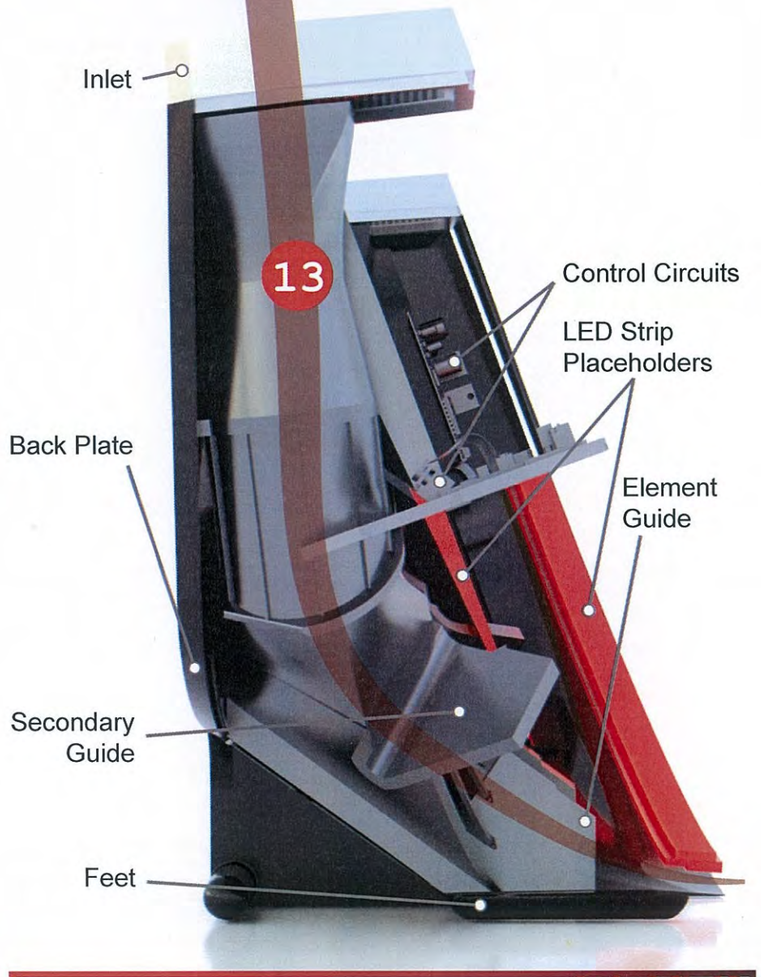
11 Modelling the design showed that the radiators top curve does not line up with the top inlet leaving a triangular sticky-outty-bit (technical term) where the end cap extends to meet the radiator (shown bellow 11). This happens because the angle between this meeting edge and the column would be too steep to conform to the designs "shallow angle" policy, hence the sticky-outty-bit at the top.



12 I've noticed in renders that a distracting line appears on the newly added top grill. This is were the internal tubing terminates. The solution is to reduce the tube height by 5mm to create a shadow gap and this line becomes much less noticeable with no structural disadvantages.

13 A stripped away view shows the heaters internals including possible control circuit placements and place holders for the LED lighting strips that create the designs lighting effects.

14 Before showing the stripped view, the model was mirrored about the Y-Z axis and some major parts merged, to complete this symmetric design. The inventor interference checker shows some minor intersections between parts which were fixed by adding small cutouts in parts.



Appearance

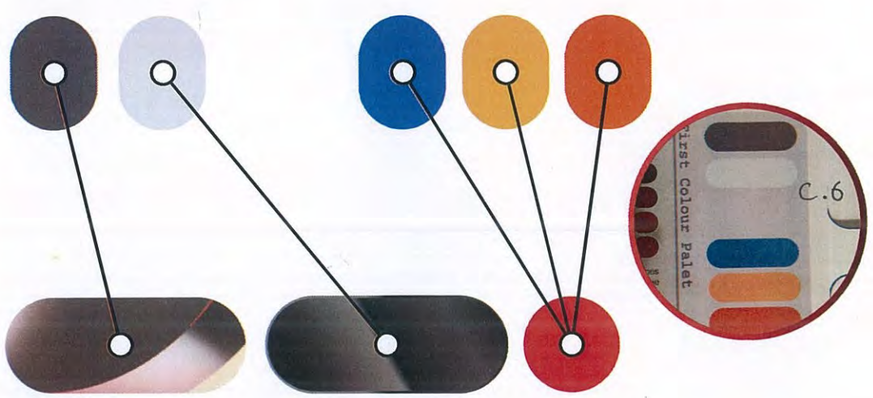
Red plastic on the top is a bold, attention drawing colour. However, manufacturing bold reds is difficult with industrial processes and, over time, they turn to dirty reds which would spoil the design. Plastics also degrade over time with exposer to UV light loosing its strength.

An all aluminium look is all very attend grabbing. Shiny materials accentuate how light changes around its curve better defining the form. This creates intense contrasts between light and dark surfaces to catch the eye. The abundance of silver creates a sterile look which apposes the organic, grounded, homely nature this design targets so this is not the chosen.

As an improvement from above, a black radiator tones down the designs intensity, highlighting the U shaped design feature. This also mimics the internal layout, by depicting the path where air flows, as a sub conscious visual aid to the user when positioning the heater in its different orientations. However, the blue lighting hues act in harmony with the reflective aluminium to produce a cold ice ambiance which again completely contradicts the warm fuzzy aura a heater should provide.

The last tweak is the reinstate the red theme into the design to mitigate the ice cold effect with warm hues that reflect around the aluminium U shape. One unintended side effect of this U shape is that it acts as an amplifier to the LED strips by reflecting their light in many directions. Thus changing the colour hue completely changes the hues reflected though the design catalysing the overall ambient theme. The theme is very volatile to change given a lighting change which could be used as a design feature to communicate information to the user.

A full black design gives an exotic, dark, and warm feel to the design. Almost like hot coals. This too could pass as an acceptable colour scheme as identified in context. However highlighting the curve feature makes it stand out as something which differentiates it form other heaters. This attracts attention and initiates discussion amongst users which is key when entering into the higher end of the market as also talked about in context. Therefore, this option was not chosen.

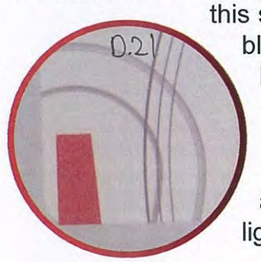


Lighting

Some small areas of the heater produce subtle lighting effects. In context it was identified that lighting could be used to create moods and ambiances, and through ideation some opportunities to communicate information using these lighting moods have arose.

Interface: changing the temperature settings on the heaters side panel touch interface could be made more responsive by chaining the overall lighting effect to mimic the setting. Whole heater inclusion makes changing the temperature very intuitive for the user.

Proximity: this heater is designed to switch off when objects get too close to the vents. It could be communicated to the user that this situation has occurred by turing the LED's blue. As shown in appearance (left) blue light is highly contradictory to the heaters target ambiance, but this means it could be used to show the heater not working or failing to do its job by showing question and defiance to the user. Equally, a warm light could indicate a state of working.



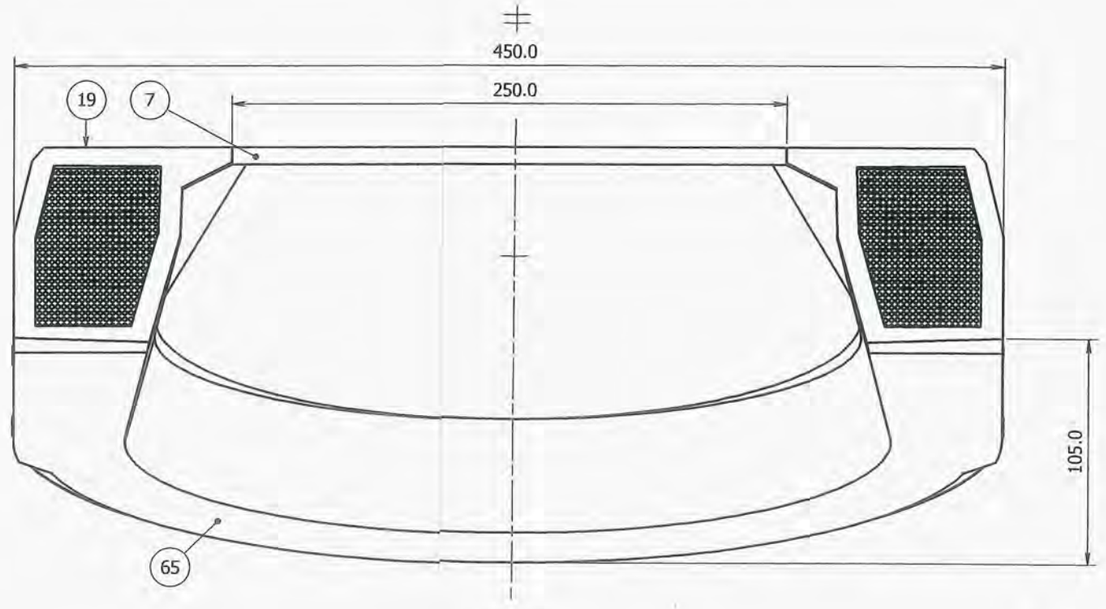
Active: using this light could indicate that the heater is on and heating.

Safety: red often means danger in many cultures. Using lighting to communicate temperature to the user could show when the heater is safe to handle (blue/cool light) and when it is too hot (red/warm light). One disadvantage is that the heater will be blue as it heats up, thus giving a cold/cool ambiance when the user is trying to warm up.

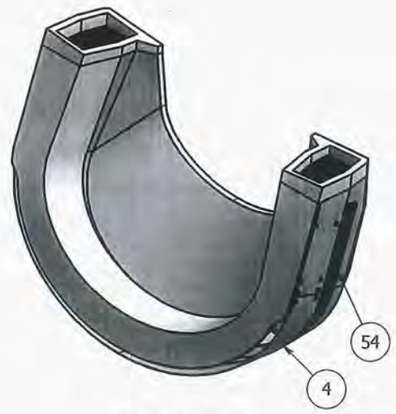
"Interface" and "safety" above, create lighting effects that contradict with the target ambiance needed to support the heating process physiologically. i.e. they could be blue when the user requires warmth. Therefore a combination of the remaining two methods will make up the final effect. The heater will glow red when heating, and turn off when not. However, where its proximity field is breached, the lights will go blue. This keeps it simple for the user where the contrast of the blue makes it obvious that something is not right.

ELECTRONICS HAVE BEEN OMITTED, OR REPRESENTED BY PLACEHOLDERS, FOR CLARITY. PLACEHOLDER DIMENSIONS ARE NOT DEFINED IN THIS DRAWING SET. FASTENERS ARE NOT LISTED BELOW AS THEY WILL BE DETAILED LATER IN THE SET.

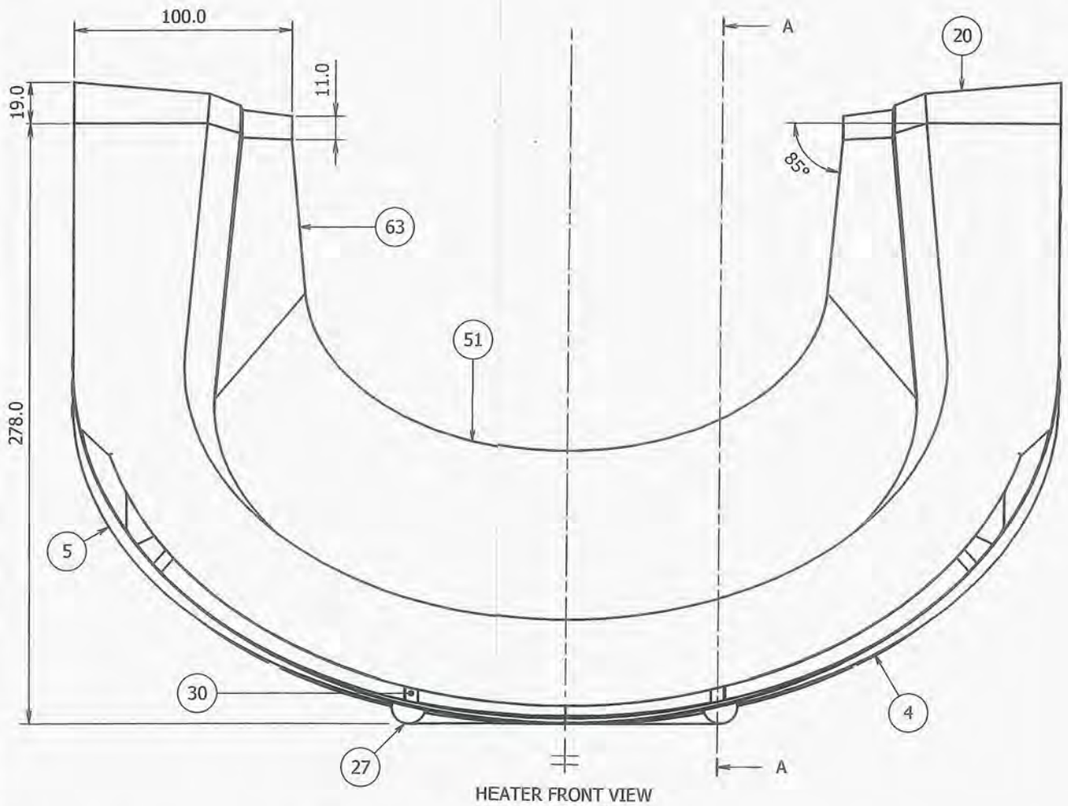
ITEM	PART NUMBER	QTY	MATERIAL
67	BASE PLATE PIN SHORT	2	Aluminum
65	VENT CASING TOP	1	Machined Aluminum, Anodized Silver
64	UPPER PLATE _R	1	Aluminum
63	UPPER PLATE _L	1	Aluminum
62	UPPER PIPE _R	1	ABS Plastic
61	UPPER PIPE _L	1	ABS Plastic
60	UPPER INTERNAL VENT PLATE	1	Aluminum
59	UNHEATED ELM _R	1	Aluminum
58	UNHEATED ELM _L	1	Aluminum
57	MOTOR SHAFT	2	Steel
56	STAND _R	1	ABS Plastic
55	STAND _L	1	ABS Plastic
54	SIDE PLATE _R	1	ABS Plastic
53	SIDE PLATE _L	1	ABS Plastic
52	RADIATOR ELM	1	Ceramic (Contains electrical elements)
51	RADIATOR ELM TOP FILM	1	Aluminum
50	OUTER LED STRIP COVER _R	1	Placeholder
49	OUTER LED STRIP COVER _L	1	Placeholder
48	MOTOR CASING _R	1	ABS Plastic
47	MOTOR CASING _L	1	ABS Plastic
46	MOTOR CAP 22MM	2	ABS Plastic
45	LIGHT STRIP UPPER _R	1	Placeholder
44	LIGHT STRIP UPPER _L	1	Placeholder
37	INNER LED COVER STRIP _R	1	Placeholder
36	INNER LED COVER STRIP _L	1	Placeholder
35	HEATED ELM 2ND _R	1	Ceramic
34	HEATED ELM 2ND _L	1	Ceramic
33	HEATED ELM 1ST _R	1	Ceramic
32	HEATED ELM 1ST _L	1	Ceramic
31	GUIDE _R	1	Aluminum
30	GUIDE _L	1	Aluminum
29	GRIP _R	1	Rubber
28	GRIP _L	1	Rubber
27	FOOT _L	1	Rubber
26	FOOT _R	1	Rubber
25	FLOW DIR PIPE _R	1	ABS Plastic
24	FLOW DIR PIPE _L	1	ABS Plastic
23	FAN BLADE	2	Plastic
22	END ELM GUIDE _R	1	Aluminum
21	END ELM GUIDE _L	1	Aluminum
20	END CAP _R	1	Aluminum, Anodized Silver
19	END CAP _L	1	Aluminum, Anodized Silver
18	END CAP GRILL _R	1	Aluminum
17	END CAP GRILL _L	1	Aluminum
14	CABLE GUIDE	2	Plastic
13	BRUSHLESS MOTOR 22MM	2	Steel (Mixed)
12	BRACE _R	1	Aluminum
11	BRACE _L	1	Aluminum
7	BASE PLATE	1	ABS Plastic
6	BACK PANEL _R	1	ABS Plastic
5	BACK PANEL _L	2	ABS Plastic
4	BACK BASE _R	1	ABS Plastic
2	AIR DUCT _R	1	ABS Plastic
1	AIR DUCT _L	1	ABS Plastic



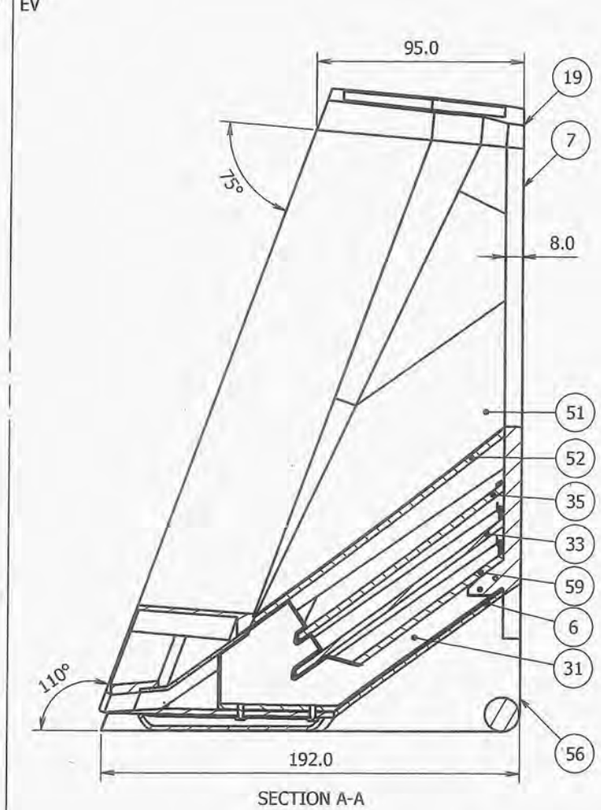
TOP VIEW



ISOMETIC VIEW
SCALE 1 : 5



HEATER FRONT VIEW
SCALE 1 : 2

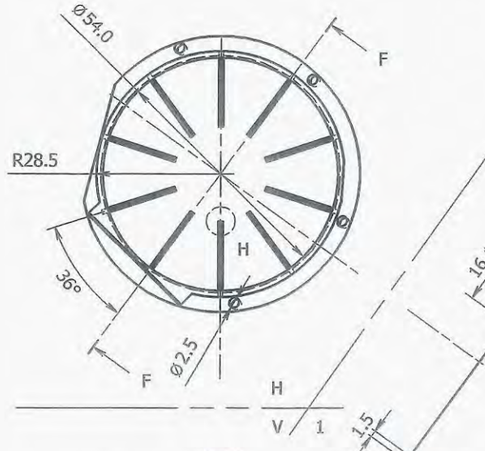


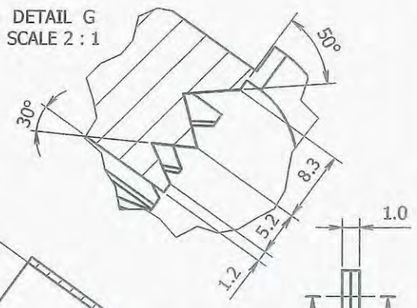
SECTION A-A

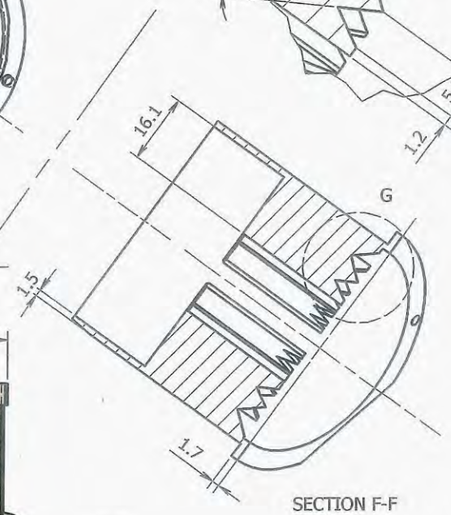
ALL MEASUREMENTS IN MM.
ACCOMPANIED PART SPECS MARKED (R) INDICATE RIGHT SIDE ONLY. LEFT SIDE SPECS CAN BE OBTAINED BY MIRRORING ABOUT A CENTERLINE MARKED ‡.

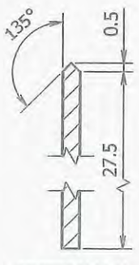
AUTODESK INVENTOR

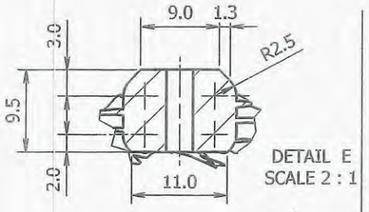
03-09-2015		ORTHOGRAPHIC PROJECTION - HEATER	1 OF 7 IN SET	

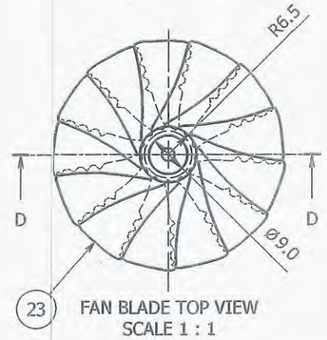


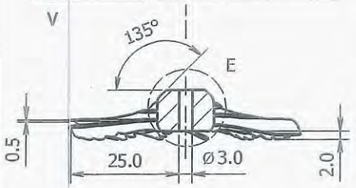


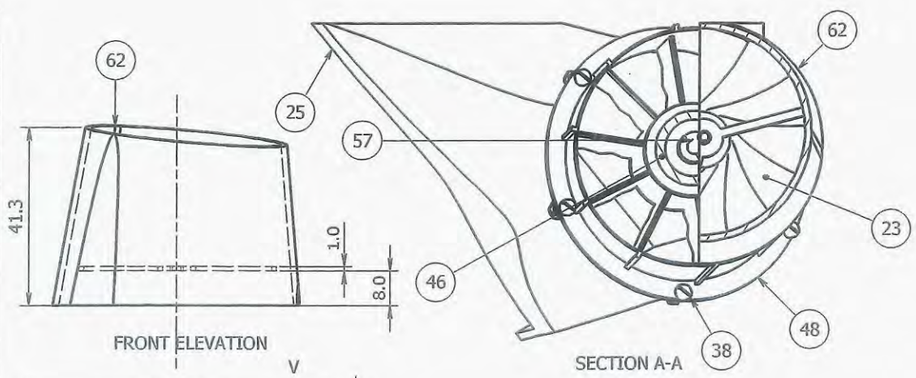


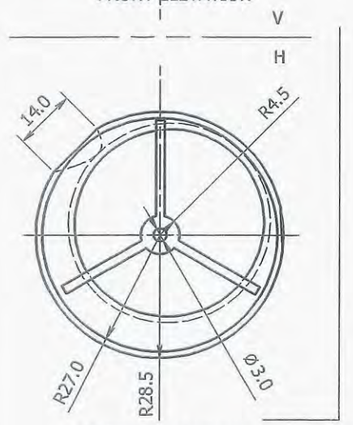


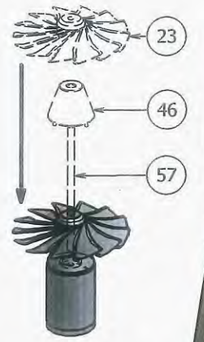


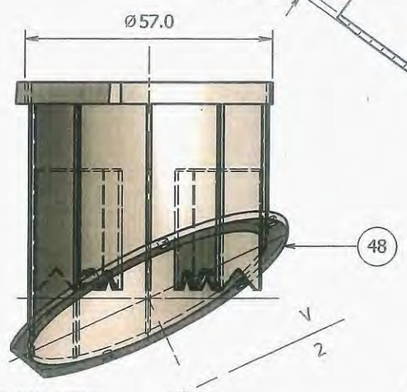


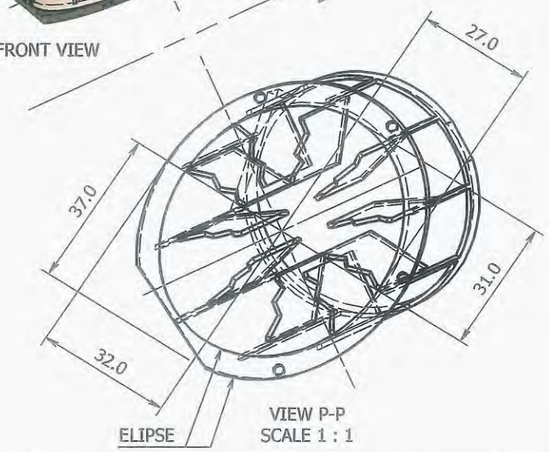


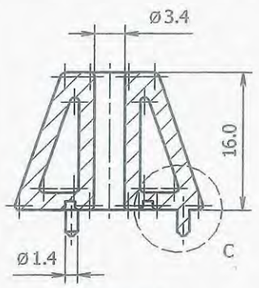


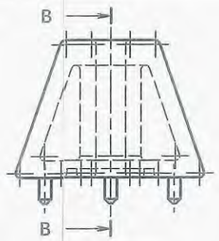


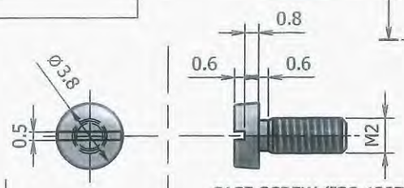


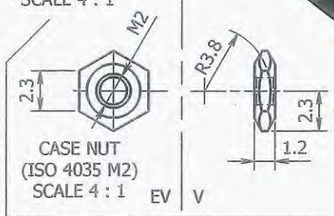


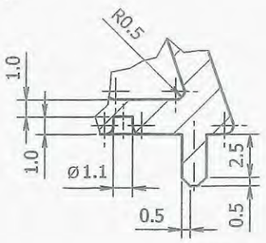


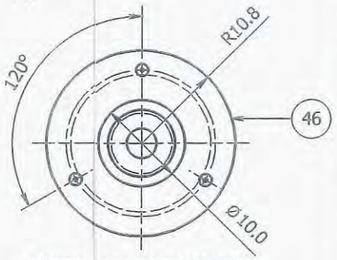


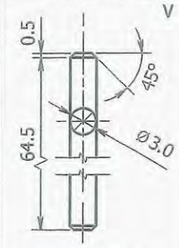


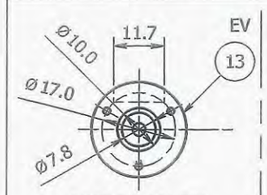


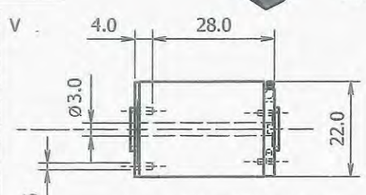










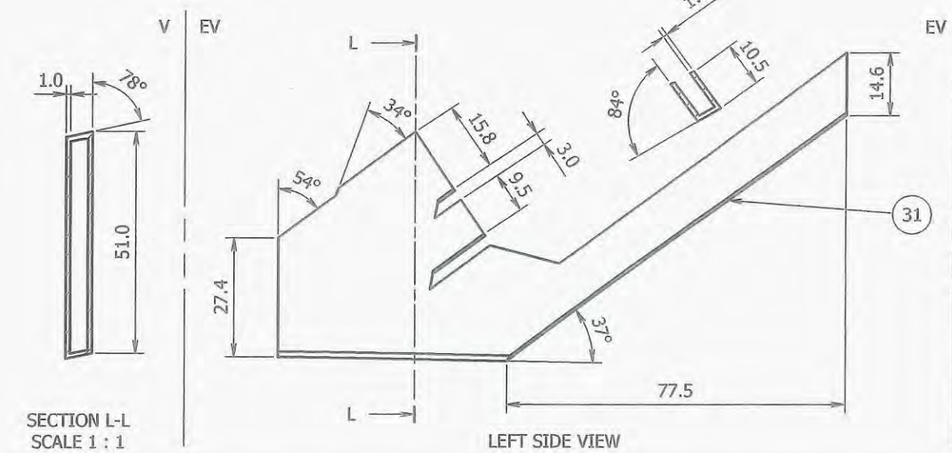


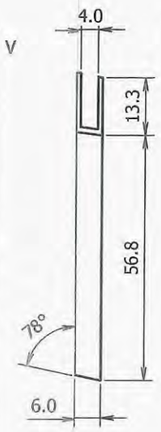
ITEM	PART NUMBER	QTY	MATERIAL
67	BASE PLATE PIN SHORT	2	Aluminum
62	UPPER PIPE _R	1	ABS Plastic
61	UPPER PIPE _L	1	ABS Plastic
57	MOTOR SHAFT	2	Steel
48	MOTOR CASING _R	1	ABS Plastic
47	MOTOR CASING _L	1	ABS Plastic
46	MOTOR CAP 22MM	2	ABS Plastic
38	ISO 1207 - M2 x 5	8	Stainless Steel, 440C
25	FLOW DIR PIPE _R	1	ABS Plastic
24	FLOW DIR PIPE _L	1	ABS Plastic
23	FAN BLADE	2	Plastic
13	BRUSHLESS MOTOR 22MM	2	Steel (Mixed)
2	AIR DUCT _R	1	ABS Plastic
1	AIR DUCT _L	1	ABS Plastic

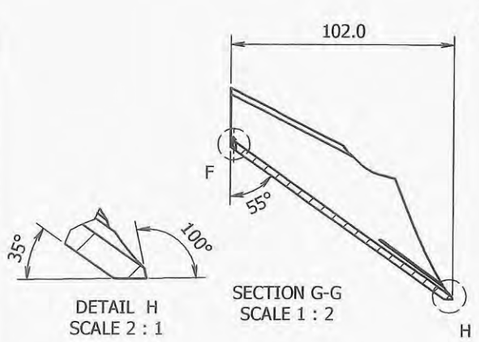
ALL MEASUREMENTS IN MM. MISSING COMPONENTS CAN BE FOUND ON DRAWING 5 IN THIS SET. (R) DENOTES RIGHT SIDE.

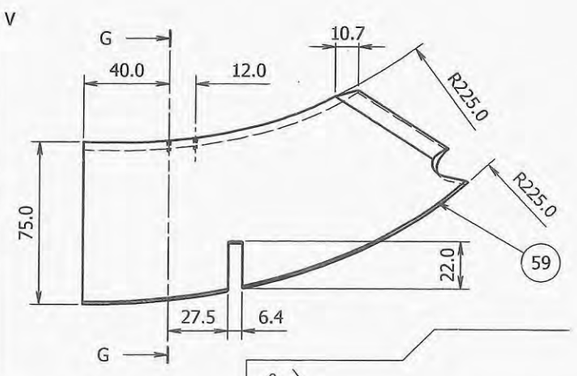
AUTODESK INVENTOR

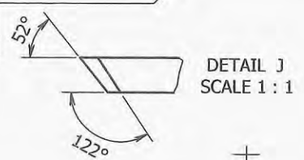
26-09-2015		INTAKE ASSEMBLY (RIGHT SIDE)	2 OF 7 IN SET	

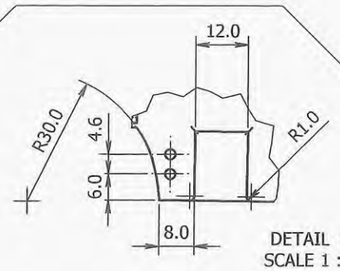


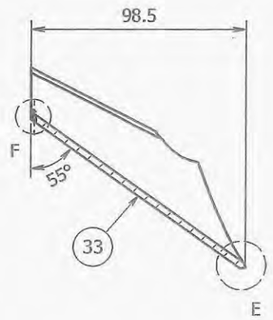


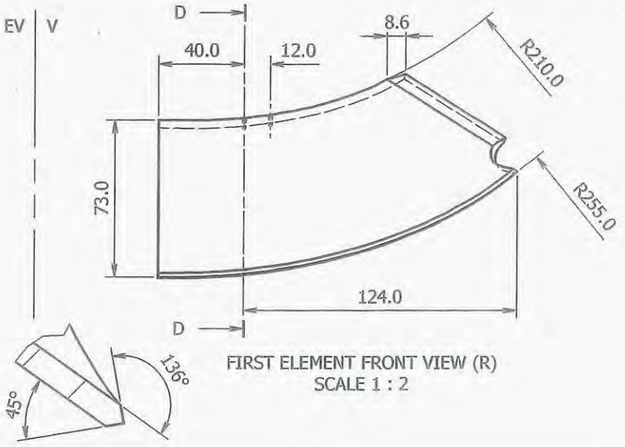


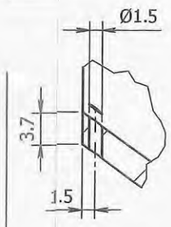


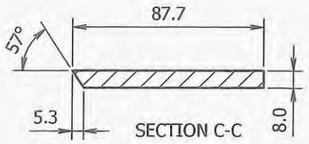


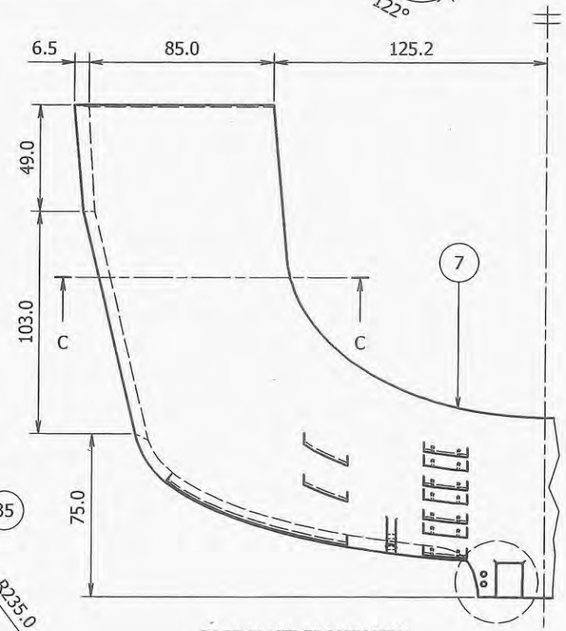


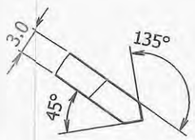


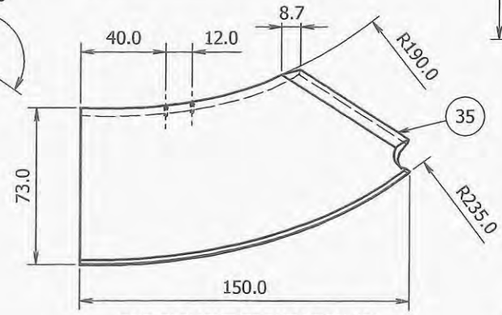


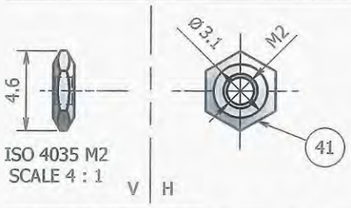


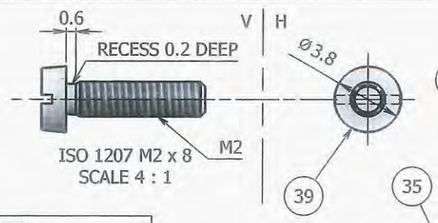


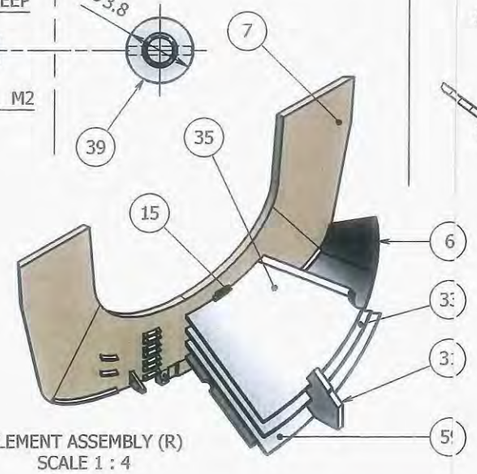


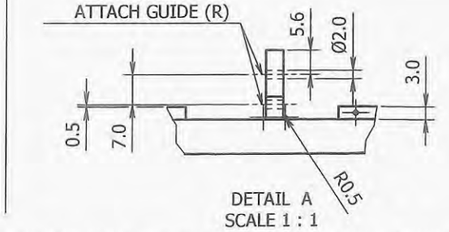


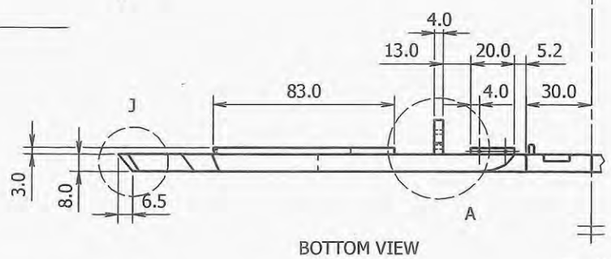










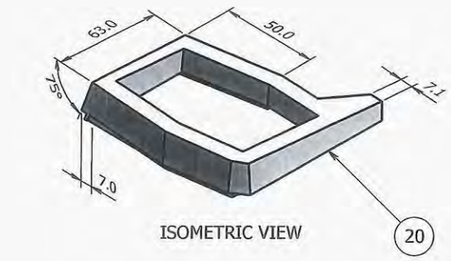


ITEM	PART NUMBER	QTY	MATERIAL
67	BASE PLATE PIN SHORT	2	Aluminum
59	UNHEATED ELM _R	1	Aluminum
58	UNHEATED ELM _L	1	Aluminum
41	ISO 4035 - M2	12	ABS Plastic
39	ISO 1207 - M2 x 8	4	ABS Plastic
35	HEATED ELM 2ND _R	1	Ceramic
34	HEATED ELM 2ND _L	1	Ceramic
33	HEATED ELM 1ST _R	1	Ceramic
32	HEATED ELM 1ST _L	1	Ceramic
31	GUIDE _R	1	Aluminum
30	GUIDE _L	1	Aluminum
16	ELE PIN _L	1	Steel
15	ELE PIN _R	1	ABS Plastic
8	BASE PLATE PIN	2	Aluminum
7	BASE PLATE	1	ABS Plastic
6	BACK PANEL _R	1	ABS Plastic
5	BACK PANEL _L	2	ABS Plastic

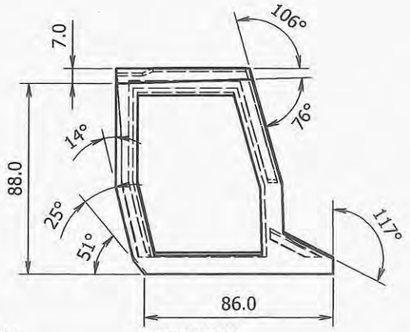
ALL MEASUREMENTS IN MM. ALL GEOMETRIES ARE SYMMETRICAL ABOUT CENTERLINES MARKED WITH ‡. (R) DENOTES RIGHT SIDE.

27-09-2015		ELEMENT ASSEMBLY (RIGHT SIDE)	3 OF 7 IN SET

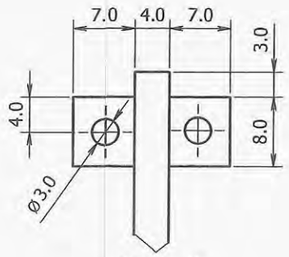
AUTODESK INVENTOR



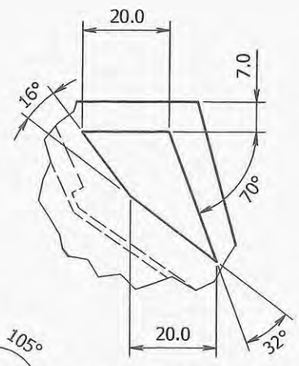
ISOMETRIC VIEW



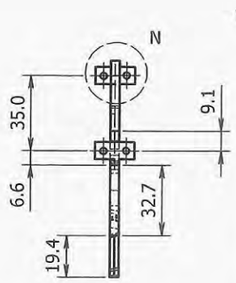
TOP VIEW



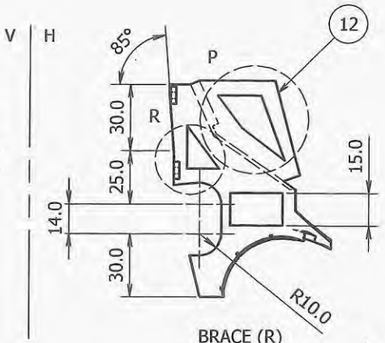
DETAIL N
SCALE 2 : 1



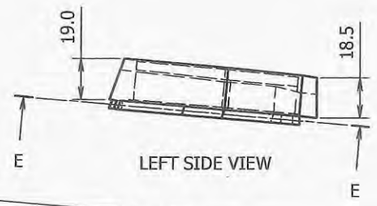
DETAIL P
SCALE 1 : 1



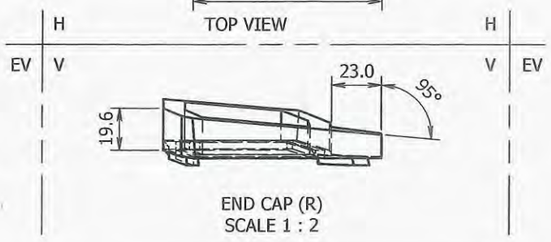
LEFT SIDE VIEW



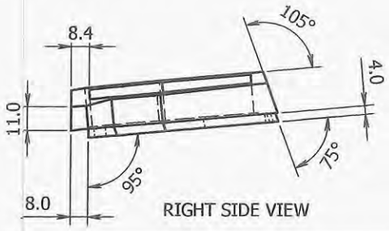
BRACE (R)
SCALE 1 : 2



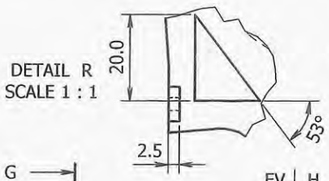
LEFT SIDE VIEW



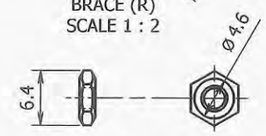
END CAP (R)
SCALE 1 : 2



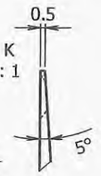
RIGHT SIDE VIEW



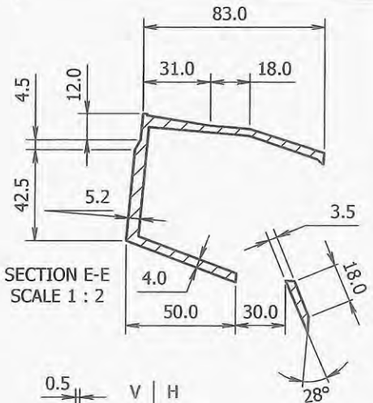
DETAIL R
SCALE 1 : 1



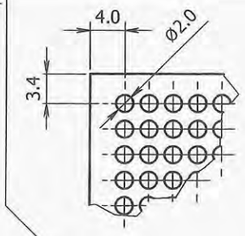
ISO 4035 M3
SCALE 2 : 1



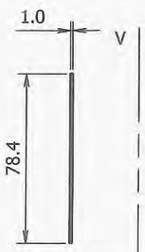
DETAIL K
SCALE 2 : 1



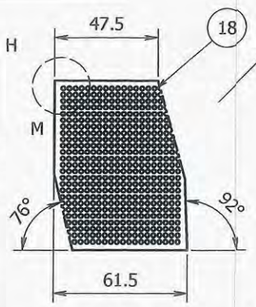
SECTION E-E
SCALE 1 : 2



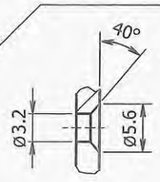
DETAIL M
SCALE 2 : 1



FRONT VIEW

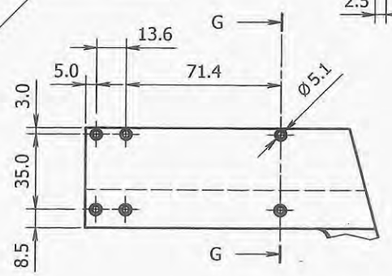


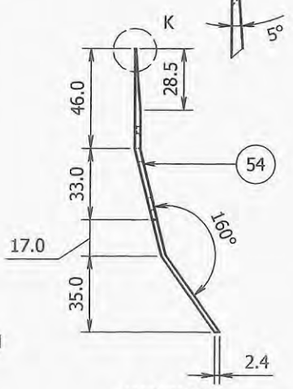
GRILL TOP VIEW (R)
SCALE 1 : 2



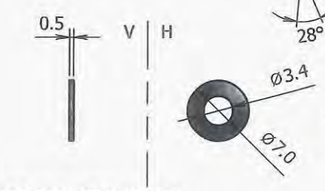
DETAIL H
SCALE 2 : 1

SECTION G-G
SCALE 1 : 2

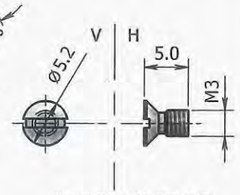




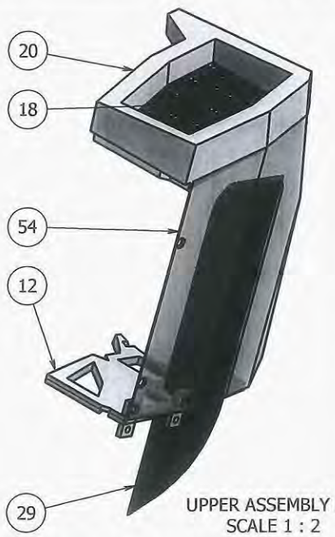
TOP VIEW



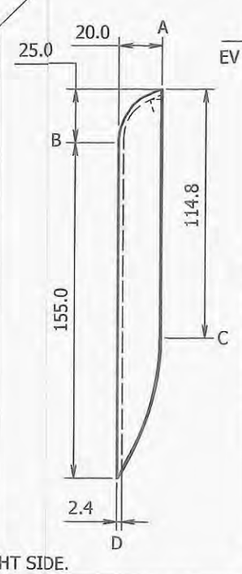
ISO 7091 ST 3 100 HV
SCALE 2 : 1

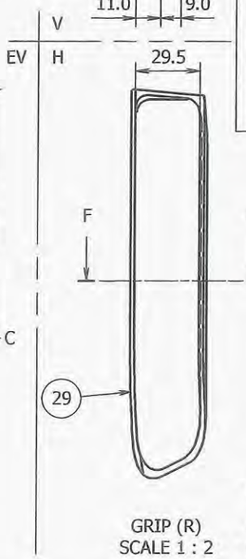


NF E 25 123 M3 x 5
SCALE 2 : 1



UPPER ASSEMBLY (R)
SCALE 1 : 2

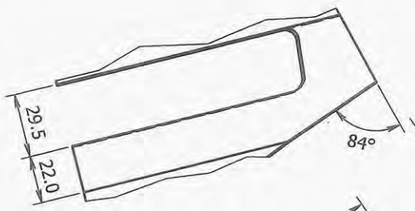




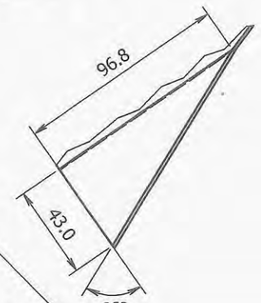
GRIP (R)
SCALE 1 : 2

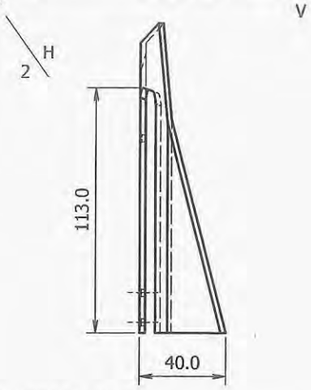
COMPOUND CURVE C-D
(TEMPLATE SCALE 1 : 1)

COMPOUND CURVE A-B
(TEMPLATE SCALE 1 : 1)



SECTION F-F
SCALE 1 : 2





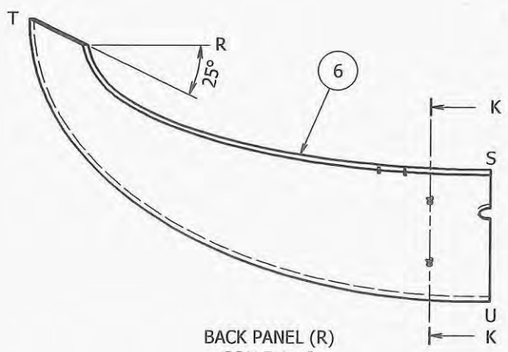
SIDE PLATE (R)
SCALE 1 : 2

ITEM	PART NUMBER	QTY	MATERIAL
67	BASE PLATE PIN SHORT	2	Aluminum
66	NF E 25-123 - M3 x 5	1	Steel, Mild
64	UPPER PLATE _R	1	Aluminum
54	SIDE PLATE _R	1	ABS Plastic
53	SIDE PLATE _L	1	ABS Plastic
43	ISO 7091 - ST 3 - 100 HV	12	Steel
42	ISO 4035 - M3	12	Stainless Steel, 440C
30	GUIDE _L	1	Aluminum
29	GRIP _R	1	Rubber
28	GRIP _L	1	Rubber
20	END CAP _R	1	Aluminum, Anodized Silver
19	END CAP _L	1	Aluminum, Anodized Silver
18	END CAP GRILL _R	1	Aluminum
17	END CAP GRILL _L	1	Aluminum
12	BRACE _R	1	Aluminum
11	BRACE _L	1	Aluminum

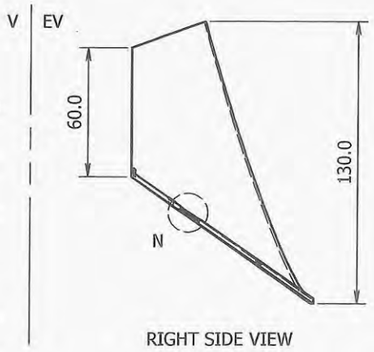
ALL DIMENSIONS IN MM. (R) DENOTES RIGHT SIDE.

05-10-2015		UPPER ASSEMBLY (RIGHT SIDE)	4 OF 7 IN SET

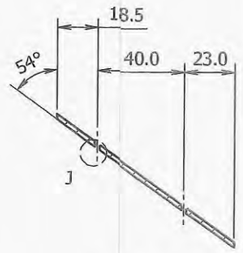
AUTODESK INVENTOR



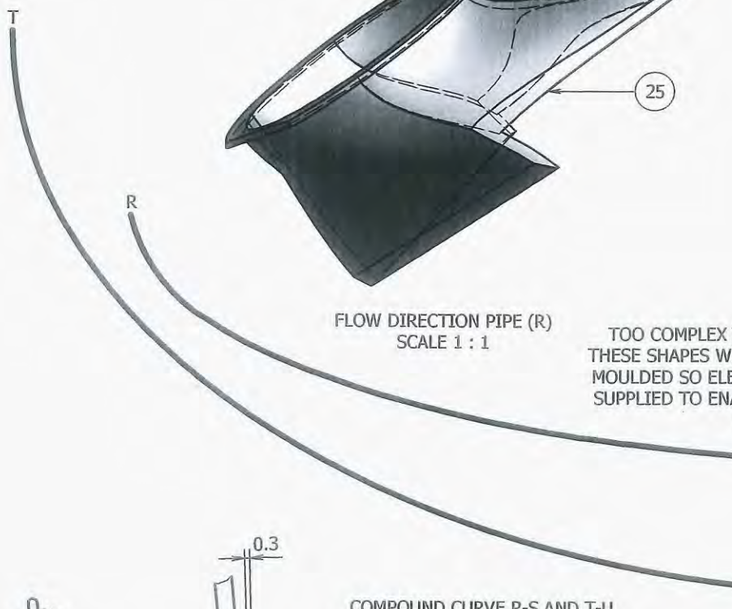
BACK PANEL (R)
SCALE 1 : 2



RIGHT SIDE VIEW

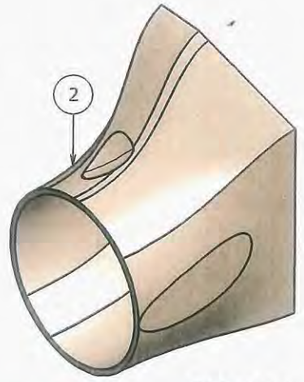


SECTION K-K
SCALE 1 : 2



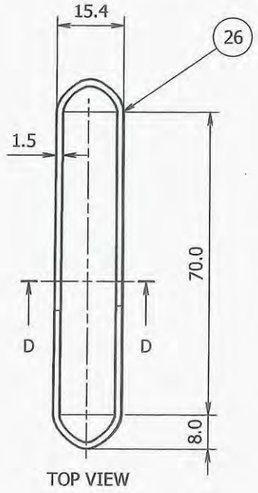
COMPOUND CURVE R-S AND T-U
(TEMPLATE SCALE 1 : 1)

FLOW DIRECTION PIPE (R)
SCALE 1 : 1

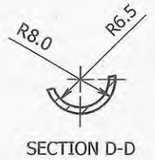


AIR DUCT (R)
SCALE 1 : 1

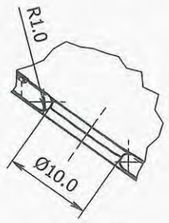
TOO COMPLEX TO FULLY DIMENSION. THESE SHAPES WILL LIKELY BE INJECTION MOULDED SO ELECTRONIC FILES WILL BE SUPPLIED TO ENABLE THE DESIGN TO BE MADE.



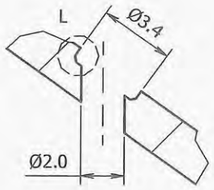
TOP VIEW



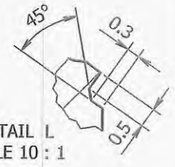
SECTION D-D
SCALE 1 : 1



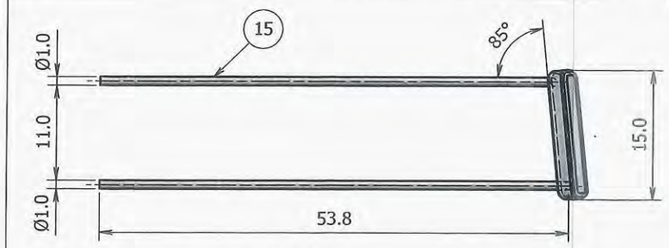
DETAIL N
SCALE 2 : 1



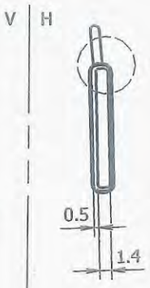
DETAIL J
SCALE 5 : 1

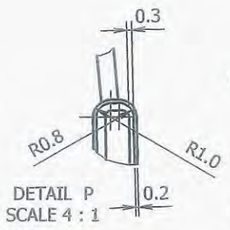


DETAIL L
SCALE 10 : 1

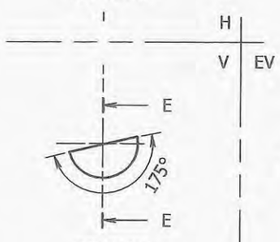


ELEMENT PIN (R)
SCALE 2 : 1

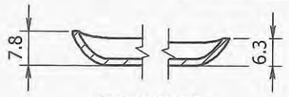




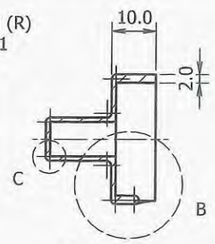
DETAIL P
SCALE 4 : 1



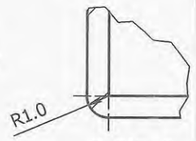
FOOT (R)
SCALE: 1 : 1



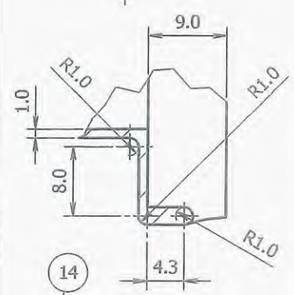
SECTION E-E
SCALE 1 : 1



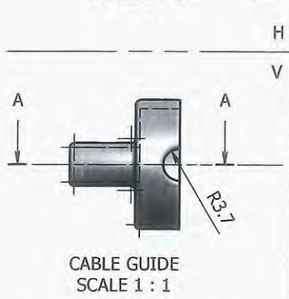
SECTION A-A
SCALE 1 : 1



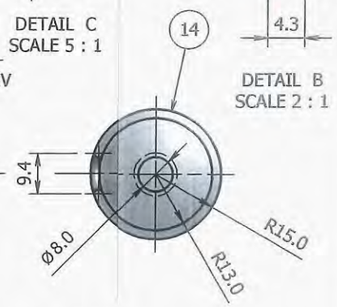
DETAIL C
SCALE 5 : 1

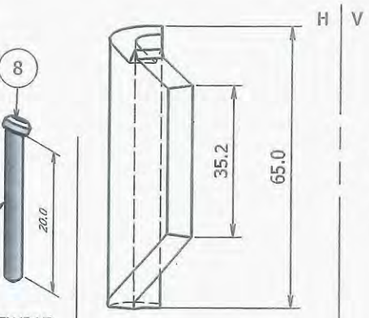


DETAIL B
SCALE 2 : 1

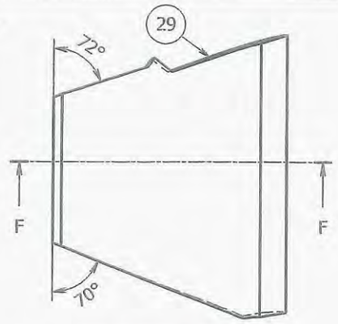


CABLE GUIDE
SCALE 1 : 1

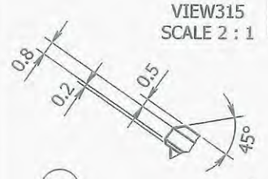




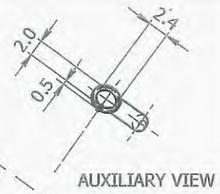
VIEW315
SCALE 2 : 1



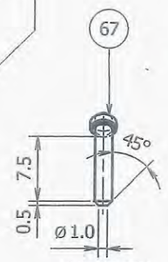
END ELEMENT GUIDE (R)
SCALE 1:1



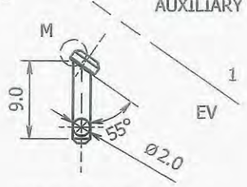
DETAIL M
SCALE 4 : 1



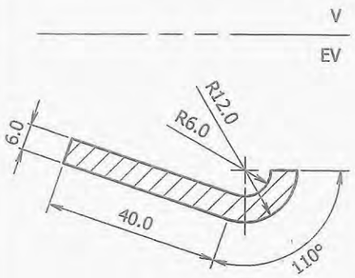
AUXILIARY VIEW



SHORT PIN
SCALE 2 : 1



RIGHT SIDE VIEW



SECTION F-F
SCALE 1:1

ITEM	PART NUMBER	QTY	MATERIAL
67	BASE PLATE PIN SHORT	2	Aluminum
29	GRIP _R	1	Rubber
28	GRIP _L	1	Rubber
27	FOOT _L	1	Rubber
26	FOOT _R	1	Rubber
25	FLOW DIR PIPE _R	1	ABS Plastic
24	FLOW DIR PIPE _L	1	ABS Plastic
22	END ELM GUIDE _R	1	Aluminum
21	END ELM GUIDE _L	1	Aluminum
16	ELE PIN _L	1	Steel
15	ELE PIN _R	1	ABS Plastic
14	CABLE GUIDE	2	Plastic
8	BASE PLATE PIN	2	Aluminum
6	BACK PANEL _R	1	ABS Plastic
5	BACK PANEL _L	2	ABS Plastic
2	AIR DUCT _R	1	ABS Plastic
1	AIR DUCT _L	1	ABS Plastic

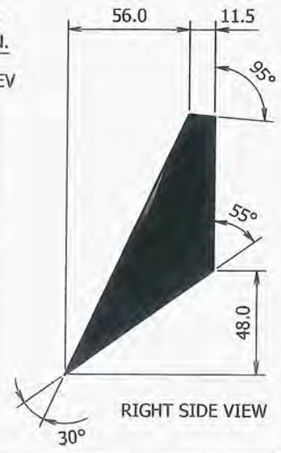
ALL DIMENSIONS IN MM. (R) DENOTES RIGHT SIDE.

05-10-2015		PARTS DRAWING - OVERFLOW	5 OF 7 IN SET

AUTODESK INVENTOR

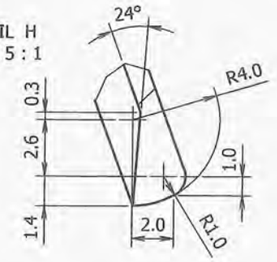
TOO COMPLEX TO FULLY DIMENSION.

UPPER PLATE (R)
SCALE 1 : 2

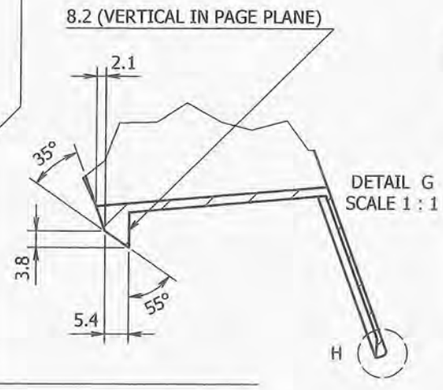


RIGHT SIDE VIEW

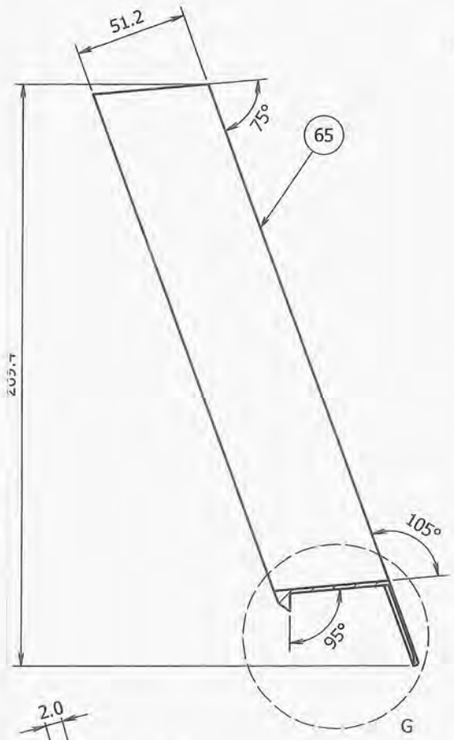
DETAIL H
SCALE 5 : 1

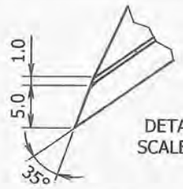


8.2 (VERTICAL IN PAGE PLANE)

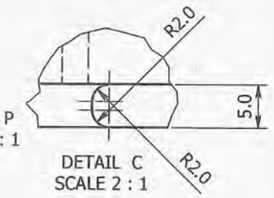


DETAIL G
SCALE 1 : 1

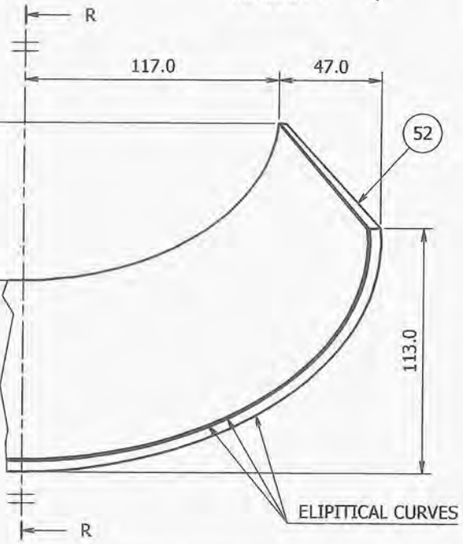




DETAIL P
SCALE 2 : 1

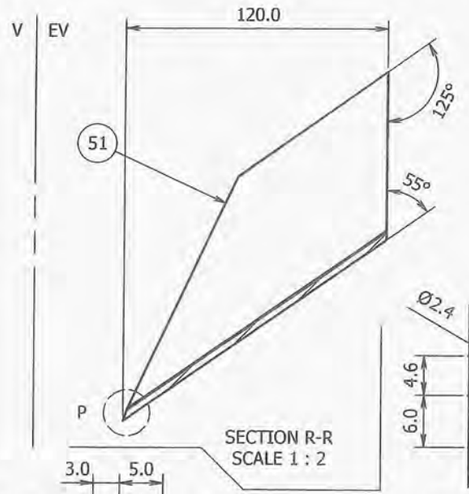


DETAIL C
SCALE 2 : 1

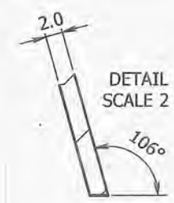


ELIPTICAL CURVES

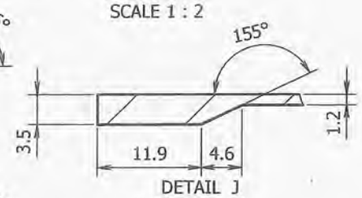
RADIATOR ASSEMBLY
SCALE 1 : 2



SECTION R-R
SCALE 1 : 2

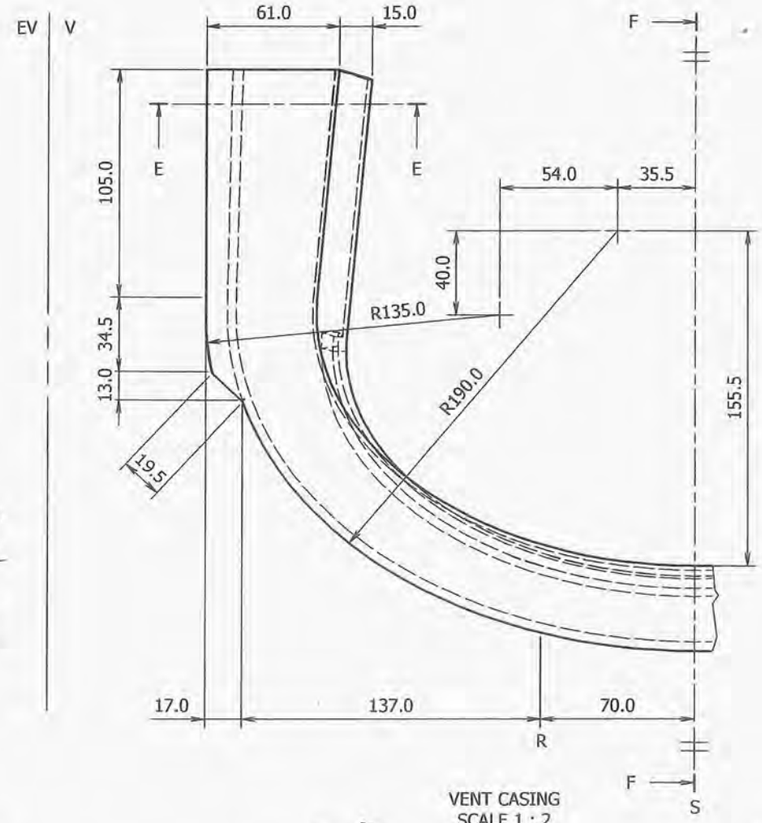


DETAIL K
SCALE 2 : 1

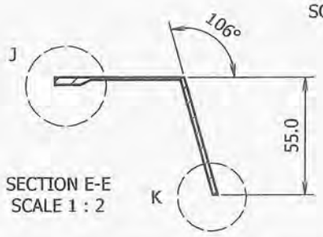


DETAIL J
SCALE 2 : 1

SECTION F-F
SCALE 1 : 2

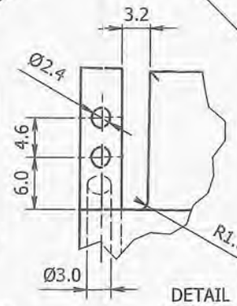


VENT CASING
SCALE 1 : 2



SECTION E-E
SCALE 1 : 2

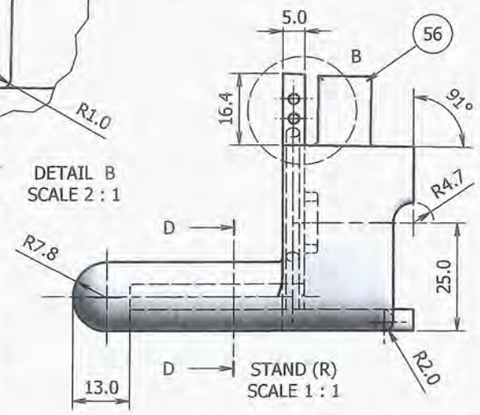
COMPOUND CURVE R-S
(TEMPLATE SCALE 1 : 1)



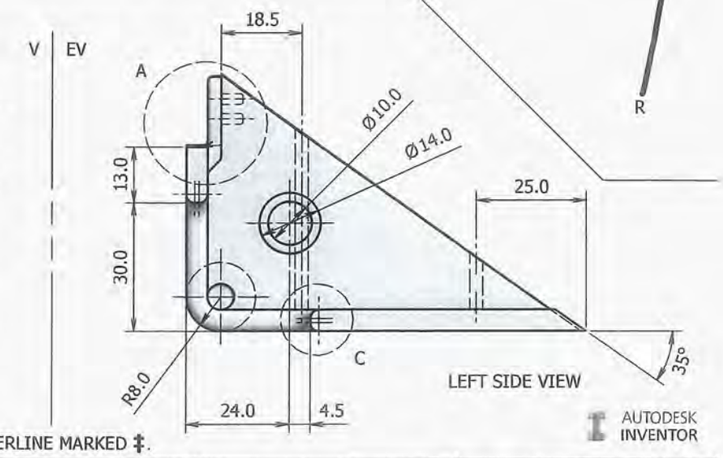
DETAIL B
SCALE 2 : 1

DETAIL A
CASE 2 : 1

SECTION D-D
SCALE 1 : 1



STAND (R)
SCALE 1 : 1



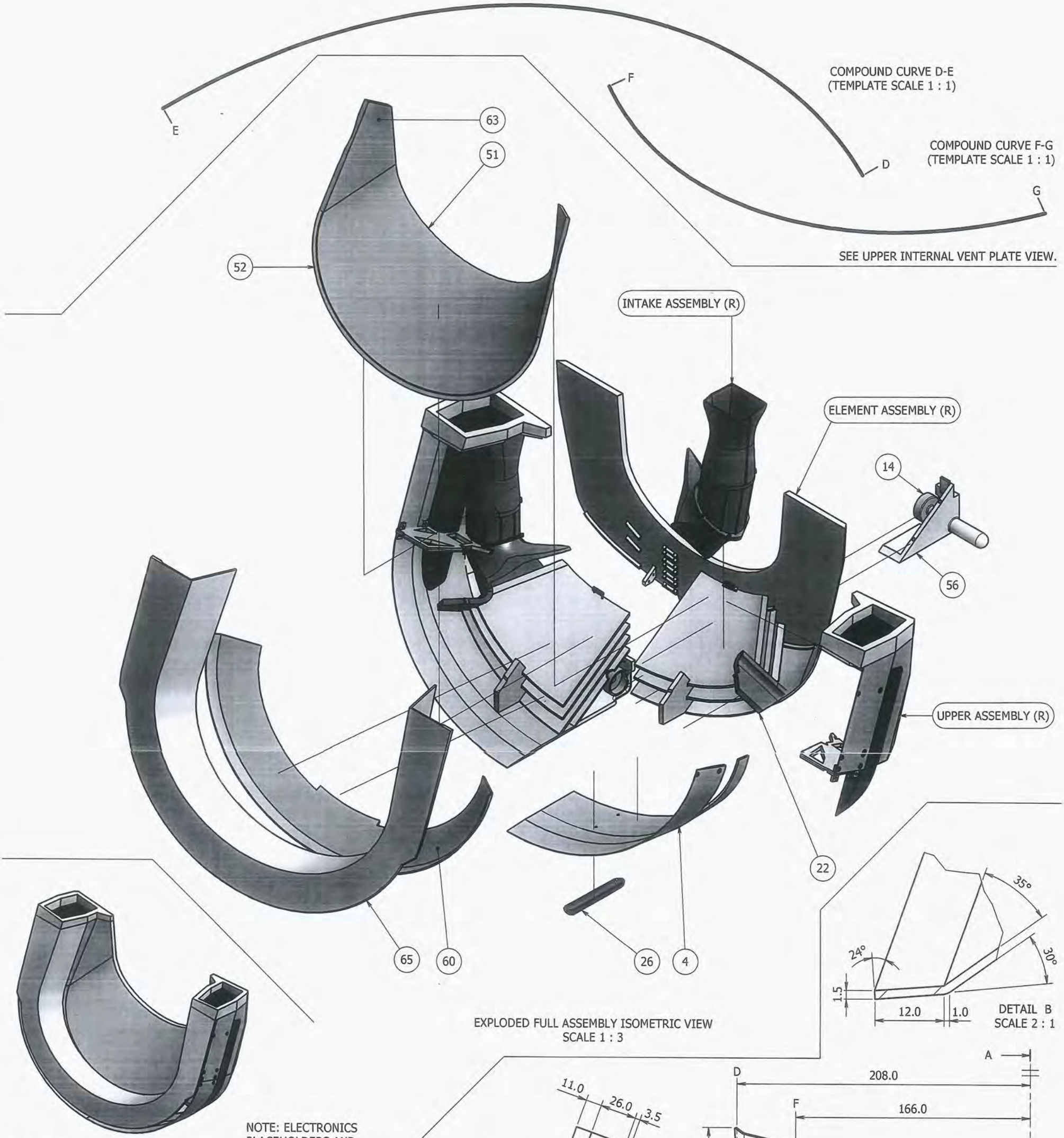
LEFT SIDE VIEW

ITEM	PART NUMBER	QTY	MATERIAL
65	VENT CASING TOP	1	Machined Aluminum, Anodized Silver
64	UPPER PLATE _R	1	Aluminum
63	UPPER PLATE _L	1	Aluminum
56	STAND _R	1	ABS Plastic
55	STAND _L	1	ABS Plastic
52	RADIATOR ELM	1	Ceramic (Contains electrical elements)
51	RADIATOR ELM TOP FILM	1	Aluminum

ALL MEASUREMENTS IN MM. (R) DENOTES RIGHT SIDE ONLY. ALL GEOMETRIES ARE MIRRORED ABOUT A CENTERLINE MARKED ‡.

AUTODESK INVENTOR

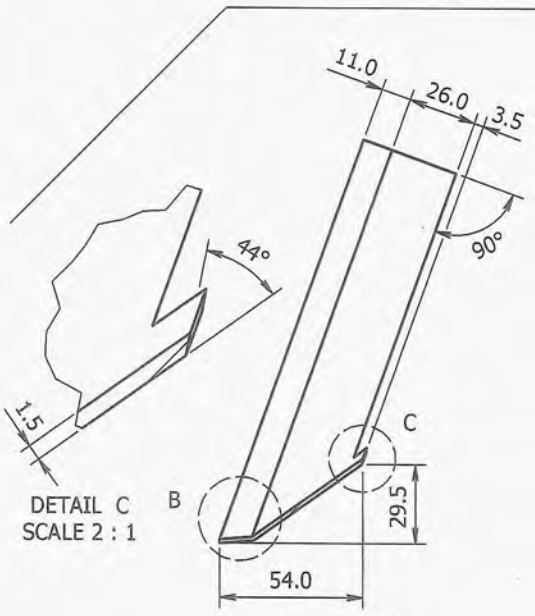
08-10-2015		PARTS DRAWING - OTHER COMPONENTS	6 OF 7 IN SET



EXPLODED FULL ASSEMBLY ISOMETRIC VIEW
SCALE 1 : 3

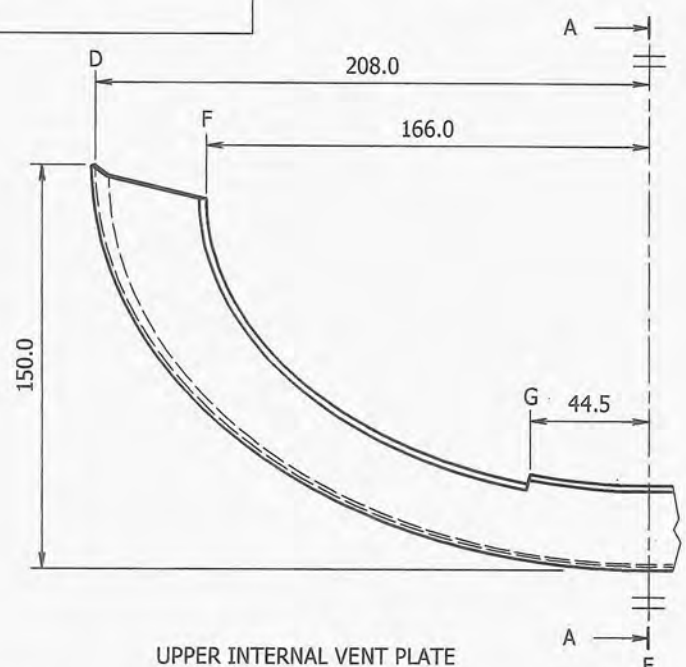
ASSEMBLED VIEW
SCALE 1 : 5

NOTE: ELECTRONICS PLACEHOLDERS AND FITTINGS OMITTED IN FULL EXPLODED VIEW.



DETAIL C
SCALE 2 : 1

SECTION A-A
SCALE 1 : 2



UPPER INTERNAL VENT PLATE
SCALE 1 : 2

AUTODESK INVENTOR

ITEM	PART NUMBER	QTY	MATERIAL
65	VENT CASING TOP	1	Machined Aluminum, Anodized Silver
64	UPPER PLATE _R	1	Aluminum
63	UPPER PLATE _L	1	Aluminum
60	UPPER INTERNAL VENT PLATE	1	Aluminum
56	STAND _R	1	ABS Plastic
55	STAND _L	1	ABS Plastic
27	FOOT _L	1	Rubber
26	FOOT _R	1	Rubber
22	END ELM GUIDE _R	1	Aluminum
21	END ELM GUIDE _L	1	Aluminum
14	CABLE GUIDE	2	Plastic
5	BACK PANEL _L	2	ABS Plastic
4	BACK BASE _R	1	ABS Plastic

ALL DIMENSIONS IN MM. GEOMETRIES ARE SYMMETRICAL ABOUT A CENTRELINE MARKED ‡.

09-10-2015		EXPLODED FULL ASSEMBLY	7 OF 7 IN SET

Scholarship Design and Visual Communication – Assessment Schedule 2015

DESIGN IDEATION – 8 marks	DESIGN PRACTICE – 8 marks	VISUAL COMMUNICATION – 8 marks
Quality of design ideas generated in terms of a creative interpretation or application of aesthetics / function.	*Quality of idea refinement and resolution for the purposes of amalgamating key design considerations relevant to a context.*	*Quality of the visual communicating of design thinking in terms of its narrative, and visual promotion of ideas selected.*
Ideas are **generated** from initiating sources. **(1 mark)**	Ideas are **clarified** through a process. **(1 mark)**	**Use visual techniques / strategies** to communicate **design ideas**. **(1 mark)**
Ideas are **regenerated and explored** from initiating sources. **(2 marks)**	Ideas are clarified through a process that **applies design and visual communication**. **(2 marks)**	Use visual techniques / strategies to **clearly** communicate design ideas. **(2 marks)**
Design ideas are informed by idea initiation. **(3 marks)**	Ideas are **evolved** through a process **in response to a design context**. **(3 marks)**	Use visual techniques / strategies to communicate **a design narrative**. **(3 marks)**
Design thinking purposefully responds to idea initiation. **(4 marks)**	Ideas are **purposefully** evolved through a process in response to a design context. **(4 marks)**	Use visual techniques / strategies to **clearly** communicate a design narrative. **(4 marks)**
Design thinking purposefully responds to idea initiation in an **in-depth** manner. **(5 marks)**	Ideas are purposefully evolved through a **coherent** process in response to a design context. **(5 marks)**	Use visual techniques / strategies to clearly communicate a design narrative **with coherence and detail**. **(5 marks)**
Complex design thinking OR **resolved design ideas** demonstrates the **clever use** of idea initiation. **(6 marks)**	Ideas are **convincingly** evolved through a coherent process OR design considerations are **integrated and synthesised** in a **convincing** manner. **(6 marks)**	Use visual techniques / strategies to **convincingly** communicate a design narrative OR **high quality** visual presentation principles / skills are used in a **convincing** manner. **(6 marks)**
Perceptive design thinking OR **innovative / sophisticated resolved ideas** demonstrates the **insightful use** of idea initiation. **(7 marks)**	Ideas are convincingly evolved and design considerations are integrated and synthesised in a **sophisticated** manner. **(7 marks)**	Use **sophisticated** visual techniques / strategies for communicating a design narrative OR **outstanding** visual presentation principles / skills are used with **visual impact**. **(7 marks)**
Perceptive design thinking AND innovative / sophisticated resolved design ideas demonstrate the **insightful use** of idea initiation. **(8 marks)**	Ideas are convincingly evolved and design considerations are integrated and synthesised in a sophisticated and **highly refined** manner. **(8 marks)**	Use **sophisticated** visual techniques / strategies for communicating a design narrative **AND outstanding** visual presentation principles / skills are used with **visual impact**. **(8 marks)**
Sub Total 7	**Sub Total** 8	**Sub Total** 7
Overall Level of Performance (maximum 24 marks)	22	

Clarification of terminology:

Design ideas – individual ideas that have design qualities that relate to both aesthetic and functional considerations as related to a design context.
Design thinking – a series of design ideas that consider and interrogate divergent and convergent possibilities – can be empathetic, purposeful, or meaningful to a design context.
Idea initiation – initial ideas that have been generated, regenerated, and explored from initiating sources – can be aesthetic, pragmatic, or theoretical.
Design context – typically defined by a brief situation and specifications – extends to relatable environmental, social, historical, cultural considerations.
Visual techniques – the modes, media, and methods associated with visually communicating information.
Visual strategies – the visually based approaches that act as design tools for the initiating and evolving of design ideas.
Design narrative – the visual story-telling of the design practice that has taken place.
Purposefully – the production of a body of design work that has clear intention and engages considered decision-making.
Coherent / Coherence – range of different elements and considerations that are brought together effectively as a set, with a logical consistency, clarity and unity of thought, purpose, or narrative.
Convincing / Convincingly – intentions are conveyed in a compelling manner with little doubt and with utter assuredness / conviction.
Integrating and synthesising – taking a diverse range of design ideas, knowledge and skills, blending them into a coherent whole or combine them in a new way so as to produce an effective outcome aesthetically and functionally.
Sophisticated – engage a complexity of design thinking or visual literacy, whether reflected through in-depth and refined understanding, or utilising multiple layers of meaning.
Innovative – ideas that lead to something new and / or different, whether it is something original or renewed, in terms of either aesthetics or function.
Insightful – perceptive design thinking that challenges the conventional in order to extend and transform design ideas.